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EFFECTIVENESS OF SMARTPHONE APPLICATION "NUTRIATLET" IN INCREASING ENERGY INTAKE OF MARTIAL ARTS ATHLETES

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Abstract

One of the pillars in achieving good sport achievement is athlete's nutritional status. Preliminary study on martial arts athletes in Student Sport Education and Training Central Office (BPPLOP) of Central Java Province showed that 8% of athletes had malnutrition. Survey of athlete's consumption showed that average of energy consumption was only 74% from the number of energy requirement. The aim of this study was to test the effectiveness of smartphone application model "Nutriatlet" to increase energy intake of athletes. This study was conducted in 2017 using pre and posttest with control group design. We recruited 30 athletes with 15 athletes in each treatment and control group. Bivariate analysis was performed using cox proportional-hazard test. The output of statistical analysis were p value, median post-intervention duration, and hazard ratio (HR). The analysis was performed using STATA 12.1. The result showed that the athletes which performed dietary planning using Nutriatlet had 4 times higher possibilities to achieve an increase in energy consumption level ≥10% per time unit compared to athletes who did not do it.

Introduction

Advancement in sport field is part of national development. Optimal development of sport is expected to contribute the national development goals. One of important aspect of sport development is its role in national character building. Sport as the media of character building means that it can be used as strategic medium to build self-confidence, national identity, and national pride. One of the effort to increase national pride is through obtaining good international sport achievement (Kemenpora, 2010).

National sport development in order to obtain international achievement need good sport guidance for athletes in national or regional level. Therefore, the Ministry of Youth and Sport Affairs of Indonesia supports the guidance program in national or regional level, especially on leading sports branch (Widowati, 2015). Through this program, every region are expected to be able to guide their leading sports branch. Province of Central Java also plays role in this guidance program through active development of several leading sports branch. One of these branch is martial arts. On National Student Sport Week (POPNAS) XIV in Central Java, taekwondo, *pencak silat*, and karate athletes were succeed in achieving gold medals.

Similar to other branch of sports, achievement of martial art athlete is determined

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by numerous factors, one of them is nutritional factor (Utami, 2012). Adequate nutritional intake will help athletes to reach their best performance. An athlete also needs dietary planning on before, during, and after the game. Imbalance in energy intake, myths regarding supplementary food, and availability of rations often became problem in fulfilling athletes nutritional needs. Inadequacy in nutritional intake, especially carbohydrate, will cause degradation of body structural proteins for materials to produce energy. This situation will cause malnutrition in athletes (Puttuck, 2014; Priamana, 2000).

Preliminary study on martial arts athletes in Student Sport Education and Training Central Office (BPPLOP) in Central Java Province showed malnutrition in several athletes. There were 8% of athletes, who had malnutrition (BMI <18.5). The result of survey of consumption showed that average of energy consumption in athletes was only 74% of recommended energy consumption. Preliminary study also showed that there was no individual dietary planning of athletes. This can be a problem because the energy needs of every athletes were different (Puttuck, 2014; Penggalih, 2016). The preliminary study also showed that several energy input and output imbalance were due to lack availability of food in the night, bad taste of food, and the athlete's lack of knowledge about their energy needs.

Situation of malnutrition in athletes indicates that there are no sports nutrition surveillances. Good nutrition surveillance system can detects malnutrition in athletes earlier. Early information of malnutrition can be a warning to perform immediate correction. Therefore, instrument that can help the effort to increase the percentage of energy consumption level in athletes is needed. We call this model "Nutriatlet".

Nutriatlet as surveillance instrument is designed with simplicity, flexibility, acceptability, representativeness, and accuracy in report time. Simplicity aspect in Nutriatlet is consisted of structural simplicity, operational simplicity, simplicity in amount of data needed to determine nutritional status, simplicity in sending information, simplicity in data analysis, simplicity in sharing information, and simplicity in time needed for its operation.

Flexibility aspect of Nutriatlet is shown with the ability in adjusting itself to information changes without a need to increase cost, time, and effort. Acceptability aspect of Nutriatlet is shown in the ability of athlete and their coach to operate or use it. Representativeness aspect is shown by its ability in accurate illustration of nutritional need of athlete at particular period of time. Representativeness is also shown by its ability in illustrating under nutrition or over nutrition of athlete at particular period of time. Report time accuracy aspect of Nutriatlet is implemented by the presence of menu, which can quickly give information about athlete's nutritional status to their coach.

Based from these problem, a study to test the effectiveness of dietary planning based on smartphone application "Nutriatlet" in increasing of athlete's energy consumption level is needed.

Method

This was a quantitative study with quasi experimental and pre and post-test design. The dependent variable was dietary planning of athlete using smartphone application "Nutriatlet", while the independent variable was the increase of energy consumption percentage of athlete.

The population were all martial arts athlete in BPPLOP of Central Java Province. The sampling method used was purposive-criterion sampling. The sample were 15 athletes in treatment group who received intervention in the form of dietary planning using "Nutriatlet". Meanwhile, 15 athletes in control group did not received intervention. Bivariate analysis was performed using cox proportional-hazard model, if the variables fulfilled the assumption of proportional hazard. Statistical output of the study were p value, median post-intervention duration, and hazard ratio (HR). Test of effectiveness of dietary planning using Nutriatlet was performed using cox regression time independent. Statistical output obtained were p value and adjusted hazard ratio (HR_{adj}). The analysis was performed using STATA 12.1.

Nutriatlet application which was developed in this study had 8 menu as follows: 1) personal data, 2) measurement of caloric needs, 3) dietary planning, 4) daily evaluation,

5) recall of consumption, 6) anthropometry, 7) report data, and 8) export data.

Nutriatlet was used as tools for individual dietary planning of athlete. In this dietary planning, athlete was advised to consume food with particular amount and type which match the energy need of each athlete.

Nutriatlet used food substitution unit concept. Through food substitution unit, athlete were expected to be able to adjust their daily dietary pattern. As the result, caloric intake can be strived correspond to their need. The following are the unit of food exchange.

Nutriatlet application in this study helped athletes to calculate their energy need. Furthermore, the athletes were guided using individual dietary planning. In order to ease the athlete to translate their energy need into dietary planning, the concept of food exchange was used. For example, an athlete with daily energy need of 3500 Kcal need 11 unit of carbohydrate exchange, 4 unit of animal protein, 4 unit of vegetable protein, 4 unit of vegetable, 4 unit of fruit, 2 unit of milk, 3 unit of oil, and 6 unit of sugar.

Knowledge about this food exchange material was then applied in the pattern of daily diet selection and consumption of food. The provided menus from the institution are general and the athlete can adjust it to fit their needs.

Results and Discussion

According to variable of sex and education, characteristics of subjects were presented as follows.

According to Table 2, proportion of male athlete on intervention group (64.7%) was higher than control group (35.3%), while proportion of female athlete on control group (69.2%) was higher than intervention group (30.8%). In term of the variable of education, proportion of athlete who had high school

Table 1. Food Substitution Unit for Athlete's Caloric Need

Food Exchange Material	Energy (Kcal)/days									
	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500
Carbohydrate	9	11	12	13	15	17	19	20	22	23
Animal Protein	4	4	6	6	6	6	7	8	9	10
Vegetable Protein	4	4	6	6	6	6	7	8	9	10
Vegetable	3	4	4	4	4	4	5	5	5	5
Fruit	3	4	4	4	4	4	5	5	5	5
Milk	2	2	2	4	4	5	5	5	5	5
Oil	3	3	3	4	6	6	6	6	6	6
Sugar	5	6	7	8	8	9	10	10	10	13

Source: Primary Data

Table 2. Characteristics of Subjects According to Variable of Sex and Education

Variables	Intervention		Control		Total	
	n	%	n	%	n	%
Sex						
1. Male	11	64.7	6	35.3	17	100
2. Female	4	30.8	9	69.2	13	100
Total	15	50.0	15	50	30	100
Education						
1. High School	8	57.1	6	42.9	14	100
2. Middle School	7	43.8	9	56.2	16	100
Total	15	50	15	50	30	100

Source: Primary Data

Table 3. Person Time (Week) in Intervention and Control Group

Person Time	N	Average	Standard Deviation	Min	Max
Control	15	8.3	1.25	6	10
Intervention	15	6.3	1.54	4	10

Table 4. Bivariate Analysis Between Meal Planning, Sex, and Education Level and Duration of Percentage Target Achievement of Energy Consumption Level

Variables	HR	CI 95%	Z score
Intervention	3.2	1.40-7.12	2.78
Sex	0.5	0.24-1.18	-1.56
Education level	2.5	1.11-5.68	2.21

educational background in intervention group was higher than control group. On the other hand, proportion of athlete who had middle school educational background in intervention group was smaller than control group. These variables were important to be analyzed further because it is expected to affect the effectivity of dietary planning and monitoring of athlete's nutritional surveillance using Nutrilet toward nutritional status, which was observed from percentage of energy consumption level.

Table 3 showed person time in intervention and control group. Person time is the time from the beginning until the end of observation. Event was defined as the achievement of target which was determined previously by the researcher. It was the percentage of increased energy consumption level ≥10% from the baseline on week 1. In addition, the sensor was if the athlete did not reached the target until week 10 or the athlete was lost to follow up.

Time of observation in this study was started on week 1 to week 10. We observed whether athlete reached the target until week 10 or not. Average of time needed to achieve the target in control group was 8.3 week, while in intervention group was 6.3 week.

Before performing cox analysis, an analysis was performed to find out the fulfilment of proportional hazard (PH) assumptions. PH assumptions were performed between meal planning and duration of increased percentage of energy consumption level, sex and duration of increased percentage of energy consumption level, and between education level and duration of increased percentage of energy consumption level. This study found that all of PH assumptions were fulfilled. Because of that, we could conduct bivariate analysis with cox test. The results were as follows.

Based from above table, the variable of intervention and education level present significant correlation with duration of percentage target achievement of energy consumption level. On the other hand, sex did not possess a significant correlation. Each of HR scores of the variable of intervention, sex, and education level was 3.2; 0.53; and 2.5. These might reflect that: 1) every time, the athlete that planned the meal with nutriatlet had a likelihood of 3.2 times to achieve the target of increased percentage of energy consumption level ≥ 10% per time unit than the athlete who used recall paper, 2) every time, the male athlete had a likelihood of 2 times to achieve the target of increased percentage of energy consumption level ≥ 10% per time unit than the female athlete, and 3) every time, the athlete that graduated at senior high school had a likelihood 2.5 times to achieve the target of increased percentage of energy consumption level ≥ 10% per time unit than the junior high school graduated-athlete.

In order to understand the effectiveness of meal planning on duration of achievement of percentage target of energy consumption level after controlling the variable of sex and education level, the researchers conducted an analysis of cox regression time independent. The analysis result is presented below.

Based from above table, there was a survival equation model that explained the

Table 5. Multivariate Analysis of The Variable of Meal Planning, Sex, and Education Level with the Percentage Target Achievement of Energy Consumption Level

Variable	Model 1	Model 2
	HR (95% CI)	HR (95% CI)
Meal planning and monitoring of athlete's nutrients surveillance	3.97 (1.64-9.63)	4.06 (1.69-9.75)
Gender	0.74 (0.32-1.76)	-
Education level	3.02 (1.21-7.49)	3.29 (1.37-7.89)
n	30	30
Log likelihood	-65.37	-65.59

hazard ratio (HR) of each variables. In model 1, it consisted of all examined variables, but the variable of sex showed a non-significant correlation, therefore this variable was excluded in model 2. Model 2 showed the best model that covered only the significantly correlated variables. From model; 2, we could conclude that every time, the athlete which plan their meal using nutriatlet had a likelihood of 4 times to achieve the target of increased percentage of energy consumption $\geq$ 10% per time unit than the athlete who used recall paper, after controlling the variable of education level.

The study results demonstrated that the use of a modest technology of information was able to help an achievement of nutrients improvement in athlete. The increased percentage of energy consumption level was an important indicator of nutrients improvement in athlete. Therefore, an exertion of athlete's nutrients improvement was essential and needed a sustainable handling.

Compared with conventional nutrient assistance, the use of nutriatlet application possessed several benefits. The success of nutriatlet application in improving the percentage of energy consumption level was influenced by several aspects. The first was its ease of use. Secondly, its simplicity in presenting nutritional messages. The third was the rapidity of the diet program evaluation. The fourth was the feature of online report to the trainer.

In terms of the ease of use, Nutriatlet application provided an easiness in calculating athlete's energy requirements. Martial arts were branch of sport with combined aerobic and anaerobic type energy metabolism. Martial art athlete required sustained energy, especially in training period. Therefore, the endurance capability was important for the athlete. In order to fulfill the energy requirements from martial art activities, the athlete should consider the energy intake precisely. Determination of the precise energy requirements was not simple and easy. Recent science could only calculate the energy requirements based on the energy expenditure. The number of energy requirements was dependent with the daily used energy. The energy requirements could be calculated by considering several components of energy expenditure such as basal metabolic rate (BMR), specific dynamic action (SDA), physical activity, and growth factor. In this context, Nutriatlet application could help to solve the problem of energy requirements calculation in athlete quickly and simply.

Energy requirements was a main priority for athlete. Energy balance was important in maintaining tissue condition, immunity and reproductive functions, and optimal performance. Energy balance was defined as energy intake (from foods, fluids, and supplement products) compared with energy expenditure (energy release, basal metabolism, foods intake effects, and physical activity). Energy expenditure was under influence of age, sex, body mass, body lipid mass, intensity, frequency, and duration of exercise. For athlete, it was recommended to evaluate the number of exercises for intensity, frequency, and duration, then to estimate energy intake for a normal activity. Many athletes required sufficient energy consumption to maintain body mass and composition during activity or exercise. (Evans, 2012; Kushartanti, 2008; Han, 2011). With Nutriatlet application, the athlete could

easily follow the guide to input important data for calculation of energy requirements.

Although Nutriatlet application was easy to operate, it still paid attention to basic principles of balanced nutrition. With this principle, the athlete's meal was prepared to contain enough carbohydrates, fats, proteins, minerals, water, and fibers. Each person's energy requirement varied depending on various factors, such as age, sex, weight and height and the level of daily activities. In order to support the achievement, the athlete needed nutrients which were good in quality and quantity. Basically, there were 2 groups of nutrients, namely: macronutrients, the nutrients which were needed by the body in large quantities such as carbohydrates and fats which acted as energy sources and protein which worked to maintain growth and improved body tissues, such as skin, muscles and hair. The second group of nutrients was micronutrient which were needed by the body in small amounts such as vitamins and minerals which contributed to facilitate various processes in the body (Kushartanti, 2008).

In terms of message simplicity, Nutriatlet apps helped athlete to understand the apps and to evaluate the execution of diet programs. The use of food substitution unit to implement a diet program proved to be easy for the athlete to understand. Through food substitution unit, athletes could control food intake in accordance with individual needs.

In the aspect of the speed of evaluation of the success of the program, athlete could take advantage of the "Daily Evaluation" menu. With this menu, the athlete could know at any time the amount of energy intake that had been consumed. By means of simple data input the athlete could evaluate a predetermined diet plan.

The fourth aspect of Nutriatlet application advantage was the presence of an online report menu to the trainer. The "Report Data" and "Export Data" menu could provide online information to trainers about the evaluation of each athlete's meal planning program. Thus there was the participation of trainer in monitoring the pattern of athlete's food consumption.

Community nutrition improvement programs, including athlete nutrition, would be most effective when an effective surveillance system was supported. This was because the main function of the surveillance system was to provide epidemiological information that was sensitive to the changes which occurs in the implementation of community nutrition improvement programs that supported development programs. One sensitive indicator of change was to keep up with the technological developments in society, namely the use of smartphones based on the android operating system to support all activities, from communication media to extracting information, including athlete nutrition monitoring.

Consistent with the above explanation, a regular, continuous, and sustainable monitoring, or surveillance, was also an integral part of athlete achievement. Basically, surveillance was classified as active and passive. Passive surveillance was a surveillance system that provided data to interested parties based on predefined patterns or rules. In other words, the observation of the case was done indirectly through reports. In general, the surveillance used was passive, because it was cheaper and easier to do by stakeholders. However, this system produced data whose quantification was lower than the actual state.

The active surveillance was an active surveillance system which was conducted by direct case observation in the field. Ideally, a developed surveillance system adopted a passive and active system, which could make the data more complex, but it still be valid and reliable. The basic concepts in surveillance activities were data collection, data processing, data analysis and interpretation, as well as good feedback and dissemination and fast response.

The purpose of athlete nutrition surveillance were 1) to monitor the nutrient requirements of the athlete based on the energy expenditure on a regular basis as well as during an event; 2) to prepare and to provide appropriate athlete food menus (before, during, and after event); 3) to monitor the fitness and endurance of athletes before, during, and after practice/event; and 4) to evaluate the existing training program.

Conclusion

Based on analysis of result and discussion,

meal planning using nutriatlet device was effective to increase the percentage of energy level of athlete. The result of the analysis showed that athlete who conducted meal planning and nutrition surveillance monitoring with nutriatlet were 4 times more likely to achieve a target of increased energy intake adequacy > 10% per unit of time than athlete who did not use nutriatlet.

The success in utilization of nutriatlet apps to help increase the percentage level of energy consumption level provided an opportunity to develop a nutrition surveillance system with nutriatlet apps instrument. Therefore, further researches were necessary in order to assess the characteristics of surveillance on implementation of nutrition surveillance with nutriatlet application.

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