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CORRELATION BETWEEN FAT CONSUMPTION, SMOKING HABIT, AND STRESS WITH HYPERTENSION AMONG DRIVERS

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ABSTRACT

Hypertension is one of major health problem that affect many people. Driver is one of the jobs that could cause hypertension due to the surrounding environment which support unhealthy lifestyles such as consuming excessive fat, smoking habit and susceptible to stress. The purpose of this research was to analyze the correlation between fat consumption, smoking habit, and stress with hypertension among drivers. This research was an observational study using cross sectional design. The samples were 74 male drivers taken by accidental sampling. The respondent was chosen around Juanda Airport Sidoarjo. The data were collected by measuring blood pressure using digital sphygmomanometer and interview using questionnaire, Semi Quantitative Food Frequency Questionnaire, and The Workplace Stress Scale. The data then analyzed using Pearson and Spearman Correlation test. The results of this research showed that stress (P=0,000; r=0,830) had strongest correlation with hypertension among drivers compared to two other variables, fat consumption (P=0,000 ; r=0,689) and smoking habits (P=0,004 ; r=0,331). This study concludes that excessive fat consumption, smoking habit 11-20 cigarettes/day, moderate and severe stress levels can increase the risk of hypertension among drivers. Drivers should adjust to reduce consumption of fried foods, smoking habit, and stress with sufficient rest ± 7-8 hours/day to prevent the occurrence of hypertension among drivers.

Keywords: hypertension, driver, fat consumption, smoking habits, stress.

INTRODUCTION

Non-Communicable Diseases (NCD) is a leading cause of death that occurs throughout the world. World Health Organization (WHO) 2017 reported total death in 2016 was 56.9 million in which 40.5 million or 71% of the total number of deaths were due to non-communicable diseases. Indonesia is a country that has an increase in NCD's prevalence including hypertension. Based on the results of the 2013 national survey data, the prevalence of hypertension was 25.8%. (Indonesia MoH, 2013).

Hypertension is a health problem that occurs in all groups of people, especially workers (Setyani and Nuraini, 2014). Type of work, workload, work environment, lifestyle, and worker characteristics are risk factors for hypertension in workers (Hardati and Ahmad, 2017). One job that has a risk of developing hypertension is the driver (Erhiano et al., 2015). Hypertension among driver can be caused by the work type that mostly sitting, work environment that is prone to stress and possess to unhealthy lifestyle (Ngateni, 2009).

Research conducted by Nasri and Moazenzadeh (2006) on drivers and non-drivers in Kerman, Iran shows that drivers both bus and taxi drivers have a higher risk of developing hypertension compared to non-drivers or other occupations. Erhiano *et al.* (2015) also proved that the incidence of hypertension in bus drivers in Nigeria was quite high (33.5%). Swestyastasari (2010) also showed that the incidence of hypertension in bus drivers in Purabaya Terminal, Surabaya was 52.4%. Most bus drivers consume excess fat and experience stress due to working hours > 40 hours per week so they tend to experience hypertension. Research conducted by Faridah (2017) also revealed that most bus drivers who are smokers ≥12 cigarettes/day tend to have hypertension.

Consumption of excess fat, especially saturated fat can increase Low Density Lipoprotein

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(LDL) cholesterol levels in the body (Wiardani et al., 2011). Fat in the blood, especially LDL cholesterol, has the potential to react with free radicals and cause oxidative stress. In addition, smoking and stress are also exposure to free radicals that trigger oxidative stress (Widayati, 2012). The occurrence of oxidative stress in the body will cause LDL to oxidize and form plaque in blood vessels (Simanjuntak, 2011). The plaque will cause narrowing of the arteries and increase blood pressure (Samuel, 2007). In addition, the nicotine and monoxide content in cigarettes can also cause narrowing of blood vessels then increase blood pressure as well (Faridah, 2017).

Based on previously mentioned studies, it is known that drivers are vulnerable to the risk of developing hypertension. Therefore, this study aims to analyze the relationship between fat consumption, smoking habits and stress level with the incidence of hypertension in the driver.

METHODS

This was an observational research with cross sectional design. The study population was all drivers around the Juanda Airport area in Sidoarjo, Indonesia. Total sample was 74 male drivers which was collected using non-probability, accidental sampling technique.

The independent variables were fat consumption, smoking habits, and stress while the dependent variable was hypertension. Data collected were blood pressure measurements using a digital sphygmomanometer by a nurse, while interviews were done for other data collection. Fat consumption was collected using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) (Ranuwirna, 2017), stress level using The Workplace Stress Scale (The Marlin Company, 2001), characteristics of respondents (age and family history of hypertension) and smoking habits using a structured questionnaire.

The incidence of hypertension was classified according to the American Hypertension Association (AHA) i.e., normal (<120 mmHg and <80 mmHg), pre-hypertension (120-129 mmHg and <80 mmHg), Hypertension I (130-139 mmHg or <90 mmHg), and Hypertension II (≥140 mmHg or ≥ 90 mmHg) (AHA, 2017). Fat consumption was assessed based on the percentage of the level of adequacy of fat consumption compared to the Indonesian Recommended Dietary Allowance (RDA). The percentage results were classified according to WNPG in 2004 which is “less” if it meets <80% RDA, “sufficient” if it meets 80-110% RDA and “excess” if it meets >110% RDA. The smoking habit of the driver was assessed based on the number of cigarettes smoked in a day, then classified into: not smoking, 1-10 cigarettes/day, 11-20 cigarettes/day, and >20 cigarettes/day. The stress level on the driver was assessed based on The Workplace Stress Scale with no stress classification (score <15), mild stress (score 16-20), moderate stress (score 21-25), and severe stress (score 26-30).

Data analysis was adjusted with the accidental sampling which includes non-probability technique so it can only analyze the strength of the relationship. Data analysis used was the Pearson and Spearman correlation test. This study has passed the ethical review by the Health Research Ethics Committee of the Faculty of Public Health, Universitas Airlangga (No: 443-KEPK).

RESULT AND DISCUSSION

Respondent characteristics (age and family history of hypertension), fat consumption, smoking habits, stress and the incidence of hypertension among drivers in this study can be seen in Table 1.

Characteristics of Respondents

The age of the drivers in this study are grouped according to the adult age group in the Indonesian RDA. This was because there was fat intake variable that compared to the RDA according to age group. Based on Table 1, the majority of drivers aged 30-49 years (78.4%), with an average age of 41-42 years. According to BPS (2014), ages 15-64 years included as productive age so that all drivers are in productive age and able to work as a driver.

In addition, the majority of respondents (77.0%) did not have a family history of hypertension and the rest 23.0% had a family history of hypertension from one parent. This is consistent with Rizkawati's study (2012) that most *TransJakarta* bus drivers do not have a family

Table 1. Frequency Distribution of Respondent Characteristics, Fat Consumption, Smoking Habits, Stress, Hypertension in Drivers

Variable	n	(%)
Age		
30-49 years	58	78.4
50-64 years	16	21.6
Family history of hypertension		
Present	17	23
Not present	57	77
Fat intake		
Deficit	0	0.0
Sufficient	46	62.2
Excess	28	37.8
Smoking habits		
Not smoking	15	20.3
1-10 cigarettes/day	15	20.3
11-20 cigarettes/day	41	55.4
>20 cigarettes/day	3	4.1
Stress		
Not stress	4	5.4
Mild stress	33	44.6
Moderate stress	35	47.3
Severe stress	2	2.7
Hypertension		
Normal	14	18.9
Pre-hypertension	26	35.1
Hypertension I	25	33.8
Hypertension II	9	12.2

history of hypertension (79.3%) and drivers who have a family history of hypertension are mostly owned by one of the driver's parents.

Hypertension

Based on Table 1, almost half of the drivers had hypertension (46.0%), 33.8% was hypertension I and 12.2% was hypertension II. This is consistent with Faridah's study (2017) that most Inter-Provincial/Inter-city bus drivers do not experience hypertension. However, the prevalence of hypertension in the driver in this study was greater than the national prevalence of hypertension based on the 2013 national health survey which revealed only 25.8% adults with hypertension. Hypertension experienced by a driver can be caused by several factors, including fat consumption, smoking habits and stress (Ngateni, 2009; Swestyastasari, 2010).

Fat Intake

Based on Table 1, there was no driver with less consumption of fat. The majority of fat intake among driver (62.2%) was sufficient with an average of 105.6% RDA of fat.

Sufficient intake of fat might be due to drivers' eating habit who consume fried foods mostly every day (81.1%). The most fried foods consumed by the driver were tofu, tempeh, eggs and fish. In addition, the driver also consumes food sources of fat in the weekly basis i.e. chicken (79.9%), beef (71.6%) and meatballs (68.9%). The frequency of food types consumed by the driver showed in Table 2.

Our result is in line with Swestyastasari's study (2010) which shows that almost all city bus drivers consume cooking oil contained in every day food. Fried foods have more delicious and savory taste compared to foods that are boiled and steamed causes majority of people process food by frying that is dependent on cooking oil (Amalia et

Table 2. Frequency of Fat Food Source Intake among Drivers

Fat food source	Daily		Weekly		Monthly		Never		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Eggs	15	20.3	49	66.2	10	13.5	0	0	74	100
Chicken	1	1.4	59	79.7	14	18.9	0	0	74	100
Beef	1	1.4	53	71.6	17	23	3	4.1	74	100
Lamb	0	0	6	8.1	51	68.9	17	23	74	100
Duck	0	0	14	18.9	44	59.5	16	21.6	74	100
Beef tripe/organs	0	0	12	16.2	27	36.5	35	47.3	74	100
Meatballs	0	0	51	68.9	18	24.3	5	6.8	74	100
Sausage	3	4.1	2	2.7	20	27	49	66.2	74	100
Full cream milk	5	6.8	29	39.2	22	29.7	18	24.3	74	100
Cheese	0	0	4	5.4	12	16.2	58	78.4	74	100
Fried foods	60	81.1	14	18.9	0	0	0	0	74	100

al., 2010). Cooking oil that is often used is palm oil which contains saturated fatty acids by 51% and unsaturated fatty acids by 49% (Hanum, 2016). The more often the cooking oil is used, the more saturated fatty acids contained in the cooking oil (Yusuf et al., 2013).

Based on Table 3, the majority of drivers who consume excess fat tend to experience hypertension, while the consumption of sufficient fat tends to not experience hypertension. Statistical test using Pearson correlation test showed P-*value* = 0,000 with r = 0.689 which means there was a strong relationship between fat consumption with the incidence of hypertension in the driver. A possible explanation is that the more consumption of fat, especially saturated fat, will increase Low Density Lipoprotein (LDL) cholesterol levels (Yusuf et al., 2013). Increasing LDL cholesterol can trigger faster reactions with free radicals and cause oxidative stress. The occurrence of oxidative stress in the body due to high ROS (Reactive Oxygen Species) and low antioxidants causes oxidized LDL. LDL oxidation then increase the plaque formation on blood vessel walls (Simanjuntak, 2011). Plaque that forms will accumulate and cause narrowing of blood vessels so that blood pressure increases (Samuel, 2007).

The results of this study are in accordance with Swestyastasari research (2010) showing that there was a relationship between fat consumption and the incidence of hypertension in bus drivers, in which drivers who consume excess fat will be 17.66 times more at risk of developing hypertension compared to those who consumption sufficient fat. Thus, high consumption of fat could increase the risk of hypertension in the driver.

Smoking Habit

The risk of hypertension in smokers does not depend on the length of smoking, but the number of cigarettes smoked in a day (Muttaqin, 2009). Based on Table 1, the majority of drivers smoke as many as 11-20 cigarettes/day (55.4%). The highest number of cigarettes smoked by the driver was 32 cigarettes/day. This is consistent with Swestyastasari's research (2010) that most city bus drivers smoke as many as 10-20 cigarettes/day.

Based on Table 3, the majority of drivers who smoke 11-20 cigarettes/day tend to have hypertension compared to drivers who don't smoke. Statistical test using the Spearman correlation test showed P-*value* = 0.004 with r = 0.331 which means there was a weak relationship between smoking and the incidence of hypertension among driver. The relationship between smoking and hypertension was due to the nicotine content in cigarettes that stimulate sympathetic nerves resulting in narrowing of blood vessels. Moreover, carbon monoxide in cigarettes can replace oxygen in the blood so that it triggers the heart to work harder then will increases blood pressure (Faridah, 2017). Cigarette smoke is exposure to free radicals originating from external sources that can increase Reactive Oxygen Species (ROS) in the body and cause oxidative stress and oxidation of cholesterol Low Density Lipoprotein (LDL). Oxidized LDL results in the formation of plaque and triggers narrowing of blood vessels resulting elevation in blood pressure (Fitria et al., 2013).

The results of this study was in line with Faridah's research (2017) that explained a relationship between smoking habits and the incidence of hypertension in inter-city/inter-provincial bus drivers (*AKAP*). *AKAP b*us drivers who experience hypertension tend to consume as much as ≥12 cigarettes/day and have 3,816 times hinger risk compared to drivers who are not smokers and drivers who smoke 1-11 cigarettes/day. Thus, we conclude that the more cigarettes smoked, the higher risk of hypertension will occur.

Stress Level

Stress level in our study was assessed based on the total score (Table 1). The majority of drivers experienced a moderate stress level (47.3%). The stress experienced by the driver was mostly caused by working in excess reasonable time limit or more than 8 hours a day. Most drivers work 9-12 hours a day and 5 days in a week. This was in line with Swestyastasari's study (2010) that most city bus drivers experience stress due to high working more than 40 hours a week.

Furthermore, based on Table 3, the majority of drivers who had severe and moderate stress tend to experience hypertension compared to drivers who had mild or not experiencing stress. Statistical test using the Pearson correlation test showed P*value*

Table 3. The Relationship between Fat Consumption, Smoking Habits, Stress with Hypertension in Drivers at Juanda Airport, Surabaya, Indonesia

Variable	Hypertension								Total		P	*r*
	Normal		Pre Hyperten-sion		Hypertension I		Hypertension II					
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)		
Fat intake												
Sufficient	14	30.4	22	47.8	8	17.4	2	4.3	46	100.0	0.000	0.689
Excess	0	0.0	4	14.3	17	60.7	9	25.0	28	100.0		
Smoking habit												
Not smoking	5	33.3	6	40.0	3	20.0	1	6.7	15	100.0		
1-10 cigarettes/day	7	46.7	3	20.0	4	26.7	1	6.7	15	100.0	0.004	0.331
11-20 cigarettes/day	2	4.9	15	36.6	17	41.5	7	17.1	41	100.0		
>20 cigarettes/day	0	0.0	2	66.7	1	33.3	0	0.0	3	100.0		
Stress												
Not stress	4	100.0	0	0.0	0	0.0	0	0.0	4	100.0		
Mild stress	10	30.3	23	69.7	0	0.0	0	0.0	33	100.0	0.000	0.830
Moderate stress	0	0.0	3	8.6	24	68.6	8	22.9	35	100.0		
Severe stress	0	0.0	0	0.0	1	50.0	1	50.0	2	100.0		

= 0,000 with r = 0.830 which means there was a strong relationship between stress level and the incidence of hypertension among driver. A possible mechanism is because severe stress stimulates the sympathetic nervous system which cause arteriolar constriction resulting changes in blood pressure in short term (Sani, 2008). Stress also triggers an increase in Reactive Oxygen Species (ROS) associated with plaque formation (Widayati, 2012). The plaque will cause narrowing of the arteries and increase blood pressure (Samuel, 2007). Stress also triggers the production of the hormone adrenaline which will increase cardiac output thereby causing an increase in blood pressure (Tilong, 2014).

Our study is in accordance with Rizkawati's research (2012) showing that the incidence of hypertension is higher in bus drivers who experience moderate stress levels compared to bus drivers who experience mild stress levels. Thus, the heavier the stress level experienced by the driver will increase the risk of hypertension.

CONCLUSION

Our study concludes that nearly half (46%) of the drivers had hypertension. Excessive fat consumption, smoking habits 11-20 cigarettes/day and stress due to >8 hours working time in a day will increase the risk of hypertension among driver. Excessive fat consumption, smoking habits and stress trigger an increase in free radicals and react with LDL cholesterol in the body which causes oxidative stress. The occurrence of oxidative stress results in LDL oxidation which triggers plaque formation and constriction of blood vessels until it increases blood pressure. The driver should begin to change behavior by reducing the consumption of fried foods, reducing smoking, and reducing stress with enough rest ±7-8 hours/day to prevent hypertension.

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EFFECT OF COOKING METHODS AND RICE VARIETY ON THE SENSORY QUALITY AND CONSUMER ACCEPTANCE

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ABSTRACT

Rice is the staple food of Indonesian which has superior taste which made it rooted in the eating culture in Indonesia. Nowadays, there is still limited research comparing cooking methods in various rice varieties. This study aim to analyze the effect of various cooking methods and rice variety on sensory quality. There were two cooking methods tested, traditional method that combines boiling and steaming, and rice cooker steaming method. Sensory test (quality characteristic) and acceptance test were measured using hedonic scale on 30 semi-trained panelist to evaluate the effect of cooking method on four rice variety, that are white rice Berlian Sae, white rice Super Slyp, brown rice, and black rice. Statistical test used was ANOVA and continued with Duncan test. Results showed differences in ratio of water and cooking time of various types of rice with different methods. White rice (Slyp Super) with conventional cooking methods was more acceptable to panelist with the characteristics of bright colors, smell, neutral taste, and delicate texture. There was a significant difference in panelist acceptance based on type of rice ($p<0.05$) which brown rice and black rice had lower acceptability than white rice. There was no significant difference in acceptance by cooking method ($p>0.05$), but there was a tendency that traditional method has higher acceptability. Color indicator became main indicator for panelist determined overall acceptability, so that it can be considered in the development of rice cooking methods.

Keywords: rice variety, cooking methods, sensory evaluation

INTRODUCTION

Rice is staple food of Indonesian people with increasing consumption levels. According to Ministry of Agriculture data (2017) Indonesian people rice consumption is 100.57 kg/capita/year with growth rate of 2.22% annually. Rice has superiority in taste and processing so that it is rooted in eating culture in Indonesia.

Rice is part of paddy grain besides husks. Among various types of cereals, rice has the most varieties, which is more than 120,000 species (IRRI, 1991). Types of rice commonly consumed in Indonesia are white rice, brown rice and black rice. The biggest part of rice (80-85%) is starch (amylose and amylopectin). Composition of this complex carbohydrate influences the characteristics of rice especially texture (Lyon et al., 2000; Wada et al., 2006; Lum et al., 2017).

Difference in rice colour caused by diversity of genes contained and affects the color of outer portion of rice called aleuron. Each rice variety has different characteristic (Yang et al., 2010). Different varieties in rice can also affect rice characteristic, including physicochemical, morphological, and taste (Yadav et al., 2007).

Cooking method is another factor that influence characteristics of cooked rice. Various studies suggest time and temperature of rice cooking affect physical quality of rice (Yamakura et al., 2005; Chakkaravarthi et al., 2008; Han and Lim, 2009; Tian et al., 2014). Higher cooking temperature will have effect on decreasing the physical quality and color of rice (Yamakura et al., 2005). According to Han et al. (2008), different cooking methods will affect the hydrolysis of starch.

In general, method of rice cooking can divided into two ways, namely conventional method and modern method. There are two stages in conventional method, there are boiling or scraping and steaming. Boiling or scraping stage consist

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of preparing water to boil and steam rice until it become rice. Meanwhile cooking rice with modern method use electricity or other non-natural instrument (Syafutri, 2016). Each cooking method will affect acceptability and chemical content.

At present there is still limited study comparing two methods of cooking various rice varieties. Brown rice and black rice that have unique characteristics (in terms of the composition of amylopectin and amylose) tend to be less acceptable by consumers (pera or less fluffy). In other hand, brown rice and black rice have better nutrients (vitamins, minerals, antioxidants, and fiber) than white rice (Monks et al. 2013). For this reason, research is needed to analyze effect of varieties and methods of cooking rice on sensory quality and consumer acceptability.

METHOD

This study use experimental design with factorial randomized design (two factors). Variable in this study are cooking method and rice variety as dependent variable and sensory quality as independent variables. Rice varieties used in study were semi-organic type (Berlian Sae white rice) / B1, non-organic type (Super Slyp white rice) / B2, brown rice / B3 and black rice / B4. Cooking method used is conventional method (a combination of boiling and steaming) and modern method (rice cooker steaming). This research was arranged in factorial consist of 3 factors, that are based on variety (B) and cooking method (M). Variety factor consist of 4 parts, namely:
B1= Berlian Sae white rice
B2= Slyp Super white rice
B3= brown rice
B4= black rice

While the cooking method consist of 2 methods:
M1= Conventional
M2= Rice Cooker (modern)

So that there are 8 treatment :
1. B1: Conventional method
2. B1: Modern method (rice cooker)
3. B2: Conventional method
4. B2: Modern method (rice cooker)
5. B3: Conventional method
6. B3: Modern method (rice cooker)
7. B4: Conventional method
8. B4: Modern method (rice cooker)

Study was conducted at Processing Laboratory and Organoleptic Laboratory, Department of Health Nutrition, Airlangga University for five months. Implementation of this study was approved by the Health Research Ethics Commission, Faculty of Public Health, Airlangga University under number 548/EA/KEPK/2018.

Rice from various varieties and processing methods were tested for sensory quality and acceptability using hedonic scale on 30 subjects of semi-trained panelist. Panelist have to fulfill inclusion criteria that are in the age range of 18-30 years, healthy at the time of data collection, not suffer from color blindness, and not experiencing impaired sensory function (colds, coughs, and others).

Sensory tests (quality characteristics) on rice are assessed based on indicators of color, aroma, taste, texture and overall. Purpose of sensory testing is to assess product quality characteristics based on panelist preferences as community representatives. The highest score on hedonic scale is expressed preference, and the lowest score indicates panelist dislike to sample. The purpose of quality test is to determine the effect of treatment on product quality characteristics. Assessment of quality characteristics consists of 5 choices as listed in table 1.

At each assessment session, water was provided for panelists to neutralize the taste on tongue. Number of samples presented is 15 gram each formula. Respondent fill out the inform consent to be panelist before conducting assessment. Data on organoleptic properties of the analysis results were statistically tested with analysis of variance (ANOVA) and continued with Duncan test.

RESULT AND DISCUSSION

Cooking Properties

Table 2 shows the ratio of water and rice ratio, optimal time and temperature in cooking rice. Based on table 2, brown rice and black rice require more water, both in conventional method and rice cooker. In addition, conventional methods require more time in cooking.

Brown rice and black rice have a higher water ratio for cooking in both methods. Twice more

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Table 2. Methods and Rice Variety

No	Rice Type	Method	Water Ratio	Duration (Minute)	Optimal Temperature (°C)
1	B1	Conventional	2:1	55	84
2	B1	Rice cooker	2:1	25	79
3	B2	Conventional	2:1	55	84
4	B2	Rice cooker	2:1	25	79
5	B3	Conventional	4:1	75	81.5
6	B3	Rice cooker	5:1	25	79
7	B4	Conventional	4:1	75	81.5
8	B4	Rice cooker	5:1	25	79

water is needed for cooking brown rice and black rice compared to white rice. The optimum water ratio in cooking white rice is 1: 1.4-1.8 in Sintanur, Ciherang and IR 64 varieties (Subarna, 2017). Red and black rice have an ideal water ratio of 1: 3-4. Black rice has an absorption ratio highest water (3.51g/g), followed by brown rice (3.20 g/g) and white rice (2.99 g/g) (Lum, 2017) Presence of amylose and amylopectin affects the ability of food to absorb water, white rice has a low amylose content (<20%) compared to black rice (> 20%). Amylose content is positively correlated with amylopectin content in rice. A linear structure in amylose allows rice to easily absorb water (Febriana et al., 2014).

The most important part of rice grain is endosperm which has main components of starch granules (amylose and amylopectin). Amylose is a straight chain polymer of glucose units (around 1000 units) that form crystalline. Amylose containing rice is giving texture of fluffier rice while rice with high amylose content has the nature of hard, dry and dry rice. This is due to ability of association between amylose structures to form rigid texture. The higher amylose content in rice grains, the higher water will absorbed to break down straight chain polymers so that rice is cooked and can be consumed (Luna et al., 2015).

Physical characteristics of brown rice and black rice are among the factors that also influence amount of water in cooking process. Rice used in this study were black rice and brown rice with broken skin. The cause of optimum absorption of water in brown rice and black rice is fat content and waxy coating on outer skin. External components of cuticle are hydrophobic which act as physical barrier to water absorption (Champagne et al., 1997; Mardiah et al., 2017).

Optimum cooking time used in conventional method is 55 minutes, while rice cooker method is 75 minutes, with higher optimum temperature needed in conventional method. Parboiled time ranges from 10-15 minutes with aim to optimize water absorption and accelerate heat transfer which give perfect texture to all parts of rice. In this study, parboiled was considered sufficient when water was absorbed. Time of parboiling considered as time when rice is heated on stove until water absorbed completely.

The optimal temperature in both methods ranges from 79-84°C. If cooking is done above that temperature, there will be decrease in physical quality of amylose and amylopectin in rice (Yang et al., 2016). This affects ratio of amylose and amylopectin which will then affect texture and hardness of rice after cooking (Patindol et al., 2010). Under 40°C, component that can be cooked is only water insoluble part, while water-soluble part can be absorbed optimally at 50°C-70°C (Yang et al., 2016). Optimum process of gelatinization of starch (amylose and amylopectin) occurs at 85°C. Gelatinization is the process of enlargement of starch granules due to water absorption (Champagne et.al, 1997).

Sensory Quality Test

Colour

Colour is the outermost appearance that influences people initial preference for a product. Colour is the first attribute that is valued by consumers. Consumers will not be interested and do not provide a good assessment to other quality attributes if the colour of a product deviates from what it should be (Winarno, 2008; Andarwulan et al., 2011).

Based on Table 3, average panelist assessment of color indicators is in range of 2.07-4.37, which shows the range of panelist assessment from somewhat dislike to like. There is a significant difference based on type of rice on color indicator ($p < 0.05$), while cooking method does not produce a significant difference between formulas. White rice (Slyp Super and Berlian Sae) has a higher acceptability than black rice and brown rice.

Table 3. Result of Acceptance Test

Treatment	Hedonic Parameter				
	Colour	Aroma	Taste	Texture	Overall
Beras Berlian Sae					
RC	4.03^{c}	3.73^{c}	3.50^{bc}	3.30^{b}	3.63^{c}
CV	4.17^{c}	3.67^{bc}	3.33^{abc}	3.33^{b}	3.73^{c}
Beras Slyp super					
RC	4.10^{c}	3.27^{abc}	3.50^{bc}	3.33^{b}	3.73^{c}
CV	4.37^{c}	3.17^{abc}	3.77^{c}	3.97^{c}	3.80^{c}
Beras merah					
RC	3.07^{b}	3.03^{ab}	2.90^{abc}	2.07^{a}	2.87^{b}
CV	2.07^{a}	2.77^{a}	2.60^{ab}	2.07^{a}	2.33^{a}
Beras hitam					
RC	2.67^{b}	3.10^{abc}	2.47^{a}	2.50^{a}	2.80^{b}
CV	2.80^{b}	3.20^{a}	2.80^{ab}	2.50^{a}	2.47^{ab}

Note : RC : Rice cooker, CV : conventional

* Superscript in the same column showed no significant differences (p>0,05).

Whereas brown rice with conventional methods has the lowest acceptability. Brown rice and black rice are less liked by people of Asia and Middle East. Indonesian people tend to prefer rice from white rice because of cultural factor (Suwanaporn and Linnemann, 2008).

Based on the quality characteristics test using hedonic scale (Table 4), there is a tendency for rice to be cooked with conventional method to produce bright and shiny colors while rice cooker method tend to be ordinary or blurry on black rice. This is due to slow heating time in conventional method so that it can maintain color quality. Slow heating can maintain color of outer portion of the rice so it looks brighter (Creed, 2001).

White rice tends to be shiny, while red rice and black rice tend to be opaque. This is due to differences in milling degree. White rice is milled rice that clean from epidermis and institutions, while red rice and black rice are mashed rice which separated only with the husk (Muchtadi and Sugiyono, 1992). During detachment, there was degradation of aleuron layer and embryo of rice grains. Degree of degradation of this layer is called milling degree. 70-80% milling degree indicate remaining 20% layer of aleuron that has not been degraded in rice grains (Indrasari, 2011). The higher the milling degree, the cleaner and shinier, so that the appearance of rice is more attractive (Subarna et al., 2017).

Aroma

Acceptance of product aroma begin when there are stimuli received by sense of smell due to physical and chemical properties of the molecule that produce odor (Gottfried, 2011). Stimulation received can be called remote tasting because the assessment of product preference is done by only smelling the aroma even though sample has not been seen. Food industry consider product evaluation are fast carried out through aroma testing to determine like or dislike (Soekarto, 1985).

Based on Table 3, average panelist rating aroma indicator range in 2.7-3.7, which show panelist acceptance range from somewhat dislike to like. There was significant difference based on type of rice on aroma indicator ($p < 0.05$), while cooking method did not produce significant difference. Berlian Sae white rice with rice cooker method has the best aroma, while brown rice with conventional method has the lowest acceptance.

Based on quality characteristics test (Table 4), average rice has normal or neutral aroma according to natural aroma of rice. According to panelists, Berlian sae and Slyp Super type white rice has fragrant aroma while black rice tend to be musty with conventional processing methods. Genetic factors are one of the cause of differences in aroma attribute in food ingredient (rice). Other factors

Table 4. Quality Characteristic Test Result

Treatment	Hedonic Parameter			
	Colour	Aroma	Taste	Texture
Berlian Sae Rice				
RC	Neutral	Fragrance	Neutral	Neutral
CV	Bright Shiny	Fragrance	Neutral	Fluffy
Slyp Super Rice				
RC	Neutral	Fragrance	Neutral	Neutral
CV	Bright Shiny	Fragrance	A little sweet	Fluffy
Browin Rice				
RC	Neutral	Neutral	Tasteless	Neutral
CV	Neutral	Musty	Tasteless	Neutral
Black Rice				
RC	Buram	Neutral	Tasteless	Less fluffy
CV	Neutral	Musty	Tasteless	Less fluffy

Keterangan: RC : *Rice cooker,* CV : Conventional

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that can affect aroma are rice growth condition and post-harvest treatment (Cagampang et al., 1973). According to Wongpornchai et al. (2004) there are more than one hundred components in rice that contribute to quality characteristics.

Milling degree is thought to affect the aroma of rice. The higher the milling degree, the less the evaporation of substances contained in the aleuron. These substances will affect colour quality of rice. Whereas rice naturally have a neutral to fragrant aroma. The cause of musty smell in rice because there are compounds resulted from oxidation of fat with air. Oxidized compounds give rancid odor characteristics. Black rice and brown rice have a layer of hydrophobic fat in some outer skin that can be oxidized (Astawan and Wresdiyati, 2004).

Taste

Taste is an accumulation of various stimuli obtained from sensory perception and digestive stimulation due to chemical stimulation from food, drinks, or herbs in mouth (Melton, 2006). Based on Table 3, panelist response to taste are in range of 2.4-3.7, showing the range of panelist rating from somewhat dislike to like. There was a significant difference based on type of rice on flavor indicator ($p < 0.05$), while the method did not produce any significant difference between formulas. Super Slyp white rice with conventional methods has higher taste acceptance, followed by other types of white rice. Black rice with a rice cooker method has the lowest acceptability among all formula.

Based on quality characteristics test (Table 4), average rice has a normal or neutral taste according to natural taste of rice. According to panelist, Berlian sae and Slyp Super rice types have ordinary taste so they tend to be rather sweet, while black and red rice tend to be bland. Conventional cooking method influence the taste of rice so that rice taste sweeter. Long heating affect taste of rice. Slow and long period heating affect characteristics of simple glucose contained in rice starch (Kohlwey, 1995). In addition, ratio of amylose and amylopectin also affect taste of rice. Amylose content has negative correlation with taste attribute. High amilosa level in rice gives lower preference of taste, because taste of rice will be more tasteless than rice with low amilosa level.

Texture

Texture is defined as multidimensional property, while the most commonly used parameters for rice are hardness and stiffness (Juliano et al, 1983). Some factors related to rice texture are amylose content (Cameron and Wang, 2005, Jinorose et al., 2014) and protein content (Saleh and Meullenet, 2007; Mestres et al., 2011).

Texture profile analysis was developed to simulate texture properties by human senses, especially during mastication by teeth. Based on Table 3, panelist response to texture ranged on scale of 2-3.9 showing the range of panelist rating range from dislike to like. Super slyp white rice has the highest acceptability for texture followed by other white rice. While brown rice has the lowest acceptability for texture testing.

Based on quality characteristics test (Table 4), average rice has less fluffy texture, normal to fluffier according to the natural texture of rice. According to panelists Slyp Super type rice cooked by conventional methods has fluffier textures, while berlian sae variety have normal textures, and black rice has less fluffy texture.

Hardness or texture of rice is positively correlated with amylose content in its composition (Yu et al., 2009). Rice with high amylose has ability to break down with water and form coating layer (coating film) that affects hardness. High amylose content will cause rice to have ability to form hydrogen bonds greater than the ability to amylopectin (Juliano, 1983). Black rice has the highest amylose content (> 20%), while white rice has lower amylose content (<20%). Characteristics of rice with dominant amylose content are non-sticky and can expand during cooking. Rice with moderate amylose content, generally has fluffier texture (Damardjati, 1995). This show that amylose content is positively correlated with water content. Unbranched amylose structure causes water to be more easily absorbed by granules, so black rice has less fluffy texture according to panelist rating (Febriana et al. 2014). Consumers in Indonesia are likely to choose rice with low to moderate amylose content (≤ 25%). This is because consumers prefer rice with fluffier texture (Haryadi 2006).

Slyp Super Rice and Berlian Sae rice cooked with conventional methods have fluffier texture and are different compared to other rice types. Duration

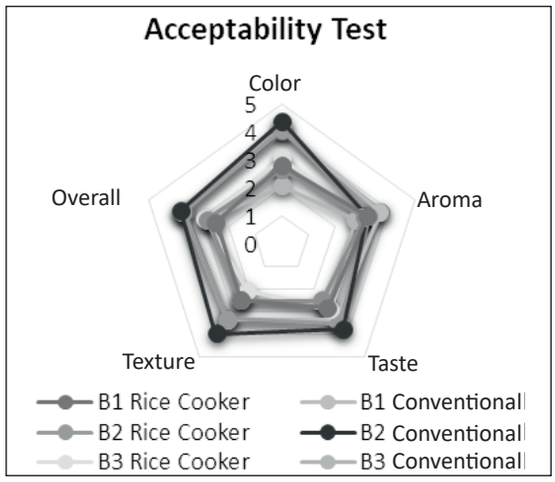

Figure 1. Radar Chart of Rice Acceptability Test

of heating affect texture of rice. Slow heating and long cooking period give effect to the texture of rice (Jualiano, 1983). This is in accordance with conventional method principle. Rice soaking time with water in conventional method affect amylose content. Long soaking time will cause amylose level to decrease so that rice tend to be fluffier (Hasbullah et al., 2013).

Acceptability

Based on an evaluation of overall acceptability test (Figure 1), the chosen formula with the highest indicator is the white Slyp Super rice cooked with conventional method. White rice has the highest value in term of colour, taste and texture. The best aroma is owned by Berlian Sae rice cooked with modern method. Figure 1 present trends of factors affecting panelist interest data in different rice type and method. Colour variable is the most prominent range affecting panelist interest, then followed by other variables.

Further research efforts are needed to improve quality of rice, especially on colour indicator. Although sensory and acceptability tests are more subjective in terms of consumer acceptance, this is important in further product development, because final assessment of rice quality lies in processed product quality, especially rice that is preferred by consumers (Akhyar, 2009).

CONCLUSION

Panelist acceptance of study sample is influenced by rice type and cooking method. White rice (Slyp Super and Berlian Sae) has a higher acceptability than brown rice and black rice. Conventional cooking method tend to be preferred because it has more attractive colour and texture. Rice with conventional processing methods tend to be brighter and fluffier. Further research is needed in designing the standardization of cooking method to optimize quality of rice, especially related to amount of water and length of time for processing. Further research is needed to establish a standard method for cooking rice, especially red and black rice to increase consumer acceptance.

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PERCEPTIONS AND LIPID PROFILES OF MIXED HERBAL DRINK (GARLIC, GINGER, LEMON, HONEY, AND APPLE VINEGAR) CONSUMERS WITH HYPERCHOLESTEROLEMIA

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ABSTRACT

Cholesterol-lowering herbal treatment made from natural ingredients are believed to be able to replace modern medicine even though it has not been scientifically proven. Purpose of this study was to test perceptions of customers and effects of mixed herbal drink on lipid profile of consumers with hypercholesterolemia. Study was conducted using cross sectional study design consisted of three stages, that is survey, questionnaire data collection, and medical record data collection. The research subjects were selected by stratified random sampling, which subjects were consumers of mixed herbal drink in total of 55 people, both men and women. Data was collected through interviews of questionnaires covering subject characteristics, subject perceptions of mixed herbal drink, and their medical record data before and after consumption of mixed herbal drinks. Paired T-test were used to observe the differences in subject lipid profile before and after consumption of mixed herbal drink. Consumer perceptions toward health aspects showed that 83.7% of subjects experienced a decrease in cholesterol after consuming mixed herbal drink. Consumer emotional perception showed that 90.9% of subjects feel healthier and filter after consuming mixed herbal drink. Results of subject medical records on lipid profile showed a decrease in total cholesterol, LDL, and triglycerides ($p<0.05$). Based on perceptions and medical records, it is known that mixed herbal drink can be used as an alternative to traditional cholesterol-lowering medicines.

Keywords: hypercholesterolemia, mixed herbal drinks, consumer perceptions, lipid profiles

BACKGROUND

Heart disease is one of major causes of death in Indonesia. The 2013 Basic Health Research Report (RISKESDAS) reported that prevalence of coronary heart disease in Indonesia was 1.5%. One of the main factors of coronary heart disease is a disruption in blood fat levels. Muchtadi (2007) suggested that high levels of triglycerides and cholesterol (especially cholesterol-LDL) in the blood would form plaque and cause atherosclerosis. Atherosclerosis is triggered due to high levels of cholesterol in the blood (hypercholesterolemia) which is one of the factors causing coronary heart disease (Anies, 2015)

Modern pharmacological treatment and medical therapy are generally used to reduce cholesterol levels. However, long-term use would cause side effects. Adib (2009) suggested the use of cholesterol-lowering drugs might give side effects such as liver damage, gastroenteritis, irritation and inflammation of the stomach, and kidney damage if used for a long period. The use of traditional medicines such as herbs or herbal medicines is considered safer than the use of modern medicine. Javed et al. (2009) stated the use of plants as medicine against various diseases has increased, considering synthetic medicines have many side effects.

There were more than 2000 types of medicinal plants that could be used to treat heart diseases such as ischemic heart disease and hypercholesterolemia (Mahmood et al., 2010). Saraswat et al. (2010) noted several plants such as garlic (Allium sativum), ginger (Zingiber officinale), lemon (Citrus limon), and apple vinegar (Malus domestica) have effects in the treatment of heart disease. Garlic, ginger, and lemon have been consumed as a mixture of traditional drinks and are believed to provide health effects and reduce cholesterol. Javed, et al. (2014) showed that mixed herbs (garlic, ginger, apple vinegar, lemon, and honey) were effective in treating hyperlipidemia in male white rats.

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Mixed herbal drink with the composition of garlic, ginger, apple vinegar, lemon, and honey has been widely used by people as an alternative treatment for heart disease and cholesterol. Mixed herbal beverage products can be well received by the public even though many similar products are circulating in the market. However, scientific research on the properties and benefits of mixed herbal drinks has not been done much. Research related to mixed herbal drinks that have been widely circulated only includes pre-clinical trials using experimental animals so there is no further research that is directly related to humans.

The purpose of this study was to test consumer perceptions of mixed herbal drinks and the effect of mixed herbal drinks on the lipid profile of consumers with hypercholesterolemia.

METHODS

This research was an observational study using cross sectional study design. The study was conducted in urban Jabodetabek areas such as Cilandak, Dramaga, Cimanggis, Ciputat, and Jatiasih from December 2018 to March 2019. The first step in this research was conducting a survey and giving initial questionnaires that had been adapted from Hendarini (2011) and Rukmana (2016) to see the compliance characteristics of the subjects in consuming mixed herbal drinks. The second step was giving questionnaires and testing the subject's perception of perceived health benefits. The third stage was collecting medical record data that includes blood lipid profiles before and after and analysis was done using a paired sample T-test to capture changes before and after herbal drink consumption. This study has been approved by the Ethics Committee of the Human Research Ethics Committee of the Research and Community Service Institute Bogor Agricultural University No.165 / IT3.KEPMSM-IPB / SK / 2018.

The research subjects were selected by stratified random sampling, where subjects were consumers of mixed herbal drinks both men and women. Research subjects were willing to follow each stage of the study to completion by signing an informed consent, and meeting the inclusion and exclusion criteria. Inclusion criteria included consumers who use mixed herbal drinks for a minimum of 3 months, consumed mixed herbal drinks daily, aged adults (26 years) to seniors (>65 years), healthy, did not drink alcohol, supplements or other herbal product, and did not consume drugs cholesterol-related routinely while consuming mixed herbal drinks, and not being pregnant or breastfeeding. While exclusion criteria included having a history of diseases such as liver, kidney, cancer, or stroke, and participating in other studies. Calculation of the minimum number of subjects using the formula Lemeshow, et al. (1997) so as to get as many as 55 subjects.

Data was collected through interviews include subject characteristics, subject perceptions regarding mixed herbal drinks, and medical record data of subjects before and after consumption of mixed herbal drinks. Subject perceptions regarding mixed herbal drinks include health perceptions and emotional perceptions. Data collection of medical records of subjects was done 6 months before and after consumption of mixed herbal drinks.

Mixed herbal drinks had the composition of garlic, ginger, lemon, apple vinegar, and honey, which had prepared by the researchers and had been consumed by several communities as an alternative drink for treatment. Liquid mixed herbal drinks and packaged in 375 gram bottles.

The initial phase of the study was a survey of consumers of mixed herbal drinks. Consumers of mixed herbal drinks were those who purchase mixed herbal drinks with a range of adults (26 years) to seniors (> 65 years) of 250 men and women. Subjects were chosen based on consumers who consistently consumed mixed herbal drinks with the use of at least one spoonful a day. So that a total of 55 subjects were participated in this study.

The second step was intended to assess consumer perception toward the perceived health benefits. The perception test questionnaire was adapted using Nurbaiti (2008), Hendarini (2011) and Rukmana (2016) study. Subjects were asked to give a response whether very agree (SS), agree (S), neutral (N), disagree (TS), or strongly disagree (STS) to the 10 statements related to the consumption of mixed herbal drinks. The last step in the study was the collection of medical record

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of blood lipid profile before and after consumption of mixed herbal drinks.

Data processing was performed using Microsoft Excel 2016 and SPSS version 16.0. Descriptive analysis was used to describe data on the subject's characteristics, nutritional status (BMI), and subjects' perceptions regarding mixed herbal drinks. Inferential statistical analysis was carried out to analyze the lipid profile level of subjects before and after consumption of mixed herbal drinks based on medical records. Paired T-test was used to see differences in the subject's lipid profile before and after consumption of mixed herbal drinks.

RESULT AND DISCUSSION

Nutritional Status

The result of this study showed that the majority of subjects (36.36%) were in the overweight category. The cause of overweight and obesity among subjects might be due to low physical activity, consequently the greater the excess energy storage. The distribution of subjects based on nutritional status is presented in Table 1

The Ministry of Health (2018) reported that overweight and obesity were more common in women, respectively 15.1% and 29.3%; whereas in men overweight is 12.1% and obesity is 14.5%. Women are said to have more fat tissue than men so they are more prone to experiencing more weight and obesity. Majority of respondents (85.5%) were aged between 46-65 years old. There were in total 20 subjects (36.4%) suffered overweight and 17 subjects (30.9%) were obese. Sudikno et al. (2015) stated that factors related to overweight and obesity were age, sex, region, marital status, occupation, economic status and smoking habits. Odgen et al. (2015) showed that the adult obesity among American were more frequent in middle age (40-59 years).

Table 1. Distribution of subjects based on nutritional status

Nutritional status	Gender				Total	
	Male		Female			
	n	%	n	%	n	%
Normal	10	18.2	8	14.5	18	32.7
Overweight	15	27.3	5	9.1	20	36.4
Obese	14	25.5	3	5.4	17	30.9
p	0.192					

Nutritional status	Age (years old)						Total	
	26-45		46-65		>65			
	n	%	n	%	n	%	n	%
Normal	1	1.8	17	30.9	-		18	32.7
Overweight	3	5.5	16	29.1	1	1.8	20	36.4
Obese	3	5.4	14	25.5	-		17	30.9
p	0.535							

Health Perception

The most common problems faced by the subjects based on the initial interview and observation of immediate condition were high cholesterol, frequent heart pain, chest tightness, abnormal palpitations, high blood pressure, easy pain, irregular bowel movements, gout, high blood sugar levels , and often dizzy. Before consuming mixed herbal drinks, 90.9% of the subjects felt an increase in cholesterol levels, 63.7% of the subjects felt the heart always aches, 69.1% of the subjects felt tightness and pain in the chest, 63.6% of the subjects felt the heart often beat irregularly, 58.1% of the subjects felt high blood pressure , 41.8% of subjects felt easy pain, 29.1% of subjects felt irregular bowel movements, 32.8% of subjects felt gout often recurred, 23.6% of subjects felt blood sugar levels increased, and 30.9% of subjects felt often experiencing dizziness.

Based on Table 2, statements one through five showed that more than 50% of subjects agree with the statement given, while in statements of six to ten more than 50% of subjects choose neutral and

Table 2. Health perception before consuming mixed herbal drinks

Health perception	Agree (%)	Neutral (%)	Disagree (%)
High cholesterol	90.9	7.3	1.8
Heart ache	63.7	21.8	14.5
The chest feels tight and painful	69.1	12.7	18.1
Arrhytmia	63.6	18.2	18.2
High blood pressure	58.1	21.8	16
Easy to fall ill	41.8	38.2	20
Irregular defecation	29.1	38.2	32.7
Pain relatd to gout	32.8	40	27.2
Hyperglicemia	23.6	34.5	41.8
Dizziness/migrain	30.9	41.8	27.3

do not agree with the statement given. This shows that the faced condition was more related to heart and blood vessel problems.

Table 3 confirmed that subjects who agreed with the statement from the questionnaire that was, 1.8% of subjects still felt an increase in cholesterol levels, 1.8% of subjects felt the heart was always sick, 3.6% of subjects felt tightness and pain in the chest, 3.6% of subjects felt the heart often beat irregularly , 7.3% subjects felt high blood pressure, 1.8% subjects felt easy to fall ill, 5.5% subjects felt irregular bowel movements, 5.4% subjects felt gout often recurred, 7.3% subjects felt blood sugar levels increased, and 10.9% subjects felt often experience dizziness. Table 4 showed the differences in health perception before and after consuming mixed herbal drinks.

The subjects relatively experienced positive perception based on Table 4. After consuming mixed herbal drinks, only 1.8% of subjects still felt an increase in cholesterol levels. Thus the subject feels decreased cholesterol levels after consuming mixed herbal drinks. This was in accordance with the research of Ifora, et al. (2016) which concluded that the provision of red ginger, garlic, honey, lemon, and apple preparations with certain doses could significantly reduce cholesterol levels. Health perception at point one to five shows positive results, where more than 50% of subjects feel the benefits of mixed herbal drinks.

Emotional Perception

Respondents' impression during the consumption of mixed herbal drink was obtained by interview and direct observation. Ten indicators were chosen to describe emotional experience of the subjects, including body fitness, health awake, good appetite, feeling satisfied with mixed herbal products, better moods, beneficial to the body, feeling safe consumption of mixed herbal drinks, originating from natural ingredients, like the taste of ingredients mixed herbal drinks; and will invite others to consume mixed herbal drinks. Table 5 shows the differences in emotional perception before and after consuming mixed herbal drinks.

Tabel 4. Difference in health perception before and after consuming mixed herbal drinks

Health Perception	Before (%)	After (%)
High cholesterol	90.9	1.8
Heart ache	63.7	1.8
The chest feels tight and painful	69.1	3.6
Arrhytmia	63.6	3.6
High blood pressure	58.1	7.3
Easy to fall ill	41.8	1.8
Irregular defecation	29.1	5.5
Pain relatd to gout	32.8	5.4
Hyperglicemia	23.6	7.3
Dizziness/migrain	30.9	10.9

Table 5. Differences in emotional perception before and after consuming mixed herbal drinks

Emotional Perception	Before (%)	After (%)
Fit body	18.2	90.9
Health awaken	21.8	90.9
Good appetite	43.7	60
Satisfied with the product	16.4	94.6
Good mood	38.2	65.4
Trust product's benefit	7.3	96.4
Feeling safe to consume the product	90.8	83.7
Believe that product used natural ingredients	86.7	95.4
Like the product taste	76.1	87.3
Will recommend the product to others	74.6	89

Most of the subjects experienced positive emotional perception after consuming the product. Positive perceptions indicate that mixed herbal product gave positive influence, thus could soar psychological aspect of its consumer.

Lipid Profie Before and After Consumption of Mixed Herbal Drink

The results of this study showed a decrease in total cholesterol, LDL, and triglycerides before and after consuming mixed herbal drinks for 6 months. Paired T-test analysis found that there were significant differences before and after consuming mixed herbal drinks for 6 months on total cholesterol ($p = 0.00$), LDL ($p = 0.00$), and triglycerides ($p = 0.00$) presented in Table 6. While for HDL values there was no significant difference ($p = 0.105$).

The decrease in total cholesterol, LDL, and triglycerides was suspected to be due to the influence of ingredients used in mixed herbal

Table 6. Lipid profile before and after consumption of mixed herbal drink

Lipid profile	Before (mg/dL)	After (mg/dL)
Total cholesterol*	210.56 ± 24.25	191.38 ± 28.48
HDL	40.44 ± 4.27	41.87 ± 6.14
LDL*	130.65 ± 21.38	115.6 ± 26.21
Triglycerides*	197.13 ± 58.52	169.31 ± 43.51

*significantly different ($p<0.05$)

drinks. Research of Handayani (2006) proven that the administration of garlic extract in ethyl acetate dissolved in soybean oil for 6 weeks decreased cholesterol and triglycerides. Hapsari (2014) showed a significant decrease of LDL among dislipidemia patient after ginger consumption. Research by Adel and Prakash (2010) showed that lemon has antioxidant activity and had an effect on lipid reduction due to the content of polyphenols, vitamin C, β carotene, flavonoids (flavonol glycosides), and tannins. Meanwhile, the research of Yohana & Yovita (2012) suggested that the content of tannins, flavonoids, D-glucaric acid in apples suppressed LDL cholesterol level which can clog blood vessels.

Unlike the other three profiles, HDL-cholesterol showed no significant difference after consumption of mixed herbal drink ($p> 0.05$). This could be happened because HDL levels in the blood are more influenced by physical activity. Rahmawati (2009) suggested that physical activity could increase HDL levels in the blood so that risk factors for coronary heart disease might be reduced. Mamat and Sudikno (2010) showed that respondents with less physical activity had an odd ratio to experience abnormal HDL cholesterol levels of 1.64 times (95% CI = 1.535-1.753) compared to respondents with sufficient physical activity.

CONCLUSION

There were a positive changes in both health and emotional perception of the subjects after consuming mixed herbal drink. Furthermore, the results of medical records on lipid profiles showed that there was a decrease in total cholesterol, LDL cholesterol, and triglycerides before and after consuming mixed herbal drinks for 6 months ($P <0.05$).

Further research needs to be done to find out the ingredients that became the main factors to reduce cholesterol levels in the blood. It is necessary to conduct intervention research to clinically test herbal mixed beverage products.

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SNACK BAR MADE FROM SORGHUM AND BEANS WITH ADDITION OF RED PALM OIL AS SUPPLEMENTARY FOOD FOR PREGNANT WOMEN WITH CHRONIC ENERGY DEFICIENCY

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ABSTRACT

The prevalence of chronic energy deficiency in pregnant women was in poor conditions since 2016 to 2018. One of the solution to overcome chronic energy deficiency in pregnant women is by providing supplementary food as snack, such as snack bar. Snack bar was made from sorghum and beans (red bean and black soybean) which are local food source of energy and protein. The objective of this study was to develop and analyze sorghum and beans-based snack bar with addition of red palm oil (RPO) as supplementary food for pregnant women with chronic energy deficiency. This study used complete randomized design with the ratio of sorghum flakes and beans chunks with the addition of RPO as treatment in three replications. Determination of selected formula were based on sensory analysis and protein content of product. The selected formula was F4 (ratio of sorghum flakes:beans = 2:1, 2% RPO) which contained 8.59% moisture, 2.38% ash, 15.26% protein, 21.38% fat, 3.67% crude fiber, 52.05% carbohydrates, 447 kcal energy, 10.98% dietary fiber, 27,35 mg/kg β-carotene, 23.00 mg/kg iron, 13.21 mg/kg zink, 304.40 mg/kg calcium, 48.69% the limiting amino acid score, and 75.84% protein digestibility. F4 could be accepted by pregnant women with overall acceptability of 97%. F4 potentially be used as one of the alternative supplementary food for pregnant women with chronic energy deficiency because of its acceptability, enable to fulfill supplementary food standard, and had higher protein and fiber content than existing supplementary food for pregnant women with chronic energy deficiency.

Keywords: beans, chronic energy deficiency, red palm oil, snack bar, sorghum

INTRODUCTION

Nutrition problem that still being focus in pregnant women is chronic energy deficiency (CED). Chronic energy deficiency is human condition which sustainable or yearly lack of nutrition or imbalance nutrition intake (energy and protein) showed by basal metabolic index (BMI) <18,5 kg/m2 which categorized as low and mid upper arm circumference (MUAC) <23,5 cm (Indonesia Health Ministry, 2013). Based on Individual Food Consumption Survey (Survei Konsumsi Makanan Individu or SKMI) (2014), pregnant women has low energy adequacy intake (<70% energy adequacy level) and low protein adequacy intake (<80% protein adequacy level) which categorized as very low (Indonesia Health Research and Development Center, 2014). Indonesia Health Ministry (2018a) showed based on energy adequacy, 53.9% pregnant women have energy deficiency (<70% energy adequacy level) and 13.1% categorized as mild deficiency (70-90% energy adequacy level). Result also showed 51.9% pregnant women have protein deficiency (<80% protein adequacy level) and 18.8% categorized as mild deficiency (80-99% protein adequacy level).

Based on Nutrition Status Evaluation result, percentage of pregnant women having energy deficiency risk in 2016, 2017, and 2018 in Indonesia is 16.2%, 14.8%, and 17.3% (Indonesia Health Ministry, 2018b). That condition showed prevalence of chronic energy deficiency in pregnant women still categorized as poor nutritional condition (WHO, 1995). Nutrient deficiency especially in 1000 first days since conception until age of 2 years has short term and long term impact which harmful to mother and fetus (Akombi et al., 2017).

According to Poverty Eradication Acceleration National Team (2017), giving supplementary food to pregnant women can solve nutrition problem in pregnant women. Giving supplementary food to pregnant women which experienced nutrition problem has highest impact in second and third semester (Imdad et al., 2016). Supplementary

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food should be given in snack form because food supplementation in bigmeal form can decrease maternal nutrition status and generally are not on target (Nurina, 2016). Supplementary food in the form of snack bar can made as option because has balance nutrition, easy to bring, and can be consumed in between of meal time (Pallavi et al., 2015). Snack bar can be made from local food ingredients as source of energy and protein which it utilization not optimal yet like shorgum or nuts like red bean and black soy.

Shorgum is local food ingredient which its development can have potential to decrease dependency to import food ingredient, especially wheat and wheat flour, also has role to promote food diversification (Irawan dan Sutrisna, 2011). Shorgum has role as carbohydrate role, has higher protein content than corn, rice, and barley, also higher dietary fiber, iron, and calcium than wheat (Suarni, 2012). On the other hand, red bean has role as carbohydrate, protein, vitamin, mineral, which has complete essential amino acid content, also high antioxidant capacity (Messina, 2014; Fidrianny et al., 2014). Soy contain high protein with good amino acid profile and better protein digestability compare with other nuts. Black soybean has nutrition potential and production which not too different than yellow soybean, also has higher functional properties than yellow soybean (Malenčić et al., 2012; Xu dan Chang, 2007). Study by Utami et al. (2017) showed red bean, peanut, and soybean formula intervention can be used as drink for pregnant women with chronic energy deficiency which give impact to maternal nutrition status. Drink intervention for 30 days as much as 300 mL (1 glass) per day can increase body weight and mid upper arm circumference in second trimester pregnant women who diagnosed with chronic energy deficiency.

Sorghum are known having lower protein, fiber, and antioxidant content than nuts. To fix that condition, red bean and black soybean addition are made to complete food product nutrition value (Fauziyah et al., 2017). Beside that, according to Galili and Amir (2013), cereal have lisin limiting amino acid, while legum has metionin limiting amino acid. This condition showed combination between cereal and nuts can increase product amino acid quality.

Other main nutrition problem in pregnant women is vitamin A deficiency (Wijayanti, 2019). Red palm oil (RPO) addition as β-karoten source is important to increase sensory properties and nutrition value. β-carotene main role in body is as pro-vitamin A which will be processed by body so that it can transform into vitamin A and have role in mother and fetal vision and immune system maintenance, organ and bone development (Maia et al., 2019). Other than that, RPO has role in berperan producing colour characteristic, especially redness pigmen in many food industry products (Robiyansyah et al., 2017). Lietz et al. (2001) showed RPO addition as many as 12 gram in pregnant women in the early of third trimester until 3 months postpartum can increase pro-vitamin A activity while still consuming green vegetable. This condition marked with α-carotene and β-carotene in breastmilk and blood plasma.

This study is expected can develop snacks with potential to optimalize pregnant women nutrition status and give positive impact to fetus. This study aim to develop and to analyze snack bar product made from sorghum with nuts (red bean and black soybean) with RPO addition as supplementary food alternative to pregnant woment with chronic energy deficiency.

METHOD

Study design is experimental in laboratory using complete random design with three repetition and factor in form of sorghum flakes and chopped nuts (redbean and black soybean) ratio with RPO addition so that obtained 6 formula. This study held between October 2018 to July 2019 in Food Processing and Experiment Laboratory, Organoleptic Laboratory, Chemistry and Food Analysis Laboratory, Community Nutrition Department, Faculty of Human Ecology, IPB University, Southeast Asian Food & Agricultural Science & Technology Center (SEAFAST) IPB University, Integrated Chemistry Laboratory IPB University, Big Agro Industry Center, and three integrated healthcare center in Sindang Barang Region Public Health Center, Bogor. This study had obtained agreement from Research Ethical Commision IPB University No:129/IT3.KEPMSM-IPB/SK/2018.

Tools and Materials

Main ingredients is sorghum flour that formed into flakes, redbean, and black soybean with RPO addition. Sorghum flour obtained from PT Agro Indah Permata 21 Bogor with Numbu variety which has brownish white or cream colour, black soybean obtained from Balai Penelitian Tanaman Aneka Kacang dan Umbi (BALITKABI) Malang with Detam 1 variety which has black skin colour and yellow bean, also RPO obtained from PT Nutri Palma Nabati Bogor.

Snack Bar Formulation and Production Process

Snack bar formulation are made based on technical guideline of Food Addition (Kementerian Kesehatan RI, 2017). Snack bar product development started by make sorghum flakes. Sorghum flakes made from sorghum flour mixed with granulated sugar, vanili powder, tapioka flour, maize flour, and egg yolk. The mixture then steamed, formed as pellet using grinder, cut, and rolled to optimalized physical aspect, nutrient content, and sensory properties especially texture (solidity, compactness, chewiness, stickiness) (Ribanar, 2014).

Next step is snack bar formulation which obtained based on modification result from energy snack bar recipe Andras et al. (2012) through trial and error. Product formulation were showed in table 1. Snack bar development started with mixing dry ingredients that is shorgum flakes, sesame seeds, chopped nuts, and sugar. Next, dehydrated cow milk (full cream), soy protein isolat, and white egg flour mixed with water until thick. After that, wet ingredients like melted chocolate, milk, soy protein isolate, and white egg flour mixture, peanut butter, egg, and RPO put into different bowl and mixed until homogen. Then, dry ingredients mixture and wet ingredients stirred until blended. Next step is the mixture were pour into baking sheet and bake in oven in 150oC for 30 minute.

Snack Bar Organoleptic Test and Nutrient Analysis

Sensory analysis through hedonic rating test using 30 semi trained panelist that is student of Community Nutrition Department, Faculty of Human Ecology IPB University. Hedonic rating test aimed to know panelist personal response based on likeliness level on every product atribute that is very dislike (1), dislike (2), less like (3), neutral (4), a little bit like (5), like (6), and very like (7) (Setyaningsih et al., 2010). Hedonic rating test atribute include colour, aroma, texture, taste, mouthfeel, aftertaste, and overall. After that, snack bar product performed protein analysis using

Table 1. Snack Bar Formulation per 100 gram

Ingredients (g)	F1	F2	F3	F4	F5	F6
Sorghum Flakes	28.67	21.51	14.34	28.37	21.28	14.18
Redbean	7.17	10.75	14.34	7.09	10.64	14.18
Black Soybean	7.17	10.75	14.34	7.09	10.64	14.18
Melted Chocolate	9.68	9.68	9.68	9.57	9.57	9.57
Sesame seed	2.15	2.15	2.15	2.13	2.13	2.13
Egg	2.15	2.15	2.15	2.13	2.13	2.13
RPO	1.08	1.08	1.08	2.13	2.13	2.13
Milk Powder	8.60	8.60	8.60	8.51	8.51	8.51
Egg White Flour	2.15	2.15	2.15	2.13	2.13	2.13
Soy Protein Isolat	5.38	5.38	5.38	5.32	5.32	5.32
Peanut Butter	19.35	19.35	19.35	19.15	19.15	19.15
Sugar	6.45	6.45	6.45	6.38	6.38	6.38
Total	100.00	100.00	100.00	100.00	100.00	100.00

Note : formula for 4 pieces snack ar. F1: ratio between sorghum flake and nuts is 2:1 with RPO addition 1%, F2: ratio between sorghum flake and nuts is 1:1 with RPO addition 1%, F3: ratio between sorghum flake and nuts is 1:2 with RPO addition 1%, F4: ratio between sorghum flake and nuts is 2:1 with RPO addition 2%, F5: ratio between sorghum flake and nuts is 1:1 with RPO addition 2%, serta F6: ratio between sorghum flake and nuts is 1:2 with RPO addition 2%.

Kjeldahl method in every formula. Determination of the chosen formula through sensory analysis and protein content from six formula (AOAC, 2005).

Next step, the chosen formula analyzed for chemical properties that is water analysis using oven method (AOAC, 2005), ash analysis using Gravimetri method (AOAC, 2005), fat analysis using Soxhlet method (AOAC, 2005), crude fiber analysis (AOAC, 2005), total carbohydrate analysis using by difference method (Andarwulan et al., 2011), energy analysis (Nielsen, 2010), total dietary fiber analysis using enzymatic method (Asp et al., 1984), β-carotene analysis (AOAC, 2000), mineral analysis (Fe, Zn, Ca) (AOAC, 2005), essential amino acid analysis using In House Method (Laboratorium Kimia Terpadu, 2002), and protein digestability analysis using in vitro method (Saunders et al., 1973). Last step is acceptability test for the chosen formula through hedonic rating test with 7 scales for attribute include colour, aroma, texture, taste, mouthfeel, aftertaste, and overall in 100 pregnant women as panelist.

Data Analysis

Sensory data and nutrient content were processed using Microsoft Excel 2010 and SPSS 16.0 for Windows. Sensory data analysis and protein content analyzed using one way ANOVA, then continued with Duncan's Multiple Range. Nutrient analysis result were showed in mean and deviation standard. Acceptance rate were analyzed by divided all panelist giving score 4 (neutral) until 7 (very like) with all panelist in total then multiplied with 100%. After that, acceptance rate analysis result showed in graphic.

RESULT AND DISSCUSION

Snack Bar Formulation

Snack bar formulation as additional food determined based on three aspects that is additional food standard for pregnant women, balance energy protein, and product contribution as snacks. Based on Indonesia Health Ministry (2017), additional food for pregnant women have minimum 270 kcal energy, 6 gram protein, and 12 gram fat. Study by Ota, et al. (2015) showed giving balance energy protein (not more than 25% energy than protein) can increase baby born weight and decrease baby mortality risk, low birth weight, premature baby, small fetus when pregnancy, and increase pregnant women body weight. Additional food hopefully can contributed as snack with amount 15-20% of Dietary Requirement Intake (Angka Kecukupan Gizi atau AKG) 2013 for second trimester pregnant women age 19-29 years old. Based on those consideration, appointed snack bar formula as showed below:

F1: Ratio between sorghum flake and nuts is 2:1 with RPO addition 1%.
F2: Ratio between sorghum flake and nuts is 1:1 with RPO addition 1%.
F3: Ratio between sorghum flake and nuts is 1:2 with RPO addition 1%.
F4: Ratio between sorghum flake and nuts is 2:1 with RPO addition 2%.
F5: Ratio between sorghum flake and nuts is 1:1 with RPO addition 2%.
F6: Ratio between sorghum flake and nuts is 1:2 with RPO addition 2%.

Sensory Analysis and Nutrient Content to Determine the Chosen Formula

Hedonic rating test result showed in table 2. Table 2 showed highest mean based on panelist likeliness level are on formula F4. Based on one-way ANOVA result, each formula has significant difference on colour, aroma texture, mouthfeel, and overall properties ($p<0.05$). Result from Duncan test showed panelist likeliness level on five attribute of F3 and F6 are significant different, lower than other formula.

Based on table 2, the fewer usage of sorghum flakes and higher usage of nuts with RPO addition, then the lower panelist likeliness level on colour, aroma, texture, mouthfeel, and overall properties. Redbean and black soybean addition suspected has contribution to colour changes into brownish (dark) because maillard reaction during baking process. Maillard reaction is non enzymatic browning reaction because reaction between carbohydrate (reduction sugar) with amino chain (protein) on high temperature so that produce brownish colour on food (Winarno, 2008). Meanwhile based on Supriadji (2012), sorghum flour contributed to increase colour brightness because it has brightness level between 61.84-63.12 which close to 100 point (bright). Beside that, RPO contributed to give

Table 2. Average of Sensory Analysis (Hedonic Rating Test) and Protein Content in Snack Bar

Formula	Colour	Aroma	Texture	Tase	Mouthfeel	Aftertaste	Overall	Protein (%)
F1	5.38±1.34^{a}	5.32±1.17^{ab}	4.85±1.47^{a}	5.00±1.34^{a}	4.93±1.22^{a}	4.77±1.20^{a}	5.15±1.26^{a}	15.01±0.09^{b}
F2	5.08±1.14^{a}	5.43±0.89^{a}	4.70±1.32^{ab}	5.30±1.12^{a}	4.73±1.15^{ab}	4.75±1.08^{a}	5.20±0.90^{a}	15.54±0.48^{ab}
F3	4.27±1.58^{b}	4.53±1.33^{c}	4.00±1.64^{c}	4.78±1.49^{a}	4.37±1.40^{b}	4.45±1.31^{a}	4.55±1.36^{b}	16.02±0.78^{a}
F4	5.43±1.27^{a}	5.47±1.17^{a}	4.73±1.35^{ab}	5.32±1.37^{a}	4.95±1.08^{a}	4.88±1.22^{a}	5.33±1.08^{a}	15.26±0.25^{ab}
F5	5.20±1.13^{a}	5.13±1.26^{ab}	4.33±1.40^{abc}	4.95±1.45^{a}	4.60±1.06^{ab}	4.55±1.17^{a}	4.88±1.15^{ab}	14.85±0.43^{b}
F6	4.25±1.49^{b}	4.92±1.23^{bc}	4.17±1.57^{bc}	4.80±1.46^{a}	4.28±1.32^{b}	4.50±1.23^{a}	4.60±1.21^{b}	15.75±0.51^{ab}

Note: Same letter in each same column showed no signfican differences (p> 0.05).

golden yellow colour which can increase product attraction (Marjan, 2016). Nuts like redbean and soybean contributed to produce unpleasant aroma because its lipoxigenase enzym component (Wiranata et al., 2017). In other hand, RPO can produce rancid aroma (Marjan, 2016).

Texture can affected by how many water content in ingredients. The higher water component in ingredients, the softer texture of its component (Santoso and Prakosa, 2010). One ingredient that high in water content is nuts. Redbean contain 66.94 gram/100 gram of water, while boiled black soybean contain 58,8 gram/100 gram water (Chaudhary dan Sharma, 2013; National Institute of Agriculture Science, 2016). In other hand, RPO contributed in producecd cruncy texture but a little bit crumbly (Marjan, 2016). Based on Manonmani, et al (2014), nuts can decrease panelist acceptance on its mouthfeel because it forming residue in mouth.

Based on table 2 known that protein analysis result in each formula are 14.85-16.02% (ww). One-way ANOVA result showed that formula differences can give significant impact to protein level ($p<0.05$). Duncan test showed that protein level in F3 has significant difference, higher than F1 and F5. But protein level in F3 has no difference with F2, F4, and F6. Ingredients that suspected contribute in protein content increment is nuts which redbean has 8.67 gram per 100 gram protein and black soybean has 39.09 gram per 100 gram protein (Chaudhary and Sharma, 2013; Nurrahman, 2015). Meanwhile, high protein supporting ingredients addition suspected can support increasing of protein content in product like full cream milk powder, soy protein isolat, white egg flour, and peanut butter. Protein has

Tabel 3. The Chosen Snack Bar Product Formula Nutrient Content (F4)

Nutrient Content	Mean ± SD	Additional Food Standard for Pregnant Women with Chronic Energy Deficiency*	Additional Food Standard for Pregnant Women *
Water (%)	8.93±0.17	2.39	-
Ash (%)	2.38±0.04	-	-
Protein (%)	15.26±0.25	10.14	Min. 6.00
Fat (%)	21.38±0.22	20.89	Min. 12.00
Total Carbohydrate (%)	52.05±0.17	-	-
Energy (kcal)	447±2.54	487	Min. 270
Rough Fiber (%)	3.67±0.51	-	-
Total Dietary Fiber (%)	14.44±0.27	6.19	-
Soluble Dietary Fiber (%)	2.06±0.12	-	-
Insoluble Dietary Fiber (%)	12.37±0.39	-	-
β-carotene (mg/kg)	27.35±0.49	-	-
Iron (mg/kg)	23.00±1.74	11.42	-
Zinc (mg/kg)	13.20±0.80	10.41	-
Calcium (mg/kg)	330.61±37.12	277.53	-

Note: *Indonesia Health Ministry 2017; Min = minimum level; - = data were not found.

role in increasing protein syntesis to maintain maternal tissue and babies growth, especially in third trisemester (Kramer and Kakuma, 2003). Energy from protein in the early of pregnancy can increase birthweight and plasenta (Ghosh, 2016). Balance protein energy intervention (not more than 25% energy from protein) can increase babies birthweight, decrease birth mortality, and increase baby size (Ota et al., 2015).

Hedonic rating test result showed all attribute in F4 has higher point than other formula. Protein level analysis also showed F4 has no significant differences than other formula. For that reason, F4 determined as the chosen formula.

Chemical Properties of the Chosen Formula

Nutrient content of the chosen formula are showed in table 3. Nutrient analysis result showed the chosen formula (F4) has fulfill minimum requirement of protein (6 gram), fat (12 gram), and energy (270 kcal) of additional food for pregnant women. F4 contain 8,93% water (ww). Additional food product to pregnant women with chronic energy deficiency that has already produced have 2.39% water content. Study result by Ribanar (2014) showed snack bar made from sorghum flakes has 5,43% water content. Water content of this product were higher that previous product which caused by the usage of chopped boiled nuts. Boiled redbean and black soybean contain respectively 66.94 gram and 58.8 gram per 100 gram water so that it contributed to increase water content of product (Chaudhary and Sharma, 2013; National Institute of Agriculture Science, 2016).

Ash analysis result showed F4 contain 2,38% ash (ww). Ash content showed mineral amount in food. The higher ash content in food, the higher mineral content in those food (Andarwulan et al., 2011). Based on Indonesia Health Ministry (2017), additional food product for pregnant woment with chronic energy deficiency needs to contain 10,14 gram protein per 100 gram. F4 has higher protein content rather than additional food for pregnant women with chronic energy deficiency that has produced previously. Beside that, F4 can be claimed as protein sources because fulfill at least 20% Nutrition Label Guideline (Acuan Label Gizi or ALG) per 100 gram in solid form (BPOM RI, 2016).

Result of fat analysis showed F4 contain 21,38% fat (ww). Based on Berdasarkan Kementerian Kesehatan RI (2017), Based on Indonesia Health Ministry (2017), additional food product for pregnant woment with chronic energy deficiency that previosly produced contain 20,89 gram per 100 gram. This condition showed F4 not too far than previous additional food product. Fat source ingredients in product include RPO, sesame seed, peanut butter, chocolate, and full cream milk.

Calculation result showed total carbohydrate in F4 is 52,05%. Carbohydrate sources in product is sorghum, chocolate, full cream milk, and nuts. Content calculation result showed F4 formula has 447 kkal energy. Based on study by Ribanar, (2014), snack bar made from sorghum flakes contain 450 kkal energy. This condition showed energy content in F4 formula is not too different than previous snack bar product. F4 formula with 15,26% protein can contribute to 13,7% energy source. Liberato, et al. (2013) stated giving balance energy-protein in pregnancy as much as 12,3% energy from protein can increase fetal growth.

Analysis result of dietary fiber content in F4 formula showed product contain 14,44 % (ww) total dietary fiber with 2,06 % (ww) soluble dietary fiber and 12,37% (ww) insoluble dietary fiber. Based on Indonesia Health Ministry (2017) additional food product for pregnant women with chronic energy deficiency which already publish has 6,19 gram per 100 gram dietary fiber. This condition showed dietary fiber in F4 has higher dietary fiber content that previous product. F4 can be claimed as high dietary fiber product because has more than 6 gram per 100 gram dietary fiber in solid form (Indonesia Food Drug Administration Center, 2016). This condition caused by used ingredients dominated by dietary fiber sources like sorghum flakes (28,37% in mixture) with fiber content in sorghum as much as 6,60-6,21 gram per 100 gram, nuts (14,18% in mixture) with dietary fiber content as much as 6,05 gram per 100 gram in redbean, and dietary fiber content in black soybean as much as 10,5 gram per 100 gram (Chaudhary and Sharma, 2013; National Institute of Agriculture Science, 2016).

Analysis result showed F4 formula contain 27,35 mg/kg β-carotene. This condition caused by

2% red palm oil (RPO) addition which contain carotenoid (α- dan β-carotene) in high amount. Based on Zeb and Malook (2009), RPO were natural food source rich in β-carotene that is 250-350 ppm (mg/kg). F4 formula can be claimed as high in β-carotene because contain β-karoten more than 1,469 mg per 100 g (1469 µg/100 g≈14,69 µg/g≈30% ALG β-carotene, Vitamin A conversion result) (Indonesia Food and Drugs Administration Center, 2016).

Mineral analysis result showed F4 formula contain 23,00 mg/kg iron, 13,21 mg/kg zinc, and 330,61 mg/kg calcium. Mineral content in F4 fulfill 7% iron RDI, 8% zinc RDI, and 3% calcium RDI which lower than previous additional food product This condition caused by previous additional food used vitamin and mineral premix meanwhile F4 formula did not used vitamin and mineral premix. Other than that, anti nutrition in sorghum and nuts like tanin, phytat, and protease inhibitor causing bond formation between anti nutrition and important mineral so that it can form complex compound which decrease mineral availability (Haliza, et al., 2007). Based on RDI 2013 for second pregnant women with age 19-29 years, 100 gram F4 as snacks can fulfill daily energy requirement as much as 18%, protein 20%, fat 25%, carbohydrate 15%, dietary fiber 31%, and β-carotene 57%. Meanwhile, mineral like iron, zinc, calcium only can fulfill respectively 7%, 9%, and 3% daily requirement.

Table 4. Profile and limiting essential amino acid score in F4

Essential amino acid	Essential amino acid mg/g protein	Essential amino acid reference*	% essential amino acid score
Histidine	28.51±0.46	-	-
Isoleuscine	54.72±1.39	40	136.80
Leucine	99.61±5.56	70	142.30
Valin	64.88±3.71	50	129.76
Lysine	54.39±5.56	55	98.89
Threonine	38.66±0.93	40	96.65
Phenylalanine	65.53±1.85	-	-
Methionine + cysteine (sulphuric amino acid)	17.04±0.00	35	48.69
Tryptophan	9.83±0.00	10	98.30

Note: *FAO 1973

Protein quality in F4 formula can be measured using limiting essential amino acid and protein digestability measurement. Limiting essential amino acid are amino acid that cannot produce in body so that it must be obtained from balance nutrition. Limiting essential amino acid consisted by histidine, isoleucine, leucine, valin, lysine, threonine, phenylalanine, methionine + cysteine, and tryptophan (Górska-Warsewicz et al., 2018). Profile and limiting essential amino acid score in F4 showed in table 4.

Based on calculation by dividing essential amino acid score in product with amino acid requirement for adult based on FAO (1973) then multiply with 100, lowest essential amino acid score showed by methionine and cysteine as much as 48,69% (FAO, 1973). This condition showed limiting essential amino acid in product is methionine and cysteine which only 48,69% from total amino acid in product which can be used by body to protein synthesis. Based on Patil, et al. (2016), nuts contain methionine, cysteine, and tryptophan in low amount. For that reason, product needs ingredients which can completing essential amino acid like animal protein and cereal (Górska-Warsewicz, et al., 2018; Galili and Amir, 2013).

Protein digestability analysis result in F4 formula showed digestable protein in snack bar product is 75,84% which categorized as not high. Based on Sediaoetama (1991), high protein digestability equal to or higher than 80%. This condition caused by internal like animal protein usage which lower than plant based protein. Animal protein are high quality protein because contain complete essential amino acid and its form near to amino acid which needed by body to maintain growth nad metabolic process in human body. Meanwhile plant based protein from nuts contain suboptimal essential amino acid (Joye, 2019). Other internal factor which can affect protein digestability is folded and agregation protein which can blocking entrance to peptide chain so that it can slowing hydrolisis process Beside that, cross bond in and between single protein can decrease protein digestability (Joye, 2019).

External factor also contributed to affect protein digestabilty. Based on Joye (2019),

heating process can affect protein digestability by causing protein denaturation and continued with aggregation. Other external factor can affect protein digestability is anti nutrition content in sorghum, redbean, and black soybean like tannin, phytate, and dan protease inhibitor which can compete with peptidase and nonactivate peptidase (Duodu et al., 2003; Chaudhary and Sharma, 2013; Yang et al., 2014; Joye, 2019). F4 can be claimed as high fiber. Based on Joye (2019), fiber can increase gastrointestinal tract viscosity so that it is suspected can slowing hydrolitic enzyme diffusion in producing amino acid.

Protein digestability score increment can be done by fermentating black soybean. Based on Çabuk et al. (2018), fermentation can decrease anti nutrition content that can inhibit trypsin and kimotrypsin inhibitor enzyme also decrease anti nutrition which can stimulating cross bond (phenolic and tannin compound). Other than that, fermentation can produce protease from microe that help to degrade protein into amino acid and help release protein from matrix.

Chosen Snack Bar Product Acceptability in Pregnant Women

Product acceptability can be measured using hedonic rating test. Like response obtained from person that representing general opinion or community population (Setyaningsih et al., 2010). For that reason, acceptability analysis to F4 held in 100 pregnant women. Result showed scale 4 (neutral) until 7 (very like) in product and showed product can be accepted by panelist. Based on Setyaningsih, et al. (2010), if consumer percetage which stated not like (refuse) product <50%, than that product can be accepted by consumer. Study result showed chosen snack bar formula can be accepted by pregnant women as panelist because >50% panelist choose scale 4-7 in each hedonic attribute. Colour properties has 92% acceptance percentage, aroma properties 93%, texture properties 86%, taste and mouthfeel properties 93%, aftertaste properties 89%, and overall properties 97%. Panelist acceptance percentage (pregnant women) in F4 formula showed in picture 1.

Gambar 1. Panelist Acceptance Percentage (Pregnant Women) in Formula F4

CONCLUSION

The choosen Snack bar (F4) has potential as additional food alternative for pregnant women with chronic energy deficiency. F4 can be accepted in sensory properties, fulfill minimum nutrient standard for additional food for pregnant women with balance energy protein, contain higher protein and fiber that other commercial additional food for pregnant women with chronic energy protein, can be claimed as protein source, high fiber, high β-carotene, and can contributed to fulfill nutrient requirement as snacks for pregnant women. But, F4 still not fulfill daily mineral requirement especially Fe, Zn, and Ca as snacks and F4 has low protein digestability. For suggestion, fortificant premix addition into the product are necessary to increase mineral content. Beside that, nutrient addition especially protein quality protein are needed by adding animal protein sources which has optimal essential amino acids and perform some process to increase protein digestability like black soybean fermentation

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KETOGENIC DIET FOR WEIGHT LOSS AND ITS IMPLICATION ON HEALTH: A LITERATURE STUDY

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ABSTRACT

The prevalence of obesity has increased significantly and it has become a public health problem globally. Many strategies were done to overcome obesity. One of them is dietary approach. The popular and widely used weight loss diet is the ketogenic diet. This literature review aimed to discuss the mechanism of ketogenic diet in weight lost as well as its long and short term effects on health. Ketogenic diet is a very low-carbohydrate and high-fat diet. This diet restricts the carbohydrate intake up to 50 gram per day. The diet effective for losing weight in short term (<6 months), after 6 months there was no significant differences compared to other wight-loss diet. Study shows ketogenic diet gives both beneficial and harmful effects in short and long term for ketogenic dieters. This diet is not applicable for anyone, thus people with chronic diseases should receive guidance from dietitian or clinician in implementing this diet. Ketogenic dieters are suggested to replace their carbohydrate intake with complex carbohydrate (whole food-not refined), reduce animal-based protein, increasing plant-based protein and polyunsaturated fat, water, fermented foods and beverages.

Keywords: ketogenic diet, low carbohydrate diet, obese, ketone, weight loss

INTRODUCTION

Obesit has became world health problem which the prevalence is increasing (8,5% in 1999 becomes 13,1% in 2016 (WHO 2016). Obesity is the risk factor for various non communicable disease like hypertension, diabetes mellitus, cardiovascular disease, and cancer (Fruh, 2017). Many effort has been performed to decrease obesity prevalence, one of them is diet therapy. Nowadays many diet has been developed in society which is low carbohydrate, high protein diet, high fat diet, or calorie restriction diet (Kirkpatrick *et al*. 2019). Low carbohydrate diet is one kind of diet which broadly used to lose body weight (Oh and Uppaluri 2019). Diet that has been proven effective to reduce body weight quickly is very low carbohydrate and high fat, or namely ketogenic diet (Bueno et al., 2013; Kirkpatrick et al., 2019; Sumithran and Proietto, 2008).

Ketogenic diet is low carbohydrate diet, high fat, and enough protein with composition 5-10% carbohydrate, 55-60% fat, and 30-35% protein (Masood and Uppaluri, 2019). Very low carbohydrate diet limit carbohydrate intake to 50 gram/day. This diet increasingly known to the public because it is believe can lose weight quickly.

The used of ketogenic diet for epileptics has been extensively reviewed (Meira et al., 2019; Qi and Tester, 2019; Roehl and Sewak, 2017), but the use of ketogenic diet for weight loss and the short and long term effects of this diet still controversial. Therefore this literature study aims to discuss how ketogenic diet can reduce body weight and its short and long term effect on health.

KETOGENIC DIET HISTORY

Ketogenic diet is a term that shows dietary therapy with diet composition that results in ketogenic state in human metabolism. Ketogenic diet contain very low carbohydrates (20-50 gram per day), high fat, and enough protein. Macronutrient intake from ketogenic diet has 55-60% fat, 30-35% protein, and 5-10% carbohdrate composition (Oh and Uppaluri, 2019).

Ketogenic diet aims to force body to break down fat into energy sources. Very low carbohydrate intake force body to do glycogen synthesis and if it happen for long time then body will begin to exp erience ketosis. Body begin

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to increase production of ketones from fat as an alternative energy source to replace glucose. This condition causes weight loss due to continuous fat breakdown (Roehl and Sewak, 2017; Oh and Uppaluri, 2019).

Ketogenic diet was originally used as therapy for epilepsy patient both in children and adults. Then this diet develop its use for people with diabetes, cancer, cardiovascular disease, including for weight loss. Ketogenic diet is one of effective non pharmacological measures for intractable epilepsy since 1920 (Meira et al., 2019). Some literature shows that fasting is a therapy to reduce the symptoms of seizures in epilepsy sufferers. At the beginning of 5th century BC, Hippocrates wrote that fasting was useful for controlling seizures (Caraballo and Vining, 2012).

In 1911, Guelpa and Marie, medical doctors from Paris noted the use of fasting as therapy for epilepsy. In 1921 Dr. Russel Wilder, a medical doctor in Mayo Clinic Minnesota formulated idea that high fat and very low carbohydrate diet can cause ketonemia (effect like fasting). Dr. Wilder build classic ketogenic diet concept consisting of ketogenic and antiketogenic component can be useful for epileps therapy (Meira et al., 2019; Caraballo and Vining, 2012; Roehl and Sewak 2017).

In 1925, pediatrician named dr. Peterman made improvements to ketogenic diet and determined minimum daily calorie requirement of 75% of nutritional adequacy rate for certain height and weight and protein as much as 1 g/kg body weight (Caraballo and Vining 2012). Ketogenic diet consider adequate nutrient intake to avoid occurrence of malnutrition. Calculation of classic ketogenic diet until this day still the same as initial formulated composition b Mayo Clinic, which is 1 gram protein/kg body weight, 10-15 gram carbohydrate, and remaining calories come from fat (Roehl and Sewak, 2017).

Ketogenic diet is currently used for weight loss (Kirkpatrick et al., 2019), diet therapy for cancer (Weber et al., 2019), mitochondrial dysfunction (Hasan-Olive et al., 2019), alzheimer (Rusek et al., 2019), inflammation, oxidative stress (Pinto et al., 2018), and movement disorders and severe or traumatic brain injury (McDougall et al., 2018).

Table 1. Diet Type Based on Carbohydrate Proportion to Total Energy

Diet	Ketogenic	Proportion Carbohydrate to total energy
High carbohydrate	No	45-65% total energy (169-244 gram/day)
Enough carbohydrate	No	26-44% total energy (130-225 gram/day)
Low carbohydrate	No	10-25% total energy (50-130 gram/day)
Very low carbohydrate	Yes	<10% total energy* (<50 gram/day)

Note: *Based on 2000 kcal diet per day, and the amount of carbohydrate needed to stimulate ketosis in most adults

Ketogenic diet began to be considered as diet for weight loss after development of low carbohydrate diet, such as Atkins diet. In 1970, Robert Atkins developed diet to lose weight by limiting carbohydrate intake (Atkins diet), then this diet was also used for seizure therap in people with epilepsy (*Modified Atkins Diet*) (Meira, et al. 2019).

Since 1972 low carbohydrate diet has been used as one strategy for weight loss. Currently, attention to low carbohydrate diets continues to grow, including ketogenic diet. All low carbohydrate diets in principle reduce overall carbohydrate intake, but there is no consensus on the definition of low carbohydrate diet (Oh and Uppaluri, 2019). Carbohydrate restrition diet is a diet with carbohydrate intake below the range of carbohydrate intake the is acceptable for healthy adults (45-65% total energy). Carbohydrate restriction diet can be divided into 4 category as shown in table 1 (Kirkpatrick et al., 2019; Oh and Uppaluri, 2019).

KETONE BODY METABOLISM

There are 3 types of ketone bodies produced by body, namely acetoacetate, ß-hydroxybutyrate, and acetone. Acetoacetate is the main ketone body produced, then acetoacetate will be converted into ß-hydroxybutyrate, and acetone (Kirkpatrick et al., 2019). A healthy adult has 2-6% ketone supply frpm body energy needs after a day of fasting and reaches 30%-40% of energy needs after 3 days of fasting (Sumithran and Proietto, 2008). Measurement of ketone body concentrations can

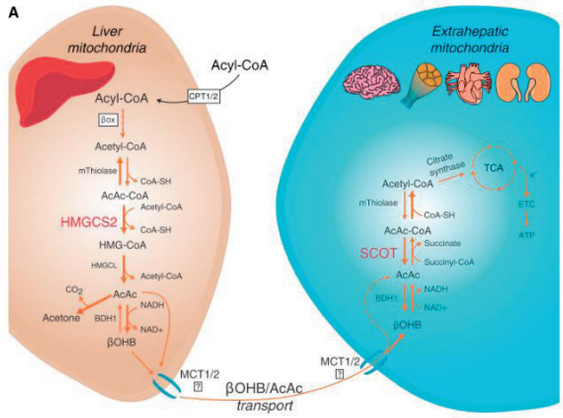

Figure 1. Ketone Bodies Metabolism.
Source: (Puchalska and Crawford, 2017)

be done in blood serum (ß-hydroxybutyrate), urine (acetoacetate), and breath (acetone) (Roehl and Sewak, 2017).

Under normal circumstances, glucose is body main energy source through three mecanism, that is glycolisis, Krebs cycle or Trycarboxylic Acid cycle (TCA cycle) and the electron transport chain (ETC) (Puchalska and Crawford, 2017). When enough carbohydrate intak, insulin will stimulate lipogenesis and suppress production of ketone bodies. Therefore ketone body concentration is very low (<0,3 mmol/L) compared to glucose (4 mmol/L). After a few days of carbohydrate intake reduction (a very low carbohydrate diet) the production of blood glucose from gluconeogenesis become inadequate and central nervous system needs additional energy sources. During carbohydrate intake restrictions, insulin level will decrease meanwhile glucagon will increase. This condition will result in decreasing lipogenesis and increasing oxidation of fatty acid in the liver. Increased fatty acid oxidation will cause excess production of acetyl-CoA as a result liver cell mitochondria will produce ketone bodies (Kirkpatrick et al., 2019). In a state of low blood glucose, gluconeogenesis will occur and body will start using second energy source, that is fatty acids. Brain use glucose as energy source and cannot be replaced by fatty acid because fatty acid cannot pass through blood brain barrier. Therefore, fatty acid must first converted into ketone body so that they can pass blood brain (Puchalska and Crawford, 2017).

Ketone bodies can be alternative source of energy for the brain other than carbohydrates because ketone bodies have the same binding affinity (Michaelis-Menten or kM) as glucose. Central nervous system starts using the ketone body as an energy source when the plasma ketone body concentration is around 4 mmol/L. Ketone bodies in healthy adults generally do not exceed 8 mmol/L because central nervous system efficiently use them as energy source instead of glucose and can be toxic if the levels are excessive (Kirkpatrick et al., 2019).

Ketogenesis is ketone bodies forming process (β-hydroxybutyrate, acetoacetate, acetone) mainly in liver cells mitochondria while ketolysis (breakdown of ketone bodies) occurs in muscle and brain cells (Gropper and Smith, 2013). When ketosis occurs, liver cell produce ketone bodies (acetacetate, acetone, and β-hydroxybutyrate) then ketone body is distributed to extrahepatic tissue (heart muscle, skeletal muscle, kidney, and brain). Ketone bodies breakdown in mitochondrial extrahepatic tissue into acetyl-CoA which can enter Krebs cycle to produce energy especially in hungry period (Gropper and Smith, 2013). Metabolic process of ketone bodies can be seen in Figure 1.

Ketone body production is tightly regulated and depends on 3 main enzymes activity that is lipase sensitive hormone, acetyl-CoA carboxylase, and HMG CoA synthase (convert acetoacetyl CoA to HMG CoA) (Sumithran and Proietto, 2008). When ketogenesis occurs, blood glucose levels are still in normal levels due to the presence of gluconeogenesis from amino acids and glycerol (triglyceride hydrolysis). On day 3 and 4 of ketogenic diet, the main source of glucose formation is from amino acids through gluconeogensis. When ketogenic condition is maintained, contribution of amino acids will decrease and amount of glucose produced from glycerol will increase. Based on studies related to the effects of fasting and very low carbohydrate diet, metabolic adaptation to ketosis occurs around two weeks or more until permanent ketone levels are reached (Kirkpatrick et al., 2019).

In general, ketosis occurs when serum ketones increase from 1 mmol/L to 7 mmol/L but do not produce acidic metabolic substances, in other words, it does not occur until ketoacidosis (Oh

and Uppaluri, 2019). Ketogenic diet in weight loss generally produces serum ketones from 0.33 to 0.72 mmol/L, whereas in diabetes ketoacidosis it is around 25 mmol/L. While hyperketonemia and ketoacidosis occur if blood serum acetoacetate levels > 0.2 mmol/L and β-hydroxybutyrate >7 mmol/L (Puchalska and Crawford, 2017; Sumithran and Proietto, 2008).

Acetoacetate and ß-hydroxybutyrate are two ketone bodies which are used as fuel when lack of carbohydrate (low carbohydrate) in body occurs (Sumithran and Proietto, 2008). Acetoacetate has pKA 3.6 and β-hydroxybutyrate has pKA 4.7. Both ketone bodies can donate proton to blood vessel which can cause acidosis or ketoacidosis (Puchalska and Crawford, 2017). Acetone is formed as a result of acetoacetate decarboxylation, has volatile characteristics, and is released through respiratory tract giving smell of ketones in breath of people who have ketosis (Sumithran and Proietto, 2008).

When ketone body is too much it will cause acetone smelling breath, high anion gap, disruption of body acid-base balance (Gropper and Smith, 2013), acidosis, and will also stimulate part of brain called postrema area and trigger excessive vomiting, dehydration until the most severe stage, which is coma (Puchalska and Crawford, 2017).

KETOGENIC DIET FOR WEIGHT LOSS

Composition of macro nutrients in diet is an important determinant factor in ketosis. Consumption of carbohydrates mainly comes from non-starchy vegetables or fruits with low carbohydrate content (Abbasi, 2018). A very strict ketogenic diet with 4: 1 or 3: 1 fat and carbohydrate ratio has low palatabillity making it difficult to do for long period. Meanwhile, ketogenic diet with ratio of 2: 1 and 1: 1 or modified Atkins diet has better palatability (Meira et al., 2019). Comparison of ketogenic diet with balance nutrition guideline can be seen in table 2.

Low carbohydrate and high protein diet do not cause ketosis because 100 gram protein from food can produce 57 gram glucose. Ketogenic diet which usually used in epilepsy therapy in children limits protein and carbohydrates with fat to carbohydrate and protein ratio 3: 1 or 4: 1).

Table 2. Comparison of Macro Nutritional Composition in Ketogenic Diet with Balanced Nutrition Guidelines

Diet	Carbohydrate	Fat	Protein
Balance Nutrition Guideline[1]	55-65%	25-35%	10-15%
Ketogenic Diet Ratio[2]			
4:1	2-4%	90%	6-8%
3:1	2-5%	85-90%	8-12%
2:1	5-10%	80-85%	10-15%
Atkin Diet Modification[2]	20-30%	60-70%	25-35%

Source : [1](Kemenkes RI, 2014); [2](Roehl and Sewak, 2017)

Ketosis will occur if fat intake more than twice intake of carbohydrates plus half protein intake of fat intake (Sumithran and Proietto, 2008).

To reach the state of ketosis, it is necessary to formulate ketogenic diet properly because fat intake and total energy are not limited. Besides very low carbohydrate intake, limiting protein intake also needs to be done. Protein intake is limited by pay attention to sufficient amount to maintain body mass (Abbasi, 2018).

The ketogenic diet limits carbohydrate and protein intake (<1 gram per kg body weight) except for individual who have heavy exercise habit (1.5 grams per kg body weight). Carbohydrate and protein restriction is done to prevent endogenous glucose production through gluconeogenesis, but does not limit overall fat or energy intake (Masood and Uppaluri, 2019).

In a state of ketosis, a reduction in overall calory intake can increase weight loss (Masood and Uppaluri, 2019). Systematic review and meta analysis by Gibson et al. (2015) showed individuals who were on low-energy diet and ketogenic diet had decreased hunger (feeling fuller) (Gibson et al., 2015). Decreasing hunger naturally can reduce overall calorie intake and lose weight (Abbasi, 2018).

Ketogenic diet significantly influences energy intake and expenditure. Some studies show that replacement of carbohydrate with fat result in greater energy expenditure. This condition is due to changes in levels of catecholamines and thyroid hormones that affect energy expenditure

of individual on ketogenic diet, although the mechanism is not fully understood (Kirkpatrick et al. 2019).

Table 3 shows results and discussion of weight changes with ketogenic diet. On the ketogenic diet, weight loss occurs significantly compared to a low fat diet, especially in the first 3-6 months. However, if compared with balanced nutritional diet and ketogenic diet > 6 months, the difference is not significant.

Results of 11 studies review conducted by Sumitharan and Proietto (2008) showed that ketogenic diet carried out for 3-6 months can lose weight higher than low fat diet. However, the difference in weight loss was not significantly different after 12 months.

In short term (≤ 6 months), low calorie ketogenic diet has higher weight loss compared to other low calorie diets such as high carbohydrate and low fat diet. But in the long period (> 6 months), weight loss between two diets is same. Very low carbohydrate diet (including ketogenic diet) are difficult to maintain in long period and are no better than diet with higher carbohydrate intake (Kirkpatrick et al., 2019).

There are several alleged mechanisn of ketonic diet ini losing body weight:

1. Ketogenic diet give diuretic effect. Weight loss happen at the beginning of diet due to diuretics or water expenditure followed by fat loss (Masood and Uppaluri, 2019; Sumithran and Proietto, 2008). Each gram of glycogen stores in liver and muscle contain about 2 gram of water. Deposits of glycogen in liver around 100 gram and in muscle around 400 gram. Decreased glycogen reserves and ketonuria increase sodium levels in kidneys and water excretion. (Sumithran and Proietto, 2008).
2. Next weight loss occur because body begin to burn fat stored in adipose tissue, then weight loss can continue (Abbasi, 2018).

Table 3. Ketogenic diet weight loss from various research results

No.	Study	Diet Period	Body Changes Reduction		Note
			Ketogenic Diet	Non Ketogenic Diet	
1.	Experimental study giving ketogenic diet intervention to 35 obese adult (Mohorko *et al*. 2019)	3 months	Male 18 ± 9 kg Female 11 ±3 kg	-	Significant body weight reduction with average 11-18 kg
2.	Clinical trial giving ketogenic diet to 20 obese adult (Gomez-Arbelaez *et al*. 2017)	4 months	20.2 ± 4.5 kg	-	Significant body weight reduction with average 20 kg, muscle mass reduction 16,5 kg
3.	Meta analysis from 11 *Randomised Control Trial* (RCT) (Mansoor *et al*. 2016)	6-24 months	2.9 kg-14.5 kg	1.8 kg-11.5 kg	Ketogenic diet has 2,2 kg body weight reduction higher than low fat diet group
4.	Ketogenic diet study in 75 people compare with *low fat* diet *Randomized Control Trial* (Hu et al., 2015)	3-12 months	3.8 kg-6.8 kg	0.3 kg-3.3 kg	Ketogenic diet give body fat reduction effect higher than 3,5 kg compare with low fat diet
5.	Ketogenic diet study in 9 male compare with *low fat diet Randomized Control Trial* (Vargas et al., 2018)	8 weeks	1.4 kg±0.1 kg	+0.9 kg±0.4 kg	Ketogenic diet can decrease body weight 1,4 kg in 8 weeks while low fat diet increase body weight
6.	Meta analysis from 13 *Randomised Control Trial* (RCT) (Bueno *et al*. 2013)	12-24 months	1.5 kg-13.1 kg	0.2 kg-11.6 kg	Ketogenic diet can decrease body weight 0,9 kg higher than low fat diet group
7.	Meta analysis from 19 RCT (Naude *et al*. 2014)	3-6 months 1-2 years	2.65 kg-10.2 kg 2.9 kg-12.3 kg	3.4 kg-9.4 kg 3.5 kg-10.9 kg	Ketogenic diet can decrease body weight as much as in balance nutrient diet (not significant)
8.	Very low calory ketogenic diet RCT study in 27 obese people (Moreno et al., 2014)	2 months 12 months	13.6±3.9 kg 19.9±12.3 kg	4.8±2.7 kg 7.0±5.6 kg	Very low calory ketogenic diet can decrease body weight 2-3 times more than low calory diet

3. Ketones can suppress appetite. This decreased appetite can naturally reduce overall calorie intake which can reduce weight. Low-carbohydrate ketogenic diets provide metabolic benefit by increasing gluconeogenesis (Abbasi, 2018; Sumithran and Proietto, 2008).
4. Limiting food choices, low palatability of low-carbohydrate diet, the satiating effect of relatively high protein and fat intake, increasing thermogenic effect of protein and fat, increasing lipolysis of fatty tissue due to reduced insulin levels, and increasing fatty acid oxidation (Sumithran and Proietto, 2008).

Effect of ketogenic diet on body composition cause decrease in total water content in body (ketosis is associated with total body water loss). This condition is being cause of weight loss at the beginning of ketogenic diet. Ketogenic dieter also experienced decrease in non-fat body mass that was higher than low-calorie diets with more balanced macro nutrients. Reduction in nonfat mass can be due to high protein content in ketogenic diet (Kirkpatrick et al., 2019).

Basically, carbohydrates are the main source of energy in body tissue. When body experiences carbohydrate deficiency due to low intake (<50 grams / day), insulin secretion will be drastically reduced and body will enter catabolic stage. Glycogen stores will decrease, forcing body to adapt to changes in energy metabolism. There are two metabolic processes that occur when availability of carbohydrates in body tissue decreases, that is gluconeogenesis and ketogenesis. Gluconeogenesis is endogenous production of glucose in liver. This glucose production comes from lactic acid, glycerol, and alanine and glutamine amino acid. When availability of glucose continues to decline and endogenous glucose production can no longer meet body needs, then ketogenesis is started to provide alternative source of energy in form of ketone bodies. Glucose is replaced by ketone bodies as main energy source (Masood and Uppaluri, 2019).

After few days of fasting (3-4 days) or a drastic reduction in carbohydrate intake (<20 grams per day), body glucose reserves become insufficient to produce oxaloacetate (for fat oxidation in Krebs cycle) and provide energy (glucose) for central nervous system (Paoli, 2014). Insulin secretion decreases and after one week, body start burning fat. This condition is called nutritional ketosis, so ketogenesis begin and energy sources switch to using ketone body (Abbasi, 2018).

Central nervous system cannot use fatty acid as energy source because fatty acid cannot pass through blood-brain barrier. Therefore central nervous system require another alternative source of energy, that is ketone body (which produced from acetyl Co-A). Liver produces ketone body, but liver and red blood cells cannot use it because there is no 3-ketoacyl CoA transferase enzyme needed to convert acetoacetate to acetacetyl-CoA (Paoli, 2014).

When ketogenesis occurs blood glucose become low. Therefore, insulin secretion become low, reducing glucose and fat storage stimuli. Other hormonal changes contribute to increase in breakdown of fat into fatty acids. Fatty acids are metabolized into acetate which then converted to β-hydroxybutyrate and acetone. This metabolic process results in accumulation of ketone bodies in body so that ketogenic diet can take place. As long as body is in state of carbohydrate deficiency, energy metabolism will continue to occur in state of ketosis. Condition of nutritional ketosis is considered safe because ketone body produced in small concentrations so that it cannot change blood pH. This condition is very different from the condition of ketoacidosis, which is a life-threatening condition due to production of ketone body so much that it changes blood pH become acidic (Masood and Uppaluri, 2019).

The results of meta-analysis show that low and very low carbohydrate diet (including ketogenic diet) is not superior compared to other diets with more carbohydrate intake. Study of Sacks et al. (2009) describe almost the same level of satisfaction in subjects given 4 types of low-calorie diets (low fat-moderate protein, low-fat-high protein, high-fat-moderate protein, and high-fat-high protein). Although there are differences in weight loss in each subject in each diet group. Some have very high or above average weight loss (Sacks et al., 2009). This explains food choices a person must consider in choosing a weight loss diet (Kirkpatrick et al., 2019).

SHORT TERM LONG TERM EFFECT OF KETOGENIC DIET TO HEALTH

Health effects experienced by people on ketogenic diet can vary depending on tolerance and the amount of carbohydrate restrictions. Table 4 shows the short-term and long-term effects of ketogenic diet on health.

Short-term effects that are felt by many ketogenic dieters are experiencing symptom such as keto flu (dizziness, lightheadedness, weakness, fatigue, difficulty exercising, lack of sleep, and constipation) (Abbasi, 2018) and digestive tract problems such as nausea, vomiting, constipation and abdominal pain (Kirkpatrick et al. 2019). Besides dehydration, hypoglycemia, increased LDL cholesterol, and uric acid can also occur in ketogenic dieters (Kirkpatrick et al., 2019; Sumithran and Proietto 2008; Mansoor et al., 2016; Bueno et al., 2013).

Prospective cohort study conducted in USA on 15,428 adults aged 45-64 years and a meta-analysis of 8 cohort studies showed low carbohydrate intake (<40% total energy) and high carbohydrate (> 70% total energy) had a higher risk of death compared

Table 4. Short-Term and Long-Term Impact of Ketogenic Diet on Health

Effect	Note
Short term (≤6 months)	
1. Weight loss (Mohorko et al. 2019; Gomez-Arbelaez et al. 2017; Mansoor et al. 2016)	Weight loss is significantly higher than other diets, especially in subjects that are obese and overweight.
2. Gastrointestinal problems such as nausea, vomiting, constipation, and stomach pain (Kirkpatrick et al. 2019)	Gastrointestinal problems are felt in the first week.
3. Symptoms such as keto flu (dizziness, lightheadedness, weakness, fatigue, difficulty to exercise, lack of sleep, and constipation) (Abbasi 2018)	This complaint is felt after starting ketogenic diet 2-4 days and can last for several days to one week. This symptom is a form of body adaptation to the use of ketone bodies as an energy source. Consumption of protein from food can provide enough sodium, potassium and magnesium to reduce these symptoms.
4. Headaches, skin rashes, muscle spasms, weakness, diarrhea, dehydration, hypoglycemia, increased uric acid in blood and vitamin and mineral deficiencies (Kirkpatrick et al. 2019; Sumithran and Proietto 2008).	Increased urine output can cause decreased electrolyte levels including sodium, magnesium and potassium which are associated with symptoms of hypovolemia and dizziness. People on the ketogenic diet should ensure adequate fluid and electrolyte intake.
5. Increased LDL kolesterol (Mansoor et al. 2016; Bueno et al. 2013)	This increase is thought to originate from a high intake of saturated fatty acids in ketogenic diet (Kirkpatrick et al. 2019).
6. Decreased *Bifidobacteria, E. rectale*, and *Dialister* also increased *E. coli amount* (Lindefeldt et al. 2019)	Changes in composition of intestinal microbiota occur after 3 months of implementing ketogenic diet in epilepsy patients. Bacteria that play a role in consumption of complex carbohydrates are reduced. Diets high in polyunsaturated fats, vegetable protein, and consumption of fermented foods and drinks can maintain the normal function of microbiota (Paoli et al. 2019).
7. Decreased total stool mass, slower bowel movement, decreased intestinal fermentation, decreased stool SCFA levels, decreased intestinal health conditions, and increased risk of colon disease (Brinkworth et al., 2009)	Decreased carbohydrate intake can interfere bowel movements and gut microbiota composition, especially Bifidobacteria. This results in decreased fermentation and decreased yield of SCFA metabolites which have a protective effect on colon disease (Brinkworth et al., 2009)
Long term (>6 months)	
1. Vitamin and mineral deficiency (Sumithran and Proietto 2008).	Adequacy of nutrients will depend on several factors such as carbohydrate restriction level, food sources of nutrient, and duration of diet.
2. Lipid profile such as triglyceride and HDL are not good (Kirkpatrick et al. 2019).	Lipid profile is better in people on low-moderate carbohydrate diet compared to very low carbohydrate diet such as ketogenic diet.
3. Increased cardiovascular disease risk (Manikam et al. 2018)	High consumption of saturated fat can increase LDL cholesterol and decrease bronchial artery dilatation thereby increasing the risk of cardiovascular disease.
4. Increased non-alcoholic fatty liver disease and insulin resistance (Kosinski and Jornayvaz 2017)	Study with animal.

to people who consume carbohydrates between 50-55% of total energy. The risk of death will increase if carbohydrates are replaced with animal foods (goats, cows, chickens, pigs), and decreases if replaced with plant foods (vegetables, beans, whole cereals) (Seidelmann et al., 2018). Therefore, when someone is on carbohydrate restriction diet for weight loss, carbohydrate should be replaced with unsaturated fats or sources of fat and vegetable protein.

People who have chronic diseases such as diabetes mellitus, heart failure, kidney disease, liver disease and cancer if want to go on ketogenic diet should be under supervision of medical person and get nutritional therapy from registered dietesien. People with history of hypertriglyceride, acute pancreatic disease, and hypercholesterolaemia are not advised to go on ketogenic diet (Kirkpatrick et al., 2019).

CONCLUSION

Ketogenic diet is a very low carbohydrate diet that limits carbohydrate intake below 10% of total energy to stimulate ketosis in body. Ketogenic diet can lose weight quickly. Ketogenic diet can cause short-term complaints (keto flu, digestive problems, dehydration, hypoglycemia, elevated LDL, and uric acid) and long-term disease risk (deficiency of mineral vitamins, poor lipid profile, increase fatty liver disease).

Person perform ketogenic diet should replace carbohydrate intake with complex (whole) carbohydrate sources, reduce animal protein, increase vegetable protein, increase polyunsaturated fat and water consumption. To maintain weight it is recommended to make diet transition to a more balanced and more durable diet. Patients with hypertriglycerides, acute pancreas, and hypercholesterolemia are not allowed to go on a ketogenic diet.

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DIFFERENCES IN VISUAL ACUITY, NUTRITIONAL STATUS AND MOTOR FUNCTION IN NEW ELEMENTARY STUDENTS IN RURAL AND URBAN AREA

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ABSTRACT

School children in rural and urban areas need attention in terms of education and health. This study was aimed to analyze differences in visual acuity, nutritional status and motor function among school-age children in rural and urban areas. This was an analytic observational with cross-sectional design. As much as 57 students at SD Sokanegara and Kedungbanteng elementary school was recruited by purposive sampling method with inclusion criterias including first grade of elementary school student in healthy condition. Visual acuity data was examined by using Snellen Chart, nutritional status data by anthropometric measurements of body weight and height was calculated using the BMI for age index, while motor function was obtained by Carpenter Motor Ability Test measurements. Data was analyze using the Mann Whitney test. The results showed there were differences in visual acuity (p= 0.001) and nutritional status (p= 0.027) in rural and urban school children, while motor function did not show any significant difference (p= 0.783). It is recommended to increase outdoor activities as a protection against visual acuity.

Keywords: school-age children, motoric function, visual acuity, nutritional status

BACKGROUND

Statistics show that the number of primary school children in Indonesia was quite large, totaling 2,238,923 students spread throughout Indonesia both urban and rural (Kemendikbud, 2019). Therefore, the health conditions of school-age children need to be considered. This is because school children are vulnerable to various health problems that can have an impact on their learning activities

The role of eye acuity in new school-age children is very important. As much as 80% of the knowledge is learned by children in through visual information processing. Vision problems can cause unwanted effects in the process of reading and writing, as well as learning achievement. A survey of school-age children in Brazil found that children with low visual acuity as much as 15.5% had lower learning achievement compared to children with better visual acuity. Eye acuity was also associated with the motor function, cognitive function and language development (Toledo et al., 2010). Basic Health Research Data showed the prevalence of less sharp vision for children aged 6-14 years was 0.8% in urban areas and 1.1% in rural areas (Ministry of Health Republic of Indonesia, 2013).

Besided the problem of eye acuity among school-age children, UNICEF Joint WHO and the World Bank in its survey found a total of 51 million (7.5%) school children in thin condition and 151 million (22.2%) in short conditions (Stunted)), as for those who overweight (38 million) (5.6%) (Unicef WHO and World Bank, 2017). Whereas in Indonesia, school-age children who are in thin and very thin conditions were 9.2%; short and very short 23.6%; and 20% were overweight and obese (Kemenkes RI, 2018).

Both gross and fine motor development of school-age children are need to be trained and developed in order to enable children to gain better achievement both academically and physically. Based on Basic Health Survey (RISKESDAS) (2018), the prevalence of disability in children aged 5-17 years was quite large. A child was said to have a disability if there was difficulty or impairment in motor function that is severe or very severe. The national prevalence of motoric disability among children was 3.3% in total, including 3.6% in

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urban areas and 2.9% in rural areas (Indonesian Ministry of Health, 2018).

The neighborhood environment could affect a person's health. Research by Renaldo and Supriatna (2017) found differences in motor functions in running and throwing among elementary school students in urban and rural areas. Research conducted by Mexitalia et al. (2012) showed there were differences in the nutritional status of school children in rural and urban areas. This study aims to analyze the difference in vision acuity, nutritional status and motor function in school-age children in rural and urban areas

METHODS

The research method used was an analytic observational research method with cross-sectional study design. This research design was used to study the dynamics of correlation by approaching, observing or collecting data at one time (point time approach). This study was approved by Internal Reviewer Board Faculty of Medicine, Universitas Jendral Soedirman (2911/KEPK/V/2019).

This research was conducted to students at SD Sokanegara I and SD Kedungbanteng I in March-May 2019. The sampling technique used purposive sampling, with the inclusion criteria including first-grade students with healthy condition. The number of samples at SD Sokanegara was 24 students and at Kedungbanteng Elementary School were 34 students, bringing the total to 57 students. Measurement of visual acuity was performed using a Snellen Card conducted by a health worker, a certified nurse. Normal vision was defines as 20/20 in feet or 6/6 in meters. Visus 6/6 was the normal vision threshold where a person can undergo activities quite well in school (Suarya et al, 2016). The lower visual acuity indicates lower eye acuity.

Nutritional status is a picture of a balance between intake and body needs. Weighing was done using digital scales (merc: Camry) with accuracy of 0.001. Height measurements was conducted using the stature meter (brand: GEA) with the accuracy of 0.1 mm. Furthermore, nutritional status was determined by Body Mass Index for Age Z-Score. Nutritional status is considered normal if it is within the range of -2 to +1 SD. The subjects were belongs to thin group if BMI/A <-2 SD and classified as overweight if BMI/A>+2 SD. The anthropometric index has been approved by the Indonesian Ministry of Health as a tools to determine the nutritional status among children. The higher BMI/A score indicates the potential for overweight (Anthropometry Standard Assessment of Child Nutrition Status, 2010).

Motor function is the development of a person's ability and volition to maximize his work. Motor function was measured using Carpenter Motor Ability. The measurement method is appropriate to be used to measure gross motor skills in lower grades (1-3) of elementary school children. The determination used 2 measurement techniques consisted of Standing Board Jump to measure leg muscle strength; and Shot Put to measure arm muscle strength. In this study we measured the length of the jump using Standing Board Jump, which is a long jump without the start using a 2x2 meter sandbox. Moreover, we also assessed distance of repulsion form Shot Put test using 2 kg bullet. Measurement was carried out 3 times, then the results were averaged. Overall score was determined by following formulation (Nurhasan, 2000):

- Male : distance of Standing Board Jump + 2.5 (Shot Put distance) + 0.05 (body weight)
- Female: distance of Standing Board Jump + 1.5 (Shot Put distance) + 0.05 (body weight)

Measurement of motor function was carried out by school sports teachers. Collected datas were analyzed using Mann Whitney test with significance level of p value <0.05.

RESULT AND DISCUSSION

All samples were first-grade students at SD Kedungbanteng I (rural) and SD Sokanegara I (urban). The average age of the sample was 6 years 9 months. The youngest age was 6 years 7 months, whole the oldest was 8 years 8 months. A total of 56.1% were male and 43.9% were female.

Visual acuity among school-age children in rural areas was higher (90.9%) than urban areas students (83.3%). Moreover, urban school had higher proportion of obese student (29.2%) compared to rural school (15.1%). BMI/A scores among rural school-age children was lower than in

Table 1. Categories of Visual Acuity, Nutritional Status and Motor Function among School-Age Children in Rural and Urban Areas

Variable	Urban		Rural	
	n	%	n	%
Visual Acuity				
Sharp	20	83.3	30	90.9
Less sharp	4	16.7	3	9.1
Nutritional Status				
Overweight	7	29.2	5	15.1
Normal	15	62.5	26	78.8
Underweight	2	8.3	2	6.1
Motor Function				
Poor	11	47.8	13	39.4
Moderate	3	13.1	5	15.2
Good	10	43.1	15	45.4

urban areas. Meanwhile, the percentage of student with good motor function was bigger in rural than urban area (45.4 vs 43.1%) (Table 1).

A significant differences in visual activity was found between urban and rural students (p=0.001). Up to 90.1% urban students had better visual acuity, while in urban area, only 83.3% students had good vision (Table 2). This result was in line with research conducted by Xu et al. (2005) in China which showed children in rural areas had better eye acuity than in urban areas.

There are 3 things that become the main factors causing the decrease in visual acuity, namely the sharpness of retinal focus, health and retina function, as well as the brain sensitivity for visual interpretation (Suarya et al., 2016). The sharpness of the eye could be affected by screen time. Screen time is the time used to do screen-based activities or activities in front of the electronic media screen such as watching television or video, using computer, or playing video games. This causes someone prone to eye problems. Eye disorders are caused by radiation waves from monitor screen that would be captured by cornea, then transmitted to the lens. School-age children who were exposed to electronic media for a long time had weak ciliary muscles. This would affect the lens to become convex because they always see objects in close distance. Furthermore, they became less sensitive to distant objects, and this might causes visual disturbances (James, 2006).

Children who spend 2 or more hours in front of an electronic screen had lower eye acuity (Porotu'o, Joseph, and Sondakh, 2015). Children in urban areas had higher screen time than in rural areas. According to Yang et al., (2016), an increase of outdoor activity time was important protection factor against visual impairment. This is because the long distance vision in the outdoor area would make eye accommodation become relaxed and reduce blur when looking at close objects. In addition, sunlight in the outdoor area causes constriction of the pupils which results in greater depth of field and less blurred images.

We also found significant differences in the nutritional status among school children in rural and urban areas (p = 0.027). This finding was in line with a research conducted by Dian et al. (2015) which also discovered differences in nutritional status in school children in urban and rural areas.

The proportion of obese student was higher in urban (29.2%) than rural school (15.1%). According to WHO (2013), a case of obesity throughout the world have been increasing and quite alarming. As many as 42 million children worldwide were overweight, whereas 31 million of them were in developing countries. In 2008, Collins et al. conducted a research on determinant

Table 2. Characteristics of visual acuity, nutrition status and motor function of school-age children in rural and urban areas

Variable	Area	Mean ± SD	Min-Max	*Mean Rank*	*p value*
Visual Acuity	Urban	0.85±0.29	0.25 – 1.33	20.71	0.001
	Rural	1,12±0.26	0.60 – 1.84	35.03	
BMI/A	Urban	0.38±1.71	-2.24 – 4.68	34.69	0.027
	Rural	-0.42±1.48	-2.38 – 4.63	24.86	
Motoric Score	Urban	581.01±221.84	300.84 – 933.80	28.29	0.783
	Rural	583.94±187.30	313.84 – 894.98	29.52	

of obesity among school-age children in Indonesia. The results proven that driven factors related to obesity comprised family income, screen time, transportation mode, and fast food consumption. Children in urban areas tend to had higher family income compared to rural children. In addition, they often went to school using motor vehicles and easier access to fast food. Rey-Lopez et al. (2008) examined the relationship of sedentary behavior in children such as playing digital games, computers and watching television with the incidence of obesity in children. The amount of time spent watching television could interfere children's growth and development because it caused children to be less active. Thus, the body fat was accumulated easily, lead it to obesity. Sedentary behavior in school-age children need to be concerned. Study by Wulandari et al. (2016) confirmed a shift of activity pattern among school-age children in rural area of Bali, Indonesia. They began to do sedentary activities after school such as watching television and playing gadgets that resulted in an increase of overweight cases.

In this study there were no differences in motor function between school children in rural and urban areas ($p = 0.783$). According to Endang (2007), gross motor skills, namely the ability to run a muscle while doing activities using large muscles such as non-locomotor and locomotor. Non locomotor movements are movements that do not move the body, such as folding, pushing, pulling, bending, and others. Whereas locomotor motion is movement that moves to a different location. Examples of these movements are throwing, catching, kicking, and dribbling.

There were many factors that affect a child's gross motor function including gender, weight, neural maturity, developmental sequence, nutritional status, exercise, motivation, experience, and environment (Kamtini, 2014). In this study, there were no differences in motor function of school children in rural and urban areas which might be influenced by environmental conditions and the neurological maturity of children. Anindhita (2017) proved that there was a correlation between age and the maturity of the body's function and gross motor abilities. Increasing the age of a child would be followed with increament of motor function abilities. In this study, all subjects were taken from first-grade with similar age, so their motor skills have not yet developed and might not significantly different.

CONCLUSION

In this study, we found differences in visual acuity and nutritional status of children, but there was no difference in motor function of children between rural and urban elementary schools. From this finding, it can be suggested to maintain the visual acuity of school children by increasing outdoor activities among school-age children in urban areas. This activity can broaden visibility and can reduce sedentary activity which is the cause of obesity in children so that it also affects the improvement of nutritional status.

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THE EFFECTIVENESS OF ANIMATION VIDEO TO INCREASE ADOLESCENTS' NUTRITIONAL KNOWLEDGE

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ABSTRACT

Nutritional needs are important for adolescent to accelerate growth. Good nutritional knowledge in adolescent can help them to consume healthy foods and prevent nutritional problems. Nutrition education with animation video is a great effort to improve adolescent nutritional knowledge. The use of attractive, effective and efficient media ease adolescent to understand the nutrition material delivered. The objective of this research was to analyzes adolescent nutritional knowledge after given animation video. This research was quasi experimental with a nonequivalent control group design. There were 84 eeadolescents as research subjects chosen with purposive sampling technique. Animation video was given one time every week for one month with the duration of each video for seven minutes. The data was analyzed using Wilcoxon signed-rank. The results of study showed that nutrition education using animation video gave a positive influence on nutritional knowledge of adolescent (p=0.000). Animation video can be used as educational media to improve adolescent nutritional knowledge.

Keywords: adolescent, animation video, nutritional knowledge

BACKGROUND

Fulfillment of nutritional needs is crucial in adolescence to support growth and development process. Adolescent nutritional adequacy rates differ significantly from recommendations for adults or children. Millions of adolescents in high-income and low-income countries still experience nutritional problems (Kumar et al., 2018).

Nationally, the results of 2017 adolescents' nutrition monitoring survey showed prevalence of thin adolescents aged 13-15 years was 6.7% and very thin was 2.6%. Moreover, 3.0% adolescents aged 16-18 years was thin, another 0.9% was very thin. In Special Region of Yogyakarta, underweight adolescents aged 16-18 years was accounted for 6.3% and 2.1% was severe underweight while adolescents aged 13-15 years with underweight was 5.7% and 1.9% was severe underweight (Indonesia Ministry of Health, 2017). In addition, a nutrition monitoring survey in 2015 among high school students in *Kulon Progo*, one of district in Yogyakarta, revealed that 54 students were severe underweight, 336 were underweight, 245 were overweight and obese (Health Office of Kulon Progo District, 2015).

Malnutrition could affect adolescent health and productivity. Obesity in adolescents will impose some impacts such as the emergence of various comorbidities, decreased self-esteem and increased levels of poverty. Nutrition problems as adults are strongly influenced by nutritional problems that occur during adolescence. Therefore, fulfilling nutritional needs in adolescence is important (Gali et al., 2017). Knowledge has a major role in shaping people's behavior (Yunitasari et al., 2019). A study found that good nutritional knowledge was significantly related to higher fruit and vegetables intake and less fat intake (Asakura et al., 2017). Good nutritional knowledge could also improve the quality and quantity of food intake (Haryana et al., 2019).

Nutrition education is one solution to improve nutrition knowledge. Not only to increase knowledge, nutrition education intervention for adolescents could also support behavior change to be more nutritious (Nurmasyita et al., 2015). The use of media in the education process is highly recommended to improve the quality of learning. The function of the media in education is as a teaching aid to facilitate the process of

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delivering information that can stimulate students' thoughts, feelings, concerns and willingness to learn (Nugroho, 2018).

Video animation has been widely used for education and training over the past few years. One positive effect of using animated videos was an increased knowledge (Lin and Li, 2018). The application of animation can eliminate students' laziness in learning. The use of animation can also enhance student learning experiences. Besides, animation can facilitate the depiction of a material (Zakirman and Hidayati, 2017). Koning *et al.* (2019) described that animated videos provide learning outcomes in the form of motor skills and cognitive tasks that are better than static images. Saengow *et al.* (2018) study results showed that animated videos can be used as an educational tool for epilepsy sufferers and caregivers as an effort to increase knowledge and compliance with drug consumption. The purpose of this study was to analyze adolescents' nutrition knowledge using animated videos.

METHODS

This was a quasi-experimental research with non-equivalent control group design. The subject was done purposively based on certain criteria, e.g. living with parents/siblings, not suffering from diseases that require a certain diet (diabetes, kidney, heart, cancer, hypertension), not a vegetarian, not conducting a weight loss or weighting program, and willing to participate in all research processes. The calculation of the research subject was using the following formula:

$$n1 = n2 = [\frac{(Z\alpha+Z\beta)\ x\ S)}{(X1-X2)}]$$

Zα = 5% = 1,96
Zβ = 10% = 1,28
S = Standard deviation
X1-X2 = Average difference

The average value was taken from previous research by Sofianita and Sartika (2010), the mean value before intervention was 7.27 and the mean value after intervention was 8.77 with a standard deviation of 2.657.

$$= [\frac{(1,96 + 1,28)\ x\ 2,657)}{(1,5)}]^2$$

$$= [\frac{8,60868}{1,5}]^2$$

$$= [5,73912]^2$$

$$= 32,94$$

$$n1 = n2 = 33$$

To avoid drop outs, a correction of 21% was made.

$$n' = [\frac{n}{1-f}]$$

$$n' = [\frac{33}{1-0,21}]$$

$$n' = [\frac{33}{0,79}]$$

$$n' = 41,7$$

$$n' = 42$$

Research subjects were 84 adolescents consisting of 42 students in control group (SMAN 1 Lendah) and 42 students in intervention group (SMAN 1 Girimulyo). The selection of the intervention group and the control group based on the working area of the public health center (*Puskesmas*) which had the highest nutritional problems in adolescents according to the 2015 nutritional status screening data from *Kulon Progo* District. Intervention group was the second largest nutrition problem, while control group was the third highest.

The intervention group was given nutrition education with animation video once a week for one month with seven minutes duration in each video. While the control group was not given any treatment until the study ended. Animated videos were made by animators based on concepts provided by researchers. The animated video was played by a teenage cartoon character who illustrates an important nutritional knowledge to prevent health and nutrition problems.

Nutrition knowledge data was collected using a questionnaire that has been tested for its validity and reliability among 30 subjects at SMAN 2 Wates *Kulon Progo*. Gold standard compared with the value of r table (0.3610) and Alpha-Cronbrach value = 0.6. The items were declared valid if r

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Table 1. Animation Video Concept

Session	Key Message	Animated Story Concepts
1	Source of nutritious food	Explanation of examples of food ingredients that contain macronutrients (protein, fat and carbohydrates) and micronutrients (vitamins and minerals)
2	Food taboo and abstinence food in adolescents	Explanation of myths and facts related to diets that are often done by adolescents
3	General message of balanced nutrition	Explanation of 10 messages and 4 principles of balanced nutrition to be a healthy and achiever teenager
4	Adolescent nutrition problems	Diseases that are often experienced by adolescents and how to prevent it

results > r table and the reliability test results were declared reliable if $\alpha \geq 0.6$ (Sugiyono, 2016). The results of the validity test show there were 22 valid items with a reliability value of 0.895. Nutrition knowledge questions for per- and post-test questionnaire was prepared based on the material presented, i.e. source of nutritious food, food abstinence and taboo, balanced nutrition and diseases that are often experienced by adolescents. Each correct answer will be given score 1 and wrong one will be given score 0.

Data analysis was done using the Wilcoxon signed-rank test by SPSS 16 because the nutritional knowledge data was not normally distributed. This study was approved by the ethical committee for health research at RSUD Dr. Moewardi Surakarta Number 1090 / XII / HREC / 2016.

RESULTS AND DISCUSSIONS

Hasil penelitian menunjukkan pada kelompok video animasi dan kelompok kontrol terdiri dari 50% remaja laki-laki dan 50% remaja perempuan. Usia subjek pada kedua kelompok penelitian sebagian besar 16 tahun yaitu 69% kelompok video animasi dan 54,8% kelompok kontrol. Pendidikan orang tua sebagian besar adalah SMA. Pendidikan SMA pada ayah dan ibu kelompok video animasi masing-masing adalah 50% dan 45,2% sedangkan kelompok kontrol 50% dan 38,1%.

Table 2. General Characteristics of Research Subjects

General Characteristics of Research Subjects	Intervention group		Control group	
	n	%	n	%
Sex				
Boys	21	50.0	21	50.0
Girls	21	50.0	21	50.0
Age				
16 years	29	69.0	23	54.8
17 years	13	31.0	19	45.2
Father's Education				
Elementary	9	21.4	10	23.8
Junior high	6	14.3	4	9.5
Senior high	21	50.0	21	50.0
College	6	14.3	7	16.7
Mother's Education				
Elementary	10	23.8	14	33.3
Junior high	6	14.3	6	14.3
Senior high	19	45.2	16	38.1
College	7	16.7	6	14.3

Table 3. Nutrition Knowledge Score

Nutrition Knowledge	Mean (SD)		*Pvalue**
	Before	After	
Control group	17.36	17.62	0.266
Intervention group	15.79	20.14	0.000

*Wilcoxon signed-rank

The results showed that both intervention and control groups consisted of 50% boys and 50% girls. The age of the subjects in the two study groups was mostly 16 years i.e. 69% in video animation group and 54.8% in control group. Parents' education both in intervention and control group was mostly high school.

Before the intervention given, homogeneity test was done both in intervention and control group which resulted p = 0.110 means there were no different in nutrition knowledge between both group at initial stage.

Based on Table 3, the mean of nutritional knowledge before the intervention in the animated video group was 15.79 and an increased to 20.14 after the intervention. Wilcoxon signed-rank test results in the intervention group showed nutritional education using animated videos significantly improve adolescent nutritional knowledge (p

<0.05). While there was no difference of nutrition knowledge in control group (p>0.05).

Furthermore, a *Mann-Whitney* analysis was done to analyze the difference between intervention and control group. The test resulted p=0.000 which means there was a significant difference in nutritional knowledge between the nutrition education group with the animated video and the control group after the intervention was given

The results of this study are in line with Safrida *et al.* (2017) which explained there were a difference in students' learning outcomes between control and experiment class. Improved learning outcomes were found in the experimental class using animation media and modules compared to the control class using conventional methods or lectures. The use of animation media during the teaching process attracted students' interests so that they could easily understand the mechanism of the circulatory process. Research by Govender *et al.* (2019) point out that education with animated videos is acceptable, interesting, informative and relevant for most cancer patients. Therefore, animated video is not only useful as an educational medium but also has the potential to influence the desire of patients to do preventive interventions.

Video animation is a combination between sound, text and graphics. This is one of the very interesting, effective and efficient media to facilitate the process of understanding the material (Ayuningsih, 2017). Animation media could be an option to support the learning process because abstract subjects can be made real and could increase student's learning concentration (Kor et al., 2014).

Animated video media also very helpful in increasing effectiveness and efficiency during the nutrition education process so it can increase knowledge. The video animation provided relates to nutrition content including source of nutritious food, food taboo and abstinence, balanced nutrition, and diseases experienced by adolescents. Such knowledge is important for every adolescent to have as a basis for forming good nutritional behaviors.

Knowledge is important as the basis for forming good attitudes and behavior. The level of knowledge will affect a person's attitude and

Figure 1. Animation Video Media

behavior in choosing and eating food (Maharani et al., 2017). The level of nutritional knowledge in adolescents is one of the factors that can affect nutrition problems, both malnutrition or over nutrition. Most of nutritional problems can be avoided if adolescents have sufficient nutrition knowledge so that they can manage good eating patterns (Meidiana et al., 2018).

Animated video media is easy to attract attention, fun, accelerate the process of understanding and applying to the material presented. The use of animated video media in the nutrition education can also minimize disruptions in the classroom, as well as sleepy research subjects who are moved to pay attention to the material presented.

CONCLUSION

Study results showed that nutrition education using animation video could improve adolescent nutrition knowledge. Increasing nutritional knowledge can be done through providing education with attractive, effective and efficient media.

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FIBER AND FAT INTAKE, SMOKING HABITS, BODY MASS INDEX AND CENTRAL OBESITY AND ITS ASSOCIATION WITH LIPID PROFILE OF MAN IN GATOT SUBROTO HOSPITAL HEART POLYCLINIC

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ABSTRACT

An increase in blood lipid profile escalates risk of coronary heart disease (CHD). CHD is the leading cause of death in the world. This study was intended to analyze the relationship between fat intake, fiber intake, smoking habits, Body Mass Index (BMI) and central obesity and lipid profile among patients in cardiology clinic. This study used cross sectional design with 60 subjects aged >29 years who were outpatients in the Cardiaology Polyclinic at Gatot Soebroto Hospital. Central obesity was measured using metline by measurung waist circumference; BMI was converted from measurements of body weight and height; characteristics and smoking habits were taken using a questionnaire; and food intake was measured using Semi Quantitative FFQ. Lipid profile data was collected through secondary data. Bivariate data analysis on categorical data used chi-square, Fisher-exact test or spearman ordinal correlation and stratification analysis using ANOVA or kruskall-wallis. There were 78.3% subjects who had abnormal LDL, 76.7% had abnormal HDL, 80% had abnormal triglycerides and 78.3% had abnormal cholesterol. There were signifiant relationship between fat intake, smoking habits, BMI and central obesity to the lipid profile (LDL, HDL, triglycerides and cholesterol) ($p < 0.05$). Fiber intake was not significantly related to lipid profile. However, based on stratification analysis,the more fiber intake the lower levels of LDL profiles, triglycerides and cholesterol, and the higher levels of HDL.

Keywords: fat intake, fiber intake, smoking habits, obesity, lipid profile

BACKGROUND

Coronary Heart Disease (CHD) is a leading cause of death globally. A total of 17.9 million people died due to CHD in 2016 which represented 31% of global deaths (WHO, 2017). Deaths from cardiovascular disease in the Asia Pacific region are mostly due to coronary heart disease and myocardial infarction (AHA, 2012). In Indonesia, coronary heart disease suffered by approximately 2.6 million people or 1.5% of total population. The highest prevalence found in West Java (Ministry of Health of the Republic of Indonesia, 2013). The best indicators of CHD risk include fat profile. The results of the National Health Survey showed high total cholesterol prevalence of 35.9% population had high level of total cholesterol, respectively 76.2% and 22.9% had abnormal LDL and triglycerides, and 22.9% had low level of LDL (Ministry of Health of the Republic of Indonesia, 2013).

Risk factors for the emergence of CHD include low physical activity, obesity, excess food intake, cigarette consumption and alcohol drinking habits (WHO, 2017). Excess food intake, that is, an unspecified and uncontrolled intake based on the amount of intake and frequency of food, can burden the heart's work. A diet high in fat (saturated fat or trans fat) can result in blockage and narrowing of the coronary arteries. Saturated fat (fried fat) from fried foods is harmful to the body because it stimulates the liver to produce cholesterol which will precipitate and inhibits the flow of oxygen in the bloodstream so that it disrupts the metabolism of heart muscle cells and is at risk of CHD events (Hardinsyah and Supariasa, 2017).

Cigarette consumption can inhibit the production High Density Lipoprotein (HDL) so that the blood clots easily, and is at high risk for clogged arteries (Nilawati et al., 2008). Moreover, High LDL levels are found more in

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smokers. With the increase in LDL, the production of HDL also decreases because the acroline in cigarettes damages HDL and inhibits the process of transporting fat to liver tissue (Sanhia, 2015).

Body Mass Index (BMI) can be a marker of fat profile disorder. The results of the study by Ecol (2008) state that both men and women in all age groups who have overweight nutritional status will be at risk of increasing total cholesterol and LDL levels (Ecol, 2008).

Central obesity results from metabolic complications and is closely related to low LDL cholesterol concentrations (Li Xu et al., 2012). The accumulation of visceral fat contributes to the low level of adiponectin. Adiponection acts as anti-diabetic, anti-hypertensive and anti-inflammatory. The lower level of adiponectin increased risk of metabolic and cardiovascular diseases (Matsuzawa, 2010). Thus, the researchers intended to analyze the association of fat and fiber intake factors, smoking habits, Body Mass Index and central obesity on the profile of blood fat in men in the Coronary Heart Disease Polyclinic in RSPAD Jakarta.

METHODOLOGY

This study was a cross sectional design in outpatients at the Gatot Soebroto Central Police Hospital. The samples in this study were selected based on inclusion criteria, consisted of male outpatients, aged >29 years old, diagnosed with CHD, and had lipid profile data. Exclusion criteria are patients who have comorbidities. The sampling technique using purposive sampling method.

Data collection was carried out using a structured questionnaire consisting of respondent identity data, anthropometric data, lipid profile and smoking habits. The smoking questionnaire consisted of open-ended questions drawn from the study of Jain & Ducatman (2018) and then modified after tested on patients in the Gatot Soebroto Army Hospital. Ethical approval was obtained from the University of Indonesia with number KET737 / UN2.F1 / ETIK / PPM.00.02 / 2019.

Meal intake data was measured using a Semi-Quantitative Frequency (SQ-FFQ) questionnaire containing 88 items of food consumed including the frequency of consumption (daily, weekly, monthly) within past month. Food intake data obtained through SQ-FFQ then was converted into fat and fiber intake per day using nutrisurvey software. The result of fat intake compared to the RDA was categorized as good intake (≥80% -110%) or excessive intake (≥110%) (WNPG, 2004). Fiber intake was classified based on mean of the fiber intake (16.7 g).

Measured anthropometric datas included weight and height. Weight was measured using a Camry digital scale with an accuracy of 0.1 kg, whereas height was measured with a microtoise (GEA) with an accuracy of 0.1 cm. Body weight and height were converted to Body Mass Index and categorized as normal (18.5-25 kg/m2) and overweight (>25.1 kg/m2). Samples with Body Mass Index <18.5 was excluded in this study. Central obesity was measured by metline (brand: Butterfly) with the accuracy of 0.1 cm, then categorized as normal (<90 cm), and central obesity (≥ 90 cm) (WHO, 2008).

Lipid profile was taken from secondary data in RSPAD Cardiac Polyclinic in the last 3 days. Fat profile datas were categorized as abnormal with LDL cut-off (> 100 mg/dL); triglycerides (>150 mg/dL)); total cholesterol (> 200 mg/dL), except for HDL which defined as abnormal if <40 mg/dL) (Mahan and Escott Stump, 2013)

For the data analysis, we employed univariate analysis (distribution and frequency) for age, education, occupation, family history and medication variables. Furthermore, bivariate analysis was carried out to analyze the relationship of independent variables with categorical dependent using chi-square test (α <0.05), or if expected count <5, using the Fischer exact test or Spearman ordinal correlation if the categorical independent variable is more than 3. The startification analysis was done using ANOVA if the data were normally distributed or Kruskall-Wallis if the data were not normally distributed.

RESULT AND DISCUSSION

Respondents in this study were mostly 50-64 years old (70.0%), the rest were 30-49 years old (26.7%) and 65-80 years old (3.3%). The educational status is dominated by the level of

Table 1. Sociodemography Characteristic

Variable	n	%
Age (y.o)		
30-49	16	26.7
50-64	42	70.0
65-80	2	3.3
Education[1]		
Low	28	46.7
High	32	53.3
Employment status		
Employed	60	100
Unemployed	0	0
Family History		
Exist	32	53.3
Do not exist	28	46.7
Consumed drugs		
Amlodipin	14	23.3
Valsartam	7	11.7
Novorapid	9	15.0
Lovastatin	16	26.7
Atorvastatin	14	23.3
Smoking status		
Active smoker	42	70.0
Former smoker	13	21.7
Non-smoker	5	8.3

Notes : 1) high education defined as >9 years of formal education;

Table 2. The Distribution of Anthropometry, Nutrient Intake, and Lipid Profile

Variable	n	%
BMI		
Normal (>18,5-25)	26	43.3
Overweight (>25,1 kg/m^2)	34	56.7
Central Obesity		
No (<90cm)	17	28.3
Yes (≥90cm)	43	71.7
Fat Intake		
Good (80-109%)	41	68.3
Excessive (≥110%)	19	31.7
Fiber intake		
Less (<mean)	30	50.0
Good (≥mean)	30	50.0
LDL		
Normal	13	21.7
Abnormal	47	78.3
HDL		
Normal	14	23.3
Abnormal	46	76.7
Trigliserida		
Normal	12	20.0
Abnormal	48	80.0
Kolesterol Total		
Normal	13	21.7
Abnormal	47	78.3

higher education as many as 32 people (53.3%) who overall work (100.0%).

Respondents who have a family history of high blood lipid profiles were 32 people (53.3%). Most common drug consumed by the subjects were lovostatin (26.7%). Majority of subjects were active smokers (70.0%).

Over and normal nutritional status had similar proportion (56.7% vs 43.3%), but there is a tendency of respondents in the study to have fat in the abdomen with a greater proportion of central obesity (71.7 %). Consumption of excess fat was found in 41 people (68.3%), while good fiber intake only applied for 30 people (50.0%). Abnormal lipid profile were found ini most of the subjects. In accordance, 76.7%, 78.3%, 80.0%, and 78.% had abdormal LDL, HDL, triglycerides, and total cholesterol (Table 2).

The results of bivariate analysis between food intake, smoking habits, BMI, and central obesity with lipid prifil can be seen in Table 3. Fat intake, smoking habits, BMI and central obesity were significantly related to LDL ($p < 0.05$).

The percentage of excessive fat intake in the abnormal LDL group was greater. Whereas, a higher proportion of active smokers was commonly found in abnormal LDL group. Overweight/obesity as well as central obesity were also frequent in abnormal LDL group.

Other fat profiles such as HDL, triglycerides and total cholesterol were influenced by fat intake, smoking habits, BMI and central obesity. However, fiber intake was not significantly related to blood lipid profile.

Overall fat intake has a significant contribution of increasing blood lipid profile (LDL, HDL, triglycerides and total cholesterol). According to Rahma (2017) and Putri (2016), excess fat intake increased the risk of developing CHD. A study by Rahma (2017) showed subjects with excessive fat intake had 13.5 times greater odds of experiencing CHD ($p<0.05$).

Excessive fat intake can increase blood lipid so that it brings adverse effects on health (Fathila et al., 2015). Fat accumulation can easily trigger plaque formation around the heart's blood vessels, making it easier to block and inhibit oxygen carried to the heart.

Analysis of the relationship between BMI and lipid profiles showed that respondents with more BMI (obesity) tended to have abnormal

Table 3. Relationship between Food Intake, Smoking Habit, BMI, and Central Obesity with LDL, HDL, Triglycerides and Total Cholesterol

Variable	LDL		*p* value	HDL		*p* value	Trigliserida		*p* value	Cholesterol Total		*p* value
	Normal n (%)	Abnormal n (%)		Normal n (%)	Abnormal n (%)		Normal n (%)	Abnormal n (%)		Normal n (%)	Abnormal n (%)	
Fat intake												
Good	12 (63.2)	7 (36.8)	0.000[b*]	12 (63.2)	7 (36.8)	0.000[a*]	11 (57.9)	8 (42.1)	0.000[b*]	11 (57.9)	8 (42.1)	0.000[a*]
Excessive	1 (2.4)	40 (97.6)		2 (4.9)	39 (95.1)		1 (2.4)	40 (97.6)		2 (4.9)	39 (95.1)	
Fiber intake												
Less	8 (22.2)	28 (77.8)	0.898[a]	9 (25.0)	27 (75.0)	0.709[a]	8 (22.2)	28 (77.8)	0.598[a]	9 (25.0)	27 (75.0)	0.443[a]
Good	5 (20.8)	19 (79.2)		5 (20.8)	19 (79.2)		4 (16.7)	20 (83.3)		4 (16.7)	20 (83.3)	
Smoking status												
Active smoker	1 (2.4)	41 (97.6)		3 (7.1)	39 (92.9)		1 (2.4)	41 (97.6)		2 (4.8)	40 (95.2)	
Former smoker	8 (61.5)	5 (38.5)	0.000[c*]	8 (61.5)	5 (38.5)	0.000[c*]	7 (53.8)	6 (46.2)	0.000[c*]	7 (53.8)	6 (46.2)	0.000[c*]
Non-smoker	4 (80.0)	1 (20.0)		3 (60.0)	2 (40.0)		4 (80.0)	1 (20.0)		4 (80.0)	1 (20.0)	
BMI												
Normal (>18,5-25)	12 (46.2)	14 (53.8)	0.000[b*]	11 (42.3)	15 (57.7)	0.002[a*]	11 (42.3)	15 (57.7)	0.000[b*]	11 (42.3)	15 (57.7)	0.001[a*]
Overweight (>25,1 kg/m^2)	1 (2.9)	33 (97.1)		3 (8.8)	31 (91.2)		1 (2.9)	33 (97.1)		2 (5.9)	32 (94.1)	
Central Obesity												
No (<90cm)	12 (70.6)	5 (29.4)	0.000[b*]	10 (58.8)	7 (41.2)	0.000[a*]	12 (70.6)	5 (29.4)	0.000[b*]	12 (70.6)	5 (29.4)	0.000[b*]
Yes (≥90cm)	1 (2.3)	42 (97.7)		4 (9.3)	39 (90.7)		0 (0.0)	43(100)		1 (2.3)	42 (97.7)	

Keterangan: *p<0.05(signifikan); [a]Pearson chi-square; [b]Fischer Exact test; [c]Spearman Ordinal Correlation

or risky lipid profiles. Waist circumference was associated with BMI (R=0.78; p<0.01), and there is an increase in the volume of visceral tissue in the abdomen (Gierach, et al., 2014). Indicators of BMI and waist circumference (central obesity) have a strong correlation with non-communicable diseases such as hypertension and diabetes mellitus (Susilawati et al., 2015; Deng et al., 2013). In the study of Hotama (2014). It was mentioned that higher BMI generally has a high body fat composition so that it is closely related to an increase in blood lipid levels

The results of data collection were summarized that respondents who have central obesity as a whole have an abnormal blood lipid profile. This causes an increase in total fat in the body that can occur in visceral fat. Visceral fat is found in the abdominal cavity which can be known from the indicators of central obesity. The increase in the size of central obesity is in line with the increase in abnormal lipid profile levels (triglycerides and LDL) (Umegaki et al., 2008; Kamso, 2007). This result was in line with Sumarni (2016) which showed significant positive correlation between total cholesterol and central obesity with weak correlation strength (p = 0.005; r = 0.342) and a significant positive correlation between central obesity and triglycerides (p = 0.002; r = 0.377).

Fiber is a form of carbohydrate that cannot be digested because there is no fiber digestive enzyme in humans. Fiber consists of water-soluble and water-soluble fibers. Water-soluble fiber is

Table 4. Difference of LDL, HDL, Triglycerides and Total Cholesterol Level Based on Fiber Intake Quintil and Smoking Habit Stratification.

	Total	Active Smoker	Former Smoker	Non-Smoker	p-value
LDL					
Fiber Intake					
Q1 (< 15.8)	129.8 ± 47.5	153.9 ± 44.9	89.0 ± 26.7	94.3 ± 10.6	<0.05[a]
Q2 (15.8-16.7)	134.3 ± 37.6	138.0 ± 36.3	94.0 ± 0.0	-	<0.05 [a]
Q3 (16.8-17.7)	116.0 ± 33.9	129.3 ± 26.0	94.5 ± 31.8	69.0 ± 0.0	<0.001 [a]
Q4 (>17.7)	138.3 ± 43.5	152.2 ± 40.3	110.4 ± 32.0	-	<0.05 [a]
p value	<0.05 [a]				
HDL					
Fiber Intake					
Q1 (< 15.8)	40.7 ± 7.5	37.2 ± 6.4	45.3 ± 5.0	47.0 ± 6.7	<0.05 [a]
Q2 (15.8-16.7)	38.3 ± 3.5	37.4 ± 1.6	48.0 ± 0.0	-	<0.05 [a]
Q3 (16.8-17.7)	40.4 ± 6.9	37.0 ± 1.9	47.5 ± 8.7	46.0 ± 0.0	<0.001 [a]
Q4 (>17.7)	37.6 ± 4.5	35.8 ± 3.0	41.2 ± 4.6	-	<0.001 [a]
p value	0.125 [a]				
Triglycerides					
Fiber intake					
Q1 (< 15.8)	170.9 ± 50.9	192.5 ± 52.3	147.3 ± 19.9	129.5 ± 27.7	<0.05 [a]
Q2 (15.8-16.7)	184/0 ± 33.8	188.2 ± 31.3	138.0 ± 0.0	-	<0.05 [a]
Q3 (16.8-17.7)	174.1 ± 30.8	182.6 ± 25.2	163.3 ± 34.1	133.0 ± 0.0	<0.05 [a]
Q4 (>17.7)	192.8 ± 42.1	209.1± 39.1	160.2 ± 20.1	-	<0.001 [a]
p value	0.089 [a]				
Total Cholesterol					
Fiber intake					
Q1 (< 15.8)	223.3 ± 42.2	242.6 ± 42.8	190.7 ± 15.9	194.5 ± 16.9	<0.05 [a]
Q2 (15.8-16.7)	236.8 ± 28.0	240.3 ± 25.8	198.0 ± 0.0	-	<0.05 [a]
Q3 (16.8-17.7)	229.5 ± 30.1	241.5 ± 20.6	207.3 ± 33.8	198.0 ± 0.0	<0.05 [a]
Q4 (>17.7)	241.2 ± 38.0	258.2 ± 31.1	209.4 ± 24.2	-	<0.001 [a]
p value	0.158 [a]				

Notes: [a]Kruskall wallis

contained in fruits, vegetables, oats and barley which functions to reduce cholesterol through several mechanisms, while water-soluble fiber is contained in lignin, cellulose and hemicellulose found in gamdum, nuts, and seeds which functions to increase emptying the stomach and improve the digestive system (Soliman, 2019)

Analysis with chi-square test showed that there was no significant relationship between fiber intake and fat profile (LDL, HDL, triglycerides, and total cholesterol) ($p > 0.05$). This was presumably because the subject's fiber intake was still relatively low. The average fiber intake of 16.7 g, was still lower than the Indonesian Recommended Nutrient Intake which suggested a minimum fiber intake of 25-30 g/day or 38 g/day for men and 25 g/day for women. The low fiber intake cannot distinguish between proportions of subjects who had over and normal lipid profiles (Soliman, 2019).

The finding of this study was in line with the study by Kustiyah et al (2013), where also found no significant difference in fiber intake between subjects with normal and abnormal blood lipid profiles. This could be happened because fiber intake had indirect effect on blood lipid metabolism through bile acid metabolism, and estradiol pathway (Jenkis et al, 2000; Kay et al, 1980). These result was also consistent with a meta-analysis by Brown et al. (1999) which stated that the provision of fiber, especially water-soluble fibers only gives a small effect on reducing cholesterol.

There was a significant difference in LDL profiles based on fiber intake quintiles ($p < 0.05$). The higher LDL level were found in higher quintiles of fiber intake. However, the lowest LDL level were found in subjects with fiber intake in quintiles 3 (16.8-17.7). Moreover, Stratification analysis based on smoking habit indicated that there was significant differences in lipid profile among subjects with various quintiles of fiber intake. LDL level of active smokers were greater compared to former and non-smokers. Among active smokers group, the higher fiber intake would followed by the decline of LDL, except for subjects with quintile 4 fiber intake. However, there were no significant differences in HDL, triglycerides and total cholesterol between various fiber intake quintiles.

The result of this study was dissimilar with study by Zhou et al (2015) which found that adjustment of several confounding factors including BMI, waist circumference, energy intake, and smoking habits affected the trend of relationship between HDL and fiber intake. The increase doses of fiber intake would enhance lipid level in men. When fiber intake was increased up to more than 30 g/day, a significant improvement on HDL and triglyceride/HDL ratio were found in male subjects (Zhou et al., 2015). In this study, the insignificant correlation between fiber intake and lipid profile could arise due to researchers did not adjust possible confounding variables such as energy intake and other habitual factors such as coffee consumption and physical activity.

This study confirmed that active smokers have abnormally higher lipid profile levels than smokers and non-smokers. Nicotine contained in cigarette can increase the production of adrenaline which results in decreased levels of HDL (High Density Lipoprotein) (Anies, 2006). Other possible mechanism on how smoking can change serum fat levels is that the absorption of nicotine causes secretion of catecholamines, cortisol, and growth hormones, which activating adenyl cyclase in adipose tissue. The process produces triglyceride lipolysis and releases free fatty acids, resulting in an increase in TG and VLDL liver synthesis (Jain and Ducatman, 2018). The decrease in HDL is also caused by an increase in free fatty acids and increased LDL production due to nicotine (Sanhia, 2015).

Researches by Trivedi et al. (2013) and Carlappa et al (2014) in 50 smokers and 50 nonsmokers showed a significant increase in total cholesterol, triglyceride, LDL and a significant decrease in HDL levels in smokers compared to nonsmokers. The long period of smoking and the number of cigarettes significantly influence the high risk of hypercholesterolemia.

There was a significant relationship between smoking and total cholesterol ($p = 0{,}000$) found in this study. Active smokers tended to have higher total cholesterol level compared to former and non-smokers. Furthermore, there was also meaningful relationship between BMI, central obesity and total cholesterol ($p = 0.001$). Subjects with higher BMI

and central obesity were more suspectible to have abnormal total cholesterol.

Table 5 shows that there were differences in LDL, HDL, triglyceride and cholesterol profiles between quintile fat intake ($p < 0.05$). Further stratification analysis represented that only subjects with quintiles 1 fat intake (<63.9 g) had different level of all lipid biomarker based on smoking status. In addition, subjects with quintiles 4 fat intake also showed divergent level of HDL, triglycerides, and total cholesterol based on smoking status (>87.4 g).

Active smokers defined as respondents who were still smoking, while former smokers were respondents who have smoked but have been stopped. Blood lipid levels are higher in active smokers, then followed by former smokers and non-smokers. This was consistent with the results of a study in China that showed active smokers tended to have low triglyceride levels (Yan-Ling, 2012).

LDL and total cholesterol level of non smoker subjects with quintile 1 fat intake 1 was higher compared to former smokers. Unjustified dose of smoking in the study could posibbly affected this results. Meanwhile, non-smokers could be exposured to cigarette smoke from other people, which also did not assessed in this study. Some studies showed passive smokers had a tendency to experience elevated serum LDL levels, as do active smokers. Nicotine levels in cigarette sidestream can reach 4-6 times more than nicotine levels in mainstream cigarettes (U.S. Department of Health and Human Services, 2009; Andrews & Tingen, 2006; Susanna et al, 2003)

CONCLUSION

There was a relationship between fat intake, smoking habits, BMI and central obesity with the lipid profile (LDL, HDL, triglycerides and total cholesterol). Fiber intake was not significantly related to lipid profile. Based on stratification analysis, as fiber intake increase, the lower the LDL, triglyceride and cholesterol profiles, and the higher the HDL levels.

The limitation of this study limitations the use of secondary data on blood lipid profiles, so there is a possibility of bias from the obtained values even though this study has been limited to using data in the last 3 days. Further research should address drug consumption compliance, fiber types, saturated and unsaturated fat intake and nicotine content in cigarettes.

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EFFECT OF FISH-OIL-ENRICHED INTRAVENOUS LIPID EMULSION ON SYSTEMIC INFLAMMATORY RESPONSE SYNDROME IN POST INTESTINAL SURGERY CHILDREN

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ABSTRACT

Intravenous lipid emulsions (IVLE) is one of the compositions of the parenteral nutrition (PN) that recommended in children who cannot meet their caloric requirements especially after small intestinal surgery and differentiated by their inflammatory effects. The first generation IVLE is proinflammatory, the second and the third are inflammatory neutral, while the fourth (fish-oil-enriched) is anti-inflammatory. The objective of this study is to investigate the effect of fish-oil enriched IVLE on systemic inflammatory response syndrome (SIRS) in children after small intestinal surgery. A retrospective study using medical record was undertaken in children after small intestinal surgery admitted Dr. Soetomo Hospital, Surabaya in 2016-2017. Children with duodenal and jejunoileal atresia who had PN for at least three days were included. The types of IVLE used are FOLE and non-FOLE. Definition of SIRS was based on International Pediatric Sepsis Consensus Conference in 2005. A total of 25 children were included in this study. There were 44% children received FOLE and 48% received non-FOLE while 8% children received no IVLE. Median duration and dose of IVLE was 8 (5-15,5) days and 1,8 (1,25-2) g/kg/day. SIRS was significantly more common in girls (OR 9 95%CI 1,3-63,0; p=0,036) and in the non-FOLE children (OR 8,0 95% CI 1,24 – 51,50; p=0,022).

Keywords: children, intravenous lipid emulsion, fish oil, SIRS, small intestinal surgery

INTRODUCTION

Parenteral Nutrition (PN) is indicated for infants and children who cannot meet nutrient need through oral and enteral in (American Society for Parenteral and Enteral Nutrition (ASPEN), 2002). The European Society for Clinical Nutrition and Metabolism (ESPEN) and The Canadian Society of Clinical Neurophysiologist (CSCN) clinical guidelines that recommend enteral nutrition that can be given within 24-48 hours after the patient gets treatment, specifically in patients who treated in the ICU/PICU (Singer *et al.*, 2009). This is similar to the recommendation of the European Community to Pediatric Gastroenterology of Hepatology and Nutrition (ESPGHAN), ie parenteral nutrition must be given immediately if nutritional intake cannot be fulfilled orally or enterally (Koletzko *et al.,* 2008; Koletzko *et al.,* 2005). Parenteral nutrition (PN) is one of the post-operative management therapies that must be given within 24 to 48 hours after surgery (Wesson, 2018).

Intravenous fat emulsion (IVLE) is one component in parenteral nutrition that plays an important role as an energy source and source of essential fatty acids in preventing essential fatty acid deficiency (Biesboer and Stoehr, 2016; Herman *et al.,* 2011; Wu *et al.,* 2014). ESPGHAN and ESPEN believe that essential fatty acids should be given to patients who receive parenteral nutrition (Van Goudoever and Vlaardingerbroek, 2013).

The American Society for Parenteral and Enteral Nutrition / ASPEN (2012) classifies the generation of intravenous fat emulsions into 4 categories based on fatty acid derivatives and the inflammatory response generated by the intravenous fat formula itself (Vanekel *et al.,* 2012). The first generation containing 100% soybean oil (SO) is a pro-inflammatory, the second generation (50:50 mixture of SO and medium-chain triglycerides / MCT) and third one (80:20 olive oil / OO and SO) is neutral inflammation while the fourth generation accompanied by fish

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oil (FO) is anti-inflammatory (Biesboer and Stoehr, 2016).

Conventional or previously used intravenous fat emulsions are IVLE that is not enriched with fish oil (non-FOLE). Increased markers of inflammation and the incidence of infection as well as a longer hospital stay were reported to be higher in patients who received non-FOLE during hospitalization. This type of fat emulsion also has limitations to be use in children with a history of previous soy allergies (Biesboer and Stoehr, 2016; Calder *et al.,* 2010). Previous studies also reported that soybean oil can disrupt the flow of bile so that it can cause deposits to the gallstones (Biesboer and Stoehr, 2016).

Various studies conducted in adult patients show a lower incidence of infection in patients who get IVLE fortified fish fat (FOLE) (Klek, 2016). Until now, information about the effects of fish oil-enriched IVLE on the inflammatory response, especially in children after gastrointestinal surgery is very limited and no studies have been done at Dr. Soetomo, General Hospital Surabaya before.

This study aims to determine the differences in systemic inflammatory response (Systemic Inflammatory Response Syndrome / SIRS) in post-gastrointestinal surgery pediatric patients who get IVLE enriched fish oil (FOLE) and not-enriched fish oil (non-FOLE).

METHODS

This study has obtained ethical clearance from the Health Research Ethics Committee Dr. Soetomo Hospital Surabaya with number 0170 / KEPK / IV / 2018 and is a retrospective study using medical records conducted in children after gastrointestinal surgery in Dr. Soetomo Hospital from January 1, 2016 to December 31, 2017 with total sample of 38 children. The sample selection used was purposive sampling. Children with duodenal and jejunoileal atresia who have had gastrointestinal surgery and received parenteral nutrition therapy for at least 3 days were inclusion criteria. The exclusion criteria were including uncomplete medical record data that will not support the research. From a total of 38 children with duodenal and jejunoileal atresia who underwent gastrointestinal surgery, 25 children met the inclusion and exclusion criteria.

The definition of Systemic Inflammatory Response Syndrome (SIRS) was based on the 2005 International Pediatric Sepsis Consensus Conference. SIRS was diagnosed if there was ≥2 out of 4 of the following criteria are found: temperature abnormalities (> 38.5ºC or <36ºC), tachycardia (heart rate >180 beats/minute) or bradycardia (heart rate <100 beats/minute, especially for ages <1 year), tachypnea (respiratory rate >50 beats/minute for ages 0-7 days and >40 times/minute for ages 7 – 28 days), leukocytosis (leukocyte count >34x10^3/mm^3 for ages 0-7 days and >19.5x10^3/mm^3 for ages 7-28 days) or leukopenia (leukocyte count <5x10^3/mm^3). Temperature and leukocyte abnormalities must be fulfilled by one of the criteria (Goldstein *et al.,* 2005). The type of IVLE data used was obtained from medical records.

The main variables in this study were SIRS and IVLE type classified into a categorical scale so as to assess the outcome differences of children who get FOLE and non-FOLE were analyzed using the *Chi Square* test with a $\alpha < 0.05$ as significant value. Data was displayed in the median (interquartile range) because it is not normally distributed.

RESULTS AND DISCUSSIONS

Thirteen children (52%) had jejunoileal obstructions. Fourteen children (56%) were male children. The median duration of parenteral nutrition use is 13 (9.5-20.5) days with the median length of use and intravenous fat emulsion dose for 8 (5-15.5) days and 1.8 (1.25-2) grams/kg/day. The basic characteristics of the research subjects are shown in table 1.

Based on the results of this study, 12 out of 23 children were met SIRS criteria and SIRS was more common in children who received intravenous fat emulsions that were not enriched with fish oil (non-FOLE) compared to children who received intravenous fat emulsions enriched with fish oil (FOLE) (OR = 8.0; 95% CI 1.24 - 51.5; p = 0.022) (Table 2). This systemic inflammatory response syndrome was also found in two children who did not get IVLE during treatment. The risk of SIRS increased 9-fold in girls compared to boys (OR 9 95% CI 1.3-63.0; p = 0.036).

Table 1. Basic Characteristics of Subjects

Characteristic	Total n (%)	Min	Max
Sex			
• Boys	14 (56.0)		
• Girls	11 (44.0)		
Age while hospitalized (day)*	9 (8.0)	0	18
Length of hospitalization (day)*	19 (24.0)	3	42
Length of TPN (day)*	14 (11.0)	3	41
Length of IVLE (day)*	8 (10.5)	0	39
Type of IVLE			
• Non-FOLE	12 (48.0)		
• FOLE	11 (44.0)		
• Without IVLE	2 (8.0)		
IVLE dosage (gram/kg/day)*	1,8 (0.75)	0	2,7
SIRS	14 (56.0)		

*median (IQR)

Research on the effects of IVLE in children after gastrointestinal surgery is very limited. A similar study conducted by Almossawi *et al* retrospectively on 50 critically ill and post-operative children showed different results from this study. The group of children who got first, second and fourth generation IVLE did not have a difference in the number of sepsis (5/8 vs 11/12 vs 15/27; p = 0.08) (Almossawi *et al.,* 2013).

Research on the effects of IVLE is more common in adult patients. Meta-analysis conducted by Chen *et al.* in 892 adult patients after major gastrointestinal surgery found that the group with IVLE enriched with fish oil had a significantly lower incidence of post-operative infections (OR: 0.56; 95% CI 0.32 - 0.98; p = 0, 04; I^2 = 0%) (Chen *et al.,* 2010). Li *et al.* also conduct a meta-analysis of 1487 adult patients after major gastrointestinal surgery and found that IVLE enriched fish oil significantly reduced infection rates (OR: 0.53; 95% CI 0.35 - 0.81; p = 0.003; I^2 = 0%) (Li et al., 2013). The results of a recent meta-analysis conducted by Manzanares *et al.* in 733 critically ill adult patients found that patients with IVLE enriched with fish oil significantly reduced the risk of infection (RR = 0.65; 95% CI 0.44 - 0.94; p = 0.02; I^2 = 0%) (Manzanares, 2015).

Inflammation is the body's normal defense response to infections or other stimuli such as trauma, surgery and others characterized by redness, swelling, heat, pain and impaired function (Calder, 2012). The inflammatory mechanism caused by the first generation IVLE is caused by the fatty acid derivatives contained therein, namely long chain triglycerides (LCT) and ω-6 essential fatty acids (EFA). LCT interferes the role of phagocytosis and chemotaxis in the immune system which can increase the risk of infection (Vanek *et al.,* 2012). Essential fatty acids ω-6 which are precursors for the formation of prostaglandin E_2 (PGE_2), prostaglandin I_2 (PGI_2) and thromboxane A_2 (TXA2) through the cyclooxygenase (COX) pathway and the formation of leukotriene B_4 (LTB_4), leukotriene C_4 (LBC_4) and thromboxane A2 (TXA2) through the cyclooxygenase (COX) pathway and the formation of leukotriene B4 (LTB4), leukotriene C4 (LBC4) and thromboxane A2 (TXA2) LTE4) through the lipoxygenase (LOX) pathway from arachidonic acid (AA) acts as a pro-inflammatory through interleukin-6 (IL-6) (Figure 1).

Fish oil (FO) contained in fourth generation IVLE contains omega-3 essential fatty acids which are precursors for the formation of prostaglandin E_3 (PGE_3), prostaglandin I_3 (PGI_3) and thromboxane A_3 (TXA_3) through the cyclooxygenase (COX) pathway and the formation of leukotriene B_5 (LTB_5), leukotriene C_5 (LBC_5) and leukotriene E_5 (LTE_5) through the lipoxygenase (LOX) pathway from eikosapentanoid acid (EPA) (Figure 1) (Chang *et al.,* 2012; Herman *et al.,* 2011; Vanek *et al*., 2012). Omega-3 directly inhibits the activity of omega-6 essential fatty acids (EFA) by substituting AA into EPA and inhibits AA production

Table 2. Relationship between Intravenous Fat Emulsion Type and Systemic Inflammatory Response Syndrome

		Type of Intravenous Fat Emulsion		Total	*p*	*OR*	*95%CI*
		non-FOLE n (%)	FOLE n (%)				
SIRS	Yes	9 (75.0)	3 (27.3)	12			
	No	3 (25.0)	8 (72.7)	11	0.022	8.0	1.24 – 51.50
Total		12	11	23			

and indirectly by changing the expression of inflammatory genes at the level of transcription factors and decreasing proinflammatory cytokines. The inhibited AA production causes an increase in EPA production so that the mediator shifts towards anti-inflammatory conditions (Calder, 2004; Chang *et al.,* 2012).

This was the first retrospective study to assess systemic inflammatory response syndrome (SIRS) in children after gastrointestinal surgery who get IVLE enriched fish oil in Surabaya. One limitation of this study is that this study was collected in only one research center with a very limited number of samples in the pediatric population with gastrointestinal surgery so that the results of this study cannot be generalized to pediatric patients with other surgeries other than gastrointestinal surgery or in children without surgery.

CONCLUSION

Boys and children who get intravenous fat emulsions (IVLE) enriched with fish oil (FOLE) as a component of parenteral nutrition after gastrointestinal surgery have a lower incidence of systemic inflammatory response syndrome (SIRS). Further research is expected to be carried out with a larger number of samples at several study centers prospectively by assessing the inflammatory response of various inflammatory markers that are not only based on clinical.

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HYPERTENSION AND RELATED FACTORS AMONG FEMALE STUDENTS AT VOCATIONAL HIGH SCHOOL BEKASI, INDONESIA

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ABSTRACT

Hypertension is one of non-communicable diseases which prevalence is high in Indonesia, not only among adult and elderly but also among adolescent. Hypertension can be caused by various factors including fat intake, fiber intake and nutritional status. The purpose of this study was analyze the correlation of fat intake, fiber intake, and obesity with hypertension among female students at Vocational high school, Bekasi, Indonesia. This was a cross sectional study among 255 female students who were selected by purposive sampling technique. Hypertension was measured using sphygmomanometer with 95 percentile cut-off based on sex, age, and body height (cut-off hypertension was > 104-115 mmHg systolic and > 62-68 mmHg diastolic blood pressure). Fat and fiber intake were assessed using Semi Quantitative Food Frequency Questionnaire (SQ-FFQ), and obesity was measured using digital weighing scales and microtoise. Data were analyzed by chi square test. The results showed that prevalence of female students with low f fat intake was 58,8%; low fiber intake was 82,0%; obesity was 25,1%; and hypertension was 16,5%. There was a positive correlation between fat intake (p=0,011) and obesity (p<0,01) with hypertension but no correlation was found between fiber intake (p=0,916) and hypertension. Fat intake and obesity were related to the hypertension in adolescents. Routine blood pressure checks and restrictions on fat intake are needed to reduce the risk of hypertension in adolescents.

Keywords: adolescents, fat intake, fiber intake, hypertension, obesity

INTRODUCTION

In recent decades, Non-Communicable Diseases (NCD) is the global health problem caused global fatalities at 68%. If it is not properly handled, the estimated mortality rate due to NCD will increase to 52 million by 2030 (Nugent et al., 2018). Hypertension, as known as high blood pressure, with systolic and diastolic pressure above the normal rate (Kumar et al., 2011), is the one of NCDs which has high prevalence in both developed and developing countries. It is prevalent not only among elderly but also among adolescent age which is in line with the trend of other NCDs, overweight and obesity, and inadequate nutrient intake in the age group. Adolescence is the right time to instill healthy eating habits and will have an impact on health in adulthood including prevent non-communicable diseases caused by unhealthy dietary pattern (Wulansari, 2009).

In Indonesia, the results of the Basic Health Research in 2013 showed that the number of people with hypertension were 25.8% or 65,048,110 people and increased to 34.1% in 2018. According to data from the West Java Provincial Health Office, there were 790,382 people (2.46% of the population ≥18 years) with hypertension in 2016. In addition, the prevalence based on Joint National Committee (JNC) VIII, 2013 Indonesian health survey counted hypertension among aged 15-17 years old was 5.3%. The prevalence of hypertension in adolescent female needs to be given more attention because, the prevalence in female tends to be higher (28.8%) than male (22.8%) (Riskesdas, 2013). Therefore, the previous study showed that 11.92% of the population suffering from hypertension which also showed a greater percentage among women (11.95%) compared to men (11.88%) (West Java Health District Officer, 2018).

Regarding risk factors, excessive fat intake, lack of fiber intake, and obesity had been known as the risk factors of hypertension. Kurnianingtyas

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et al. (2017) found that 52% of adolescents with excess fat intake had hypertension. Furthermore, Amilia et al. (2014) showed that a relationship between the habit of consuming high fat foods with the prevalence of hypertension. Adolescents who tend to consume high-fat food and reduce consumption of fiber including vegetables and fruits have higher risk of hypertension compared to adolescent with a healthy diet. A study using population data from Central Java province showed that rarely consumed fiber causes higher hypertension prevalence (27.2%) among adult groups compared to groups who often consumed fiber foods (23.8%) (Sadiyah, 2016). The problem of dietary intake imbalance can lead to risk of obesity. On another hand, the previous study in Pekanbaru city showed that adult people with obesity increases the risk of hypertension by 6.47 times (Sapitri et al., 2016). Therefore, the aims of the present study were to investigate the relationship of fat intake, fiber intake, and obesity with the prevalence of hypertension of adolescent female in Bekasi City Vocational High School".

METHODS

This was an observational analytic research with cross sectional design. The population in this study were female students in Bekasi City Vocational High School (N=3808). A total of 255 students were recruited as the sample of this study with two side calculation method. Sample was purposively selected using inclusion criteria (female students with 14 – 18 years old, BMI >-2 SD, having no significant medical condition, no previous diet program and not consumed drugs) and exclusion criteria (female students with previous hypertension, and not willing to participate). Individuual characteristic data (age, parent's education and occupation). Indivual characteristic data (age, parent's education and occupation) were collected using questionnaire.

The independent variables are fat intake, fiber intake and obesity. The weight of the subjects was measured with digital floor scale, with a precision of up to 100 g and the height was measured with microtoise with 0.1 cm precision. BMI was calculated as weight in kg divided by height in meter squared then classified based ob BMI/age as normal (> -2 SD) and obese (>+1 SD) (WHO, 2007).

The fat intake were estimated using Semi Quantitative Food Frequency Questionnaire (SQ-FFQ) included 21 food items for the last 1 month. The result was converted to gram per day intake then classified as less intake (<80% RDA), sufficient intake (80 - 110% RDA), and excess intake (>110% RDA) (Hardinsyah and Tambunan, 2004).

The fiber intake were estimated also using SQ-FFQ included 18 food items for the last 1 month. The result was converted to gram per day intake then classified as less intake (< 20 gram per day), sufficient (20 – 30 gram per day), and excess (>30 gram per day) (Muchtadi, 2009).

Furthermore, the dependent variable is hypertension. Hypertension was measured using digital sphygmomanometer with 95 percentile cut-off based on sex, age, and body height (cut-off hypertension was >104-115 mmHg systolic and >62-68 mmHg diastolic blood pressure)

Descriptive statistics were used to describe the variables. Chi-square test were used to analysis the relationship between variables with p-values <0,05 were considered to be statistically significant.

RESULTS AND DISCUSSIONS

Subject Characteristic

The subject characteristics observed were age, father and mother education level, and occupation. The mean age of the respondents was 16 years (SD ± 1.04), the youngest was 14 years and the oldest was 18 years. Regarding to education level, mostly father (56.1%) has graduated Senior High School as well as mother (49.8%). Father's occupation were mostly (67.1%) an employee. The main finding of this study was the correlation between hypertension and fat intake, fiber intake and nutritional status (overweight) among female students.

Fat Intake

Based on the table 1, it can be seen that most of the subject (58.8%) werw having less fat intake (<80% of the RDA) . Mean fat intake was 59.97 gr/day with the lowest intake was 12 gr/day and the

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Table 1. Distribution of Subject According to Fat Adequacy

Fat Intake	n	(%)
Less (<80% RDA)	150	58.8
Sufficient (80-110% RDA)	45	17.7
Excess (>110% RDA)	60	23.5
Total	255	100.0

highest was 216 gr/day. Subjects mostly consumed fat source foods including snacks one time in a day with a percentage of 44.7%. Based on the results of the study it can be seen from the 255 subjects studied, 23.5% of subjects consumed excess fat. This percentage is less than the research conducted by Wulandari (2017) in one of the high school in Sukoharjo Regency, his research obtained 30% of adolescents who consume excess fat. Meanwhile, another study in Semarang found 17.5% of adolescents who consumed excess fat, which was less than the results of the study (Putri, 2016). The high fat intake in adolescents is closely related to the socioeconomic factors of the subject as well as unhealthy lifestyles, especially the eating habits of adolescents who often consume high-calorie beverage foods.

Fiber Intake

Table 2 showed that most of the subjects (82.0%) having low fiber intake (<20 g/day). The average fiber intake was 13.6 gr/day, with the lowest was 1 gr/day and the highest intake was 59 gr/day. Most of the subjects consume sources of fiber from vegetables and fruit only once a day by 35.7%. Fiber intake found in our study was greater than previous studies in Semarang which found as many as 67.1% of adolescents consume less fiber (Claudina et al., 2018). Many factors affect the low fiber intake in adolescents such as the selection of foods that tend to be high in energy and fat, less fruits and vegetable, lifestyle, and family environment. Latest study on adolescents showed that more 70% girls insufficient fruits and vegetables consumed (Asna et al., 2019)

Table 2. Distribution of Subject Based on Fiber Intake

Fiber Intake	n	(%)
Less (<20 g / day)	209	82.0
Sufficient (20-30 g / day)	32	12.5
Excess (> 30 g / day)	14	5.5
Total	255	100.0

Table 3. Distribution of Subject Based on Nutritional Status

Nutritional status	n	(%)
Normal	191	74.9
Overweight-Obese	64	25.1
Total	255	100.0

Nutritional Status

Table 3 showed that 25.1% subjects were overweight-obese. This percentage is higher than the research in Bekasi and Semarang which found 19% of adolescents who experienced overweight and obesity (Putri, 2016) (Syah et al., 2019). The prevalence of obesity in adolescents is closely related to energy intake, fat, excess carbohydrates, frequency of consumption of fast food, low physical activity, genetic, and the habit of skipping breakfast (Kurdanti et al., 2015).

Blood Pressure

Table 4 showed that the prevalence of hypertension occurs in 42 students (16.5%). This percentage is higher than the research of Kurnianingtyas et al. (2017) who found the prevalence of hypertension by 12% in adolescents in Semarang. The strength of blood pressure is strongly influenced by activity and many other factors including age and sex, family history, genetics, stress, obesity and lifestyle such as smoking, alcohol consumption, and an unhealthy diet (Wang et al., 2014). The wrong diet, both of the amount and type of food consumed is at high risk of increasing hypertension.

Table 4. Distribution of Subject According to Blood Pressure

Blood Pressure	n	(%)
No hypertension	213	83.5
Hypertension	42	16.5
Total	255	100.0

Table 5. Distribution of Subject Frequencies Based on Relationship between Fat Intake and Hypertension

Fat Intake	Blood Pressure				*P value*
	No Hypertension		Hypertension		
	n	(%)	n	(%)	
Less	133	88.7	17	11.3	0.011
Sufficient	37	82.2	8	17.8	
Exces	43	71.7	17	28.3	
Total	213	83,5	42	16,5	

Table 6. Distribution of Subject Frequencies Based on Relationship of Fiber Intake and Hypertension

Fiber Intake	Blood pressure				*P value*
	No Hypertension		Hypertension		
	n	(%)	n	(%)	
Less	175	83.7	34	16.3	0.916
Enough	26	81.3	6	18.8	
Over	12	85.7	2	14.3	
Total	213	83.5	42	16.5	

Correlation of Fat Intake with Hypertension

Based on table 5 , it can be seen that most of the subjects have less fat intake (58,8%). Table 5 showed that among those who have high fat intake, twenty eight percent were suffer from hypertension. Statistical test results obtained *p value* = 0,011, it can be concluded that there was a significant relationship between fat intake and hypertension.

The results of this study are in line with the research of Mafaza et al. (2016) which states that fat intake is associated with the prevalence of hypertension. The higher consumption of fatty foods can be the risk of hypertension. High fat consumption can increase levels of fat in the blood and cause the formation of plaque. The plaque will develop into atherosclerosis which results in lower elasticity of blood vessels so that the narrowing of the pressure of coronary blood flow causes blood pressure to rise (Widyaningrum & Rahmat, 2011). Syahrini et al. (2012) who also proved that there was a significant relationship between the consumption of fatty foods such as fat-based foods and snacks with the prevalence of hypertension. Sargowo & Andarini (2011) explained the effect of the composition of food intake on the components of metabolic syndrome in adolescents, showed that there was a relationship between the composition of fatty food intake against hypertension.

Correlation of Fiber Intake with Hypertension

Based on table 6 above, 82.0% subjects were having less fiber; among those who eat less fiber, 83.7% were not having hypertension and 16.3% was having hypertension. Statistical test results obtained p value = 0,916, means there wass no significant relationship between fiber intake and hypertension.

This study is in line with research conducted by Listiana & Rizal (2017) which states there wass no relationship between fiber intake and the prevalence of hypertension. In addition, it is known that fiber is not directly related to a decrease in high blood pressure, but fiber is directly related to cholesterol, where fiber binds bile acids (cholesterol end products) and then excreted with feces. Low fiber intake can cause less stool to excrete bile acids, therefore a lot of cholesterol is reabsorbed from the rest of the bile. As a result, cholesterol circulates in the blood more and accumulates in blood vessels (Sari & Panunggal, 2013). No correlation found between fiber intake and hypertension was because it is not only fiber intake that can affect blood pressure. Although fiber intake is maintained at 20-30 g/ day, if other triggers are not controlled then the possibility of hypertension can still occur such as genetic factors, age, sex, and race. In addition, the results of this study are also in accordance with research conducted by Indira, where there was no significant relationship between fiber intake with systolic blood and diastolic blood pressure. This was probably due to the presence of other nutrient intake factors such as sodium, fat, magnesium and kalium (Indira, 2013).

Correlation of Obesity with Hypertension

Based on table 7, prevalence of hypertension was found more in subjects who are overweight and obesity (31.3%) compared to those who have normal nutritional status (11.5%). Statistical test results using the chi square test obtained p <0.05 means that there was a significant

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Table 7. Distribution of Subject Frequencies Based on Relationships with Hypertension

Nutritional Status	Blood Pressure				*P value*
	No Hypertension		Hypertension		
	n	(%)	n	(%)	
Normal	169	88.5	22	11.5	
Overweight-Obese	44	68.8	20	31.3	0.000
Total	213	83.5	42	16.5	

relationship between obesity and the prevalence of hypertension.

Our results shows a smaller percentage than the study of Kurnianingtyas et al., 2017 who found obese adolescents with hypertension accounted for 94.1%. Salam's research also found 61.5% of obese adolescents had hypertension, which also found a significant relationship between obesity and the prevalence of hypertension (Salam & Sulchan, 2009). The results of this study are in line with research conducted by Hidayatullah & Pratama (2019) which states the relationship between obesity and the prevalence of hypertension in adolescents. Obesity is closely related to an increased risk of hypertension. Obesity can increase the prevalence of hypertension. Fat can cause blockages in blood vessels so that the heart works hard in pumping blood resulting in increased blood pressure. Weight gain also causes the heart rate to increase and reduces the capacity of blood vessels to carry blood so that it can increase blood pressure (Suiraoka, 2012). Again, the results of this study are in line with Ikramullah et al., (2014) which also stated that there was a relationship between systolic blood pressure and distolic blood pressure and obesity.

CONCLUSION

Base on the study, it may be concluded that fat intake has significant correlation with hypertension on female students. This is also in line with the overweight and obesity has a relationship with hypertension. Monitoring and evaluation in the school, especially on hypertension, fat intake and nutritional status, could be a mandatory regulation.

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NUTRITIONAL AND DEVELOPMENTAL STATUS AMONG UNDER FIVE YEARS OLD CHILDREN IN TANJUNG KARANG, WEST NUSA TENGGARA

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ABSTRACT

To improve the human capacity in West Nusa Tenggara (WNT) province, a community-based intervention called Generasi Emas NTB (GEN) has been implemented in 2014. One of the programs is to ensure children's nutritional and developmental wellbeing. However, there remains limited information regarding the situation of nutritional and developmental status of the children living in the GEN villages. This study aimed to assess the nutritional and developmental situation of under-five years old children living in Tanjung Karang district, WNT. A cross-sectional study was conducted in Tanjung Karang district, one of the GEN villages in WNT, through integrated post service (posyandu). Children who met the sampling criteria were screened for their nutritional status using anthropometric measurement and developmental status using a prescreening developmental questionnaire (KPSP). A total of 638 children completed the demographic baseline assessment and were enrolled as participants. Most of the children were in the age group 7-12 months (19.1%) and 25-36 months (19.4%). The proportion of children who were underweight, stunting, and wasting were 19.4%, 32.2%, and 8.0%, respectively. The findings for developmental screening showed that 12.2% children had dubious development and 3.1% (20/638) children were suspect of having a developmental delay. The proportion of under-five years old children in Tanjung Karang district who were underweight, stunting, and wasting were still high but lower than the provincial average prevalence in 2017. Children who were found to have a doubtful result and suspect to have a developmental delay need to be evaluated further.

Keywords: developmental status, nutritional status, *posyandu,* under-five children

INTRODUCTION

Growth and developmental aspects play an essential role in children's life. Any disorders occurring in those two aspects could impact children's wellbeing and does not only affect in a short-term but also a long-term period (Stewart et al., 2013). Globally, it is estimated that 88% countries encounter severe burden in handling malnutrition, with 155 million children are stunting (length/height for age z-score/HAZ <-2SD) and 52 million children are wasting (weight for length/height z-score/WHZ <-2SD) (Development Initiatives, 2017). Although in the last five years (2013-2018) the prevalence of stunting and wasting among under five years old Indonesian children are declining, the proportion of these conditions are still high, accounting for 30.8% and 17.7%, respectively (Agency of Health Research and Development, 2018; The Indonesian National Health Research Council, 2013). Studies showed that the consequences of stunting include reduced cognitive function and physical development, lower health capacity, higher risk of obesity in the future, increased school absence, and lower annual income later in life (Bhutta et al., 2013; Pusat Data dan Informasi Kementerian Kesehatan RI, 2016; Stewart et al., 2013).

On the other side, developmental aspects are shown to be essential in children's lives, since this particular factor reflects the maturation process of an individual's neurological function. Globally, the prevalence of developmental disorder occurs in 1-3% children, with an estimated 1% of the children have autism spectrum disorder (Mackrides & Ryherd, 2011; Scharf et al., 2016). In Indonesia,

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data from the Indonesian Pediatric Association (2013) showed that 5-10% children have a developmental disorder and 1-3% under five years old children have a developmental disorder in two or more developmental aspects or widely known as global developmental delay (GDD). However, different with the nutritional status data, the current national data on children's developmental status is still limited and can only be accessed for those aged 3-5 years only (Agency of Health Research and Development, 2018).

The Indonesian Ministry of Health has already promoted screening for growth and development at primary care level by launching a screening guideline called "*Stimulasi, Deteksi, dan Intervensi Dini Tumbuh Kembang Anak*" (SDIDTK), aimed to increase the coverage of growth and developmental screening for under five years old and preschool children (Kementerian Kesehatan RI, 2016). However, until recently, there is no study aimed to describe the implementation of this program in Indonesia, making it harder to ensure if this program is routinely implemented. Drawing from the United States' experience, the implementation of regular developmental screening for children is still low at 20%, and only 19.5% children received a standardized developmental screening (Dobrez et al., 2001).

West Nusa Tenggara (WNT) is one of the provinces in Indonesia, which has high prevalence of stunting and wasting in 2013, accounted for 45.3% and 11.9%, respectively (The Indonesian National Health Research Council, 2013). To deal with this issue, in 2014 the Department of Health WNT initiated a program called *Generasi Emas NTB* (GEN) that integrates multisectoral endeavors and focuses on investing in the young, particularly in their growth and development (Dinas Kesehatan Provinsi Nusa Tenggara Barat, 2015; Tim Koordinasi Pengembangan GEN 2025, 2017). Compared to the proportions in 2013, the prevalence of children with stunting and wasting are declining in 2017 but still high at 37.2% and 8.6%, respectively (Kementerian Kesehatan RI, 2018). Meanwhile, data for developmental status for children screened using the SDIDTK kit remains none, which leads to difficulty in assessing the developmental status of the children in the region.

This study aimed to describe the profile of nutritional and developmental status among under five years old children living in Tanjung Karang district, Mataram, WNT. As Tanjung Karang district is one of the 100 villages for the implementation of GEN program, our study sought to reflect the current nutritional and developmental status among the children living in the particular area and compared it with the reported profile from the provincial and national data. For developmental status, this study assessed children aged 0 to 59 months, which is different from the current developmental data reported by the Indonesian Basic Health Research, which only captured children aged 36 to 59 months. It is expected that the study results could be used to support the implementation of GEN program and promote the current nutritional and developmental screening in children through integrated health service post for children (*posyandu*).

METHODS

This was a community-based cross-sectional study conducted in January 2018 in 16 *posyandu* in Tanjung Karang district, Mataram, WNT. The study population was under five years old children living in villages which were enrolled as the implementation locations for GEN program in WNT province. By using a convenience sampling, Tanjung Karang district was selected as the study location, considering the proximity to the research center and access to the study location. This district is located on the west coast of Lombok island, with an approximate population number of 8544 or equal to 3325 people/km^2 (Pemerintah Kota Mataram, 2015).

All under five years old children coming to the *posyandu* were recruited. Inclusion criteria were children aged under five years old and in a fine condition with no apparent illness, which was examined by history taking. Exclusion criteria included parents or guardian who declined to participate and participants with incomplete demographic data. Data collection was initiated by collecting demographic data, such as parent's occupation and educational level, through interview and maternal and child handbook. Subsequently,

children underwent anthropometric measurement, including weight, length/height, and head circumference. This measurement was conducted by the health care workers from Tanjung Karang PHC. Weight was measured using *dacin* weight scale, while length and height were measured using length board and *microtoise*, respectively.

Developmental aspects were assessed using prescreening developmental questionnaire (*Kuesioner Pra-Skrining Perkembangan/*KPSP), which is used in the SDIDTK guideline. This questionnaire had a sensitivity of 60% and specificity of 92% and explored four aspects of development including gross motor, fine motor, speech and language, and personal social aspect (Dhamayanti, 2016). Scores generated from the developmental screening were interpreted according to the KPSP guideline, i.e.9-10 as normal, 7-8 as dubious, and ≤6 as suspected to have developmental delay. All data were recorded into an individual case report form and verified by the study team. Children's nutritional status was classified according to weight for age z-score (WAZ), height/length for age z-score (HAZ), and weight for height/length for age z-score (WHZ) using the World Health Organization Anthro® v3.2.2 anthropometric calculator. Data analysis was conducted using a descriptive approach in SPSS® 11.0 and presented using table and graphs.

RESULTS AND DISCUSSION

Sample Characteristics

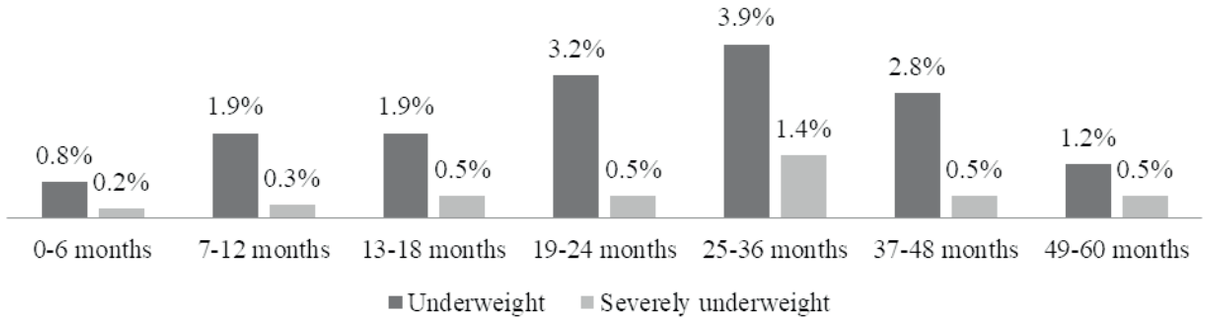
This was the first study describing the nutritional and developmental status of under five years old children in Mataram, WNT that is conducted through *posyandu* as a part of primary health care service in Indonesia. A total of 696 under five years old children came to the *posyandu*, and 91.7% (638/696) met the sampling criteria and were recruited as study participants. Although all children completed the developmental screening, not all of them underwent anthropometric measurements. There were 628 children and 570 children who had weight and height/length data, respectively, and only 561 children who had both weight and height/length data. The proportion of male and female were similar, with most of the participants were in the age group 25-36 months old (19.4%) and 7-12 months (19.1%). The mean age of the mother was 29.1 years old, with most of the mothers had educational level less than nine years (53.4%) and did not work (74.5%). The summary of the participant's characteristic is shown in Table 1.

Nutritional Status

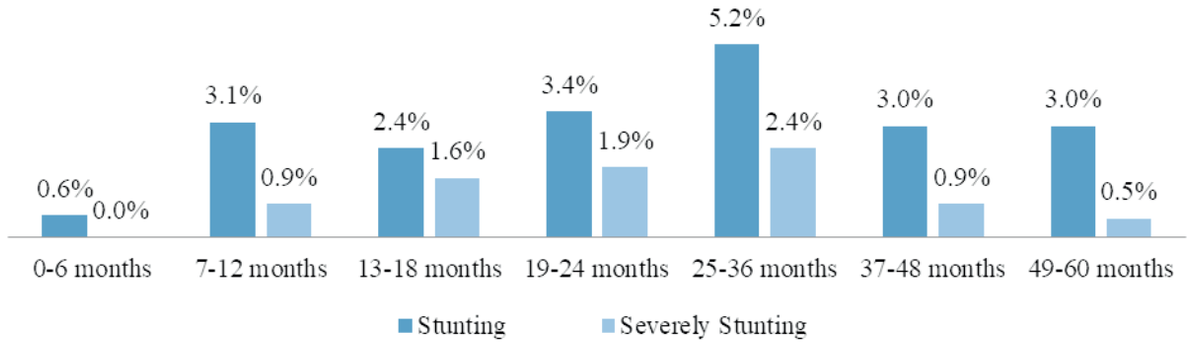
According to the results for the weight for age z-score (WAZ), approximately 15.6% of children were underweight (WAZ -3-<-2 SD) and 3.8% were severely underweight (WAZ <-3 SD). Meanwhile, according to height/length for age z-score (HAZ), there were 23.1% of children who were stunting (HAZ -3-<-2SD) and 9.1% who were severely stunting (HAZ <-3SD). Lastly, using the criteria for the weight for height/length z-score (WHZ), there were 5.5% of children who were wasting (WHZ -3-<-2 SD), 2.5% of children who were severely wasting (WHZ <-3SD), and 2.0% who were overweight. The summary of the nutritional status among the participants is shown

Table 1. Characteristics of the Participants

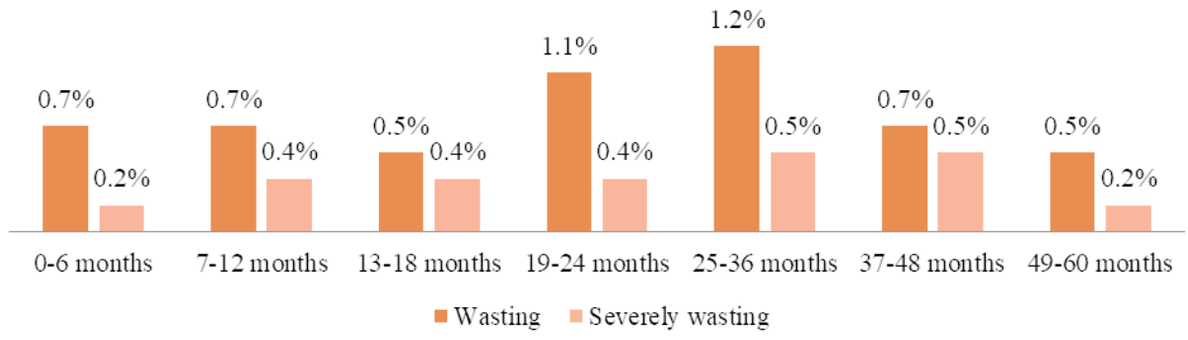
Characteristics	n	%
Under-five years old		
Male	312	48.9
Female	326	51.1
Age Group (months)		
0 - 6	77	12.1
7 -12	122	19.1
13 - 18	84	13.2
19 - 24	87	13.6
25 - 36	124	19.4
37 - 48	97	15.2
49 – 60	47	7.4
Birth Weights (gram)		
<1500	2	0.3
1500 - <2500	51	8
2500 - 4000	558	87.5
>4000	11	1.7
Mother		
Age (mean ± SD)	29,14±6,27	
Occupation		
Housewife	475	74.5
Fulltime worker	36	5.6
Entrepreneur	95	14.9
Others	23	3.6
Education status		
Low (≤9 years)	335	53,4%
Moderate (10-12 years)	213	34,0%
High (>12 years)	79	12,6%



(A) Distribution of under five years old with underweight and severely underweight according to the age groups



(B) Distribution of under five years old with stunting and severely stunting according to the age groups



(C) Distribution of under five years old with wasting and severely wasting according to the age groups

Figure 1. Distribution of under five years old with underweight and severely underweight (A); stunting dan severely stunting (B); and wasting and severely wasting (C) according to children's age groups

in Table 2. The distribution of children who were underweight and severely underweight, stunting, and wasting based on children's age groups showed that the peak for either underweight and severely underweight, stunting, or wasting were at age group 25-36 months old (see Figure 1).

The proportions of under five years old children which were underweight and severely underweight (19.4%), stunting (32.2%), and wasting (8.0%) in our study were lower than the findings reported by the Ministry of Health in 2017 which were 22.6%, 37.2%, and 8.6%, respectively (Kementerian Kesehatan RI, 2018). These lower proportions might be due to the fact that Tanjung Karang district is located in an urban setting of Mataram city and has both convenient access to health care facilities and access to employment

Table 2. Profile of Nutritional Status among Under Five Years Old Children in Tanjung Karang, WNT

Nutritional Profile	n	%
Weight for Age z-score (WAZ)		
Overweight (WAZ >2SD)	6	1
Normal (WAZ -2-2SD)	500	79,6
Underweight (WAZ -3-<-2 SD)	98	15,6
Severely underweight (WAZ <-3SD)	24	3,8
Height/Length for Age z-score (HAZ)		
Tall (HAZ >2SD)	8	1,4
Normal (HAZ -2-2SD	379	6,4
Stunting (HAZ -3-<-2SD)	132	23,1
Severely stunting (HAZ <-3SD)	52	9,1
Weight for Height/Length z-score (WHZ)		
Overweight (WHZ >SD)	11	2
Normal (WHZ -2-2SD)	505	90
Wasting (WHZ -3-<-2 SD)	31	5,5
Severely wasting (WHZ <-3SD)	14	2,5

opportunities in the city. This is in line with a study using data from the Demographic and Health Survey from 36 countries, stating that better nutritional status among children living in an urban area might be explained by "the cumulative effect of a series of more favourable socioeconomic conditions" which eventually lead to better care for the children (Smith et al., 2004). However, when compared to the data from the Indonesian Basic Health Survey in 2018, the proportions of children with underweight and severely underweight and stunting in this study are still higher than the national level which were 17.7% and 30.8%, respectively (Agency of Health Research and Development, 2018). According to a study from Hanandita and Tampubolon (2015), the clustering of under-nutrition is still apparent in several regions in Indonesia, including Nusa Tenggara islands, and that under-nutrition is still consistent with being found in low-income areas. This finding echoes the urgency of relevant policy that is able to close the existing socio-economic gaps between regions in Indonesia.

Furthermore, the prevalent cases of undernutrition in the study location might be explained by the high proportion of mothers who have low educational status. As reported by Stewart et al. (2013), lower educational status of children's guardian is strongly associated with poor nutritional status of the children and increases the risk of stunting. Furthermore, studies conducted in Sragen and Boyolali were consistent to show that mother's knowledge in child's nutrition is significantly associated with their children's nutritional status (Hapsari, 2018; Munthofiah, 2008). While promoting a longer formal education for parents is promising, improving parent's knowledge in child nutritional status is also important and might be more feasible to be conducted as a community intervention to reduce stunting and wasting prevalences in WNT.

The distributions of children with underweight, wasting, and stunting in this study were shown to be highest in the age group 25-36 months, even though the numbers might not be remarkably different with the other age groups. The findings for underweight and stunting in this study are similar with the data from the Indonesian Basic Health Survey (2018), of which the highest prevalences for underweight and stunting are in age groups 24-35 months and 12-35 months, respectively. Meanwhile, Garenne et al., (2019) suggest that wasting is usually occurred in younger children (6-29 months), while stunting might be more prevalent in the older age group (30-59 months).

Developmental Status

The results from the developmental screening showed that approximately 12.3% and 3.1% of under five years old children had a dubious result and suspect for developmental delay, respectively (Table 3). Among those children, gross and fine motor aspect (58.1% and 58.1%) were the most prevalent aspects that were impaired, followed by

Table 3. Profile of Developmental Status among Participants

Characteristics	n (%)
KPSP Results	
Normal (9-10)	540 (84,7)
Dubious (7-8)	78 (12,2)
Suspect to have a delay (≤6)	20 (3,1)
Delayed Aspect	
Gross motor	57 (58,1)
Fine motor	57 (58,1)
Speech and language	46 (46,9)
Personal social	35 (35,8)
Number of Impaired Aspects	
1	29 (4,5)
≥2	69 (10,9)

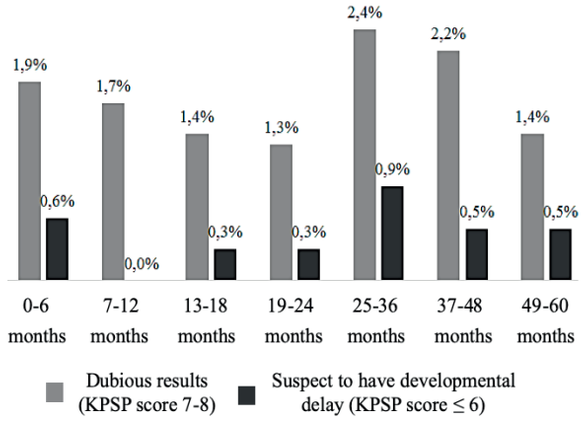


Figure 2. Distribution of Children Who Were at Risk of Developmental Delay According to the Age Group

speech and language aspect (46.9%) and personal social aspect (35.8%). A number of 69 participants (10.9%) had a developmental delay in two or more aspects and were at risk of GDD. The distribution of children who were at risk of developmental delay according to the age group was shown in Figure 2.

Our results on developmental screening showed that there is a considerable proportion of children (15.4%) who need further examination and stimulation for their developmental aspects. Similar to the determinant for nutritional status, low educational status among parents is also associated with a higher risk for developmental delay in children, mediated by the lack of stimulation for children's development (Fadlyana et al., 2003; Sitaresmi et al., 2008).However, the number of children who were suspected of having developmental delay (3.1%) in our study was lower than the national estimate from the Indonesian Pediatric Society (5-10%) (Medise, 2013). A previous research conducted in Bandung showed that the prevalence of developmental delay is higher in a rural area compared to an urban area (29.3% vs 18.7%, p=0.012), which might be due to lower socioeconomic status and more moderate knowledge in child development among those who live in the rural area (Fadlyana et al., 2003). This is also in accordance with study from Sitaresmi et al. (2008) which reported that the proportion of children with dubious KPSP result and suspect to developmental delay in a rural area of Bantul, Yogyakarta was high, i.e. 28% and 8%, respectively. It was also reported that low socioeconomic status increased the odds of developmental delay among under five years old children by 180% (OR 2.8, 95% CI 1.4, 5.7) (Sitaresmi et al., 2008).

According to the trend of distribution of KPSP results and children age groups, the proportion of children who had dubious and suspect to have developmental delay results are higher in the age group 24 months old and over, compared to its counterparts. This is in line with a study from Sitaresmi et al. (2008) which showed that the prevalence of developmental delay in their study was higher for children aged 18 months old and over. Although conducted in the same setting, i.e. urban area, our results on aspects that the children had developmental delay on are different from study by Fadlyana et al., (2003). Their study reported that speech aspect was the most prevalent (66%), followed by perception (38%), fine motor (35%), gross motor (35%), and social (1%). However, this particular study used different developmental screening tool, of which the modified Munchener method was used (Fadlyana et al., 2003).

Research Limitations

There are some limitations to this study. Firstly, although the response rate of this study was excellent, our study population was only taken from an urban area. This might impact the generalisability of this study to a broader WNT area, which consists predominantly of rural regions. Secondly, our study is subject to information bias arisen from error in the measurement of both nutritional status and developmental status. Although training had been conducted for all of the research staffs prior to the study, we did not measure the inter-rater reliability, which is more objective to assess the difference of measurements between observers. This leads to a non-differential measurement error, reducing the true prevalence of the outcomes.

CONCLUSION

The profile of nutritional and developmental status of under five years old children in

Tanjung Karang district, Mataram, WNT could be examined using tools provided in SDIDTK kit through *posyandu* in the community. In this study, the prevalences of underweight and severely underweight, stunting, and wasting among under five years old children in Tanjung Karang district, Mataram, WNT are lower than the average provincial prevalences for the respective parameters in 2017. Furthermore, there is a considerable proportion of children in the region who are at risk of developmental delay and need to be assessed further.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this study.

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