DIETARY MODELLING IN INCREASING CARDIORESPIRATORY RESISTANCE THE STUDENT OF EDUCATION AND TRAINING CENTER

Rina Hasniyati[1], Defniwita Yuska[1], Zulkifli[1], Kasmiyetti[1], Edmon[1], Novelasari[2], Rapitos Sidiq[2]

[1]Department of Nutrition, Padang Health Polytechnic
[2]Department of Health Promotion, Padang Health Polytechnic
Email: rinahasniyati43@gmail.com

ABSTRACT

The Sport Development Index (SDI) survey in 2006 reported that the fitness level of students in Indonesia tended to be low. Dietary factor is among the most important determinant for cardio-respiration resistance. This study aims to develop a dietary model to increase cardio-respiration resistance of athletes at Student Education and Training Center (SETC) in Padang, West Sumatra, Indonesia. This study used a cross sectional design. The population is all students of SETC as many as 77 people. According to the inclusion criteria, a sample of 46 people was obtained. Sampling is done by simple random sampling method. Primary data collection includes data on characteristics, cardiorespiratory resistance, energy intake, fe intake, and physical activity. Data were analyzed univariately uses descriptive statistical measures. Bivariate analysis uses the Pearson and the Spearman correlation test. The results obtained an average cardiorespiration resistance of 102.8, energy intake of 2957.9 kcal, carbohydrate intake of 447.8 grams, protein intake of 105.7 grams, fat intake of 85.9 grams, intake of fe 11, 5 grams and physical activity averaged 8,1. Pearson correlation test results had a significant relationship between energy intake, carbohydrate intake and fat intake with cardiorespiratory resistance ($p < 0.05$). Multiple linear regression test obtained a model equation to increase cardiorespiratory resistance with one independent variable, Cardiorespiration resistance = 71,324 + 0.070 carbohydrate intake. After calculating the needs according to the type of exercise, a significant relationship was found between the needs and resistance of cardiorespiration. It is hoped that the results of the equation found and can be applied by SETC.

Keywords: cardiorespiratory resistance, intake, physical activity

INTRODUCTION

A very tight competition in the era of globalization requires every individual to have a healthy and fit physical condition (Afriwardi 2011). Someone who has a low level of fitness will be at risk for various types of diseases including cardiovascular disease, diabetes,

hypertension and cancer (Arsenault et al. 2011). Fitness is a person's ability to do everyday tasks easily without feeling too tired, and still has extra energy to do leasurebly activities (Afriwardi 2011; Wiarto 2013). The Sport Development Index (SDI) in 2005 reported the level of fitness for students which tended to be low, namely the level of fitness with excellent the results mean good of 5.66%, moderate of 37, 66%, 45.97% fair, and poor of 10.71%. Based on research conducted by Lubis et al in 2013 in Padang 91.7% students observed had poor cardiorespiratory resistance (Lubis and Sulastri 2015). Fitness is influenced by many factors including age, gender, heredity, smoking habit, exercise and food, (Afriwardi 2011; Wiarto 2013) and the type of muscle fiber(Arsenault et al. 2011).

Micronutrient which plays an important role in a person's health and fitness is iron. It plays a role in folate metabolism associated with DNA synthesis and tissue development. In addition, iron also plays a role in the breakdown of fatty acids so that it produces energy when a person is physically active (L 2004). The presence of iron as a supporter of fitness is closely related to energy intake. Lack of calorie intake and nutrition will have an impact on the decreasing ability of the body to do it,s activities. This occurs because muscle contraction requires ATP while the supply of ATP in the muscle is limited so that additional energy is needed to replace or reshape ATP (Afriwardi 2011). This is consistent with the results of research conducted by Putra in 2014 which concluded that there was a significant relationship between energy intake and cardiorespiratory resistance.

Apart from dietary factors in supporting fitness, physical activity is a factor that cannot be ruled out. Someone who performs regular physical activity will have more glycogen stores in his or her muscles than people who don't move. Besides, regular physical activity also increases maximum oxygen consumption. So people who are accustomed to physical activity are more resistant to activity and they are not feeling tired. so that their fitness is well maintained (Wiarto 2013). This is consistent with the research conducted by Diana et al in 2009 on 937 male workers of PT Semen Padang aged 18-56 years, which produced workers with low physical work activities compared to workers with high physical work activities who had 10 times higher risk of experiencing poor physical fitness (Diana, Basuki, and Kurniarobbi 2009).

Resistance cardiorespiration is a direct guide and the best single component in assessing one's fitness level (Afriwardi 2011). Cardiorespiratory resistance illustrates the ability to take oxygen from one person and send it to the central muscles of another cell and use it to supply energy. A person with good cardiorespiratory resistance, has an efficient heart, effective lungs and good blood circulation which can also supply muscles. (Broersen

and Dull 2011). Based on the description above, the researcher is interested in conducting research with the title " Dietary Modelling in Increasing Cardiorespiration Resistance the Student of Education and Training Center ".

METHODS

The study used a quantitative method with cross sectional study. The population is all students of the West Sumatra Student Education and Training Center (SETC) the number of 77 students, based on established sample criteria, a sample of 46 students was obtained. The collected data includes data on the characteristics and resistance of cardiorespiration of students collected with the help of Physical Education graduates. Cardiorespiratory resistance tests are carried out with several conditions, namely respondents in good health, which can be seen from PAR Q and YOU questionnaire. Then the data were obtained through a pulse count after going up and down the bench for 5 (five) minutes guided by the Harvard Step Test. Energy and Fe intake data were obtained through interviews with students, using a semi-quantitative FFQ questionnaire. Students physical activity was assessed through interviews, using a questionnaire modified from Baecke (Baecke, Burema, and Frijters 1982). Data processing was done through the process of editing, coding, entry and cleaning. Data analysis was univariate analysis uses descriptive statistical techniques. Relationship between the two variables used Pearson correlation test was conducted for normally distributed variables and Spearman's correlation for variables that were not normally distributed. Next, multivariate analysis used logistic regression.

RESULTS AND DISCUSSION

Sample Characteristics

The distribution of research samples by age and gender can be seen in the following table.

Table 1.Sample distribution according to the age group and gender

Age (years)	Total

	male	%	female	%
14	0	0	2	15
15	11	69	5	39
16	10	77	3	23
17	12	80	3	23
Total	33 (71.7%)	100	13 (28.3%)	100

Based on table 1, it is known that 71.7% male and 28.3% female, the largest proportion of male students 80% is 17 years old while women 39% are 15 years old.

Cardiorespiration resistance, energy intake, carbohydrates, protein, fat, fe, and physical activity measurements

The average results of measurements of cardiorepiration resistance, energy intake, carbohydrates, protein, Fe fat and physical activity can be seen in table 2 below:

Table 2. Distribution of cardiorespiratory resistance, energy intake, carbohydrate, protein, fat, fe and student physical activity measurements

No	Variable	Mean	SD	Med	Min	Max
1	Cardiorepiration resistance	102.,8	21.59	100.3	67.4	142.8
2	Energy intake	2957.9	759.3	2807.3	1163	5129
3	Carbohydrate intake	447.8	132.8	451.9	180.3	788.6
4	Protein intake	105.7	30.9	104.	36	200
5	Fat intake	85.9	29.7	82.9	11,8	165.7
6	fe intake	11.5	6.39	11.0	3	41
7	physical activity	8.1	2.1	8.5	2.5	10.9

Based on table 2 above, it can be seen that the average resistance of the cardiorespiration of respondents is 102.8 (in the fit range), the average energy intake of respondents per day was 2957.9 cal, carbohydrate was 447, 8 g, protein was 105.7 g, fat was 85.9 g, fe was 11.5 mg, and the average the respondent's physical activity level was 8.1.

Nutritional needs especially energy depends on age, physical activity and gender. According to the 2018 Recommended Dietary Allowances (RDA), the recommended energy adequacy for men aged 13-15 years is 2400 cal / day and ages 16-18 is 2650 cal / day, while women aged 13-15 years are 2050 cal / day and ages 16-18 are 2100 cal / day (RDA, 2018).

When it is compared to the Nutrition Adequacy Rate, the average energy intake of respondents is above RDA.

The high intake of respondents from RDA is caused by their role as both students and athletes who run routine exercises every day. Based on the calculation of athletes' needs, soccer athletes must meet the intake of 4.166 kcal for ages 16-18 years and 3.941 kcal for ages 13-15 years, takraw athletes 3.575 kcal for ages 16-18 years and 3.350 kcal for ages 13-15 years, martial athletes themselves 3.55 kcal for ages 16-18 years and 3,630 for ages 13-15 years, running athletes with 2.601 for ages 13-15 years and archery athletes 2.536 kcal for ages 16-18 years.

The result is still below the level of nutritional adequacy recommended in 2013 which was 19 mg for men aged 13-15 years and 15 mg for men aged 16-18 years, while for women aged 13-18 years was 26 mg.This study also shows that the average physical activity was active. Although, there was no statistically significant difference sex, but the average physical activity of men was higher than women, which was 8.52 in men and 6.89 in women.

Different mean measurements test by genders

The average difference test results of the measurement of variables can be seen in the following table:

Table 3. Different test results on average cardiorespiratory resistance, energy intake, fat, protein, fat, fe and physical activity according to sex

Variable	sex	n	Mean	SD	p value
cardiorespiratory resistance	male	33	108.2	20.1	0,005*
	female	13	89.1	19.6	
energy intake (kcal/day	male	33	3137.6	705.6	0,009*
	female	13	2498.4	718.9	
carbohydrate intake (gr/day)	male	33	482.1	125.1	0,004*
	female	13	361.0	113.8	
protein intake (gr/day)	male	33	111.4	31.2	0,041*
	female	13	91.0	25.4	
fat intake (gr/day)	male	33	89.8	27.3	0,158
	female	13	76.0	34.2	

Fe intake (gr/day)	male	33	12.4	7.1	0,116
	female	13	9.1	3.1	
Physical Activity	male	33	8,5	1,7	0,016*
	female	13	6,8	2,5	

* significancy (p <0.05)

Based on table 4, it was significance difference to the average cardiorespiratory resistance, energy intake, carbohydrate, protein and physical activity in men and women (p <0.05), while fat and fe intake are not different significantly.

The difference in energy, carbohydrates, and protein intake between male and female athletes lies on the fact that there were some female athletes who were in a weight loss program so there is a difference in intake with athletes who were during so. Based on the observal menu and interview with respondents, it was found that athletes who join a weight loss program the intake of animal fat and protein was reduced this may not cause significant differences in Fe and fat intake between male and female athletes.

The results of this study also found a significant difference between the physical activity of male and female respondents, this might be influenced by sports involved in athletes. Most male athletes were found of soccer and women chose martial arts. It caused the differences and training techniques they did so as to affect the level of their physical activity.

The relationship between energy intake, cabohydrates, protein, fat, Fe and physical activity with cardiorespiratory resistance

To see relationship between variables, Pearson's test for normally distributed variables and Spearman's tests for variables that are not normally distributed. Were to conducted find out whether there is a relationship between variables. While the closeness of the relationship between variables is seen from the value of r. The results of the test of the relationship between variables can be seen in the following table.

Table 4. Relationship of Energy, intake Carbohydrate, Protein, Fat, and Fe Intake Physical Activity with students Cardiorespiratory Resistance

Variable	Cardiorespiratory Resistance (seconds)	
	R	p value
energy intake	0.411	0.005
carbohydrate intake	0.432	0.003
protein intake	0.255	0.088
fat intake	0.299	0.044

fe intake	0.270	0.067
physical activity	0.150	0.324

Based on table 4, it was found that is energy intake, carbohydrate intake and fat intake with cardiorespiratory resistance show moderate correlation (r = 0.411, 0.432 and 0.299) have a positive patternt, means that the higher the intake of energy, carbohydrates, protein and fat the higher the level of cardiorespiratory resistance. Based on statistical tests, the results found that there was a significant difference between energy, carbohydrate, protein and fat intake with cardiorespiratory resistance. Mean while there was no correlationbetween intake and physical activity with cardiorespiratory resistance.

Energy intake is needed to do muscle work obtained from food consumed every day which consists of macro nutrients, including carbohydrates, protein, and fat (Williams and Rollo 2015). Energy from food is transferred to a storage molecule called adenosine tripospate (ATP). Muscle contractions for each sport or physical activity produced by movements using muscles are supported by energy released from the separation of high-energy phosphate from ATP.

Although ATP is a direct source of energy for muscle contraction, the amount of ATP found in the muscles is very small (only about 85 grams) which must be continuously refilled or it will be exhausted after a few seconds of high intensed exercise. ATP is replenished by two separate systems, namely the anaerobic system and the aerobic system. Anaerobic systems produce ATP without oxygen from the storage of small ATP-creatine phosphate (CP) and lactate systems while the aerobic system uses oxygen (Antony 2011). If the athlete's energy intake is fulled, then cardiorespiratory resistance can be increased.

This study also found a significant relationship between carbohydrate intake with cardiorespiratory resistance. The results of this study are also in line with the research done by Rizki H, 2018 which concluded that there is a significant relationship between carbohydrate intake and cardiorepiration resistance. (Rizqi and Udin 2018)

Carbohydrate is one of the macro nutrients which act as the main energy source at various levels and types of physical activity. There are two types of carbohydrates. There are namely simple and complex carbohydrate. Glucose is a simple carbohydrate that can beused directly as a source of energy by the body's cells, but if the amount is excessive it can be converted into glycogen reserves in the liver and muscles. If it is still excessive it will be stored in the form of fat in adipose tissue. Complex carbohydrate is long-chain carbohydrate which is a combination of 3 or more glucose molecules. There is another form of

carbohydrate, namely fiber (including cellulose) which cannot be digested by digestive enzymes (I.Ilyas 2004).

When doing physical exercise, the body's muscles, heart system, and blood and breathing circulation are activated. At the beginning of aerobic exercise, the main source used is glucose which is derived from muscle glycogen stores. Furthermore, if the exercise portion is increased, the use of glucose comes from liver reservation (Thankachan et al. 2012). So the better the intake of carbohydrates, is the better the glycogen stores so that it will play a role in maintaining performance in physical exercise. This research also produced a significant relationship between fat intake and cardiorespiratory resistance. The results is consistent with the study conducted on Sholehah et al 2018 which concluded that there was a significant relationship between fat intake and good fitness level.(Sholeha, Humairoh R, Katrin E 2018)During physical exercise, the process of breaking down fat into ATP or beta oxidation occurs. The amount of ATP produced depends on the C (carbon) atom content of certain types of fat(Williams and Rollo 2015).

Fat is the main source of energy for long physical activities such as long distance running and marathons. Fat is also an ideal source of energy for body cells because each molecule contains a large amount of energy. It is also easily transported and changed when needed. One gram of fat contains 9 KKal, 2 times the amount of energy contained in carbohydrates and protein (I.Ilyas 2004).

Fat is also the main source of energy for growth and physical activity for children. Fat is stored in the form of triglycerides in muscle tissue and adipose tissue in the body. When exercising, triglyceride stores will be broken down into glycerol and free fatty acids and then metabolized to produce energy. Burning fat contributes more than burning carbohydrates, especially in low intensity sports (walking, jogging, etc.) the its contribution will decrease as increasing of sport intensity. To help maintaining energy and adequate nutrition, fat consumption should be around 20-35% of the total energy needs. One essential function of fat is a source of energy for muscle contraction(L 2004).

The research also found a significant relationship between protein intake and cardiorespiratory resistance. People who often do physical exercise really need adequate protein intake because it will cause the formation of muscle mass. Muscle mass plays a role in the formation of energy in a fast time, so that when the body conducted its activities in the first minutes, it will burn muscle mass. If protein intake is insufficient, it will cause a decrease in muscle mass. This can result in decreased muscle function and physical performance of a person. (Pasiakos et al. 2017) Protein is needed for growth, development

of muscle formation, formation of red blood cells, the body's defense against disease, enzymes and hormones, and the synthesis of other body tissues. Protein requirements after exercise increase slightly because they are used for tissue recovery and muscle mass gain. The recommended protein consumption is 12 to 15% of the total energy needs.(L 2004)

The result of this study did not find a significant relationship between Fe intake and cardiorespiratory resistance. This study is not in line with the Refiana study, 2015 which found there was a relationship between iron intake and the level of fitness of students in UNY soccer UKM with p values = 0.042 and r = 0.341. A person who practices every day is very susceptible to loose Fe even in small amounts, because the body can loose Fe through sweat. This makes athletes who have resistance such as runners at risk of experiencing Fe deficiency. Without enough iron, the body cannot use oxygen properly to produce energy. This incident will interfere with the ability of athletes to compete. A common problem for athletes with Fe deficiency is the inability to maintain constant heart rate during moderate to severe exercise. Another problem that is the respondents of this study are athletes and teenagers as well. Adolescence is an important period of nutritional insecurity due to the increasing need for food to grow and develop. The need for Fe increases as a result of intensive growth and muscle development, which means an increase in blood volume exists; thus, it is very important to meet the intake of Fe. (Taylor et al. 2013).

The result of this study did not find a significant relationship between physical activity and cardiorespiratory resistance. Physical activity continously and regularly will made cardiorespiratory resistance will be good because energy sources to be used more efficiently, thus allowing glycogen storage in the liver and muscles and causing greater muscle mass, and will more resistant to activity and not easily tired as well. (Wiarto 2013). Physical activity also causes maximal oxygen uptake, decreasing heart rate and blood pressure, increasing work efficiency of the heart muscle, increased resistance in physical exercise, increasing activity of aerobic enzymes in skeletal muscle and increasing muscle strength and metabolism (Wiarto 2013). More over, physical activity will make the blood distribution to muscle fibers more smoothly so that capillaries will increase, a result body fitness will be maintained well.(Broersen and Dull 2011)

Multivariate analysis was conducted using multiple linear regression analysis. The results of the analysis were used to model the cardiac resistance of the heart in the form of a regression equation. The results of multivariate analysis are shown in the following table:

Table 5. The results of multiple linear regression analysis

Variable	Coef. Beta	SE	T	p-value	
Const.	71.324	10.315	6.915	0,000	R =0.432
Carbo intake	0.070	0.022	3.182	0,003	R2= 0.187

Based on table 5 it is known that carbohydrate intake is a more dominant variable affecting cardiorespiratory resistance with the equation of the cardiorespiratory resistance model obtained is:

Cardiorespiration resistance = 71.324 + 0.070 carbohydrate intake

The determinant coefficient (R2) of the equation obtained is low, R2 = 0.187, which means that the equation can explain the proportion of variable diversity in the cardiorespiratory resistance variable which is only 18.7%.

Carbohydrates are the most important fuel source for athletes because they provide glucose which is used for energy. One gram of carbohydrate contains about four kilocalories of energy. Glucose is stored as glycogen in the muscles and liver. Muscle glycogen is the most available energy source for working muscles and can be released faster than other energy sources (Hoch, Goossen, and Kretschmer 2008). Carbohydrates must comprise 45% to 65% of total calorie intake for ages 4 to 18 years (Hoch et al. 2008; Otten, Hellwig, and Linda 2006).

Carbohydrates are needed in aerobic exercise, because the energy obtained comes mainly from carbohydrates at that time, energy derived from the aerobic process originally comes from muscle glycogen. If sport activity continues, the formation of ATP comes from the glucose and liver glycogen reservation, whereas glycogen reservation will not be formed without carbohydrates. Carbohydrates are important for endurance. Athletes with strenuous exercise require energy output 2-3 times greater than individuals who do not practice (L 2004).

CONCLUSION

The results of multivariate analysis are carbohydrate intake is a more dominant variable affecting cardiorespiratory resistance with the equation of the cardiorespiratory resistance model obtained is:

Cardiorespiration resistance = 71.324 + 0.070 carbohydrate intake

It is hoped that the results of the equation found and can be applied by SETC.

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