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The effect of whey protein on malondialdehyde, aerobic capacity, and leg muscle explosive power in basketball athletes

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ABSTRACT

Background: *High-physical activity, including aerobic capacity and leg muscle explosive power, can cause stress oxidative and decrease the performance of athletes. Whey protein contains essential amino acids that were beneficial to decreased malondialdehyde (MDA) levels.*
Objective: *To analyze the effect of whey protein on MDA level, aerobic capacity, and leg muscle explosive power in basketball athletes.*
Materials and Methods: *Randomized controlled trial using pre- and post-test design was conducted on 12 male athletes aged 16-18 years at PPLOP Central Java Basketball Club. The treatment group received 30 grams of whey protein, and the control group received 30 grams of chocolate powder as a placebo for 28 days. MDA levels were measured through Elisa methods. Aerobic capacity was measured by 20 meters sprint. Leg muscle explosive power was measured by vertical jump. Data were analyzed by an independent t-test.*
Results: *The mean MDA levels before intervention in the whey protein group were 182.36 (±59.05), and the mean after the intervention was 171.83 (±5.46). The mean before the aerobic intervention capacity was 36.95 (±5.84), and the mean after the intervention was 49.75 (±3.53). The mean leg muscle explosive was 83.50 (±21.58), and the mean after the intervention was 87.33 (±16.68). There were no effect of whey protein on MDA levels (p>0,05), aerobic capacity (p>0,05) and leg muscle explosive power (p>0,05).*
Conclusion: *Whey protein for 28 days had no effect on MDA levels, aerobic capacity, and leg muscle explosive power*

Keywords: *whey protein; MDA levels; aerobic capacity; and leg muscle explosive power*

BACKGROUND

Basketball is a high-intensity intermittent sport. This sport involves various types of physical activity, namely aerobic and anaerobic.[1] In basketball, practice is needed, especially in improving physical condition because the physical condition is one of the factors that significantly determines the athletes' performance.[2] The components of physical conditions that have an essential role in basketball sports activities, both as a supporting element in a particular movement or the main element in the effort to achieve perfect movement techniques, are power explosiveness and aerobic capacity. Aerobic capacity is related to high-intensity workouts [3,] whereas explosive power is the maximum force used in the shortest possible time. The power of leg muscles is required for lay-up and jump short techniques. [4]

The physiological impact of high-intensity physical exercise on basketball athletes can increase the production of reactive oxygen species (ROS), which can cause imbalance and tissue damage [5.] The part of the cell that is prone to damage is cell membrane lipids. This process of membrane breakdown is called lipid peroxidation. One of the products of lipid peroxidation is malondialdehyde (MDA). MDA is an aldehyde derivative that can act as a secondary toxic messenger and trigger oxidative injury. Therefore, the level of MDA in the body can be used as an indicator of oxidative stress.[6] Oxidative stress damages cells and tissues, which are a significant factor in muscle fatigue and underperformance of athletes, leading to decreased glutathione concentrations. Maintaining glutathione status is proven to minimize oxidative stress and improve athletes' performance,[7] giving whey protein.

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Whey protein contains long-chain amino acids (BCAAs), including leucine, valine, and isoleucine which can play an antioxidant mechanism.8 Research on a high-protein diet containing BCAAs can reduce oxidative stress caused by high-intensity exercise in rats.[9]Amino acids in milk protein contain cysteine and taurine, reducing glutathione concentration during exercise. This mechanism is known through increased glutathione concentration caused by increased plasma antioxidant capacity, namely an increased aerobic metabolism without causing damage due to accumulated ROS.[10] In addition, whey protein can reduce muscle fatigue. The reduction in muscle fatigue during resistance training is the result of an increase in muscle buffer capacity during endurance sports. [11]

Previous studies of whey protein on improved performance in athletes show performance in the treatment group with a value of P = 0.001. In contrast, there was no improvement in performance in the placebo group.[12] Other studies have shown that administration at a dose of 30 grams in 300 ml can affect the total serum protein alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and creatine kinase (CK) .[13]

This study analyzes whey protein on malondialdehyde levels, aerobic capacity, and leg muscle explosive power in basketball athletes at PPLOP Central Java.

MATERIALS AND METHODS

This was an experimental study with a randomized controlled trial design with pretest-posttest groups. This research was approved by the ethics commission No. 541/EC/KEPK/FK UNDIP/XII/2019. This research was conducted at *Pusat Pendidkan dan Latihan Olaharaga Pelajar* (PPLOP) Central Java. Subjects in this study were 12 basketball athletes divided into two groups, namely the treatment group, which was given 30 grams of whey protein. The control group was given 30 grams of cocoa powder for 28 days. This study's variables were MDA measurement, aerobic capacity, and leg muscle explosive power. Data collection was carried out two times. Namely, pre and post-intervention were carried out in the control group and placebo with each (n = 6 subjects in the whey group and n = 6 subjects in the placebo group). The data obtained were analyzed statistically using the SPSS version 21 program; data with normal distribution was stated by mean (±SD) while data with abnormal distribution was stated by median (min-max). Statistical differences were analyzed using independent t-test and paired t-test (data with normal distribution), and Wilcoxon, Mann Whitney (data with abnormal distribution). Intake data were obtained from the average 24-hour recall carried out two times in the control and placebo groups. MDA levels, aerobic capacity, and leg muscle explosive power were measured two times. The samples used to measure MDA levels were blood serum, aerobic capacity using multistage fitness, and leg muscle explosive power measured by jumping upright on a scaled board. MDA levels in blood serum were analyzed using the Thiobarbituric Acid Reactive Substances (TBARS) test method spectrophotometrically at a wavelength of 454 with maximum absorbance. Aerobic capacity and explosive power write the numbers according to at PPLOP standard. The research subjects are the athlete basketball men aged 16-18 years in PPLOP Java Central. The requirement to follow the practice of physical five times a week with a duration of 1.5 hours per workout, not taking supplements of antioxidants such as vitamin C, vitamin E during the intervention, did not exist, willing to follow the study through informed consent from the beginning of the study until the end.

RESULTS

Subject Characteristics

A total of 12 athletes from PPLOP Central Java were the subjects in this study. Subject characteristics data consisted of age, weight, height, BMI, Z-score (BMI / U), and physical activity. There was no significant difference in the data on subject characteristics (p> 0.05).

Tabel 1. Subject Characteristics in Both Groups

Data Characteristics	Whey Protein		Control		*p*
	Mean±SD	Minimum-Maximum	Mean ±SD	Minimum-Maximum	
Age (years)	17,33±1,366	16,00-19,00	16,33±0,516	16,00-17,00	0,240[b]
Weight (kg)	72,32±5,51	62,60-77,90	73,30±8,63	63,30-85,70	0,819[a]
Height (cm)	183,33±3,67	179,00-190,0	183.33±3.67	179,00-190,0	0,100[a]
BMI for age (kg/m^2)	21,28±1,53	19,50-23,40	22,85±1,54	21,20-25,00	0,107[a]
Z-Score (BMI/Age)	0,14±0,63	-0,50-0,92	0,32±0,72	-0,46-1,23	0,655[a]

Physical Activity (unit)	1,83±0,63	1,80-1,86	1,80±0,023	1,78-1,83	0,134[a]

[a:] Independent *t-test*, [b:] *Mann-Whitney*

The level of adequacy is obtained from the amount of intake in one day compared to individual needs and is calculated in percent. Table 2 shows no significant difference in energy intake, protein, fat, and carbohydrates (P> 0.05).

Table2. Adequacy Level of Nutrient Intake in Both Groups

Adequacy Level of Nutrient Intake	*Whey* Protein n=6		Control n=6		*p*
	Mean±SD	Minimum-Maximum	Mean±SD	Minimum-Maximum	
Energy (%)	68,33±5,58	60,70-75,30	67,31±7,95	58,53-77,42	0,802
Protein (%)	76,45±13,23	54,29-89,28	78,89±11,12	64,27-77,42	0,820
Fat (%)	79,68±13,35	64,58-95,30	73,86±7,65	63,64-82,90	0,376
Carbohydrate (%)	70,66±10,96	57,10-80,97	64,76±7,45	54,11-76,01	0,301

independent *t-test*

Malondialdehyde Levels, Aerobic Capacity, Leg Muscle Explosive in Both Groups

Tabel 3. MDA Levels, Limb Muscle Explosive Power, and Aerobic Capacity Before and After Intervention

Variable	Kelompok	n	Before	After	△	*P*
			Rerata±SD	Rerata±SD		
MDA levels (ng/ml)	*Whey* protein	6	182,36±59,05	171,83±53,46	10,55±6,56	0,011[a]
	Kontrol	6	195,17±48,75	190,46±48,26	-4,69±3,22	0,016[a]
	p		0,691[c]	0,540[c]	0,078[c]	
Aerobic Kapasity (ml/kg/min)	Whey Protein	6	36,95±5,84	49,75±3,53	12,80±5,97	0,003[a]
	Control	6	36,43±4,61	48,57±2,44	12,13±4,39	0,001[a]
	p		0,868[c]	0,515[c]	0,830[c]	
Leg Muscle Explosive (cm)	*Whey* protein	6	83,50±21,58	87,33±16,68	4,33±6,37	0,157[a]
	Control	6	64,33±8,91	73,00±9,57	8,67±11,69	0,140[b]
	p		0,065[d]	0,132[d]	0,444[c]	

[a:] Paired *t-test*, [b:] *Wilcoxon*, [c:] Independent *t-test*, *d Mann-Whitney*

Malondialdehyde levels, aerobic capacity, and leg muscle explosive power baseline by statistical Independent t-test and Mann-Whitney in the *whey* protein group and the control group are presented in Table 4.3. The test used was the independent t-test having the same conditions (p =>0.05) and after the intervention was not significant (p >0.05).

DISCUSSION

Research has not shown a significant effect before and after the intervention. There was no possible effect due to the short study time (28 days). In line with studies conducted on experimental animals, whey protein was not affected for four weeks to improve athletes' performance (p = <0.05).[14-15] In addition, high physical activity causes inflammation in athletes to be a factor. Sub-maximal exercise can increase neutrophils, reduce lymphocytes. 84 Previous studies have stated that high physical activity can cause inflammation with increased neutrophils, a secondary source of free radical production that can reduce an athlete's performance.[16]

On the other hand, this study has not been proven to increase the explosive power of leg muscles in either the whey protein group or the control group. Optimal explosive power is obtained progressively through training. There was no increase in the explosive power of the leg muscles because, during the study, there was no additional special training. Subjects only received appropriate

training from the PPLOP institution. We recommend that the subject be given additional training to increase the explosive power of the leg muscles, namely by adding a training method with training circuits and plyometric exercises, in line with the research that the training method with training circuits can increase the explosive power of the leg muscles in athletes ($p = <0.05$)[17,] as well as athletes with high motor skills given the plyometric training method resulted in a high increase in explosive power ($p = <0.05$) [18]

Physicological factors, including stress factors and levels of anxiety in athletes, are caused by training and high demands. Therefore, the level of anxiety in athletes plays an essential role in determining achievement. In addition, the level of anxiety tends to be higher in competitive sports than in relatively non-competitive sports. In competitive sports, athletes are expected to win with high demands.[19] The research results in line with athletes measuring the level of anxiety associated with performance in athletes mention anxiety.

The study results show no effect on leg muscle explosive power performance because most athletes have the low aerobic capacity (36.0) and low explosive category athletes (60, cm). The researcher uses category standards used in institutions. PPLOP Central Java. It affects athletes' performance because the athlete's training period at PPLOP is different. Some are old and have just joined PPLOP. In line with the research, the performance of the training period of fewer than six months is still low because it is not used to the training being undertaken.[20]

The difference in value (Δ) for the decrease in MDA levels increased aerobic capacity in the whey protein group. Decreased malondialdehyde levels can also be triggered by the higher content of BCAAs, such as leucine, valine, isoleucine compared to other protein products.65 Whey protein is easily digested so that it has the characteristics of increasing the ability to stimulate muscle protein synthesis and repair skeletal tissue.[21] This study is also in line with research testing the antioxidant whey protein in cell culture using the C2C12 myoblasts technique. It has been shown that whey protein increases antioxidant capacity against oxidative stress and whey protein stimulates increased GSH, CAT / SOD enzyme activation, and inhibition of lipid peroxidation. The intervention of whey protein before and after for 60 days can reduce oxidative stress and increase endurance in athletes.[22]

CONCLUSION

There was an effect before and after 30 grams of whey protein for 28 days on decreasing malondialdehyde levels and increasing aerobic capacity.

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Red dragon fruit juice in reducing ros levels and insulin resistance In rats with type 2 diabetes mellitus model

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ABSTRACT

Background: *The peel of red dragon fruit (Hylocereus polyrhizus) had been proven to have a total polyphenol content and total flavonoids 2 to 3 times more than its flesh. These components could reduce oxidative stress and maintain the function of pancreatic beta cells, which could affect blood sugar levels.*

Objectives: *This study aimed to test the red dragon fruit juice using peel and flesh to reduce oxidative stress and insulin resistance in T2DM model rats.*

Materials and Methods: *This study was a true experimental study with a randomized controlled trial, with a Matching Pretest Post-test Control Group Design. We used 21 white male rats (Rattus norvegicus) Wistar strain which was divided into three groups: (P1) negative control group (induced Streptozotocin + Nicotinamide induction), (P2) positive control group (given Streptozotocin + Nicotinamide and given Metformin HCl induction 0,9 mg/kg BW, and (P3) Red Dragon fruit group (induced Streptozotocin + Nicotinamide and given Red Dragon Fruit juice 3.6 ml / 200 g BW / day given for 14 days. The data were analyzed using a one-way ANOVA test, paired t-test, and Post Hoc.*

Results: *After 14 days of intervention, the average HOMA-IR levels were as follows: negative control group (Mean=8.32; SD=0.26), positive group (Mean 4.89; SD=0.29), and the Red Dragon Fruit intervention group (Mean=4.65; SD=0.30). The average MDA levels were as follows: control group (Mean = 9.08; SD = 0.68), positive group (Mean=3.34;SD=0.22), and the red dragon fruit intervention group (Mean = 3.05; SD = 0.47). Both the Metformin group and the Red Dragon Fruit group had low HOMA-IR and MDA levels compared to the negative control group.*

Conclusions: *When administered alone, red dragon fruit and metformin effectively reduced HOMA-IR and MDA levels in rats with type 2 DM. Red dragon fruit can be used as an alternative to metformin because of its effectiveness in reducing plasma HOMA-IR and MDA.*

Keywords: *HOMA-IR; Red Dragon Fruit; Type 2 Diabetes Mellitus*

BACKGROUND

Red Dragon fruit (RDF) is a fruit source that is rich in natural antioxidants, namely betacyanin, flavonoids, polyphenols, ascorbic acid, and also fiber [1]. The main antioxidant content in RDF is flavonoids. Flavonoids have a polyphenolic structure which is found in many fruits [2]. Increasing RDF flesh consumption leaves the skin that is currently not used optimally. Apart from the flesh, RDF skin can also be used as an alternative because of its nutritional content and antioxidant effects [3]. The total content of polyphenols and flavonoids from 80% methanol extract of RDF skin is three times higher than RDF flesh. The total phenolic content extracted from the skin and flesh is 14.82 ± 1.07 and 4.91 ± 0.55 mg Gallic Acid Equivalent (GAE) / 100g [4].

In type 2 diabetes mellitus (T2DM), hyperglycemia is caused by the inability of Insulin to mobilize blood glucose into cells due to insulin receptor resistance [5]. Hyperglycemia increases the auto-oxidation of glucose from free radicals. In hyperglycemia conditions, the formation of free radicals or Reactive Oxygen Species (ROS) comes from glucose oxidation, on-enzymatic glycosylation of proteins, and oxidative degradation of glycolic proteins [6]. The increase in intracellular glucose causes an abundance of electron donors to be generated during the Kreb cycle, thereby pushing the potential of the inner mitochondrial membrane upward - a condition associated with mitochondrial dysfunction and increased production of ROS [7]. In addition, ROS will increase the expression of Tumour Necrosis Factor-α (TNF-α) and exacerbate oxidative stress. TNF-α can result in insulin resistance through decreased autophosphorylation (auto-phosphorylation) of insulin receptors [8,9]. These oxidative stress markers can be measured using Malondialdehyde (MDA) [10].

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Insulin resistance impairs the ability of muscle cells to take up and store glucose and triglycerides, which results in high levels of glucose and triglycerides circulating in the blood [11]. One of the biomarkers used to measure insulin resistance is the Homeostatic Model Assessment of Insulin Resistance (HOMA-IR). HOMA-IR measures insulin resistance (IR) based on the value of fasting blood glucose and plasma insulin levels [12].

Hypoglycemic effects of flavonoids are by regulating carbohydrate digestion, insulin signaling, insulin secretion, glucose uptake, and adipose deposition [13]. Flavonoids work by targeting many molecules involved in regulating multiple pathways, such as increasing β cell proliferation, promoting insulin secretion, reducing apoptosis, and increasing hyperglycemia by regulating glucose metabolism in the liver [14]. Red dragon fruit skin makes up 22% of all RDF, usually thrown away.

Two-thirds of the fruit consumed is whole fruit, and one-third is 100% fruit juice. One hundred percent of consumption of fruit juice treatments with several health benefits, such as reduced levels of lipid profiles and reduced obesity [15]. A meta-analysis study has proven that an alternative way to consume the right amount of fruit is by drinking, such as consuming fruit juices, especially on glycemic control [16]. Therefore, in this study, the authors are interested in using both skin and flesh of RDF to determine their effectiveness in reducing ROS and insulin resistance in T2DM model rats.

MATERIALS AND METHODS

Experiment Protocols

The Red Dragon Fruit (*Hylocereus polyrhizus*) is obtained from Tawangmangu and the same plantation to maintain variety homogeneity. The maintenance and treatment of experimental animals were carried out at the Laboratory of the Center for Food and Nutrition Studies, Gadjah Mada University, Yogyakarta. The antioxidant test was conducted at the Sebelas Maret University Nutrition and Food Lab. Preparation and observation of examination of levels of fasting blood glucose, serum insulin, and plasma MDA were carried out at the integrated Research and Testing Institute of Gajah Mada University, Yogyakarta. All chemicals used have met lab analysis standards. The ethics committee approved this study of The Health Research Ethics Committee of Faculty Medicine Universitas Sebelas Maret for medical research, protocol number 465/UN27.06/KEPK/EC/2019.

Sample Size and Study Design

This study is a true experimental study with a randomized controlled trial, with a Matching Pretest Post-test Control Group Design. This study used white male rats (*Rattus norvegicus*) Wistar strain as research objects with three treatment groups: 1 negative control group, one positive control group, and one treatment group. The sample size for each group was determined based on the provisions of the Institutional Animal Care and Usse Committee (IACUC) (2002): at least six rats in one study group. Each group added 20% for the probability of dropping out. The sampling technique was simple random sampling to obtain seven rats in each group. This study used three treatment groups, so that the total sample of this study was 21 rats.

Dosages

The dose of juice therapy used in humans corresponds to 1 glass of juice consumed daily by adult individuals with an average weight of 200 ml [17]. Higher fruit and vegetable juices consumption was associated with higher-quality diets and better compliance with the French National Plan for Nutrition and Health. Making 200 ml of RDF juice requires 274 grams (both flesh and peel). The conversion dose for a rat was 0.018, so the dose for the sample was 3.6 ml/200g BW/day, which was given by sonde for 14 days. The maximum volume of fluid administration for white rats weighing 200 grams is 5ml so that the volume of juice given is appropriate.

The reference material used in this study was metformin HCl. The usual dose of metformin HCl used to reduce blood glucose levels is 500 mg - 1700 mg per day in humans with a bodyweight of 70 kg given orally in a single dose [18]. Metformin is a biguanide compound that is still used as an oral hypoglycemic drug in Indonesia which works to reduce blood glucose levels by improving glucose transport to muscle cells. In addition, this drug can improve glucose uptake by 10-40%). In this study, there are three groups: (P1) negative control group (induced Streptozotocin + Nicotinamide induction), (P2) positive control group (given Streptozotocin + Nicotinamide and given Metformin HCl 0 induction, 9 mg/kg BW, and (P3) Red Dragon fruit group (induced Streptozotocin + Nicotinamide and given Red Dragon Fruit juice 3.6 ml / 200 g BW / day given for 14 days.

Biological Experiment Protocols

Rats were obtained from Inter-University Center (IUC) Nutrition of Gadjah Mada University in pre-clinical service and experimental animal development. Rats were kept in a particular room placed in clean polypropylene cages with seven rats

per large cage which were then given transparent dividers so that one rat occupied one small cage. The food was a standard Comfeed feed consisting of 70% corn starch, 10% casein corn oil, 4% salt mixture, 1% vitamin mixture, and 5% cellulose. The study was started by preparing 24 male Wistar rats aged 8-10 weeks, body weight ± 180 grams and adapted for seven days in the cage, then randomized into three groups. Diabetic rats were induced by giving 230 mg/kg Nicotinamide (NA), then 15 minutes later given 65 mg/kg Streptozotocin (STZ) in cold citrate buffer, pH 4.5, intraperitoneally to male rats, which previously did not need to be fastened. Hyperglycemia confirmed after 48 hours of STZ-NA administration was characterized by an increase in fasting blood glucose levels. Therefore, rats with blood glucose levels of 180 mg/dL were considered diabetic and were included in the study.

Measurement Instruments

A sampling of test animal blood is part of a series of in vivo studies. In this study, blood sampling in rats used the Plexus Retro-Orbital method in the eyes [19]. Measurement of MDA levels from blood samples of Wistar rats was examined quantitatively using the thiobarbituric acid-reactive substance (TBARS) kit. Measurement of plasma insulin levels from blood samples of Wistar rats that were examined quantitatively. Rat Enzym-Linked Immunosorbent Assay (ELISA) Insulin kit DRG brand no EIA catalog 2048. r. The amount of glucose contained in the blood of Wistar rats was examined quantitatively by the Enzymatic Colorimetric Test GOD-PAP (Glucose Oxidase Phenol 4-Aminophenazone) method, which was carried out before being given treatment (pre-test) and at the time after being given treatment (day 14). The homeostasis model assessment-insulin resistance (HOMA-IR) is a validated and widely used method to measure insulin resistance from fasting glucose and Insulin.

HOMA-IR : $\frac{Fasting\ blood\ glucose\ levels\ \left(\frac{mg}{dL}\right) x\ insulin\ level\ \left(\frac{ng}{mL}\right)}{405}$ 20

Statistical Analysis

The data were coded and analyzed using SPSS for Windows version 20. This study used paired T-test for normal data with 95% significance. Data that were not normally distributed were analyzed using Mann Whitney U Test. If the value of p <0.05, there was a significant difference between variables, and if p> 0.05 means that there was no statistical difference in the effect before and after the intervention. The different effects of those three groups were analyzed using the parametric statistical test, one-way ANOVA for normally distributed data, and homogeneous data, then continued with the Post Hoc test .

RESULT

Tabel 1. Chemical Compositions of Red Dragon Fruit Juice per 3,6 ml

Sample	Test	Analysis Parameters			
		Reducing Sugar [1)] (% wb)	**Antioxidants [2)] (% wb)**	**Total Phenol [3)] (% wb)**	**Anthocyanins [4)] (ppm wb)**
RDF	I	8.29	2.29	0.064	147.84
	II	8.46	2.50	0.061	135.90
	Average	8.37	2.39	0.063	141.87

Source: Primary Data (2019)

1) *Nelson Somogyi;* 2) *Spektrofotometri;* 3) *Spektrofotometri;* 4) *Giusti & Worlstad*

The chemical and antioxidant composition of Red Dragon Fruit juice has been investigated, and the results are recorded in Table 1. Table 1 shows the reduced sugar content of 8.37% wb; Antioxidants 2.39% wb; Total Phenol as much as 0.063% wb and anthocyanin content in 3.6 ml of RDF juice as much as 141.87 ppm wb.

Tabel 2. The Effect of RDF Juice on Fasting Blood Glucose Levels

Group	Duration		Δ Fasting Blood Glucose (mg/dL)	p^a
	Day-0 (*mean* ± *SD*) mg/dL	**Day-14 (*mean* ± *SD*) mg/dL**		
P1	272.69 ± 9.53	275.03 ± 8.69	2.33 ± 2.92	0.080

P2	282.49 ± 7.35	116.95 ± 7.32	-165.54 ± 8.89	< 0.001*
P3	276.25 ± 8.84	112.42 ± 6.69	-163.82 ± 13.65	< 0.001*
p [b]	0.090	< 0.001*	< 0.001*	

Source: Primary Data (2019)
*) There is a significant difference; [a]) (p < 0.05) *Paired T-Test ;* [b]) (p < 0.05) *One Way Anova*

One Way-Anova is a comparative test used to test the difference in the mean (average) of data for more than two groups. The difference in the mean effect of RDF juice on Fasting blood glucose (FBG) levels can be seen in Table 2. Table 2 shows the mean FBG after being tested with One Way-Anova and Paired T-Test. Before administering the intervention, mean values of FBG levels were compared among the three study groups, and it was not statistically significant (Day-0), indicating that randomization had achieved the intended goal. However, both the Metformin group (P2) and the RDF group (P3) had lower FBG levels (p=<0.01) than the negative control group (P1), and the mean difference in their partners was statistically significant. After the One Way-Anova test, the three groups were statistically significant (Day-14; Δ Fasting Blood Glucose). Therefore, a further test was carried out to determine which group was different (Table 6).

Tabel 3. The Effect of RDF Juice on Insulin Levels

Group	**Duration**		**Δ Insulin Plasma (pg/ml)**	***p*** [a]
	Day-0 (*mean* ± *SD*) pg/ml	**Day-14 (*mean* ± *SD*) pg/ml**		
P1	414,01 ± 6,07	409,90 ± 2,92	-4,10 ± 5,47	0,095
P2	413,55 ± 2,97	549,88 ± 4,90	136,32 ± 6,48	< 0,001*
P3	414,92 ± 4,33	548,66 ± 7,70	133,74 ± 6,22	< 0,001*
p [b]	0,160	< 0,001*	< 0,001*	

Source: Primary Data (2019)
*) There is a significant difference ; [a]) (p < 0.05) *Paired T-Test ;* [b]) (p < 0.05) *One Way Anova*

Table 3 shows the difference in mean Insulin after being tested by One Way-Anova and Paired T-Test. Before administering the intervention, the mean scores of insulin levels were compared among the three study groups. It was not statistically significant (Day-0), indicating that randomization had achieved the intended goal. Both the Metformin group (P2) and the RDF group (P3) had lower Insulin levels than the negative control group (P1), and the mean difference in their partners was statistically significant. After the One Way-Anova test, the three groups were statistically significant (Day-14; Δ Insulin Plasma). A further test was carried out to find out which group was different (Table 6).

Tabel 4. The Effect of RDF Juice on MDA Level

Group	**Duration**		**Δ MDA Plasma (nmol/ml)**	***P*** [a]
	Day-0 (*mean* ± *SD*) pg/ml	**Day-14 (*mean* ± *SD*) pg/ml**		
P1	8,98 ± 0,69	9,08 ± 0,68	0,09 ± 0,10	0,061
P2	8,77 ± 0,66	3,34 ± 0,22	-5,43 ± 0,62	< 0,001*
P3	9,25 ± 0,32	3,05 ± 0,47	-6,20 ± 0,50	< 0,001*
P [b]	0.658	< 0.001*	< 0.001*	

Source: Primary Data (2019)
*) There is a significant difference ; [a]) (p < 0.05) *Paired T-Test ;* [b]) (p < 0.05) *One Way Anova*

Table 4 shows the difference in mean MDA after being tested with One Way-Anova and Paired T-Test. Before administering the intervention, mean MDA levels were compared across the three study groups, and it was not statistically significant, indicating that randomization had achieved its intended goal. Both the Metformin group (P2) and the RDF group (P3) had lower MDA levels than the negative control group (P1), and the mean difference in their partners was statistically significant. After the One Way-Anova test, the three groups were statistically significant (Day-14; Δ MDA Plasma). A further test was carried out to find out which group was different (Table 6).

Tabel 5. Effect of Red Dragon Fruit Juice on HOMA-IR Level

Group	Duration		Δ HOMA-IR	*P* [a]
	Day-0 (*mean* ± *SD*) pg/ml	Day-14 (*mean* ± *SD*) pg/ml		
P1	8.35 ± 0.19	8.32 ± 0.26	-0.03 ± 0.12	0.460
P2	8.65 ± 0.25	4.89 ± 0.29	-3.75 ± 0.09	< 0.001*
P3	8.49 ± 0.28	4.65 ± 0.30	-3.83 ± 0.08	< 0.001*
p [b]	0.067	< 0.001*	< 0.001*	

Source: Primary Data (2019)
*) There is a significant difference; [a]) (p < 0.05) *Paired T-Test* ;[b]) (p < 0.05) *One Way Anova*

Table 5 shows the difference in mean HOMA-IR after being tested with One Way-Anova and Paired T-Test. Before administering the intervention, the mean scores of HOMA-IR levels were compared among the three study groups. It was not statistically significant, indicating that randomization had achieved its intended goal. Both the Metformin group (P2) and the RDF group (P3) had lower HOMA-IR levels than the negative control group (P1), and the mean difference in their partners was statistically significant. After the One Way-Anova test, the three groups were statistically significant (Day-14; Δ HOMA-IR). A further test was carried out to find out which group was different (Table 6).

Tabel 6. Effect of Red Dragon Fruit Juice on Mean Difference Group Pair

Group Pair		Mean Different			
Group I	Group II	FBG	Insulin	MDA	HOMA-IR
P1	P3	< 0.001*[a]	< 0.001*[a]	0,002*[b]	< 0.001*[a]
P2	P3	0,655 [b]	1.000 [a]	0.229 [a]	1.000 [a]

Source: Primary Data (2019)
*) There is a significant difference; [a]) (p < 0.05) *Post hocTest* ; [b]) (p < 0.05) *Mann-Whitney*

Table 6 shows a difference with the mean at P1 and P2 with a significance of <0.001. This indicates that both Metformin (P1) and RDF juice (P3) can reduce GDP, MDA, HOMA-IR and increase Insulin compared to P1. When the mean P2 is compared with the mean P3 group, the result is >0.005, which means that RDF dose (P2) had the same effect as Metformin (P3) in reducing GDP, MDA, HOMA-IR, and increasing Insulin in T2DM model rats.

DISCUSSION

One way-ANOVA only provides conclusions about whether there are differences between three or more data groups, while which groups are different cannot be concluded. To solve which group has differences in one-way ANOVA, a Post Hoc follow-up test is carried out. The result shows that the mean difference is not statistically significant between P2 and P3 in FGB (p=0,655), Insulin (p=1.000), MDA (p=0.229), and Insulin level (p=1.000). This study proves that the provision of red dragon fruit (peel and flesh) with the dose of 3.6 ml / 200 gr BW / day had the same effect as Metformin HCl in reducing FGB, MDA, HOMA-IR also increase Insulin level (table 6). The assessment of insulin resistance is complex and challenging to apply. The Homeostasis

Model Assessment-Insulin Resistance (HOMA-IR), which uses fasting glucose and Insulin parameters, is a validated and widely used insulin resistance index.

Fasting Blood Glucose Level

The FBG levels in the T2DM model rats after STZ-NA induction increased above 200 mg/dl in all groups. This illustrates the condition of hyperglycemia due to the provision of STZ causing cell damage β Langerhans pancreas which results in decreased insulin secretion resulting in T2DM (21). In comparison, Nicotinamide (NA) is a vitamin B3 (niacin) derivative with antioxidant capacity that reduces the cytotoxic action of STZ and protects β cells against STZ. STZ is transported into the B-cells via the GLUT2 glucose transporter and causes DNA damage leading to increased activity of poly (ADP-ribose) polymerase (PARP-1) to repair DNA (22). However, the overactivity of this enzyme results in depletion of intracellular NAD (+) and ATP, and insulin-secreting cells undergo necrosis. Therefore, the protective action of NA is to inhibit PARP-1 activity. Therefore, NA inhibits this enzyme, preventing the depletion of NAD (+) and ATP in STZ-exposed cells [23].

The hypoglycemic effect of RDF is obtained from the main antioxidant components in RDF peel and flesh, namely flavonoids. Flavonoids, especially quercetin, are potent inhibitors of GLUT 2 in the intestinal mucosa, a pathway for glucose and fructose absorption in the intestinal membrane. This inhibitory mechanism is noncompetitive. A recent systematic review and meta-analysis of animal studies showed that quercetin decreases serum glucose levels at doses of 10, 25, and 50 mg/kg of body weight [24]. This results in a reduction in the absorption of glucose and fructose from the intestine to decrease blood glucose levels [25].

Apart from Quentin, one of the flavonoid compounds that play a role in the mechanisms involved in hypoglycemia and its protective activity against diabetes complications is the Rutin compound [26]. This compound is proven to be in the RDF, and its content is higher than white dragon fruit (4). In testing on T2DM model rats that STZ insulated, oral administration at a dose of 5-10 mg/kg significantly decreased FBG levels (27,28). Nature et al. reported that common effects (50 and 100 mg/kg) on FBG and glycosylated hemoglobin were comparable to pioglitazone. This is due to receptor agonists activated by proliferation [29]. Jadhav and Puchchakayala [30] observed that among rutin, boswellic acid, ellagic acid, and quercetin, rutin was the most active flavonoid in increasing glucose tolerance and lowering FBG. Furthermore, they found that rutin (100 mg/kg), comparable to glibenclamide (10 mg/kg), lowered plasma glucose in diabetic and normoglycemic rats [31]. Rutin's mechanism in reducing glucose absorption from the small intestine is by inhibiting α-glucosidase and α-amylase, which are involved in carbohydrate digestion [30–32].

Insulin Level

Increased blood glucose (hyperglycemia) and free fatty acids stimulate the formation of reactive oxygen species (ROS), reactive nitrogen species (RNS), and oxidative stress. This can interfere with pancreatic beta-cell function and insulin resistance to worsen diabetes conditions [33]. The increase in plasma insulin levels is caused by the antioxidant flavonoids present in the peel and flesh of RDF. Flavonoids have a mechanism in inhibiting phosphodiesterase so that cAMP levels in pancreatic β cells increase. This will stimulate insulin secretion through the Ca pathway. In addition, this increase in cAMP levels will cause the closure of the K + ATP channels in the plasma membrane of β cells. This situation causes membrane depolarization and opens Ca channels depending on the voltage, thereby accelerating the entry of Ca ions into the cell. The increase in Ca ion in the cytoplasm of β cells will cause insulin secretion by β cells of the pancreas [34–36].

One of the flavonoid compounds that play a role in the mechanism involved in the antihyperglycemic effect and its protective activity against diabetes complications is the Rutin compound (vitamin P) [26]. Routine can stimulate insulin secretion from beta cells and increase glucose uptake by tissues. In isolated mouse pancreatic islets, the routine significantly increased insulin secretion [37.] In mouse beta cells, rutin has been shown to increase glucose-induced insulin secretion and maintain glucose-sensing ability in high glucose conditions [38]. In rat beta cells, rutin increased glucose-induced insulin secretion, and rutin also demonstrated a role for insulin-mimetics in rat soleus and diaphragm muscles [32,38]. It stimulates glucose transport into muscle via activation of the synthesis and translocation of the GLUT-4 transporter. Like the insulin signaling pathway, phosphoinositide 3-kinase (PI3K), protein kinase C, and mitogen-activated protein kinase (MAPK) are involved in routine intracellular transduction, leading to a stimulatory effect on tissue glucose uptake [38]. Rutin also increases PPARγ expression, increasing insulin resistance and glucose uptake in skeletal muscle and adipose tissue [32].

Insulin Resistance (HOMA-IR)

Insulin resistance is an abnormal physiological condition that occurs when Insulin from pancreatic β cells cannot trigger signal transduction pathways in target organs such as the liver, muscle, and adipose tissue. Loss of insulin sensitivity is commonly associated with persistent hyperglycemia (diabetes) [39]. Insulin resistance impairs PI3K / Akt activation of skeletal muscle and adipose tissue, leading to decreased expression and translocation of GLUT4, resulting in impaired glucose uptake. Deficits in hepatic insulin signaling release FOXO1 back into the nucleus to promote expression of PEPCK and G6P genes, promoting gluconeogenesis and reducing activation of Glucokinase/Glycogen Synthase Kinase (GK and GSK), which suppress glycogen synthesis [40]. Based on the research, flavonoids can increase the expression of Akt, AMPK, GLUT4, and adiponectin in skeletal muscle tissue [41] and increase levels of IRS1 and GLUT4 mRNA in skeletal muscle tissue [42] resulting in increased insulin resistance in skeletal muscle tissue. Also can increase GK activity in liver tissue [43] and increase GSK mRNA levels in liver tissue resulting in an increase in insulin resistance in the liver [42].

The HOMA-IR value was inversely proportional to plasma insulin levels and directly proportional to FBG levels. The results showed the value of insulin resistance (HOMA-IR), then the uptake and use of glucose by the body's cells were disrupted. As a result, the glucose levels in the blood increased. Flavonoids can reduce insulin concentration and improve glucose tolerance through adipocytokine regulation, including increased serum adiponectin [44]. Flavonoids have also been shown to stimulate adipocyte differentiation and increase glucose transport in adipocytes by inducing PPARg-mediated adiponectin expression and translocation of GLUT4 in 3T3-L1 adipocytes [45]. Previous research also revealed that intake of flavonoids could reduce insulin resistance levels [46].

MDA Level

MDA levels in the T2DM model rats after STZ-NA induction increased in all groups compared to controls. This indicates that the induction of STZ-NA succeeded in increasing Reactive Oxygen Species (ROS) levels in the T2DM model rats. The source of oxidative stress in T2DMs is due to a shift in the balance of redox reactions due to changes in carbohydrate and lipid metabolism, which will increase ROS formation from glycation and lipid oxidation reactions, thereby reducing the antioxidant defense system [47].

The effect of decreasing plasma MDA levels can be caused by antioxidant flavonoids in the RDF peel and flesh. One of the flavonoids content, namely betacyanin, which is a pigment of RDF, has a high antioxidant effect and plays a role in reducing ROS levels to provide a protective effect on diabetic rat pancreatic cells. [25].

Hyperglycemia in T2DM can produce intracellular reactive oxygen/nitrogen species (ROS / RNS) excess. Experiments on diabetic animals prove that giving rutin can increase antioxidant status in various tissues by increasing non-enzymatic antioxidant status (reducing glutathione) and enzymatic antioxidant status (Superoxide dismutase and catalase) [29,48,49]. Rutin contains many OH substitutions so that it has a sufficient effect in reducing free radical levels [26]. Analysis of the structure-function relationship shows the importance of Bring and 3'-OH and 4'-OH groups to free radicals that work on the effect of Rutin [50]. Because of this group, rutin tends to give electrons to free radicals, converting them into more stable radical intermediates and inhibiting further free radical reactions [50].

CONCLUSIONS

The administration of RDF fruit juice intervention for 14 days significantly reduced FBG, MDA, HOMA-IR levels and significantly increased plasma insulin levels in the T2DM rats model. RDF fruit juice can be an alternative therapy to reduce ROS and insulin resistance in the T2DM rats model. Long duration follow-up studies are required before application in diabetic patients.

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Effectiveness of Parental Assistance in Providing Food on Nutritional Intake Among Children with Malnutrition

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ABSTRACT

Background: *Prevalence of stunting continues to affect 21.3% of children aged <5 years worldwide. The problem of malnutrition in children is caused by several factors, such as poor access to nutritious food, recurrent infections, and inadequate practice of offering food and care for mothers and children during the first 1,000 days.*

Objectives: *The purpose of the study was to know the effectiveness of feeding parenting style assistance to mothers of toddlers in increasing the nutritional intake of under-nutrition children*

Materials and Methods: *This study used a quasi-experimental design with a pre-test and post-test control group design approach. The population in this study was toddlers with malnutrition (according to weight/height). The sample size for each group was 35 mothers. The sample was divided into two groups. The first group was given parental assistance consisting of nutrition education and food processing guidance for the toddler for 3 months (the intervention group) and the second group was given health education about balanced nutrition for children under five (the control group). Collecting data had used a checklist of identity, nutritional status, and semi-quantitative food frequency questionnaire. Data were analyzed using paired t-test, p-value <0.05 for the 95% confidence interval.*

Results: *The nutritional intakes of children under five showed a significant difference between the group of mothers under five who were given intensive assistance (the intervention group) and the group that was only given nutrition education for children under five (the control group). The differences in nutritional intakes seen in macronutrients were the difference in calorie intake (p-value: 0.042; CI: 4.005-213.543) and protein intake (p-value: 0.040; CI: 0.197-8.065). The differences in micronutrient intakes were seen in the increase in consumption of vitamin E (p-value: 0.000; CI: 0.446-4.416), sodium (p-value: 0.000; CI: 61.859-193.741), potassium (p-value: 0.005; CI: 70.743-373.102), calcium (p-value: 0.000; CI: 51.851-137.863), and phosphor (p-value: 0.041; CI: 2.133-99.604).*

Conclusion*: Food parenting assistance for mothers of toddlers was effective in increasing toddler nutrition*

Keywords: *Food parenting assistance; Toddler; Nutrition; Malnutrition*

BACKGROUND

Stunting is a physical manifestation of chronic malnutrition and has shown higher rates of suboptimal development, morbidity, and mortality in young children, with frequent occurrences later in life [1]. The prevalence of stunting worldwide had decreased from 1990 to 2018. However, it was predicted that it would be increased to 21.3% in children aged <5 years worldwide. The burden of stunting is almost entirely in low-income countries where there is an increase, an excess of childhood infections, and an inadequate diet [2]. The problem of malnutrition in children is caused by several factors, such as poor access to nutritious food, recurrent infections, and inadequate practice of offering food and care for mothers and children during the first 1,000 days, from conception to the age of two[3]. The results of Rodiger's assessment (2020) in his research state the determinants of stunting which consist of basic determinants and direct determinants. The basic determinants are 1) household income asset index and 2) parental education, particularly maternal education. The underlying determinants are: 1) sanitary sewage, 2) clean water, 3) bed nets, 4) vaccination coverage, 5) attendance at antenatal polyclinic visits, 6) optimal breastfeeding practices, and 7) household food security. The direct determinants of stunting are: 1) decreased fertility, 2) birth spacing, 3) maternal height, 4) birth weight babies, 5) dietary diversity, and 6) incidence of diarrhea[2].

Controlling the practice of offering children's meals (guarding and pressure to eat) has been theorized to predict an increase in the child's weight status[4]. Infant and young child feeding (IYCF) has major implications for a child's survival, health,

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growth, and development. Cook, et. al (2020) also reported that age-appropriate IYCF practice especially complementary foods - was significantly associated with increased height-for-age z-score (HAZ) and decreased likelihood of stunting ($p < .05$). Also, age-appropriate IYCF practice - in isolation - made a modest statistical contribution to the rapid and sustained decline in age-specific linear growth of children from 1996-2016. A complemented multisectoral nutrition strategy - integrating and optimizing IYCF practice- is essential to further accelerate progress in dealing with childhood linear growth disorders. In addition, a special focus is needed on improving IYCF practices that have not shown significant progress over the past two decades: exclusive breastfeeding (EBF), a minimum acceptable diet, and providing minimal bottle feeding[5]. Therefore, researchers modified mentoring for mothers of children under five in training mothers to prepare and provide food for under-nutrition children. The aim of the assistance given to mothers of toddlers is to make efforts to prevent wasting and stunting in malnourished toddlers by preparing mothers of toddlers in terms of knowledge and skills in preparing economical and nutritious food for their toddlers.

MATERIALS AND METHODS

This study used a quasi-experimental design with a pre-test and post-test control group design approach. This research had passed the ethical test with the number :155/KEPK-FKM/UNIMUS/2019. This study used a simple random technique with an estimation approach where the population size was 90 mothers who had toddlers with malnutrition at Kedungwuni II Health Center. The malnutrition based on height/age indicators The calculation of the sample size is calculated using an alpha value approach of 0.05, 80% power based on Ayu SD's research (2008) previously obtained the mean (SD) of each item. The sample size was determined by simple random sampling. The sample size for each group was 35 mothers with under-five children. The sample was divided into two groups, namely the group that was given parental assistance consisting of nutrition education and food processing guidance for the toddler for 3 months (the intervention group) and the group that was given health education about balanced nutrition for children under five (the control group). In this study, inclusion and exclusion criteria were determined in determining the sampling. Inclusion criteria are mothers who have toddlers aged 1-3 years whose parents are permanent residents in Kedungwuni II Public Health Center, Pekalongan Regency. Meanwhile, the exclusion criteria were mothers whose children under five are malnourished and have congenital disabilities and chronic illness; mothers who are not willing to be respondents; mothers whose children under five are stunted and certain food allergies (including dropouts), mothers who do not comply with the intervention rules (not followed-up). The sampling technique was taken by making a serial number of respondents according to the list provided by Kedungwuni II Public Health Center. Researchers make numbers and draw random numbers that come out of their names and make them as respondents in the study. The enumerator collected data according to the name given by the researcher in the toddler class and continued with assistance to mothers who were willing to become research respondents in the toddler class organized by the researcher. Assistance is carried out in three face-to-face sessions, namely by providing education and training to prepare food according to the child's age followed by home visits. Home visits are carried out to monitor activities of supplementary feeding and to evaluate the achievements of Mothers with under-five children. Evaluation of the effect of the intervention was carried out after (follow-up) three months, by looking at differences in nutritional intake of children before mentoring and after mentoring.

Collecting data were using a checklist of identity, nutritional status checklist, and semi-quantitative food frequency instruments. While the tools used in the weight assessment were baby scales and microtoise to measured height. Data were analyzed using an independent t-test on the mean difference of infant nutritional intake between the control and intervention groups. The level of significance used in this test was p-value <0.05 for the 95% confidence interval.

RESULTS

The results of the research on 70 respondents who have participated in the toddler class for 3 consecutive months in two different groups are as follows:

Tables 1 and 2 show that most mothers of toddlers are housewives, who have a lot of time with their children and have a great opportunity to prepare food for their children. With the provision of higher education, education will be easier to do. The level of understanding is directly proportional to the level of education.

Table 3 shows the nutritional intake of children under five before and after Parental Assistance was carried out. This table shows a change in nutritional

intake for children under five, especially in the intake of macronutrients in energy, protein, and fats.

Table 4 shows that some of the nutritional intakes of children under five showed a significant difference between the group of mothers under five who were given intensive assistance (the intervention group) and the group that was only given nutrition education for children under five (the control group).

Table 1 Characteristic of Toddlers and Mother Toddlers

Variable	Intervention		Control		p-value
	n	%	n	%	
Gender					
Male	12	34	20	57	0.055
Female	23	66	15	43	
Breastfeeding History					
Exclusive	25	71	19	54	0.138
Not Exclusive	10	29	16	46	

Table 2 Characteristic of Mother Toddlers

Variable	Intervention		Control		p-value
	n	%	n	%	
Mother's educational level					
Lower secondary education	4	12	8	23	0.205
Upper secondary education	31	88	27	77	
Mother's working status					
Workers	6	17	10	29	0.255
Housewife	29	83	25	71	

Table 3 Comparison of Differences in Nutritional Intake of Children Under Five Before And After Intervention In The Intervention Group

Variable	Before	After	p-value	CI 95%
	Mean ± SD	Mean ± SD		
Energy	697±242.768	906.983±263.576	0.005	-350.898 – (-69.067)
Protein	20.04±9.69	27.663±9.806	0.005	-12.779 – (-2.466)
Fat	25.217±11.537	32.663±12.245	0.018	-13.549 – (-1.341)
Vitamin A	387±234.605	406.703±193.103	0.699	-119.086-80.756
Vitamin E	0.994±1.163	2.223±1.572	0.001	-1.949- (-0.508)
Vitamin B1	17.08±100.386	0.16±0.082	0.326	-17.573 – 51.413
Vitamin B2	0.217±0.207	0.188±0.211	0.586	-0.077-0.134
Vitamin B6	17.2±100.538	0.246±0.030	0.325	-17.596 – 51.505
Vitamin C	29.691±99.725	10.017±16.170	0.261	-7.616-7.428

Table 4 Comparison of the difference in nutritional intake of children under five in the intervention group with the control group

Variable	Intervention	Control	p-value	CI 95%
	ΔMean ± SD	ΔMean ± SD		
Energy	106.883±178.905	1.891±188.517	0.042	4.005-213.543
Protein	3.971±6.280	0.160±7.368	0.040	0.197-8.065
Fat	3.903±1.369	0.18±1.605	0.123	-1.156-9.321
Carbohydrate	14.645±25.811	0.400±26.574	0.057	0.480- 29.692
Vitamin A	1.349±155.576	8.257±187.648	0.896	-114.086-100.269
Vitamin E	0.720±0.828	0.106±0.691	0.000	0.446-4.416
Vitamin B1	0.014±0.091	0.009±0.082	0.824	-0.046-0.058
Vitamin B2	0.014±0.142	7.930±0.153	0.739	-0.101-0.072
Vitamin B6	0.008±0.008	0.029±0.125	0.359	-0.118-0.044
Vitamin C	-1.091±11.669	0.997±12.651	0.979	-7.616-7.428
Sodium	116.76±141.68	-11.04±19.387	0.000	61.859-193.741

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Potassium	209.46±251.27	-12.462±272.485	0.005	70.743-373.102
Calcium	81.914±87.044	-12.948±79.826	0.000	51.851-137.863
Magnesium	0.108±20.965	7.328±22.397	0.280	-21.227-6.352
Phosphorus	60.394±81.572	9.526±87.223	0.041	2.133-99.604
Iron	0.454±0.935	0.071±1.046	0.190	-0.199-0.964
Zinc	0.014±0.862	-0.011±0.910	0.922	-0.503-0.555

The differences in nutritional intakes seen in macronutrients were the difference in calorie intake (p-value: 0.042; CI: 4.005-213.543) and protein intake (p-value: 0.040; CI: 0.197-8.065). The differences in micronutrient intakes were seen in the increase in consumption of vitamin E (p-value: 0.000; CI: 0.446-4.416), sodium (p-value: 0.000; CI: 61.859-193.741), potassium (p-value: 0.005; CI: 70.743-373.102), calcium (p-value: 0.000; CI: 51.851-137.863), and phosphor (p-value: 0.041; CI: 2.133-99.604).

DISCUSSION

This study shows the differences in nutritional intake of children under five whose mothers receive nutrition training for toddlers with groups that are given nutrition education for toddlers only. This can be seen in the difference between nutrients consumed by toddlers before and after the intervention. The difference can be seen in the calorie intake of toddlers whose mothers are given assistance in parenting for toddlers with toddlers whose mothers are given nutrition education for toddlers only (p-value: 0.005; -350.898 – (-69.067)).

Improvement of childcare practices, especially at the end of mentoring nutrition is closely related to increasing the knowledge that mothers hold a dominant role in childcare. That is, nutritional messages and health-related childcare can be implemented by mothers as babysitters[6]. The toddler family assistance program conducted by Purwanti, Rachma, et al. (2020) shows an increase in the knowledge of mothers under five about exclusive breastfeeding and complementary breastfeeding that is following toddler nutrition, increased awareness of mothers to monitor the growth and development of toddlers through posyandu, increased maternal skills in making the F-100 increase the nutritional intake of children under five (seen from simulation activities and home visits), and the consumption of a more diverse diet for toddlers and an increase in energy, carbohydrate, protein, and fat intake [7]. Other research shows that there was a significant difference in knowledge before and after the Mother Smart Grounding (MSG) program (p = 0.000), there was a significant difference in attitude (p = 0.000), and there was a significant difference in motivation (p = 0.000). The MSG program is an educational package in the form of counseling conventional, booklet distribution, and demonstration of healthy snacks made from local moringa (Moringa oleifera)[8].

Inadequate nutritional intake is a direct cause of malnutrition in toddlers. Arifin (2012) said that toddlers with toddler nutrition less risk 2.6 times more stunted than toddlers with good toddler nutrition. This research has shown that there was a different protein intake of toddlers whose mothers are given assistance in parenting for toddlers with toddlers whose mothers are given nutrition education for toddlers only (p-value: 0.040; CI: 0.197-8.065)[9.] This is in line with the research results of Cahya and Sulistyaningsih which suggest that protein is associated with incidence stunting (p-value 0.002). Protein works in carrying out body regulations and new DNA forms for the body. Long-term protein deficiency will disrupt regulations body and growth hormone can distraction that it can cause nutritional disorders such as stunting[10, 11].

Several micronutrients showed a significant influence between vitamin and mineral intake between groups of toddlers whose mothers were provided with nutritional parenting and those whose mothers were only given nutrition education for toddlers. The study showed an increase in the amount of vitamin E intake in children under the intervention group amounting to 0.720 (p-value: 0.000; CI: 0.446-4.416). Vitamin E functions as an antioxidant which functions to increases body immunity. Lack of vitamin E will cause red blood cells to be easily damaged, damage to muscles and nerves to impaired intestinal absorption. In infants and toddlers who are deficient in vitamin E, it can inhibit growth and development so that the developmental stage cannot match the age it should be [12.] The results showed no significant difference in the consumption of vitamins A, B1, B2, B6, and C. This study is not in line with that research done by doing fortification micronutrients, including vitamins B1, B6, and B12 in toddlers who have an infection. Research result states that there is a decrease in disease infections in toddlers who get extra micronutrients[13.] While the taken amount of vitamin C insufficient amount can prevent the occurrence of infection. Low intake of vitamin C

represents risk factors for infection, especially in the area which are endemic to parasitic infections [14].

Several minerals important in the growth and development of children are the target of increasing intake in this study. This proved to be a significant difference in the intake of minerals such as sodium, potassium, and calcium which are important for skeletal growth. Sodium functions in the balance of body fluids maintain acid-base balance, regulates muscle and nerve sensitivity, plays a role in glucose absorption, and is a means of transporting nutrients through the membrane, especially the intestinal wall [12]. Sodium is a mineral that is needed in large quantities in the body, including during growth. While potassium is a macromineral that plays a key role in fluid balance, muscle contraction, and nerve function [15]. Potassium deficiency results in sluggishness and no appetite so that the role of potassium in increasing children's daily consumption is very important.

Apart from these two macro minerals, the most popular macro-mineral in preventing stunting is calcium. Calcium plays a role in the formation of bones, teeth, regulates blood clotting, catalyzes biological reactions, coordinates muscle contraction, increasing cell membrane transport, accelerates the transmission of stimuli, and activates certain enzymes[12]. Studies in China on boys' ages under 6 years proved that there is a link between stunted intake and intake of low fat and protein. The study also reported being stunted in men ages 2–5 years associated with other macronutrients such as protein as well as micronutrients such as calcium and riboflavin[16]. Increased phosphorus intake also serves to increase growth, especially in preventing stunting. Phosphorus functions in forming the main structure of bones together with calcium. Phosphorus is found in milk like calcium. But it is also abundant in other foods such as meat, fish, eggs, poultry, nuts, and seeds so children usually get a lot of phosphorus in their diet[15].

CONCLUSIONS

There were a significant difference in the nutritional intake of children under five whose mothers were provided nutritional parenting style assistance with groups of toddlers whose mothers were only given health education about toddler nutrition both in calorie intake, macronutrients, and micronutrients.

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Correlation of dietary intake and physical activity with nutritional status, body composition and hand grip strength in elderly

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ABSTRACT

Background: *Increased life expectancy has both positive and negative impacts. Elderly group are prone to nutritional issues and body function disorder such as sarcopenia. Factors including dietary intake and physical activity are contributors of sarcopenia.*

Objectives: *The purpose of this study is to analyze the correlation of dietary intake and physical activity with nutritional status, body composition and hand grip strength (HGS) in elderly.*

Materials and Methods: *The study was held on July-October 2020 at the Panti Wredha Dharma Bakti Surakarta. This was a cross-sectional study of 54 elderly subjects. Subjects were selected by purposive sampling method. The data included height was measured using microtoise, while weight and body composition was measured using Bioelectrical Impedance Analyzer (BIA). Dietary intake was obtained through comstock observation. Physical activity was measured by the International Physical Activity Questionnaire. Hand grip strength values was measured by hand grip dynamometer. Data normality analyzed by Kolmogorov-Smirnov test. Bivariate test analyzed by Rank Spearman test.*

Results: *Energy, carbohydrate and fat intake had no correlation with nutritional status, total body fat percentage, subcutaneous fat percentage and skeletal muscle mass percentage (p value > 0.05), but there was a relationship between energy (p value = 0.33), carbohydrate (p value = 0.016) and fat intake (p value = 0.047) with visceral fat percentage. Physical activity had relation with nutritional status (p = 0.048) but had no relationship with total body fat percentage, visceral fat percentage, subcutaneous fat percentage and skeletal muscle mass percentage. Protein intake also had no relationship with HGS value (p value> 0.05).*

Conclusions: *Dietary intake only correlated with visceral fat percentage, but had no correlation with other body composition parameters. Physical activity correlated with nutritional status, but had no correlation with all of body composition parameters. Protein intake also had no correlation with HGS.*

Keywords: *Nutritional status; dietary intake; body composition; HGS; physical activity*

BACKGROUND

Globally, Indonesia has the fifth-largest elderly population in the world. Population projection data in 2019 shows 27.5 million elderly or 10.3% from the whole population and predicted to grow into 57 millions in 2045 or 17.9% from total population in Indonesia.[1] Central Java is province with the second-largest elderly population after Yogyakarta Special Region. In 2015, elderly population in Central Java reached 11.7% and grows to 12.59% in 2017.[2] This shows the increasing life expectancy of the elderly population in the world, including Indonesia.[3] According to population projection data in 2010-2035, Indonesia will experience an ageing period, where 10% of Indonesian population will be 60 years old. In 2004 to 2015 there was an increased life expectation rate in Indonesia from 68.6 to 70.8 years old and projected to be 72.2 years old in 2030-2035.[4]

The growing number of elderly populations has both positive and negative impact. Elderly will make positive contribution if they are healthy, physically active, and productive. While the negative impacts are when elderly has deteriorating health condition and chronic diseases.[2] The age-related decline in metabolic rate will make elderly more prone to diseases.[5,6] Elderly are specific population prone to nutritional status abnormality (over or undernutrition) and body composition changes.[7]

Ageing will affect changes in energy intake due to impaired glucose homeostasis, hormonal, gustatory and olfactory system.[8] Basal metabolic rate (BMR) studies in elderly shows a 1-2% decline yearly and substantially 5% less than younger age.[9] All of the above contributes to nutritional status changes in elderly.

Increasing age is associated with the loss of muscle mass which occurs continuously and consistently, also the gain of body fat composition. In adult, muscle mass makes up 45% of total body weight, while in elderly decreases to 27%. This will

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attributes to the decreased energy requirement for 5% every 10 years.[10] Moreover, ageing in elderly will affect clinically to body function, such as the increasing risk of sarcopenia. Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength and it is strictly correlated with age, gender and physical activity.[11]

Nutritional issues in elderly should be addressed by adequate nutrition intake and focusing on physical activity as the body function are declining. Increased physical activity will improve health outcomes, while inactivity will impose elderly to diseases.[5] Gerontologists and geriatricians stated that nutrition holds 30-50% role in achieving and maintaining optimum health condition in elderly. Certain nutrient needs are increased due to rapidly occurring degradation process.[6] Several studies shows there is a significant correlation between energy intake consumption with nutritional status in elderly. In elderly, body protein need is not decreased, even higher than adults. But several studies shows most of elderly experiencing protein consumption deficit.[10] Based on mentioned above background, authors are interested in identifying correlation between dietary intake and physical activity with nutritional status, body composition and hand grip strength value in elderly.

MATERIALS AND METHODS

This study was performed in July to October 2020 in Panti Wredha Dharma Bakti Surakarta. This is an observational-analytic study with cross-sectional design. Sample size for this study was calculated using population proportion estimation with minimum 50 subjects sample size. Subjects were pre-screened, then 54 subjects eligible to inclusion criteria was chosen using purposive sampling method. Inclusion criteria of this study are elderly living in Panti Wredha Dharma Bakti Surakarta from July to October 2020 >60 years old, able to communicate effectively, and gave consent to participate. Exclusion criteria for this study is if subject resigns when the study took place. This study had been approved by Health Research Ethics Committee of Medical Faculty Diponegoro University Number 55/EC/KEPK/FK-UNDIP/V/2020.

Independent variables in this study are dietary intake (energy, fat, carbohydrate, protein) and physical activity. Dietary intake data was obtained from Comstock visual observation converted to *ukuran rumah tangga* (URT), then analyzed using Nutrisurvey 2007. Energy, fat, protein, and carbohydrates requirement was calculated from Recommended Daily Allowance (RDA) 2019 adjusted by age group.[12] Dietary intake was considered 'adequate' when intake was meeting 80-110% requirement, considered 'more' if surpass 110% and 'less' if not meeting 80% requirement. Physical activity data was obtained from calculated daily physical activity including last 7 days exercise. Physical activity was scored using International Physical Activity Questionnaire (IPAQ). Physical activity score was calculated according to IPAQ scoring protocol. Physical activity score was classified as 'low' if under 600, 'moderate' if 600-2999 and 'high' if $\geq$ 3000.

Dependent variable in this study are body mass index (BMI), hand grip strength (HGS) and body composition parameters consist of percent fat mass, visceral fat, subcutaneous fat, and skeletal muscle mass. Body mass index value was obtained from weight divided by square height. Body mass index is categorized as underweight if <18.5 kg/m^2, normal if 18.5-22.9 kg/m^2, overweight if 23-24.9 kg/m^2, obesity grade I if 25-29.9 kg/m^2, obesity grade II if $\geq$ 30 kg/m^2. Body composition measured by OMRON (Karada Scan) model HBF 375. All procedures were carried out according to manufacturer instructions. Percent fat mass is categorized as normal if 20-30 % for women and 20 % for man. Visceral fat is categorized as normal if 0.5-9.5 %. Subcutaneous fat is categorized as normal if 20-29.9 % for women and 10-19.9 % for men. Skeletal muscle mass is categorized as normal if 23.9-29.9% for women and 32.9-38.9 % for men.

Hand grip strength is a measure of muscular strength or the maximum force/tension generated by one's forearm muscles. Hand grip strength value was measured by hand grip dynamometer. Univariate data analysis in this study was used to describe each study variables characteristic. Data normality was analyzed by Kolmogorov-Smirnov test. Bivariate data analysis was done using Spearman Rank test. Bivariate analysis was used to identify correlation between each variable in this study.

RESULTS

Subjects characteristic

Subjects characteristic table shows average of subjects age is 71.96 years old. Subjects' nutritional status by BMI is 23.37 kg/cm^2, there was underweight elderly subject with BMI 15.08 kg/cm^2 and obese elderly subject with BMI 36.86 kg/cm^2.

The result of this study shows that most of the subjects has normal nutritional status (37%) but 50% of them has obesity and are overweight. While based on percent fat, there are 63% subjects are overweight

and obese. Most subjects (66.7%) has low physical activity score, only 1 subjects was found to be highly active. More than half subjects (66.7%) has low hand grip strength (HGS) value. Most of the subjects hare normal visceral and subcutaneous fat, but all subjects have low skeletal muscle mass. Majority of the subjects (72.2%) has adequate dietary intake.

Correlation of dietary intake and physical activity and body composition

Fat percentage in this study has no correlation with energy, carbohydrate, fat intake and physical activity. Instead, energy, fat, and carbohydrate intake has positive correlation in the same direction, just physical activity alone has negative correlation direction. After analysis, visceral fat has significant correlation with dietary intake irrespective of energy, fat, or carbohydrate intake, while physical activity has no correlation with visceral fat. In this study, dietary intake (energy, fat, carbohydrate) has no significant correlation with subcutaneous fat and skeletal muscle mass ($p > 0.05$).

Correlation of dietary intake and physical activity with BMI and HGS

This study shows that BMI has no significant correlation with energy intake, but correlates in positive direction for 0.259. Inversely, this study shows a significant correlation between BMI and fat and carbohydrate intake, and physical activity. Handgrip strength value also does not significantly correlate with protein intake, but correlates in positive direction for 0.235.

Table 1. Subjects Characteristic

Variable	Min	Max	Mean ±SD
Age (years)	59	92	71.90±8.44
Weight (kgs)	28.30	101.20	56.30±13.55
Height (cm)	137.68	169	153.41±6.50
Body Mass Index (kg/cm^2)	15.08	36.86	23.30±4.16
Physical activity (score)	120	3986	1100.10±871.17
HGS (kg)	2.60	34.60	16.60±6.78
Percent Fat (%)	13.60	49.20	33.40±8.02
Percent Visceral Fat (%)	0.50	30	8.50±5.37
Percent Subcutaneous Fat (%)	10.60	37.20	25.10±5.95
Percent Skeletal Muscle Mass (%)	13	31.10	22.90±3.71
Energy intake (kcal)	1489	1887	1610±110
Carbohydrate intake (g)	265	313	270.90±11.31
Fat intake (g)	30	47	35.70±5.06
Protein intake (g)	41	74	50.7±9.01

Table 2. Distribution and Frequency of BMI, Physical Activity, HGS, Body Composition and Dietary Intake

Characteristic	N	%
BMI		
Underweight	7	13
Normal	28	37
Overweight	10	18.50
Obese I	14	25.90
Obese II	3	5.60
Physical activity		
Low	36	66.70
Moderate	17	31.50
High	1	1.90
HGS		
Normal	18	33.30
Low	36	66.70
Percent fat		

Ideal	20	37

Characteristic	N	%
Overweight	25	46.30
Obese	9	16.70
Percent visceral fat		
Normal	36	66.70
High	15	27.80
Very High	3	5.60
Percent subcutaneous fat		
Low	8	14.80
Normal	26	48.10
High	7	13
Very hight	13	24.10
Percent skeletal muscle mass		
Low	54	100
Energy intake		
Low	1	1.90
Adequate	39	72.20
High	14	25.90
Fat intake		
Low	2	3.70
Adequate	18	33.30
High	34	63
Protein intake		
Low	22	40.70
Adequate	27	50
High	5	9.30
Carbohydrate intake		
Low	29	53.70
Adequate	25	46.30

Table 3. Correlation of Dietary Intake and Physical Activity with Body Composition Parameters

Variable	R	P Value*
Percent Fat		
Energy intake	0.188	0.174
Fat intake	0.239	0.081
Carbohydrate intake	0.017	0.901
Physical activity	-0.036	0.796
Percent Visceral Fat		
Energy intake	0.291	0.033*
Fat intake	0.272	0.047*
Carbohydrate intake	0.328	0.016*
Physical activity	0.242	0.078
Percent Subcutaneous Fat		
Energy intake	0.009	0.947
Fat intake	-0.023	0.872
Carbohydrate intake	-0.105	0.450
Physical activity	0.161	0.246
Percent Skeletal Muscle Mass		
Energy intake	-0.151	0.275
Fat intake	-0.219	0.111
Carbohydrate intake	0.110	0.429
Physical activity	0.179	0.195

Rank Spearman Test *Significant ($p<0.05$)

Table 4. Correlation of Dietary Intake and Physical Activity with Nutritional Status and HGS

Variable	R	P Value*
BMI		
Energy intake	0.259	0.059
Fat intake	0.275	0.044*
Carbohydrate intake	0.289	0.034*
Physical activity	0.270	0.048*
HGS		
Protein intake	0.235	0.087

Rank Spearman test *Significant (p<0.05)

DISCUSSION

Subjects of this study are 54 elderly in Panti Wredha Dharma Bakti Surakarta. Result of this study shows 50% BMI of the subjects are overweight and obese. Thirteen percent elderly are underweight, and the rest are within normal weight. Other studies on elderly in Semarang also shows 50% elderly are overweight, 7.5% are underweight and 42.5% are normal.[13] Based on percent total fat, there are 63% elderly with obesity and overweight. Other study on elderly in Puskesmas Sukawati also shows 77.8% subjects are obese. Overweight or obesity is predominantly caused by excess calories from eating more than energy requirement and the lack of physical activity.[14]

This study shows 66.7% elderly has low score of physical activity, 31.5% elderly has moderate score and only 1.9% elderly has high score. Low physical activity in elderly is caused by limited daily activities in the environment. A study on elderly in Karangjati also shows 70.6% of the subjects has low activity level. Elderly over 70 years of age indeed engaged in less physical activity as much as 64.8%.[15] Low or moderate physical activity is associated with declining cognitive function, especially memory and language function. Physical activity are known to improve executive function, directing attention, thinking speed, working memory, and short/long term memory.[16]

Handgrip strength value for most of the elderly (66.7%) were low, only 33.3% of the subjects has normal HGS value with average 16.61±6.78 kg. A study on elderly in Semarang also shows 63.8% subjects has low grip strength. Hand grip strength is one of important indicator in diagnosing sarcopenia in elderly.[17] Decreased grip strength in ageing is associated with muscle type transformation, muscle fiber composition changes, and excitation-contraction (EC) process, genetic factor, and oxidative stress (increased IL-6 and pro-apoptosis cytokine TNF-α).[18] Decreased type II muscle fiber which plays role in anaerobic metabolism is main mechanism in lower grip strength in elderly. Less neurotropic factor as serotonergic, cholinergic, adrenergic, dopaminergic, acid-aminobutyric, and glutaminergic system caused hypo excitability in the cortex, decreased motoric coordination and cortical plasticity which affect motoric work.[19] Based on the European Working Group on Sarcopenia in Older People (EWGSOP), grip strength is a valid and reliable parameter of measuring muscle strength in diagnosing sarcopenia.[20] Sarcopenia is a geriatric condition which characterized with the loss of muscle mass and declining muscle function caused by less physical activity, caloric intake, more fibrotic progressivity, muscle metabolic changes, inflammation and oxidative stress.[21]

Bivariate analysis in this study shows BMI is significantly correlates with fat and carbohydrate intake but not with energy intake. A study on 214 elderly in Yogyakarta shows dietary intake (energy, carbohydrate, fat, protein) correlates with nutritional status.[22] Dietary intake is a direct factor in determining one's nutritional status.[23] If an elderly consume more than 3500 kcal of energy, the excess of calories will produce 0.45 kg of fat. Excess calories of 1000 kcal per day will add 1 kg of fat per week. Chronic excess calories will result in weight gain.[24] One with inadequate dietary intake will have 3.2 times higher risk of being malnourished, compared to subjects with adequate dietary intake.[25] A study on elderly in Puskesmas Rambung Kota Binjai in 2019 also shows BMI significantly correlated with energy intake. Although inversely correlated, this study also has positive correlation with the value of 0.259. Inadequate energy intake occurs overtime will caused decreased body weight while excess energy intake will increased body fat deposit and weight gain.[26]

Energy, fat, and carbohydrate intake in this study is significantly correlated with percent visceral fat. A study on 624 elderly in Japan shows different result where energy, fat, carbohydrate and protein do not have significant correlation with visceral fat accumulation.[17] A study in 81 elderly in Puskesmas Jagir Surabaya also shows same result. Elderly does not likely to be obese and centrally obese. Visceral fat is body fat deposited in the middle of the body and covering internal organs. A study shows that obese people tend to have more visceral fat.[27]

This result shows that dietary intake does not correlate with body composition parameters (percent body fat, subcutaneous fat, and skeletal muscle mass). Dietary intake positively correlated with body fat percentage. Body fat percentage will be lower if the dietary intake is subsided and energy expenditure is increased through physical activity.[28] Although the result of this study is not correlated significantly but energy, carbohydrate and fat intake has correlation in positive direction with percent body fat. A study in 167 subjects also show similar result, energy, carbohydrate and fat intake are not correlated with subcutaneous fat tissue.[29]

Hand grip strength value in this study does not have significant correlation with protein intake. This result is similar to a study on 4123 elderly in the States, where dietary intake with ≥25 gram and ≥30 gram protein does not correlates with grip strength. Nevertheless, a high protein consumption correlates positively with grip strength in female subjects.[22] Although not correlates significantly, protein intake and HGS has correlation in positive direction (r=0.235).

In this study, physical activity correlates significantly with BMI. Physical activity is one of important determinants of BMI. Excess energy intake if not accompanied by balanced energy expenditure through physical activity will results in weight gain. Lifestyle changes also influence population eating pattern that will refer to high dense calorie, fat, cholesterol and sedentary activity also play role.[30] Most elderly subjects in this study has low physical activity which contributes to the high number of overweight and obesity in BMI.

This study showed that physical activity was not significantly correlated with body composition parameters (percent body fat, visceral fat, subcutaneous fat and skeletal muscle mass). A study in 60 scholar subjects also showed a similar result. This result is different with previous study, which physical activity in working days correlates with BMI and body fat. The higher one's physical activity, the better the nutritional status. Based on the literature, physical activity is more influential to body composition than weight loss. The average loss of visceral fat is 44%.[31] Physical activity is able to increase fatty acids oxidation in skeletal muscle mass, mitochondrial volume, and adipocytes lipolysis to fatty acids, and fatty acids transport into cells. Besides, physical activity yields more energy contribution from fatty acids deposited in adipocytes.[32]

CONCLUSIONS

Dietary intake only correlates with visceral fat percentage, but has no correlation with other body composition parameters. Physical activity correlates with nutritional status, but has no correlation with all of body composition parameters. Protein intake also has no correlation with HGS

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Catfish Oil (Pangasius hypophthalmus) effect to ferritin and sTfR in iron deficiency anemia

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ABSTRACT

Background: *Iron deficiency anemia is a micronutrient problem and the prevalence is still high. Catfish oil (Pangasius hypophthalmus) is a natural source of heme iron which can improve body iron levels.*
Objectives: *This study was aimed to examine and analyze the effect of catfish oil on ferritin and sTfR levels in male wistar rats with iron deficiency anemia models.*
Materials and Methods: *This study was conducted on male wistar rats which were divided into groups C- (standard feed), C+ (standard feed but had the iron removed), X1 (standard feed without iron but was supplemented with catfish oil), X2 (standard feed without iron but was supplemented with ferrous sulfate) for 14 days. Ferritin and sTfR levels were measured before and after intervention using ELISA.*
Results: *The study showed an increase ferritin levels in X1 (21.87 ng/ml ±0.76), X2 (24.47 ng/ml ±0.54) and there was no significant difference between the two (p=0.069; p>0.05); a decrease in C- (0.25 ng/ml ±0.43), C+ (0.32 ng/ml ±0.059) (p=0.00; p<0.05). The sTfR levels decreased before and after intervention (p=0.00; p<0.05) in C+ (0.24 µ/mL ±0.99), X1 (60.66 µ/mL ±0.29), X2 (62.10 µ/mL ±0.90) and increased in C- (0.40 µ/mL ±0.97).*
Conclusions: *The study indicates ferritin levels increased in the rats receiving catfish oil is not different from the rats that received ferrous sulfate and sTfR levels decreased significantly in wistar rats with iron deficiency anemia receiving catfish oil although the results were not as good as ferrous sulfate supplementation.*

Keywords: *Catfish oil (Pangasius hypophthalmus); Ferritin; Iron Deficiency Anemia; sTfR*

BACKGROUND

Iron is key to the body's metabolism, namely tissue oxygenation through red blood cells. The absorption of iron in the body is regulated in the small intestine, stored in cells in the form of ferritin, and transported by transferrin. Transferrin that binds to iron will be captured by soluble transferrin serum receptors (sTfR) on the surface of cells.[1,2] Therefore, measuring the serum ferritin level is a sensitive and specific test to diagnose iron deficiency anemia. However, serum ferritin levels require additional examination in the form of checking sTfR levels, especially in iron deficiency anemia sufferers who experience chronic infection or inflammation. This is because sTfR is not affected by infectious conditions.[3] Iron deficiency anemia can result in, among others, low birth weight (LBW) in infants, decreased iron reserves in infants, anemia in newborn, the impairment of brain growth and development, and inhibition in the production and breakdown of transmitter compounds needed to deliver stimulated messages from one neuron cell to another affecting the work of the brain.[3]

The data of Riskesdas (Basic Health Research) for Indonesia in 2013 about anemia in children 12-59 months show that 28.1% and 70% of anemia in children in Central Java is microcytic hypochromic anemia caused by iron deficiency.[4] Iron deficiency anemia can be prevented by consuming foods rich in iron and iron supplements. The daily iron requirement for children aged two years is 7 mg per day.[6] Several studies have seen that the use of iron

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supplementation syrups is effective in reducing anemia but has disadvantages such as causing digestive problems and overdose.[5–8] Athe et al declare that potential extraction of natural iron sources from foods high in iron, such as fish, is still being carried out.[6] Patin fish (Pangasius hypophthalmus) contains various nutrients and is affordable, making it widely cultivated. Patin fish has higher iron content than other freshwater fish.[10] One of the processed patin fish (Pangasius hypophthalmus) that contains many nutrients is catfish oil. This oil is obtained from the extraction of patin fish meat. Current researches related to fish mostly determines the potential content of macronutrients such as protein, fat and rarely looks at the micronutrients on fish in dealing with nutritional problems.[11] Previous studies indicate that catfish oil contains essential compounds for tissue synthesis, such as albumin, zinc (Zn), copper (Cu), and iron (Fe).[12] The aim of this study to determine the effect of catfish oil (Pangasius hypophthalmus) on ferritin and soluble transferrin serum receptor (sTfR) levels in male wistar rats with iron deficiency anemia models.

MATERIALS AND METHODS

The research was carried out in February-March 2020. Initial research was in the form of making catfish oil which was carried out at the Food Technology Laboratory of the Department of Nutrition, Diponegoro University, Semarang, continued with elemental Fe content analysis at the Integrated Laboratory of Diponegoro University Semarang, analysis of the quality of catfish oil (number peroxide and free fatty acid levels) at LPPT UGM, and intervention research on experimental animals at the PSPG PAU UGM Yogyakarta Animal Laboratory for 21 days, from acclimatization to blood collection for the post test. Research on experimental animals has been approved by the Health Research Ethics Committee of the Faculty of Medicine, Undip with the ethical clearance number 161/EC/H/KEPK/FK-UNDIP/XII/2019

Catfish Oil Extraction

The catfish oil (Pangasius hypophthalmus) processed using the wet rendering method.[13] The meat of patin fish (Pangasius hypophthalmus) was taken and steamed for 30 minutes at a temperature of 95°C.[14] The fish must be fresh and processed immediately because spoiled fish has a cathepsin enzyme that can accelerate spoilage so that the quality of fish oil will be affected.[15] It was then pressed using a hydraulic press IWT (International Wrench & Tools) EC-HP-20T at 1378 Pa.

Catfish Oil Purification

The water and oil of the patin fish were separated using a separatory funnel Schoot Duran 250 ml. The catfish oil (Pangasius hypophthalmus) was purified using the Suseno's modification method by adding 3% of adsorbent in the form of bentonite from the amount of oil at a temperature of 29°C.[16] The oil was then centrifuged with Eba200 Hettich Centrifuge at 6,500 rpm 10°C for 10 minutes to obtain refined catfish oil. Refined catfish oil was stored in dark glass bottles Taiso 15 mL, tightly closed, and not exposed to direct sunlight so that it is safe from oxidative changes. Yield in the process of catfish oil from catfish meat was 12%.

Catfish Oil Analysis Procedure

Refined catfish oil was duplo tested for value of free fatty acid, peroxide value, and elemental Fe. The method for calculating free fatty acid levels was putting 5 g of refined catfish oil in Erlenmeyer, then 25 mL of hot neutral alcohol and 1 mL of PP indicator were added. It was stirred until homogeneous and titrated with 0.05 N NaOH solution until it turned pink for 30 seconds. The method of calculating the peroxide value was putting 5 g of catfish oil in a 100 mL flat flask. Then added 30 mL of chloroform (3: 2) acetic acid solution, shake until all dissolved. 0.5 mL of saturated KI solution added and let stand in 1 minute. 30 mL of distilled water added then titrated with Na2S2O3 until the yellow color disappears. 0.5 mL of 1% starch solution added until the blue color was gone. Elemental Fe of catfish oil measured using XRF Spectrophotometry WDXRF Rigaku Supermini 200.

Experimental Animals

In this experimental study, randomized pre-post-test design with a control group on white wistar rats (Rattus novergicus) was used. The rats used were male rats aged 4 weeks with a body weight of 150-200 grams, healthy, and active. Exclusion criteria were rats with infection and bleeding. Mice that bleed and died during the study will be dropped out. However, none of the mice bleeding or died during

the study. The samples were randomly divided into four groups, namely groups C- (negative control), C+ (positive control), X1 (treatment 1), and X2 (treatment 2) consisting of 6 rats, respectively.[17] Implementation of experimental animals begins with 14-day induction in wistar rats from the C+, X1, and X2 groups to create iron deficiency anemia rats by giving standard feed without iron, followed by 14 days of intervention. Selection of 14 days according to the metabolism of iron in the body.[18] Group C- received standard feed (AIN 93M), C+ received standard feed with the iron removed, X1 received standard feed with the iron removed and supplemented with catfish oil of 0.0039 ml/day, and X2 received standard feed without iron supplemented with ferrous sulfate of 0.126 mg/day. All rats took ad libitum.[19] The standard feed used is AIN 93 M composed of (% body weight) 46.75% of corn starch, 14% of casein, 15.5% of dextrin, 1% of vitamin mix, 5% of sugar, 3.5% of solca floc-40, 1% of soybean oil, 0.3% of mineral mix, 0.25% of L-Cystine, and 7% of choline bitartrate.

Dose of iron given per day to the rats was adjusted to the daily requirement of iron for two years old, namely 7 mg per day. Then it converted to the dose in rats, which is multiplied by 0.018 (7 mg x 0.018 = 0.126 mg). The amount of catfish oil needed to meet the iron needs of rats is 3.5575 mg (Fe requirement: percentage of elemental fe in catfish oil = 0.126 mg: 3.5418% = 3.5575 mg). Ari Ridha Amril et al states that the density of catfish oil is 0.8924 g/ml so that 3.5575 mg is equal to 0.0039 ml (3.5575 mg x 0.8924: 1000 = 0.0039 ml).[20]

Research on experimental animals was carried out after obtaining permission from the Health Research Ethics Commission (KEPK) of the Faculty of Medicine at Diponegoro University Semarang. Ferritin and sTfR levels were measured before and after the intervention using the ELISA kit Elx 800 ELISA reader model with a wavelength of 450 nm and an mg/mL unit.[21] The data were analyzed using the SPSS 22 program with the Shapiro-Wilk test to determine the normality of data distribution and Paired t-test to determine differences in ferritin and sTfR levels before and after the intervention. ANOVA test followed by Post-hoc Bonferroni was performed to analyze the difference in the effect of the four groups.

RESULTS

Fe Elemental Analysis of Catfish Oil

There are several methods of refining fish oil. Before determining the method to be used in this study, the fe elemental test of catfish oil with several methods was carried out. The method tested for its elemental content was the Suseno modification method and the Hastarini modification method. Fe elemental analysis aims to determine the iron content in catfish oil.

Table 1. The results of Fe Elemental Analysis by Suseno modification method and Hastarini modification method

Mineral Name	Suseno modification method Content (%)	Hastarini modification method Content (%)
Silicone	2,8 ± 1,1	2,5 ± 0,26
Phosphor	0,5 ± 0,1	0,36 ± 0,02
Potassium	3,1 ± 0,15	2,1 ± 0,26
Fe Elemental	3,54 ± 0,22	1,4 ± 0,22

The difference between Suseno modification and Hastarini modification was the level of bentonite use in purification, namely the Suseno modification method uses 3% bentonite while Hastarini uses 1% bentonite. Bentonite is a clay that contains more than 85% montmorillonite, brownish in color, has 100-180 mesh of particles, in the form of a powder. The absorption property of bentonite is due to the pore space of its mineral bonds so it is often used as an absorbent material for various purposes, both wet and dry.[16] Fe Elemental in catfish oil Suseno modification method higher than catfish oil Hastarini modification method. This is in line with research conducted by Sari Rodiah Nurbaya et al which states that the best fish oil refining results use the Suseno modification method. The percentage of bentonite used in the Suseno modification method

is higher when compared to the Hastarini modification method so that it affects impurities that are bound to bentonite. The amount of lost impurities causes higher iron content in catfish oil purified using the Suseno modification method.[22]

The Quality of Catfish Oil

The quality of catfish oil was analyzed by looking at the percentage of free fatty acids and the value of peroxides then compared with the standards issued by IFOS (International Fish Oil Standards).

Table 2. Comparison of catfish oil parameters with IFOS standards

Parameter	Value of purified catfish oil	IFOS Standard
Free Fatty Acid	0,29 ± 0,07	< 1,5 %
Peroxide Value	10,59 ± 0,04	< 5 meq/kg

The low level of free fatty acids in catfish oil in this study shows that catfish oil has good quality, but it had higher peroxide value than the International Fish Oil (IFOS) standard, which was 10.59 meq/kg. The addition of bentonite in the purification stage can reduce the free fatty acid levels in catfish oil because it can absorb the non-glyceride components of free fatty acids. It also causes maximum absorption of impurity components, which can allow natural antioxidants to be absorbed so that the oxidation stability of fish oil is affected especially in peroxide number result.[16]

Experimental Animals Results

Ferritin Level

The ferritin levels in rats were measured before and after the intervention. Based on the Shapiro Wilk test with p>0.05, the data were normally distributed.

Table 3. Differences in Rat Ferritin Levels before and after Intervention

Group / Marker	C-	C+	X1	X2	p[1]
Ferritin Level (ng/mL)					
Pre	61.94 ± 0.86[b, c, d]	37.34 ± 1.00[a, d]	36.10 ± 0.84[a]	35.33 ± 0.48[a, b]	0.001
Post	61.69 ± 0.72[b, c, d]	37.02 ± 0.96[a, c, d]	57.98 ± 1.34[a, b]	59.81 ± 0.45[a, b]	0.001
Δ	-0.25 ± 0.43[c, d]	-0.32 ± 0.059[c, d]	21.87 ± 0.76[a, b, d]	24.47 ± 0.54[a, b, c]	0.001
p	0.001	0.001	0.001	0.001	

Four groups of rats (n = 6 each groups) consist C-: control healthy, C+: control iron deficiency anemia, X1: catfish oil (Pangasius hypophthalmus) of 0.0039 ml/day treatment, X2: ferrous sulfate of 0.126 mg/day treatment; p = value between pre and post treatment were analysed using Paired t-test; p[1] = value between all groups were analysed using one-way ANOVA test with post hoc Bonferroni [a] = p<0.05 compared as C-, [b] = p<0.05 compared as C+, [c] = p<0.05 compared as X1, [d] = p<0.05 compared as X2. Δ changes between pre and post value. Significant if p < 0.05.

The highest mean ferritin level after the treatment in C- of 61.69 ± 0.72. X1 and X2 have increased ferritin levels while the ferritin levels of C- and C+ decreased. This confirms that standard feed and standard feed with the iron removed cannot increase ferritin levels in rats. X2 that received iron supplements in the form of ferrous sulfate has the most significant increase in ferritin levels before and after the treatment. X1 rats supplemented with catfish oil have increased ferritin levels but still less than X2. The results of the Paired- T-Test on the ferritin levels before and after the treatment for each group show a significant difference with P=0.001 (P<0.05).

The mean difference in ferritin levels for each group after the treatment shows in table 3. The mean ferritin levels of X2 and C- are significantly different but not too much, namely 1.88; p = 0.013. Likewise, X1 has a significantly different value from C- with not too far difference, namely 3.7; p = 0.00. The mean ferritin levels of X1 and X2 are not significantly different (p = 0.069; p > 0.05), but the mean ferritin level of X1 is less than X2. This indicates that the supplementation of catfish oil has a similar effect to ferrous sulfate in increasing ferritin levels. Compared with C-, the order of interventions from the most to the least effective is X2, X1, and C+.

Soluble Transferrin Serum Receptor (sTfR) Level

The sTfR levels were analyzed before and after the treatment in all groups. The sTfR level data were tested for normality using Shapiro Wilk, and the results of the distribution of sTfR levels were normal with $p > 0.05$.

The results of Paired T-Test show a significant difference in sTfR levels before and after the treatment with $P = 0.00$ ($P < 0.05$). Table 5 shows a decrease in sTfR levels of C+, X1, and X2 and an increase in the sTfR level of C-. The most significant decrease in sTfR levels was found in X2. The decrease in sTfR levels of X1 is also quite significant but less than that of X2.

There is a significant difference in the sTfR levels of each group after the treatment with $p < 0.05$. The largest difference is between C- and C+ (-63.38) and the smallest between C- and X2 (1.83). The difference in sTfR levels between X1 and X2 is not too significant. The order of mean difference of sTfR levels, compared with C-, from the highest to the lowest is C+, X1, and X2; it means that the order of interventions from the most to the least effective in reducing sTfR levels is X2, X1, and C+.

Table 4. Differences in sTfR before and after Intervention

Group / Marker	C-	C+	X1	X2	p^1
sTfR Level (µ/mL)					
Pre	6.87 ± 0.25 [b, c, d]	70.89 ± 0.49 [a]	71.30 ± 0.43 [a]	71.20 ± 0.48 [a]	0.001
Post	7.27 ± 0.29 [b, c, d]	70.65 ± 0.52 [a, c, d]	10.37 ± 0.45 [a, b, d]	9.10 ± 0.50 [a, b, c]	0.001
Δ	0.40 ± 0.97 [c, d]	-0.24 ± 0.99 [c, d]	-60.66 ± 0.29 [a, b, d]	-62.10 ± 0.90 [a, b, c]	0.001
p	0.001	0.001	0.001	0.001	

Four groups of rats (n = 6 each groups) consist C-: control healthy, C+: control iron deficiency anemia, X1: catfish oil (Pangasius hypophthalmus) of 0.0039 ml/day treatment, X2: ferrous sulfate of 0.126 mg/day treatment; p = value between pre and post treatment were analysed using Paired t-test; p^1 = value between all groups were analysed using one-way ANOVA test with post hoc Bonferroni [a] = $p<0.05$ compared as C-, [b] = $p<0.05$ compared as C+, [c] = $p<0.05$ compared as X1, [d] = $p<0.05$ compared as X2. Δ changes between pre and post value. Significant if $p < 0.05$.

DISCUSSION

Fish is a source of heme that has economic value so that it can be an alternative in fulfilling iron needs. 100 grams of catfish contains 1.6 mg of iron. Meanwhile, humans, especially children, need 7 mg of iron per day.[1,10] Therefore, to meet these needs, children should consume a very large amount of fish. Matthew S Wheal et al. in their study show that the iron in fish is mostly heme of around 20% to 90% and bioavailability of 23%, meaning that humans can absorb iron in the form of heme from fish by 4.6% to 20.7%.[23] The processed fish products in the form of fish oil were used in the study because it has higher iron than fish meat.

The iron content in the catfish oil (Pangasius hypophthalmus) purified by the Suseno's modification was 3.5%. The density of catfish oil based on the study of Ari Ridha Amril et al. analyzing the bio-lubricant synthesis of patin fish waste oil was 0.8924 g/ml, meaning that 1 ml of catfish oil (Pangasius hypophthalmus) contains 31.15 mg of iron (3.5 % x 0.89 g: 1000 = 31.15 mg).[16,22]

This study demonstrates that giving catfish oil can increase ferritin levels due to its heme content although it is not as significant as iron supplementation in the form of ferrous sulfate. This study shows that giving catfish oil can increase ferritin levels because of its heme content, although its value is not higher than iron supplementation in the form of ferrous sulfate. This is in line with the previous study by Fu-Rong Wang et al. in their study on extracting squid ink melanin-Fe for the treatment of iron deficiency anemia in rats showed that there was an increase in ferritin levels in rats with iron deficiency after supplemented with squid ink melanin-Fe.[24] The bioavailability of heme iron is higher than non-heme iron, thereby accelerating the increase in ferritin levels as more iron is absorbed. Besides, non-heme iron sources in plant-based foods contain substances that inhibit iron absorption, such as phytic acid, calcium, and

polyphenols. Iron reserves in people consuming heme are higher than those consuming non-heme iron.[25] Timmer et al. through their study also stated that there were differences in ferritin levels between people who consume heme iron every day and those who consume non-heme; the more heme is consumed, the higher the ferritin levels will be.[26] Another study by Isabel Young et al. stated that food intake rich in heme (beef, mutton, poultry, and fish) can maintain ferritin levels.[27]

Deficiency anemia is characterized by a lack of iron in erythropoiesis activity, high levels of serum transferrin receptors, low levels of ferritin, and decreased levels of Hb. This study shows that the serum transferrin receptor levels in iron deficiency anemia are high. The mechanism is in the small intestine where the amount of iron absorbed is adjusted to the body's needs. The body's need for iron is determined by DMT-1 and ferroportin levels found in the villi of the duodenum. Iron deficiency anemia causes an increase in DMT-1 expression resulting in the increased mechanism of transferrin receptor activity. Transferrin receptors are commonly used as a parameter of erythropoiesis activity.[21]

There was a significant decrease in sTfR levels in the group of rats that received iron supplements in the form of ferrous sulfate and catfish oil (Pangasius hypophthalmus) in this study. In the early phase of iron deficiency anemia, iron reserves in the liver, spinal cord, and spleen decreased, but the sTfR levels were still stable. In the second phase, iron levels decrease while sTfR levels increaseConsumption of heme foods can increase ferritin levels and reduce sTfR levels because the need for iron is fulfilled.[21,24,29] Less food intake containing heme iron, such as red meat, poultry, and fish, high intake of non-heme iron from plants, and the high consumption of foods containing substances inhibiting iron absorption causes iron deficiency anemia. This was put forward by Nils Milman in his study showing that 54% of the food intake containing heme iron, such as meat and fish, in women of childbearing age in Europe from 1993 to 2015 was still below the daily iron requirement.[30] Giving catfish oil can be an alternative in reducing sTfR levels because a previous study states that consumption of ferrous sulfate can disrupt good bacteria in the large intestine, increase infection and inflammation in the digestive tract, and increase free radicals from unabsorbed ferrous iron sulfate. When iron enters the body, some will be absorbed in the upper gastrointestinal tract and some other will enter the large intestine and react to superoxide and hydrogen peroxide causing free radicals through the Fenton reaction.[31] A similar study was conducted by Fu Rong Wang et al. stated that the treatment group that received squid ink melanin-Fe experienced a decrease in sTfR levels and had fewer side effects than the group receiving ferrous sulfate.[24] This shows that the use of natural Fe sources is safer.[31]

The other study conducted by Al-Alimi et al. stated that the prevalence of iron deficiency anemia among college students in Yemen was 30.4% due to the lack of iron intakes, such as red meat, fish, or poultry.[32] Lack of iron-rich intake is often associated with family income, eating habits, and lifestyle. Nanna Roos et al. stated that the habit of consuming fish cooked into soup by poor rural Cambodians around the Mekong river can meet 36% of the daily needs of iron in women of childbearing age. Fish cooked into soup has an iron bioavailability of 25%. This further confirms a great potential in the development of processed fish products as a source of natural iron.[33]

CONCLUSIONS

Giving catfish oil (Pangasius hypophthalmus) influences ferritin and soluble transferrin serum receptors (sTfR) levels. Ferritin levels increase while sTfR levels decrease significantly in male wistar rats with iron deficiency anemia given catfish oil although the results are were not higher than iron supplementation in the form of ferrous sulfate. However, the values of the ferritin level increase and sTfR level decrease in the rats receiving catfish oil are not much different from those receiving ferrous sulfate. It is recommended that further research regarding the bioavailability of iron in catfish oil (Pangasius hypophthalmus) and levels of iron in the tissues that store iron be conducted.

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Evaluating the food consumption among Indonesian young adults lived in a different environment

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ABSTRACT

***Background**: Indonesian young adults who live abroad usually buy meals from café or catering. These meals tend to be less nutritious, including high fat, low fiber, and high carbohydrate.*
***Objective**: This study aimed to investigate the pattern of food consumption among young Indonesian adults who lived in a different environment.*
***Materials and Methods**: A cross-sectional observational study was carried out with 497 participants (73 men and 420 women). Data were collected using a validated food frequency questionnaire (FFQ) of 78 food groups. In addition, the Mann-Whitney U test was conducted to compare consumption patterns among study participants who lived in a different environment (Malang city, East Java, Indonesia, and Taipei City, Taiwan). Furthermore, the Chi-Square test and Fisher's exact test analyzed the consumption level by gender.*
***Results**: Our study indicated no significant differences between food consumption of Indonesian young adults in Malang city, Indonesia, and Taipei City, Taiwan (p=0.623). Meanwhile, beverage (tea) was significantly different between gender in the home country (p=0.005). In contrast, participants who lived abroad showed significantly different consumption levels of fast food (instant noodle) and plant protein source (tofu) across gender (p=0.01 and p=0.02).*
***Conclusion**: The present study showed that fruits were often changed into juices, especially more frequent in a home country than abroad. Meanwhile, several food items, including beverages (tea), fast food, and plant protein source (tofu), showed significant differences across gender.*

***Keywords**: food consumption; young adults; Indonesian-style diet*

BACKGROUND

Indonesian students who study abroad are experiencing many changes in order to adapt to the new environment, including a change in eating habits[1]. A previous study by Doo and Kim (2017) indicated that changing dietary habits among international students might increase the risk of obesity[2]. One cross-sectional study described that International students tended to fulfill their requirement of energy intake by purchasing meals from stores[3]. However, as dining out is becoming a trend, studies found that frequent dine-out eating habit was closely linked to obesity[4]. The more frequent having away-from-home meals, the more prevalent obesity[5]. According to previous investigations, meals are usually characterized by high energy content, total fat, saturated fat, and low micronutrient compositions [3,4]. In addition, a previous study conducted in the United States indicated that caloric intake from adults who frequently eat out was higher than participants who consume at-home meals in daily habit[6]. Moreover, a study by Larson et al. (2011) reported that frequent fast-food consumption was associated with a higher risk of getting overweight/obese in young adults[7]. In Indonesia, several observational studies had reported that dining out significantly elevated the risk of having higher body mass index (BMI) status[8,9]. A study in 148 adolescents showed that local street food consumption (> 300 kcal) contributed 3.2 times to obesity[9].

According to World Health Organization (WHO), overweight and obesity are defined as abnormal or excessive fat accumulation that adversely affects nearly all body's physiological functions and comprises a significant public health threat[10]. A general population measure of overweight and obesity is the BMI, calculated by dividing a person's weight (in kilograms) by the square of a person's height (in meters)[11]. The Indonesian Ministry of Health specifies a BMI ≥25 kg/m^2 as overweight, while BMI ≥27 kg/m^2 as obese [12]. The globalization of food systems that produce more processed and affordable food, nutrient-poor meals, and beverages has been identified as a significant reason for increased obesity worldwide[13]. In Indonesia, the

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prevalence of obesity among young adults was high among men (6.7%) and women (15%) [14]. Therefore, to prevent obesity, understanding possible differences in the living environment in the association between dietary patterns and obesity is essential.

Evidence from observational studies is limited regarding the most favorable consumption pattern to be healthy or unhealthy. Therefore, the objective of this study is to investigate the association between eating away from home and obesity and to evaluate the food consumption among Indonesian young adults in the home country and abroad.

MATERIALS AND METHODS

Study design

The cross-sectional survey recruited 497 Indonesian young adults aged 17-42 years. Our participants were divided into two groups, following their current living places. We collected data for living abroad participants from Indonesian people who resided in Taipei city, Taiwan (n=100) and living in their home country from Indonesian people who resided in Malang city (n= 397). This study was conducted from September to October 2016.

Dietary assessment

FFQ consisted of 10 sections comprised of 78 food items. Participants had to indicate the frequency of consumption of each food item during the last three months period. Frequency was measured in standard portions per day/week/month/rarely. There were six frequencies assessed 'more than one times a day' valued as 1,'1 times a day' valued as 2, '4-6 times a week' valued as 3, '1-3 times a week' valued as 4,' 1-3 times a month' valued as 5, and 'never' valued as 6.

Food items were divided into staple food, fast food, animal protein sources, plant protein sources, dairy products, fruits, vegetables, snacks, beverages, and supplements. The staple food group comprised white rice, corn rice, red rice, noodle, sweet potato, cassava, bread, and potato. The fast-food group comprised cereal havermout, instant noodle, spaghetti, burger, french fries, pizza, nuggets, sausage, sardines, kebab, and fried chicken. Animal protein sources comprised beef, lamb, chicken, pork, egg, salted egg, innards, fish, salted fish, shrimp, and squid. Plant protein sources comprised mushrooms, tofu, Tempe, long bean, bean sprouts, and red beans. Vegetables comprised broccoli, carrot, mustard, tomato, spinach, kale, chayote, cabbage, papaya leaves, and lettuce. Fruits comprised apple, orange, guava, tomato cherry, banana, kiwi, dragon fruit, mango, melon, watermelon, pineapple, pear, blackberry, papaya, longan, and yoke. Dairy products comprised whole cream milk, skimmed milk, soy milk, yogurt, ice cream, cheese, and mayonnaise. The snack group comprised traditional cake, rice cake, mochi, moon cake, packaging food, frying food, meatball, sweet cake, pudding, chocolate, and candy. Beverages comprised fruit juices, soft drinks, coffee, tea, bubble tea, and alcohol. Supplements comprised honey, omega-3, vitamin C, vitamin B complex, and iron.

Ethics

A panel of experts reviewed a self-administered questionnaire. Prior to the commencement of research, ethical approval was obtained from the IRB of Poltekkes Kemenkes Malang with the register no.190/KEPK-POLKESMA/2016. Written consent was obtained from all participants.

Statistical analysis

Statistical analyses were performed using SPSS software version 25.0. Descriptive statistics were used to describe the distribution of the variables. The Wilcoxon Mann Whitney U test was conducted to compare consumption patterns in Malang and Taipei. Two-tailed statistical significance was set at $p < 0.05$. The comparison of level consumption and gender were assessed with the Chi-Square test and Fisher's exact test.

RESULTS

Food frequency in the home country

Figure 1 showed that young adults who lived in a home country (Malang city, Indonesia) tended to consume white rice more than once a day as the main staple food (n=319, 80.4 %). The fast-food group frequently consumed instant noodles around 1 – 3 times a week (n=136, 34.3 %). Favorite animal protein sources for Indonesian young adults were chicken (n=105, 26.4 %) and egg (n=129, 32.5 %) approximately 4 – 6 times a week. Malang city consumed Tempe (n=136, 34.3%) and tofu (n=131, 32.9%) as plant protein sources 4 – 6 times a week. The vegetable group consumed mustard (n=96, 24.2%) approximately 4 – 6 times a week. Moreover, they were seldom consuming apple, orange, banana, watermelon, and melon (n=130, 32.7%; n=138, 34.8%; n=111, 28%; n=127, 32%; n=126, 31.7%; respectively) around 1 – 3 times a month. For dairy products, ice cream (n=159, 40.1%), cheese (n=117, 29.5%), and full cream milk (n=101, 25.4%) became their favorite to consume in 1 – 3 times a month. Their favorite snacks group was packaging food, frying food, and meatball (n=121, 30.5%; n=123, 30.9%; n=138, 34.8%; respectively), consumed around 1 – 3 times a week. Furthermore, they consume juices (n=128, 32.2%) as their beverage 1 – 3 times a week. Last, they almost neither consumed honey (n=253, 63.7%) nor supplements (n=390, 98.2%).

Food frequency in abroad

In Figure 2, Indonesian young adults who lived abroad (Taipei City, Taiwan) consumed white rice (n=64, 64%) as their main staple food more than once a day. They also consumed instant noodles (n=42, 42%) as their favorite fast food approximately 1 – 3 times a week. They tended to consume chicken (n=35, 35%) and egg (n=32, 32%) around 1 – 3 times a week in animal protein sources. They frequently consumed tofu (n=34, 34%) as a plant protein source approximately 4 – 6 times a week. Vegetables group such as spinach, mustard, carrot, and tomato (n=32, 32%; n=35, 35%; n=35, 35%; n=32, 32%; respectively) were consumed around 1 – 3 times a week as well as fruit group such as banana (n=30, 30%). Most of them seldom consumed dairy products, especially ice cream (n=45, 45%) 1 – 3 times a month. For snacks, packaging food (n=35, 35%) was their favorite to consume

around 1 – 3 times a week. Tea (n=22, 22%) and its product such as bubble tea (n=27, 27%) became their favorite beverage to consume 1 – 3 times a week. Last, they did not consumed honey (n=69, 69%) even supplements (n=71, 71%).

Comparison of food consumption in the home country and abroad

Table 1 showed no significant differences between food consumption of Indonesian young adults in Malang city and Taipei city (p=0.623). However, there were significant differences in consumption of pizza, sausage, nugget, spaghetti, chicken, egg, fish, shrimp, squid, tofu, tempeh, long beans, bean, kale, mustard, chayote, banana, watermelon, melon, yogurt, soy milk, frying food, traditional food, meatball, juices, tea, coffee, and bubble tea (p<0.01, respectively). Of fast food, pizza and spaghetti were more favorites in Taipei (1 - 3 times a month) than in Malang. On the other hand, young Malang adults consumed sausages and nuggets more frequently than in Taipei. Moreover, chicken and egg were less consumed (1 – 3 times a week) in Taipei than in Malang. They who lived abroad tended to consume seafood such as shrimp and squid 1 – 3 times a month than others who lived in their home country, but not for fish. In Taipei, tofu was more prevalent (4 – 6 times a week) than time. Nevertheless, young adults in Malang city more often consumed vegetables at least 1 – 3 times a week than Taipei, but the opposite for fruits. The favorite fruit of young adults who lived in Taipei was bananas (1 – 3 times a week). On the other hand, yogurt and soy milk were more often consumed (1 – 3 times a month) in Taipei than in Malang. Of snacks, frying food, and meatballs were often consumed (1 – 3 times a week) in the home country. The favorite beverage in Malang city was juices (1 – 3 times a week). However, tea and bubble tea were more frequently consumed in Taipei city (1 – 3 times a week) and coffee (1 – 3 times a month).

Characteristic of level consumption according to gender in the home country and abroad

Table 2. Staple food (white rice) is habitually consumed among Indonesian who live both in the home country (87.7% for women, 90% for men) and abroad (74.6% for women, 89.2% for men). In the home country, women had a higher intake of fruit (banana 11.5%), dairy products (full cream milk 14.2%), and snack (packaging food 19.9%) compared to men. While the proportion of staple food (white rice 90%), fast food (instant noodle 12.5%), an animal protein source (egg 37.5%), a plant protein source (tofu 50%), vegetable (mustard 22.5%), and beverage (tea 20%) among men was higher than women. Level consumption of beverage (tea) was significantly different between gender (p=0.005), but not in others.

Furthermore, abroad (Table 2), women tend to have a higher proportion of animal protein (egg 19%), a plant protein source (tofu 20.6 %), vegetable (mustard 19%), snacks (packaging food 12.7%), beverage (tea 12.7%) than men. In contrast, the proportion of staple food (white rice 89.2%), fast food (instant noodle 10.8%), fruit (banana 8.1%), and dairy product (full cream milk 16.2%) consumption was higher among men than women. Furthermore, level consumption of fast food (instant noodle) and plant protein source (tofu) were significantly different between gender (p=0.01 and p=0.02).

DISCUSSION

This study was based on a socio-demographic characteristic of participants in the previous study [15,16.] In total, 397 participants lived in Malang city, while 100 participants lived in Taipei city as overseas students. This result shows no significant differences between the food consumption of Indonesian young adults in Malang city, Indonesia and Taipei city, Taiwan does not expect from the authors' hypothesis. Eating patterns describe how people eat at the level of an eating occasion and may include a range of indicators such as frequency, timing, skipping of meals, and frequency and timing of snacks [15]. An Indonesian-style diet consists of staple food, animal or plant protein sources, but sometimes with vegetables and fruits. Rice, especially white rice, is a typical starchy food eaten by Indonesian people. The important role of diet in preventing non-communicable diseases (e.g., cardiovascular disease and some cancers) is well documented [16]. Current dietary advice was framed around the amount and types of food populations should consume rather than considering eating patterns[17]. A recent study showed that animal protein sources were less consumed in Taipei. It might be because of the limited access to halal food and fear of eating non-halal food[18]. Because of that, they prefer seafood such as shrimp and squid.

Pizza and spaghetti were also more prevalent in Taipei city. The previous study indicated that high consumption of carbohydrate sources and a high dietary GI is associated with good sleep, especially good sleep duration. Meanwhile, higher noodle consumption is associated with poor sleep quality. The effects of starchy foods on sleep may differ according to their GI values. Diets with a high GI, especially those with high rice, may contribute to good sleep [19]. Despite this, consuming enough fruits and vegetables as a healthy dietary pattern could reduce the risk of obesity [20, 21].

Moreover, limiting energy-dense food, low-nutrient food, and sugary drinks could also decrease heart disease 22 and type 2 diabetes [23, 24]. However, young adults did not consume enough fruits and vegetables [25]. In this study, Indonesian young adults consumed fruits and vegetables once a week. Moreover, they frequently consumed frying food, meatballs, coffee, and tea or bubble tea. In addition, they often ate energy-dense food, low-nutrient food, and sugary drinks[26,27].

The tea consumption and instant noodle and tofu are significantly different among gender. This case may prove that men drinking tea are more habitual than women in both cities. On the contrary, Demura et al. [28]found more young females drank tea than males. In addition, men's instant noodles and tofu consumption are more different than women abroad. According to Huh et al. (2017), males are also more likely to consume instant noodles. Subjects who frequently consumed instant noodles had lower-income, more physical activity, and were more likely smokers[29]. The present study showed that fruit juice had become the favorite healthy beverage of young adults in

their home country. In large parts of the world, food consumption has changed over the last decades towards higher intakes of processed and energy-rich foods, including beverages[30]. Lately, great attention has been given to health aspects of beverage consumption, investigating the association between specific beverages and the development of metabolic diseases[31].

Additionally, a previous review study on children reported that consuming 100% juice provided beneficial nutrients and a higher overall diet quality[31]. In vitro study showed that fiber retention in the fruit smoothies might positively affect glycemic response and may contribute to daily fiber requirements[32]—consumption of juice and tea associated with beneficial lifestyle characteristics including healthy food choices [31]. On the other hand, Snack behaviors seemed to be more variable and might represent a more significant opportunity for improving overall dietary profiles [33].

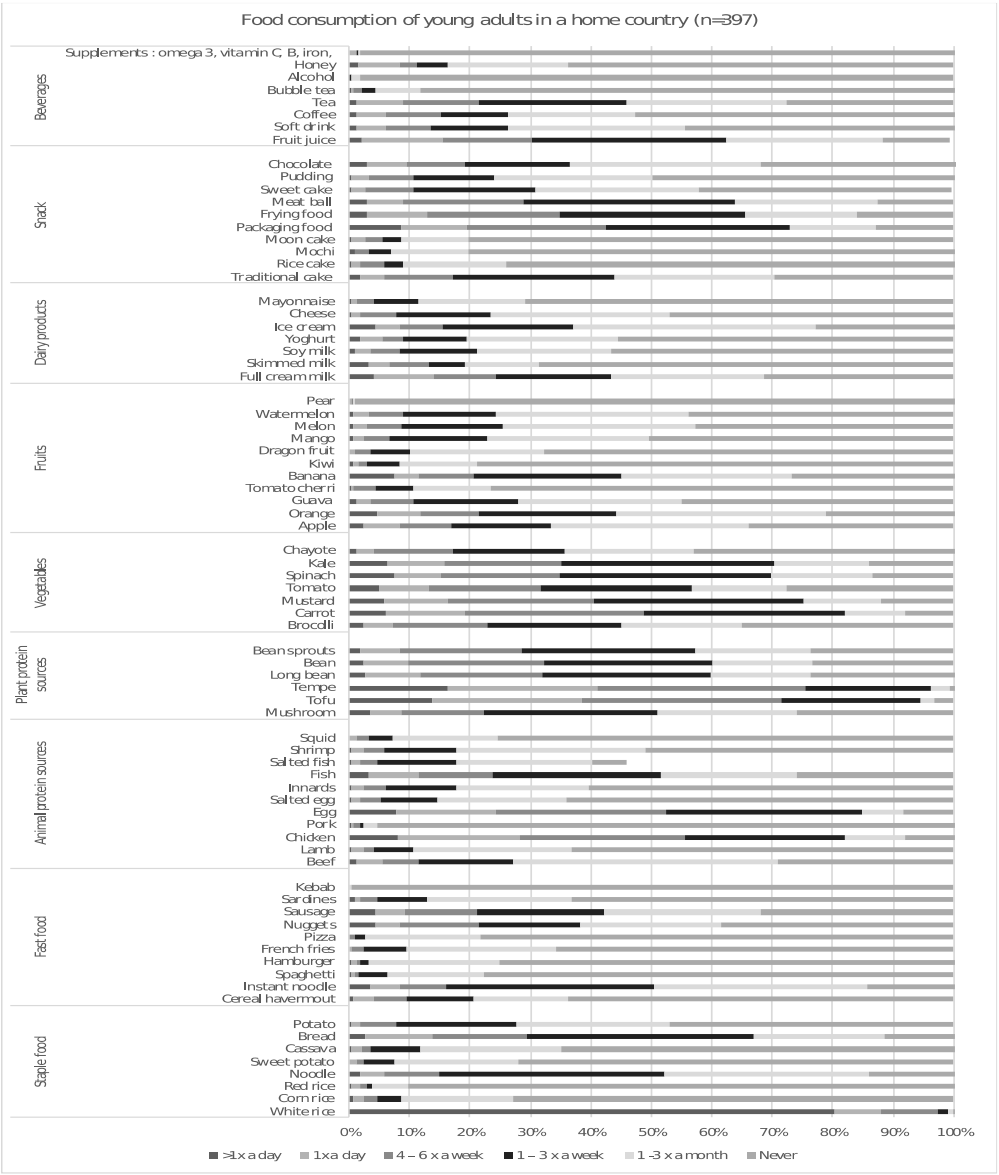

Figure 1. Food frequency in the home country (n=397)

Successful promotion of fruits and vegetable intake in young adults might require a constellation of efforts that influence young adults' eating behaviors[34]. The development of multi-context or multilevel interventions needs to be considered. In particular, more effort was necessary to improve home and school neighborhood environments to promote adolescents' healthy eating behaviors. In addition, parents' education through nationwide and local campaigns might be continually implemented[35].

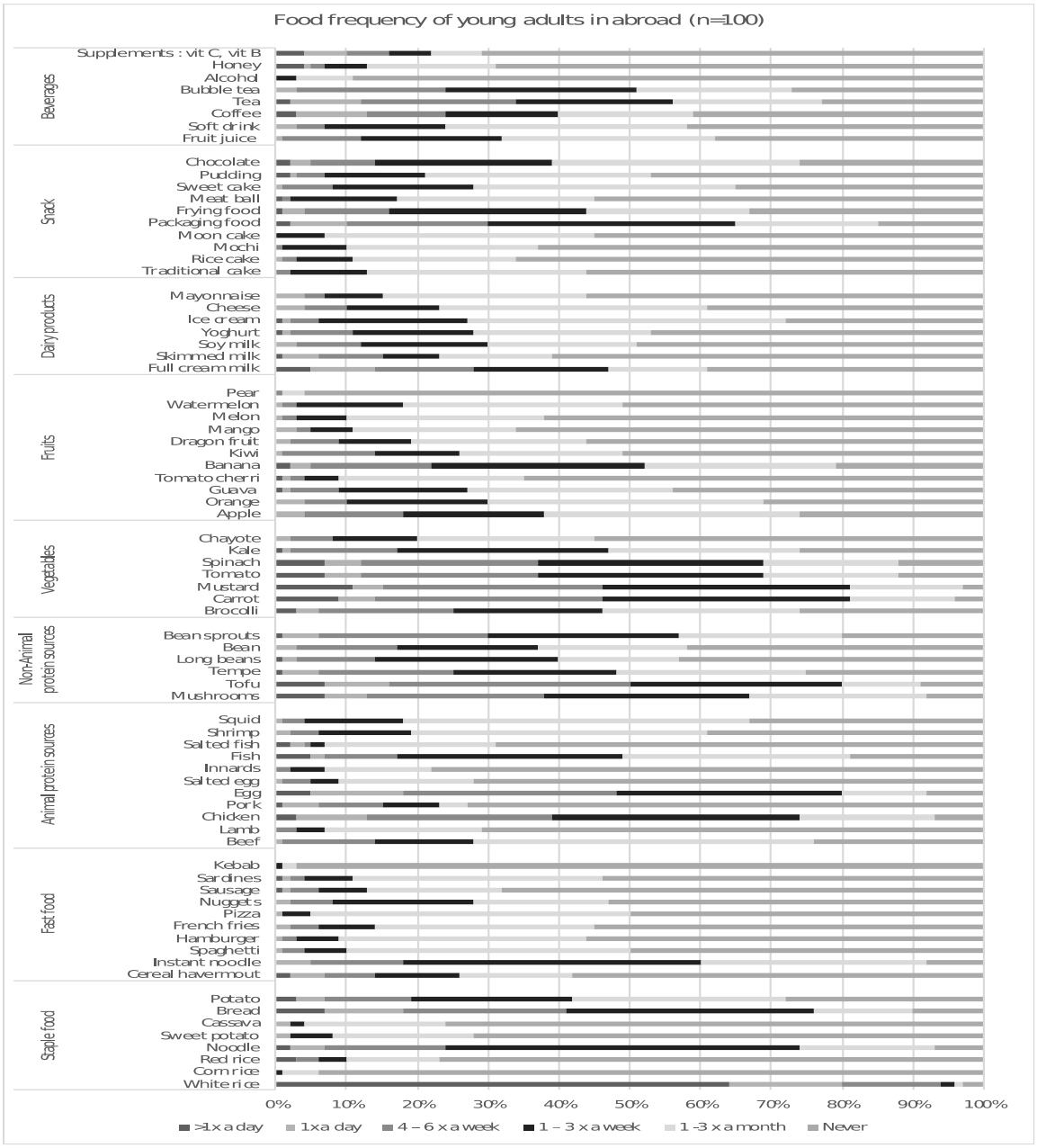

Figure 2. Food frequency in abroad (n=100)

There were limitations associated with the assessment of dietary intake. Even though FFQ were commonly used to infer dietary patterns and dietary intake in epidemiological studies, they were prone to inherent error and limited in their ability to assess all dietary components. Although 78 foods were considered within FFQ, other food consumed may have been missed. There were also drawbacks of dietary pattern analysis, including consolidation of the food items into groups, choosing the number of factors to be retained, selecting the rotation method, and naming the factor identified[36]. As this was a cross-sectional study, dietary patterns were only assessed at a single time point. Therefore we were unable to account for temporal changes over some time.

However, other studies had used comparable methods and highlighted the reproducibility of dietary patterns over time [37]. The importance of adjusting for energy misreporting when examining relations between eating patterns, nutrient intakes, and diet quality[33].

CONCLUSIONS

This study presents no significant difference in food consumption among Indonesian young adults in Malang and Taipei. Overall, they seldom consumed healthy food such as yogurt, vegetables, and fruits. However, consuming fruits is often changed into juices,

especially more frequent in Malang city than Taipei city. Furthermore, the level of beverage consumption (tea) was significantly different between gender in the home country. Whereas, abroad, level consumption of fast food (instant noodle) and plant protein source (tofu) were significantly different between gender.

Table 1. The comparison of food consumption in home country (Indonesia) and abroad (Taiwan) (n=497)

Food Items	Home Country (n=397)			Abroad (n=100)			p-value
	Median	IQR	Min-Max	Median	IQR	Min-Max	
Staple food							
White rice	1	1 - 1	1 - 6	1	1 - 2	1 - 6	> 0.05
Bread	4	3 - 5	1 - 6	4	3 - 4	1 - 6	> 0.05
Noodle	4	4 - 5	1 - 6	4	4 - 5	1 - 6	> 0.05
Potato	5	4 - 6	1 - 6	5	4 - 6	1 - 6	> 0.05
Corn rice	6	5 - 6	1 - 6	6	6 - 6	4 - 6	> 0.05
Red rice	6	6 - 6	1 - 6	6	6 - 6	1 - 6	> 0.05
Sweet potato	6	5 - 6	2 - 6	6	5 - 6	2 - 6	> 0.05
Cassava	6	5 - 6	1 - 6	6	6 - 6	2 - 6	> 0.05
Fast food							
Cereal havermout	6	5 - 6	1 - 6	6	4 - 6	1 - 6	> 0.05
Instant noodle	4	4 - 5	1 - 6	4	4 - 5	1 - 6	> 0.05
Pizza	6	6 - 6	3 - 6	5	5 - 6	3 - 6	< 0.01*
Sausage	5	4 - 6	1 - 6	6	5 - 6	1 - 6	< 0.01*
Nugget	5	4 - 6	1 - 6	6	4 - 6	1 - 6	< 0.01*
Sardines	6	5 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Spaghetti	6	6 - 6	1 - 6	5.5	5 - 6	2 - 6	< 0.01*
Hamburger	6	5.5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
French fries	6	5 - 6	2 - 6	6	5 - 6	2 - 6	> 0.05
Kebab	6	6 - 6	5 - 6	6	6 - 6	4 - 6	> 0.05
Animal protein sources							
Chicken	3	2 - 4	1 - 6	4	3 - 5	1 - 6	< 0.01*
Egg	3	3 - 4	1 - 6	4	3 - 4	1 - 6	< 0.01*
Beef	5	4 - 6	1 - 6	5	4 - 5	1 - 6	> 0.05
Innards	6	5 - 6	1 - 6	6	6 - 6	1 - 6	> 0.05
Fish	4	4 - 6	1 - 6	5	4 - 5	1 - 6	< 0.01*
Shrimp	6	5 - 6	1 - 6	5	5 - 6	1 - 6	< 0.01*
Salted fish	6	5 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Squid	6	6 - 6	1 - 6	5	5 - 6	2 - 6	< 0.01*
Lamb	6	5 - 6	1 - 6	6	5 - 6	3 - 6	> 0.05
Pork	6	6 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Salted egg	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Plant protein sources							
Mushroom	4	4 - 6	1 - 6	4	3 - 5	1 - 6	> 0.05
Tofu	3	2 - 4	1 - 6	3.5	3 - 4	1 - 6	< 0.01*
Tempe	3	2 - 3	1 - 6	5	3.25 - 5.75	1 - 6	< 0.01*
Long bean	4	3 - 5	1 - 6	5	4 - 6	1 - 6	< 0.01*
Bean sprouts	4	3 - 5	1 - 6	4	3 - 5	1 - 6	> 0.05
Bean	4	3 - 5	1 - 6	5	4 - 6	2 - 6	< 0.01*
Vegetables							
Spinach	4	3 - 5	1 - 6	4	3 - 5	1 - 6	> 0.05
Kale	4	3 - 5	1 - 6	5	4 - 6	1 - 6	< 0.01*
Mustard	3	3 - 4.5	1 - 6	4	3 - 4	1 - 6	< 0.01*
Carrot	4	3 - 4	1 - 6	4	3 - 4	1 - 6	> 0.05
Brocolli	5	4 - 6	1 - 6	5	3.25 - 6	1 – 6	> 0.05
Tomato	4	3 - 6	1 - 6	4	3 - 5	1 - 6	> 0.05
Chayote	5	4 - 6	1 - 6	6	5 - 6	2 - 6	< 0.01*
Fruits							
Apple	5	4 - 6	1 - 6	5	4 - 6	1 - 6	> 0.05

Food Items	Home Country (n=397)			Abroad (n=100)			p-value
	Median	**IQR**	**Min-Max**	**Median**	**IQR**	**Min-Max**	
Orange	5	4 - 5	1 - 6	5	4 - 6	1 - 6	> 0.05
Banana	5	4 - 6	1 - 6	4	4 - 5	1 - 6	< 0.01*
Watermelon	5	5 - 6	1 - 6	6	5 - 6	2 - 6	< 0.01*
Melon	5	4 - 6	1 - 6	6	5 - 6	2 - 6	< 0.01*
Guava	5	4 - 6	1 – 6	5	4 - 6	1 - 6	> 0.05
Tomato cherri	6	6 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Kiwi	6	6 - 6	1 - 6	6	4 - 6	2 - 6	> 0.05
Dragon fruit	6	5 - 6	2 - 6	6	5 - 6	2 - 6	> 0.05
Mango	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Pear	6	6 - 6	2 - 6	6	6 - 6	3 - 6	> 0.05
Dairy products							
Ice cream	5	4 - 5	1 - 6	5	4 - 6	1 - 6	> 0.05
Cheese	5	5 - 6	1 - 6	5	5 - 6	2 - 6	> 0.05
Full cream milk	5	4 - 6	1 - 6	5	3 - 6	1 - 6	> 0.05
Yogurt	6	5 - 6	1 - 6	5	4 - 6	1 - 6	< 0.01*
Skimmed milk	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Soy milk	6	5 - 6	1 - 6	5	4 - 6	2 - 6	< 0.01*
Mayonnaise	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Snacks							
Packaging food	4	3 - 5	1 - 6	4	3 - 5	1 - 6	> 0.05
Frying food	4	3 - 5	1 - 6	5	4 - 6	1 - 6	< 0.01*
Sweet cake	5	4 - 6	1 - 6	5	4 - 6	2 - 6	> 0.05
Traditional cake	5	4 - 6	1 - 6	6	5 - 6	3 - 6	< 0.01*
Meatball	4	3 - 5	1 - 6	6	5 - 6	1 - 6	< 0.01*
Pudding	5	5 - 6	1 - 6	5	5 - 6	1 - 6	> 0.05
Chocolate	5	4 - 6	1 - 6	5	4 - 6	1 - 6	> 0.05
Rice cake	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Mochi	6	6 - 6	1 - 6	6	5 - 6	3 - 6	> 0.05
Moon cake	6	6 - 6	1 - 6	6	5 - 6	4 - 6	> 0.05
Beverages							
Juices	4	3 - 5	1 - 6	5	4 - 6	2 - 6	< 0.01*
Softdrink	5	4 - 6	1 - 6	5	5 - 6	2 - 6	> 0.05
Tea	5	4 - 6	1 - 6	4	3 - 5	1 - 6	< 0.01*
Coffee	6	4 - 6	1 -6	5	4 - 6	1 - 6	< 0.01*
Bubble tea	6	6 - 6	1 - 6	4	4 - 6	2 - 6	< 0.01*
Alcohol	6	6 - 6	4 - 6	6	6 - 6	4 - 6	> 0.05
Honey	6	5 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Supplements	6	6 - 6	2 - 6	6	5 - 6	1 - 6	> 0.05

*Statistical analysis was using Wilcoxon Mann Whitney U-test with significant p-value set at < 0.05.
P-value between home country and abroad was 0.62.
FFQ code: 1 is for more than one times a day, 2 is for one times a day, 3 is for 4-6 times a week, 4 is for 1-3 times a week, 5 for is 1-3 times a month, 6 is for never.

Table 2. Characteristic of level consumption according to gender in home country (Indonesia) and abroad (Taiwan) (n=497)

Level consumption	**Home country (n=397)**			**Abroad (n=100)**		
	Women (n=357)	**Men (n=40)**	**p-value**	**Women (n=63)**	**Men (n=37)**	**p-value**
	n (%)	**n (%)**		**n (%)**	**n (%)**	
Staple food (white rice)			0.99			0.22
High	313 (87.7)	36 (90)		47 (74.6)	33 (89.2)	
Moderate	40 (11.2)	4 (10)		13 (20.6)	3 (8.1)	

Level consumption	Home country (n=397)			Abroad (n=100)		
	Women (n=357)	**Men (n=40)**	**p-value**	**Women (n=63)**	**Men (n=37)**	**p-value**
	n (%)	**n (%)**		**n (%)**	**n (%)**	
Low	4 (1.1)	0		3 (4.8)	1 (2.7)	
Fast food (instant noodle)			0.35			0.01*
High	29 (8.1)	5 (12.5)		1 (1.6)	4 (10.8)	
Moderate	147 (41.2)	19 (47.5)		32 (50.8)	23 (62.2)	
Low	181 (50.7)	16 (40)		30 (47.6)	10 (27)	
Animal protein source (Egg)			0.07			0.7
High	81 (22.7)	15 (37.5)		12 (19)	6 (16.2)	Chi-s
Moderate	219 (61.3)	22 (55)		40 (63.5)	22 (59.5)	
Low	57 (16)	3 (7.5)		11 (17.5)	9 (24.3)	
Plant protein source (Tofu)			0.35			0.02*
High	133 (37.3)	20 (50)		13 (20.6)	3 (8.1)	
Plant protein source (Tofu)			0.35			0.02*
Moderate	204 (57.1)	18 (45)		34 (54)	30 (81.1)	
Low	20 (5.6)	2 (5)		16 (25.4)	4 (10.8)	
Vegetable (Mustard)			0.24			0.32
High	56 (15.7)	9 (22.5)		12 (19)	3 (8.1)	
Moderate	208 (58.3)	25 (62.5)		39 (62)	27 (73)	
Low	93 (26)	6 (15)		12 (19)	7 (18.9)	
Fruit (Banana)			0.99			0.58
High	41 (11.5)	4 (10)		2 (3.2)	3 (8.1)	
Moderate	120 (33.6)	14 (35)		31 (49.2)	16 (43.2)	
Low	196 (54.9)	22 (55)		30 (47.6)	18 (48.7)	
Dairy product (Full cream milk)			0.88			0.82
High	51 (14.2)	5 (12.5)		8 (12.7)	6 (16.2)	
Moderate	103 (28.9)	13 (32.5)		22 (34.9)	11 (29.7)	
Low	203 (56.9)	22 (55)		33 (52.4)	20 (54)	
Snack (Packaging food)			0.95			0.45
High	71 (19.9)	7 (17.5)		8 (12.7)	2 (5.4)	
Moderate	190 (53.2)	22 (55)		35 (55.6)	20 (54.1)	
Low	96 (26.9)	11 (27.5)		20 (31.7)	15 (40.5)	
Beverage (Tea)			0.005*			0.07
High	28 (7.8)	8 (20)		8 (12.7)	4 (10.8)	
Moderate	127 (355.7)	19 (47.5)		22 (34.9)	22 (59.5)	
Low	202 (56.6)	13 (32.5)		33 (52.4)	11 (29.7)	

p-value was from the Chi-Square test and Fisher's exact test.
*Significant p-value set at < 0.05

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Defining food literacy and dietary patterns among senior high school students in Malang City, East Java

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ABSTRACT

Background: *Food literacy is a collection of interrelated knowledge, skills, and behavior required to plan, manage, select, prepare, and eat food for further meeting dietary requirements and determining dietary intake. In Indonesia, 93.6% of all adolescents aged 10 years or over consumed an inadequate amount of fruits and vegetables and more than half often consumed food rich in sugar, fat and salt. Only one-third of students always had breakfast, only 3,81% always brought their own food to school. Adolescence has been considered as a nutritionally critical period of life. Improve the health promotion is important to prevent malnutrition and risk of chronic disease.*

Objectives: *The study aimed to investigate the association of food literacy and dietary patterns among senior high school students in Malang, East Java.*

Materials and Methods: *The cross-sectional study determined food literacy level and dietary patterns among senior high school students using a questionnaire as the instrument. This study recruited 464 students aged from 14 to 18 years old. Demographic characteristics of adolescents and their parents, adolescent food literacy, and dietary intake data were self-report collected. The height was measured using stature meter and weight using electronic scale to determine the BMI-for-age. The research was conducted from July to September 2015 in Malang, East Java.*

Results: *Out of 464 adolescents, 59.9% were females, and female adolescents had a better food literacy ($P < .001$) and higher dietary pattern scores ($P < .05$). Adolescents whose family had higher income or higher percentage of income spent on food consumed more vegetables ($P < .05$) and dairy products ($P < .05$), and had higher dietary pattern scores ($P < .05$) compared with those whose family had lower income or lower percentage of income spent on food. The perception of food literacy ($r = 0.187$, $P < .001$), the behavior of food literacy ($r = 0.333$, $P < .001$), and overall food literacy ($r = 0.329$, $P < .001$) were positively correlated with dietary pattern scores.*

Conclusions: *Food literacy is positively associated with dietary patterns in adolescents. Nutrition education is suggested to implement as a guide in healthy food choices for adolescent.*

KEYWORDS: *food literacy; dietary intake; anthropometric data; adolescent; Indonesia*

BACKGROUND

Food literacy has been influenced by health professionals, nutritionist, and home economists, and fundamentally aims to achieve personal health-related goals.[1] Food literacy was defined as the concept that empowers individuals, households, communities, or nations to protect diet quality through changing and strengthening dietary resilience over time. Food literacy is a collection of interrelated knowledge, skills, and behavior required to plan, manage, select, prepare, and eat food for further meeting dietary requirements and determining dietary intake.[1,2] Food literacy could affect the quality of dietary intake and health status.[3] Low literacy level of nutritional knowledge among adolescents in Minnesota, USA was associated with poor decision making on the maintenance of energy balance and healthy body weight in adulthood.[4] Additionally, better nutritional knowledge and more frequent food preparation in adolescents were correlated with healthy dietary practices.[5,6]

In regard to eating habits in Indonesia, 93.6% of all adolescents aged 10 years or over consumed an inadequate amount of fruits and vegetables and more than half often consumed food rich in sugar, fat and salt. Data from the Indonesian Global School Health Survey in 2015 showed that only one-third of students always had breakfast, only 3,81% always brought their own food to school and more than half teenagers consumed fast food at least once per week.[7] Daily dietary intake as dietary patterns of an individual is crucial in health promotion throughout the lifespan.[8] However, the diversity of dietary patterns could be varied in different countries. Dietary patterns of school children and adolescents in 42 developing countries were limited in

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diversity, primarily a plant-based diet, but limited in the intake of fruit and vegetables, which resulted in insufficient energy and micronutrient intake.[9] The healthy diet is one of the most important factors for maintaining ideal body weight and preventing chronic disease.[10,11] Dietary patterns such as fruit and vegetables,[12] dairy products,[13] and whole grains[14] have been considered to reduce the risk of chronic disease, whereas saturated fat intake was associated with greater risk of chronic disease.[12]

Adolescence has been considered as a nutritionally critical period of life because of rapid physical growth and development as well as a change of lifestyle and dietary habits that can affect both nutrient intake and needs.[15] Malnutrition, particularly under-nutrition, was prevalent in adolescents which may lead to the retardation of growth and intellectual capacity.[16,17] Limited evidence has demonstrated the impact of food literacy on dietary patterns in adolescents. Therefore, this study aimed to investigate determine the association between food literacy and dietary patterns among adolescents in Malang City, East Java.

MATERIALS AND METHODS

The study design was a cross-sectional survey using a questionnaire to define the food literacy and dietary patterns among adolescents in Malang City, East Java, Indonesia. This study recruited the students aged 14 to 18 years old from 6 senior high schools in Indonesia. There were a total of 530 students aged 14 to 18 years old from 6 senior high schools in Malang City, East Java After excluding 66 students who did not complete the questionnaire, 464 students participated in this study. The research approved by Brawijaya University Institutional Review Board (No. 465/EC/KEPK/088/2015).

All participants were provided the informed consent form under their parents or guardian signature. This study used a questionnaire to collect data among adolescents from July to September 2015 in Malang City, East Java. The questionnaire was comprised of 4 parts: demographic characteristics, food literacy, dietary patterns, and anthropometric measurements.

The demographic characteristics such as gender, age, parental education, parental employment, family income, and the person who took the responsibility for cooking at home were collected by self-report in the questionnaire. The employment status was classified as part-time (<8 h per day) or full-time (≥8 h per day). The cutoff family income of 3,000,000 Indonesian Rupiah (IDR) was the monthly regional minimum wages in Malang city, East Java.

The food literacy questionnaire included the perception of food literacy with 8 questions and the participants' behavior regarding food literacy with 26 questions. The four components of food literacy including planning and management, selection, preparation, and eating from empirical research were identified, and the best aligned questions with these components were selected.[1] The questionnaire started with proposing the suitable scale or questionnaire items using a series of validity and reliability processes. The content validity was evaluated by 5 panel nutrition experts who provided content and format feedback during the development of questionnaire based on components of food literacy.[1,2] The questionnaire was then tested to the face validity by 10 students aged 14-18 years using forum group discussion with the participants to establish how the target group understood questions. The pilot study was conducted to the participants (n = 31) who completed the questionnaire, and the questionnaire was revised based on feedback response to examine the performance of each question. Cronbach's alpha was used to assess the reliability of the internal consistency. The acceptable values of Cronbach's alpha for internal consistency were ranged from 0.71 to 0.84.[18]

The perceived importance of food literacy was categorized as unimportant, somewhat unimportant, neutral, somewhat important, and very important. The scores were assigned as 1 to 5 from unimportant to very important. The minimum and maximum scores of the perception of food literacy were 8 and 40, respectively. The response frequency of participants' behavior regarding food literacy was classified as never, 1-2 times, 3-4 times, 5-6 times, and 7 times per week, and the scores were assigned accordingly as 1 to 5 from never to 7 times per week. The minimum and maximum scores of the behavior on food literacy were 26 and 130, respectively. Therefore, the total minimum and maximum scores of food literacy including perception and behavior were 34 and 170, respectively.

Dietary patterns in the past three months were determined using a validated semi-quantitative food frequency questionnaire (FFQ). All food items were adopted from Indonesian dietary guideline represented by four-layer food groups in a rice cone-like shape, locally known as *Tumpeng Gizi Seimbang*. A rounded pyramid-like shape represents the principle of balanced nutrition made up of different food groups.[19] The individual food items from 24-h recall were also collected from 50 senior high school students to add other food list by a trained person.

The FFQ included 6 food groups: cereals with 13 food items, vegetables with 20 food items, legumes with 6 food items, meat with 18 food items, fruit with 10 food items, and dairy products with 2

food items. The dietary intake frequency of 69 food items in the FFQ included 6 categories: never, 1 to 3 times a month, once a week, 2 to 4 times a week, 5 to 6 times a week, and 7 times or more a week. The score of each food item was assigned as 0 to 5 from the lowest frequency (never) to the highest frequency (7 times or more a week). The score of the dietary intake was then calculated by summing the score for each food item. The total score of all 6 food-groups was ranged from 0 to 345, and the cutoff point was the median of 172 in this study. The score ≥172 or <172 was defined as a good or a poor dietary pattern, respectively.

The anthropometric data including height, body weight, and body mass index (BMI) of adolescents were determined. Height in centimeter (cm) measured using stature meter with accurately record to the nearest 0,1cm. The measurer put the scale correctly in the wall and participant have to stand with feet flat against the flat surface while head, shoulders, buttocks and heel touching the wall. Measurer's eyes were at the same level as the headpiece to get the height measurement. Body weight in kilogram (kg) measured using an electronic scale accurately record to the nearest 0.1kg. The measurer placed the scale on firm flooring and participant should stand with both feet in the center of the scale without shoes and heavy clothing. BMI (kg/m^2) was calculated as body weight (kg) divided by the square of height in meters (m^2). After BMI is calculated for adolescent, it is plotted by age on a gender specific growth chart. WHO AnthroPlus was used to calculate BMI-for-age among adolescents using Z-score. Underweight, overweight, and obesity were defined as BMI-for-age Z-score <-2 standard deviation (SD), >+1 SD, and >+2 SD, respectively.[20,21]

All statistical analyses were performed using SPSS Statistics version 22.0 (IBM Corp., Armonk, NY). [1] The normality test was done by the Shapiro-Wilk test and the data were analyzed using nonparametric measurements due to a skewed distribution. Mann-Whitney U and Kruskal-Wallis tests were used to compare the median between the groups. Chi-square test was performed to compare the distribution of age groups, parental education, parental employment, family income, the percentage of income spent on food, cooking responsibility, and BMI weight status between males and females. Spearman's rank correlation coefficient was used to assess the relationship between food literacy and dietary patterns. After normalization by log transformation, the association between food literacy and dietary patterns was determined using the multivariate linear regression analysis. The *P*-values <.05 were considered statistically significant.

RESULTS

The demographic characteristics of adolescents and their parents are presented in Table 1. Out of 464 adolescents, 59.9% were female, and 71.3% aged 16 to 18 years old. Parents' demographic information showed that over half of parents (fathers and mothers) had university-level education (66.8% vs. 59.5%), and 95.0% of participants' fathers and 56.3% of their mothers had a part-time or full-time job. The results found that 55.2% of participants' household had a monthly family income of ≥3,000,000 IDR. In addition, 55.0% of household spent 50% or more on food. Mothers (81.7%) were the main responsible person for cooking in the family. There were no significant different in demographic characteristic such as parents education level, employment status and family income for all participants (P>.01). The anthropometric data showed that the prevalence of underweight, overweight, and obesity was 23.3%, 10.1%, and 4.1%, respectively. The distribution of weight status was significantly different between males and females (*P* = .01). The prevalence of underweight, overweight, and obesity was 26.9%, 14.0% and 4.8% in males, and 20.9%, 7.5%, and 3.6% in females.

The median scores of food literacy and dietary intake are summarized in Table 2. The median scores of food literacy in the perception of food literacy and behavior of food literacy were 30 and 64, and the overall median score of food literacy was 94. The median scores of dietary intake in cereals, vegetables, legumes, meat, fruit, and dairy products were 19, 26, 9, 25, 12, and 5, respectively, and the overall median score of dietary intake was 97.5.

The results in Table 3 showed that adolescents aged from 16 to 18 years consumed more cereals (*P* = .04), vegetables (*P* = .01), and legumes (*P* = .05), and had higher dietary intake scores (*P* = .03) compared with those aged 14 to 15 years. Female adolescents had better perception of food literacy (*P* < .001), behavior of food literacy (*P* < .001), and overall food literacy (*P* < .001) than males. In addition, female adolescents consumed more vegetables (*P* = .03) and fruit (*P* = .03), and had higher dietary intake scores (*P* = .04) compared with males. The intrapersonal may influences such as psychological and biological influence adolescents eating behaviors and food choice. Factor influencing eating behavior of adolescents need to be better understood to develop effective nutrition intervention including possible difference in male and female adolescents.[22]

Table 1. Demographic characteristics of participants

Characteristics	Total (n = 464)	Male (n = 186)	Female (n = 278)	*P*-value
	n (%)	n (%)	n (%)	
Age, years				0.62
14-15	133 (28.7)	51 (27.4)	82 (29.5)	
16-18	331 (71.3)	135 (72.6)	196 (70.5)	
Father's education				
Primary	15 (3.2)	4 (2.1)	11 (4.0)	0.04
High school	139 (30.0)	47 (25.3)	92 (33.1)	
University	310 (66.8)	135 (72.6)	175 (62.9)	
Mother's education				0.02
Primary	19 (4.1)	3 (1.6)	16 (5.7)	
High school	169 (36.4)	62 (33.3)	107 (38.5)	
University	276 (59.5)	121 (65.1)	155 (55.8)	
Father's employment				
None	23 (5.0)	11 (5.9)	12 (4.3)	0.70
Part-time job	130 (28.0)	53 (28.5)	77 (27.7)	
Full-time job	311 (67.0)	122 (65.6)	189 (68.0)	
Mother's employment				0.94
None	203 (43.7)	81 (43.5)	122 (43.9)	
Part-time job	89 (19.2)	37 (19.9)	52 (18.7)	
Full-time job	172 (37.1)	68 (36.6)	104 (37.4)	
Family income, IDR[a]				
<3,000,000	208 (44.8)	78 (41.9)	130 (46.8)	0.30
≥3,000,000	256 (55.2)	108 (58.1)	148 (53.2)	
Percentage of income spent on food				0.81
<50%	209 (45.0)	85 (45.7)	124 (44.6)	
≥50%	255 (55.0)	101 (54.3)	154 (55.4)	
Cooking responsibility				0.61
Mother	379 (81.7)	154 (82.8)	225 (80.9)	
Maid/others	85 (18.3)	32 (17.2)	53 (19.1)	
BMI, kg/m^2				0.01
Underweight (Z < -2SD)	108 (23.3)	50 (26.9)	58 (20.9)	
Normal weight	290 (62.5)	101(54.3)	189 (68.0)	
Overweight (Z > +1SD)	47 (10.1)	26 (14.0)	21 (7.5)	
Obese (Z > +2SD)	19 (4.1)	9 (4.8)	10 (3.6)	

[a]1 USD = 14,347.3 IDR (Indonesian Rupiah).

Adolescents whose fathers had higher education level consumed more vegetables compared with those whose fathers had primary education (P = .02). Adolescents whose family had higher income or higher percentage of income spent on food consumed more vegetables (P < .05) and dairy products (P < .05), and had higher dietary intake scores (P < .05) compared with those whose family had lower income or lower percentage of income spent on food. Parents with higher education and income level more likely affect the availability and knowledge of healthier food such as vegetable and dairy product. Also in the level of self-efficacy to eat healthy food were noted in some higher educational level. The facilitation from the parents more likely acted as mediators to consume healthy food.[23]

A significant positive correlation was found between food literacy and dietary intake (Table 4). The perception of food literacy, behavior of food literacy, and overall food literacy were positively correlated with the intake of cereals, vegetables, legumes, meat, fruit, and dairy products. The perception of food literacy (r = 0.187, P < .001), the behavior of food literacy (r = 0.333, P < .001), and overall food literacy (r = 0.329, P < .001) were also positively associated with dietary intake scores.

The association between food literacy and dietary patterns using the multivariate linear regression analyzes after the log transformation of food literacy data is shown in Table 5. The results revealed that the perception of food literacy (β = 0.40, P = .001), the behavior of food literacy (β = 0.32, P = .002), and food literacy (β = 0.35, P = .001) were positively correlated with dietary intake scores. The concept of food literacy is not just nutrition knowledge; it includes skills and behaviors in ways

that meet nutrition guideline. Food literacy builds upon the work that has been done around the relationship between food knowledge and food choice. Food literacy may play a role in shaping dietary intake.[22]

DISCUSSION

Female adolescents had not only better food literacy, but also higher scores of dietary patterns compared with male adolescents in this study. A previous study demonstrated that nutritional knowledge was significantly associated with a higher dietary pattern score.[24] Personal knowledge in nutrition was considered as an important factor by both males and females across different levels of habitual intake.[25] Similarly, the differences in food literacy between genders were also reported in the previous studies.[17,26] Female adolescents had better nutritional knowledge, and male adolescents showed good nutritional practice.[17] Additionally, premenopausal women had a better dietary intake in terms of energy distribution from macronutrients and a higher eating-related self-determination index than men.[26] Different aspect of adolescents' food consumption behavior may be influenced by different factors, which may vary between males and females. Educational and treatment strategies need to be specific to both genders.[27]

Dietary intake scores were positively associated with family income and the percentage of income spent on food. Consistent with a previous study in Malaysia, low socioeconomic status and low household income led to limited access to an adequate diet.[21] Food prices had a greater effect on dietary consumption in low-income countries and in poorer households.[28] A high-quality diet or a nutritionally adequate diet was, in general, consumed by better educated and more affluent people with higher socioeconomic status.[29,30] Dietary patterns could be varied by sex, ethnicity, income, and education. The present study also reported that the adolescents whose fathers had higher education consumed more vegetables compared with those whose fathers had lower education. Similar to a previous study, children and adolescents whose parents had a higher education level had significantly better dietary intake of vegetables, fruit, and dairy products.[31] Study showed that higher parental education level and higher income had the strongest mediators such as availability, knowledge and self efficacy about healthy food.[32]

The present study pointed out that food literacy was positively correlated with dietary intake scores. Both the perception of food literacy and the behavior of food literacy exerted a positive influence on dietary intake scores. Consistent with a previous study, higher nutritional knowledge scores were associated with a healthy dietary pattern.[33] Contrarily, low nutritional knowledge resulted in an unhealthy eating habit.[34,35] Additionally, positive behavior on food literacy such as more frequent food preparation was correlated with a healthy dietary pattern toward more vegetables and fruit in adolescents.[34] A healthy dietary pattern could be attributed to the improvement of nutritional knowledge in children and young adolescents.[36]

Food literacy education could positively influence dietary behavior and long-term health among adolescents.[37] The link between food literacy and dietary patterns is clearly highlighted in this study as a significant strength. To the best our knowledge, this is the first study in Indonesia to determine the relationship between food literacy level and dietary patterns among adolescents. However, the present study has some limitations. First, the study was conducted in the senior high schools in Malang, East Java that may limit generalization to other community settings and populations in Indonesia. Second, the cross-sectional design of the present study just indicated the association between the study variables, but did not infer any causality from the current findings.

Table 2 Median scores of food literacy and dietary intake

	Median	Interquartile
Food literacy	94.00	85.00-102.00
Perception of food literacy	30.00	27.00-32.00
Behavior of food literacy	64.00	57.00-71.00
Dietary intake	97.50	74.25-124.00
Cereals	19.00	15.00-24.00
Vegetables	26.00	17.00-37.00
Legumes	9.00	6.00-12.00
Meat	25.00	19.00-33.00
Fruit	12.00	8.00-18.00
Dairy products	5.00	3.00-6.00

Table 3 Comparisons of food literacy and dietary intake scores in participant subgroups

Characteristics	Perception of food literacy *P*-value Median	Behavior of food literacy *P*-value Median	Food literacy *P*-value Median	Cereals *P*-value Median	Vegetables *P*-value Median	Legumes *P*-value Median	Meat *P*-value Median	Fruit *P*-value Median	Dairy products *P*-value Median	Dietary intake *P*-value Median
Age, years	0.40	0.69	0.90	0.04	0.01	0.05	0.54	0.52	0.76	0.03
14-15	29.00	64.00	94.00	18.00	24.00	8.00	25.00	13.00	5.00	95.00
16-18	30.00	63.00	94.00	20.00	27.00	9.00	25.00	12.00	5.00	99.00
Gender	<0.001	<0.001	<0.001	0.35	0.03	0.15	0.48	0.03	0.53	0.04
Male	29.00	62.00	92.00	19.50	24.50	9.00	24.00	10.50	5.00	96.00
Female	31.00	65.00	95.00	19.00	27.00	8.00	26.00	12.00	5.00	99.00
Father's education	0.56	0.61	0.51	0.32	0.02	0.95	0.67	0.54	0.82	0.79
Primary	30.00	62.00	92.00	18.00	22.00	10.00	26.00	12.00	5.00	95.00
High school	30.00	63.00	93.00	20.00	24.00	10.00	24.00	13.00	5.00	97.00
University	30.00	64.00	94.00	19.00	26.00	10.00	25.00	12.00	5.00	98.00
Mother's education	0.38	0.93	0.67	0.45	0.13	0.34	0.66	0.19	0.16	0.18
Primary	30.00	65.00	95.00	21.00	28.00	10.00	26.00	13.00	4.00	29.50
High school	30.00	64.00	94.00	20.00	27.00	9.00	24.00	12.00	4.00	30.00
University	31.00	64.00	95.00	20.00	27.00	9.00	25.00	12.00	5.00	30.00
Father's employment	0.79	0.24	0.29	0.64	0.79	0.38	0.11	0.45	0.12	0.54
None	30.00	65.00	97.00	22.00	23.00	7.00	19.00	10.00	4.00	96.00
Part-time job	29.50	62.00	92.00	19.00	27.50	9.00	26.00	11.50	5.00	98.00
Full-time job	30.00	64.00	94.00	19.00	26.00	9.00	25.00	12.00	5.00	99.00
Mother's employment	0.87	0.88	0.94	0.53	0.71	0.35	0.62	0.94	0.35	0.54
None	29.00	63.00	94.00	20.00	25.00	8.00	24.00	12.00	5.00	96.00
Part-time job	30.00	62.00	93.00	20.00	25.00	9.00	26.00	12.00	5.00	97.00
Full-time job	30.00	64.00	94.00	21.00	25.00	9.00	25.00	12.00	5.00	98.00
Family income, IDR[a]	0.60	0.83	0.89	0.65	0.03	0.95	0.91	0.40	0.01	0.02
<3,000,000	30.00	63.00	94.00	20.00	25.00	8.00	25.00	11.00	4.50	96.00
≥3,000,000	30.00	64.00	93.50	19.00	27.00	9.00	25.00	12.00	6.00	99.00
% of income spent on food	0.09	0.14	0.10	0.20	0.04	0.30	0.02	0.30	0.03	0.02
<50%	29.00	63.00	93.00	19.00	24.00	8.00	24.00	11.00	4.00	94.00
≥50%	30.00	64.00	94.00	20.00	28.00	9.00	26.00	12.00	5.00	100.00
Cooking responsibility	0.39	0.70	0.45	0.12	0.52	0.11	0.70	0.26	0.60	0.17
Mother	30.00	64.00	94.00	20.00	26.00	9.00	25.00	12.00	5.00	99.00
Maid/others	29.00	63.00	92.00	19.00	26.00	8.00	26.00	12.00	5.00	97.00

[a]1 USD = 14,347.3 IDR (Indonesian Rupiah).

Table 4 Correlation coefficient (r) between food literacy and dietary intake

	PFL 1	**BFL 2**	**FL 3**	**Cereals 4**	**Vegetables 5**	**Legumes 6**	**Meat 7**	**Fruit 8**	**Dairy products 9**	**Dietary intake 10**
1	1.000									
2	0.461***	1.000								
3	0.673***	0.960***	1.000							
4	0.078	0.170***	0.172***	1.000						
5	0.196***	0.298***	0.300***	0.444***	1.000					
6	0.081	0.164***	0.153***	0.360***	0.524***	1.000				
7	0.118*	0.282***	0.267***	0.505***	0.589***	0.473***	1.000			
8	0.207***	0.289***	0.300***	0.484***	0.549***	0.396***	0.490***	1.000		
9	0.084	0.180**	0.170***	0.280***	0.235***	0.236***	0.350***	0.277***	1.000	
10	0.187***	0.333***	0.329***	0.684***	0.856***	0.637***	0.810***	0.749***	0.411***	1.000

Abbreviations: PFL, perception of food literacy; BFL, behavior of food literacy; FL, food literacy.
*$P < .05$; **$P < .01$; ***$P < .001$.

Table 5 Association between food literacy and dietary patterns using the multivariate linear regression analysis after the log transformation

	β	**95% CI**	***P*-value**
Log10 Perception of food literacy	0.40	0.33-0.74	0.001
Log10 Behavior of food literacy	0.32	0.28-0.68	0.002
Log10 Food literacy	0.35	0.14-0.76	0.001

Abbreviation: CI, confidence interval.

CONCLUSIONS

The present study indicated that food literacy might influence adolescents' dietary intake. In conclusion, a significant positive correlation is found between food literacy and dietary patterns. Female adolescents have a higher food literacy level and better dietary patterns with more vegetables and fruit intake than male adolescents. Dietary patterns are also positively associated with household socioeconomic status. Nutrition education in food literacy is suggested to guide adolescents in choosing healthy foods. Further researches are needed to investigate the association between food literacy and nutritional status among adolescents with bigger community setting and population in Indonesia. The other methods to find direct causality between variables could be determined in the future.

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Counselor's Knowledge, Attitude and Practice of Infant and Young Child Feeding (IYCF) Counselling

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ABSTRACT

Background: *It needs an effort to reduce the prevalence of undernutrition with the proper IYCF practices. IYCF promotion and counseling activities for caregivers can increase the success of IYCF implementation and reduce the prevalence of malnutrition.*
Objectives: *The objective of this study was to determine the association between the level of education, knowledge, and attitude of Posyandu counselors on IYCF practice in the Parongpong District of West Bandung Regency.*
Materials and Methods: *This research used a cross-sectional study with a consecutive sampling technique. The data collection was conducted from June until August 2020, involving 67 respondents. The dependent variable was Posyandu counselor practice; meanwhile, the independent variables were knowledge and attitude. Descriptive analysis was conducted to describe the characteristics of the respondents, and the multivariate test used multiple logistic regression.*
Results: *Bivariate analysis showed that only level of education had a significant association with a p-value of 0.024. Further analysis using a multivariate test showed that the variables that significantly related to the practice of IYCF counseling were the level of education, knowledge, and attitude, which were controlled by the confounding variable for the period of being a counselor.*
Conclusion: *The level of education, knowledge, and attitude of Posyandu counselors in IYCF counseling practice was an essential factor that can improve children's nutritional status.*

Keywords: *IYCF; knowledge; Posyandu counselor*

BACKGROUND

Nutritional problems result from internal factors with cultural and socio-economic conditions in the community. The term Double Burden of Malnutrition (DBM) is the coexistence of overnutrition (overweight and obesity) alongside undernutrition (stunting and wasting) at all levels of the population, where many of these events are found in poor and middle-income countries (low-income and middle-income countries / LMICs). A study in 2019 showed that Indonesia is a country with the most considerable incidence of DBM in the world [1]. Nutritional problems can occur in every stage of the life cycle, starting from babies, infants, children, adults, and the elderly. However, the most critical periods of human life are the periods of intense growth and development stages (the first 1000 days of a child's life) [2]. Stunting in the childhood period is one of the significant factors that hinder human development, and globally affects around 162 million children under the age of 5 [3]. A child is classified as stunting if the length or height according to their age is lower than the applicable standards [4]. The prevalence of stunting in Indonesia is the fifth largest in the world. Indonesia Basic Health Research Data (*Riskesdas*) in 2018 showed the prevalence of stunting (body height/ age) was 30.8 %, whereas the number of short toddlers was 19.3 %, and very short toddlers were 11.5%. West Java is one of the provinces with a stunting rate of 31.1%, and in West Bandung Regency, the number has reached 13.23% [5].

The lack of nutritional intake commonly causes growth failure conditions in children under five for a long time and recurrent infections. In contrast, these two factors are influenced by inadequate knowledge, especially in the first 1000 days of a child's life [6]. The 1000 days period is a critical factor in stunting children under five years and has a long-term effect [7]. Stunting in children, especially in children under two years of age, causes long-term effects such as lower body height as an adult, economic level/income, school achievement, and the risk of developing chronic disease as an adult [8].

Nutritional problems can affect all aspects of life, especially the economic aspect and individual health status in the future. Efforts to reduce the prevalence of malnutrition can be made with adequate

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and proper Infant and Young Child Feeding (IYCF). The practice of IYCF starts with the early initiation of breastfeeding, followed by giving exclusive breast milk and providing appropriate complementary feeding [9]. However, the lack of knowledge and practical skills to provide adequate additional feeding for infants and children can affect the nutritional status of children and contribute to the high prevalence of stunting [10] [11]. IYCF promotion and counseling for caregivers are known to increase the success of IYCF implementation and reduce the number of malnutrition cases [12]. Implementing IYCF counseling is also known to have an indirect effect on improving children's nutritional status, such as reducing the incidence of malnutrition and stunting in children [13].

The delivery of information about IYCF practice by health workers or counselors is often considered ineffective and inadequate so that caregivers do not acquire adequate knowledge [14]. Various indicators such as lack of information regarding IYCF techniques/practices and lack of nutrition counseling materials for children who are not breastfed are known to affect the success of the IYCF program [10]. Good IYCF promotion and counseling can help caregivers make the right decision to provide nutritious food for their children. *Posyandu* in Indonesia is an integrated health service post that provides primary health service, especially for children and pregnant women. Adequate knowledge of *Posyandu* counselors in the IYCF counseling practice is an essential factor that can improve children's nutritional status. Currently, there is not much research in Indonesia that study the level of IYCF knowledge, attitudes, and practices of *Posyandu* counselor. A study in India shows that parents will implement better IYCF practices when counseling from counselors who have higher knowledge [15]. This study aims to determine the association between the level of education, knowledge, and attitude of *Posyandu* counselors on IYCF practice in the Parongpong District of West Bandung Regency.

MATERIALS AND METHODS

This study used a cross-sectional design with a consecutive sampling technique. All counselors are invited, and those present are taken as study samples. There are 67 *Posyandu* counselors involved in this study from 56 *Posyandu* in three villages in Parongpong District. Data for the *Posyandu* counselors were obtained through the Nutrition Driving Team (Tim Penggerak Gizi) from the Parongpong Community Health Center. The inclusion criteria in this study are the *Posyandu* counselor who can communicate in the Indonesian language and can read well; meanwhile, the exclusion criteria are the counselor absent during the data collection process and did not fill all the questions in the questionnaire. First, descriptive analysis was conducted to describe the characteristics of the respondents. In the next stage, the chi-square bivariable test was used to determine the relationship between two categoric variables, where significant variables showed a significance value of $p < 0.05$. Furthermore, a multivariate test is carried out to determine which variables meet the logistic regression equation model. Logistic regression is a method of predictive analysis carried out when the dependent variable in testing is binary. This study has been approved by the Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health, and Nursing Universitas Gadjah Mada, KE/FK/0994/EC/2020.

RESULTS

1. Respondent Characteristic

The research was conducted in the Parongpong District of West Bandung Regency. A total of 67 *Posyandu* counselors participated in this study. A descriptive analysis of the respondents is presented in

The average age of *Posyandu* counselors was 43.18 years old, with the oldest being 63 years old. Most of them were graduated from high school (47.8%) and worked as housewives (97%). *Posyandu* counselors have an average monthly income of IDR 2,046,296.3, with the lowest income of IDR 600,000. On average, the counselors had worked for 7.8 years, and the counselors who had worked the longest were 34 years. Most *Posyandu* counselors have not received IYCF training (73.1%). The measurement results based on the questionnaire showed that the counselor's average score for knowledge was 76.2, the average attitude score was 46.25, and the average practice score was 68.8.

2. Bivariate Test

A bivariable test was conducted on the IYCF counseling practice and other variables in this study. Table 2 summarizes the result of the bivariable test. Knowledge, attitude, and IYCF practice were divided into two categories with a cut-off point from the median score. The results showed that only the education variable had a significant relationship with IYCF counseling practice, with a value of 0.024, $p < 0.05$.

The results of data analysis in Table 2 show that almost all variables did not meet the

requirements for multivariate analysis, except for the education and attitude variables which have a p-value less than 0.25. However, since the other variables are also considered essential variables, the researcher decided to include all the variables for the multivariate logistic regression test.

The next step is carried out by conducting an interaction test and a confounding test. The results show that there is no interaction between the variables.

Tabel 1. Respondent Characteristic

Variable	Mean	SD	Min	Max
Age	43.18 year	9.2 year	25 year	63 year
Education (n, %)				
Primary School	18 (26,9 %)			
Junior High School	7 (10.4%)			
Senior High School	32 (47.8%)			
College	10 (14.9%)			
Occupation (n, %)				
Housewife	65 (97%)			
Entrepreneur	1 (1.5%)			
Lecturer	1 (1.5%)			
Monthly income (n=54)	IDR 2,046,296.3	IDR 1,427,157.5	IDR 600,000	IDR 8,000,000
Service period	7.9 year	7.8 year	1 year	34 year
IYCF Training (n, %)				
No	49 (73.1%)			
Yes	18 (26.9%)			
Knowledge	76.2	0.76	30	100
Attitude	46.25	0.79	1	7
Practice	68.8	17.38	8	76

Table 2. Bivariable Test of IYCF Counseling Practice

Variable	IYCF Counseling Practice		total	p-value
	Poor	Good		
Age	43.18	9.2	43.18	0.784
Education (n, %)				0.024
Primary School	4(22.2)	14(77.8)	18 (26,9 %)	
Junior High School	2 (28.6)	5 (71.4)	7 (10.4%)	
Senior High School	19 (59.4)	13 (40.6)	32 (47.8%)	
College	7 (70)	3 (30)	10 (14.9%)	
Occupation (n, %)				0.366
Housewife	31 (47.7)	34 (52.3)	65 (97%)	
Entrepreneur	1 (100)	0	1 (1.5%)	
Lecturer	0	1 (100)	1 (1.5%)	
Service period	7.9	7.8		0.432
< 1 year	3 (33.3)	6 (66.7)	9 (13.4%)	
1-10 year	23 (53.5)	20 (46.5)	43 (64.2%)	
> 10 year	6 (40)	9 (52.2)	15 (22.4%)	
IYCF training (n, %)				0.378
No	25 (51)	24 (49)	49 (73.1%)	
Yes	7 (38.9)	11 (61.1)	18 (26.9%)	
Knowledge (n, %)				0.389
Poor	18 (52.9)	16 (47.1)	34 (50.7%)	
Good	14 (42.4)	19 (57.6)	33 (49.3%)	
Attitude (n, %)				0.194
Poor	13 (59.1)	9 (40.9)	22 (32.8%)	
Good	19 (42.2)	26 (57.8)	45 (67.2%)	

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3. Logistic Regression Model

The results of the multivariate logistic regression test are presented in Table 3. The results of the multivariate analysis showed that the education level, knowledge, and attitude had a significant relationship with the practice of IYCF counseling, controlled by the service period.

Table 3. Fix Model from Multivariate Logistic Regression Test

Variable	B	P-value	OR	95% CI	
				Lower	Upper
Education		0.022			
Junior High School	-1.386	0.095	0.25	0.049	1.275
Senior High School	-3.824	0.002	0.02	0.002	0.244
College	-21.483	0.999	0.00	0.000	.
Service period		0.170			
1-10 year	-2.161	0.077	0.1	0.010	1.268
>10 year	-1.413	0.301	0.2	0.017	3.541
Knowledge	1.744	0.027	5.7	1.216	26.924
Attitude	2.140	0.010	8.4	1.666	43.356

Based on the analysis, the most dominant variable was attitude. This result also showed that the attitude variable's Odds Ratio (OR) value was 8.5. This result indicated that *Posyandu* counselors with poor variables are most likely to give poor IYCF counseling practices 8.5 times greater than Posyandu counselors with a good attitude toward IYCF counseling practice. The other result was that the Odds Ratio (OR) value of the knowledge variable was 5.7. This result shows that *Posyandu* counselors with a lack of IYCF knowledge have a 5.7 times greater possibility to conduct poor IYCF counseling practice.

DISCUSSION

The Convention on the Child's Rights states that every child has the right to receive good nutrition. Providing optimal infant and child feeding (IYCF) in the first 1000 days of life can prevent the mortality rate for children under five years by up to 20% [16]. About 60% of death in children under five years old are directly or indirectly related to malnutrition [17]. Malnutrition cases in children can be caused by parents' lack of understanding about providing nutritious food for children [18]. A study in 2012 revealed that the lack of knowledge and practical ability to provide supplementary feeding for infants and children could affect the nutritional status of children and further contribute to the highly increasing number of stunting in the world [19]. Community health workers (CHWs) are well-established as change agents for promoting health attitude change among community members. However, their knowledge and counseling skills play an essential role in promoting optimal infant and young child feeding practices (IYCF)[16]. Counseling ability is a skill that must be possessed by a counselor in translating knowledge of IYCF into messages or interpreting existing IYCF practices to provide suggestions or advice for the caregiver [20].

The average age of *Posyandu* counselors is 43 years, which can be categorized as an adult person [21]. Adults have a greater responsibility because they deal with a broad group of people. Counselors' experience and age are related to their ability to provide information and understanding related to IYCF for mothers in their environment. Research by Faridi et al. (2020) states a correlation between the counselor's age and the implementation of the IYCF in Pandeglang, Banten. Senior counselors and counselors who are over 35 years old tend to be more active in assisting mothers in implementing PMBA compared to younger counselors [22].

Posyandu counselors' knowledge showed an average score of 76.2, so it can be concluded that most of the *Posyandu* counselors have poor knowledge of IYCF, especially about infant feeding and basic knowledge of breastfeeding. According to Kohli and Chahda (2017), if the score for the subject's knowledge of IYCF is more than 80, the subject is considered to have a good level of IYCF knowledge [16]. *Posyandu* counselors are health promotion agents and positively impact health practices in the community [23]. The practice of IYCF for the caregiver in the community, including the practice of breastfeeding, introduction to complementary feeding, the suitability of the amount,

frequency, and variety of foods, is influenced by the knowledge, abilities, attitude, and motivation of health counselors played an essential role in conveying IYCF messages to caregiver [14 16 24 25]. In practice, the success of IYCF for children under five is inseparable from the ways the counselors explain the appropriate IYCF practice and grid. Contento (2011) explains that the success of external factors such as the availability of food and the role of counselors is one of the environmental factors that affect the practice of IYCF from caregiver to the children. The ability of counselors to build communication is highly dependent on empathy, the ability to listen, and pay attention to the child's feeding history [26].

In addition to knowledge, we also measured the attitude and practices aspect of *Posyandu* counselors regarding breastfeeding and complementary feeding. The analysis results showed that 52.9% of *Posyandu* counselors had poor knowledge of IYCF counseling practice, and 59.1% had a poor attitude toward IYCF counseling practice. Attitude parameters in this study were collected through agreeing and disagreeing statements regarding the practice of IYCF based on the counselors' opinions of the material or concepts of IYCF practice. This value becomes a benchmark that the counselors' low attitudes regarding IYCF were affected by the lack of knowledge from the counselors (Table 1). Therefore, counselors' attitude data is obtained from practice when giving IYCF counseling to caregivers. In addition to the knowledge aspect, the results of this study also show that the attitude aspect shows a low score. This is presumably because the practice of IYCF counseling for mothers in the community has not been carried out routinely and focuses on measuring children's nutritional status without giving a proper IYCF education to children's caregivers.

The IYCF program has been proven to reduce the number of morbidity and mortality. Health workers have a significant role in providing education and support for caregivers regarding breastfeeding and infant feeding [27]. The results of the descriptive analysis showed that most *Posyandu* counselors only graduated from high school and worked as housewives. *Posyandu* counselors in Indonesia are not health workers who can provide health counseling practice. They are generally individuals who have received training and knowledge from the Community Health Center (Puskesmas). Therefore, the level of knowledge, practice, and attitude of *Posyandu* counselors is minimal. World Health Organization (WHO) and the Indonesian Ministry of Health has various guidelines covering the implementation of IYCF counseling activities [5 28 29]. However, not all *Posyandu* counselors have access to received adequate IYCF training. In this research, we found that most *Posyandu* counselors have not received IYCF training (73.1%). IYCF training is a critical factor that ensures the community's successful implementation of IYCF practices. IYCF training makes Posyandu counselors manage to provide appropriate counseling to the community and help the caregivers provide nutritious and good food for babies and children [30].

The multivariate analysis in this study indicates that the level of education, knowledge, and attitude has a significant relationship with the practice of IYCF counseling. We find evidence for an association between health worker compliance and client health attitudes; however, small effect sizes suggest that attitude change is multifactorial and affects factors beyond care quality. Improvements to the technical quality of care may contribute to desired health outcomes. Health worker compliance may impact caregiver attitude through pathways other than the mediating pathway of IYCF knowledge. Health worker counseling compliance was significantly and positively associated with health worker knowledge. IYCF practiced at the age of 6-24 months must be done correctly and appropriately. Feeding errors during this period can lead to malnutrition and stunting. The role of counselors is needed to prevent the chain of nutritional problems that occur in society. According to Notoatmojo (2007) in Wahyuningsih and Handayani (2015), educational factors can influence a person's knowledge, which states that a person's education will make it easier to process information. However, the statistical analysis results show that the level of education does not affect one's knowledge, as well as with service period, so it requires further analysis or study whether it has nothing to do with or is there other factors that influence it [31]. The IYCF training is a crucial factor in the implementation of counseling. Even though a counselor has a high level of education, if they have never received IYCF training, their ability to carry out IYCF counseling becomes very limited [32].

Based on table 3, the result showed that *Posyandu* counselors with a lack of IYCF knowledge have a 5.7 times greater possibility to conduct poor IYCF counseling practice. Other results showed that the attitude variable's Odds Ratio (OR) value was 8.5. This result indicated that *Posyandu* counselor with poor attitude is most likely to give poor IYCF counseling practices 8.5 times greater than Posyandu counselor, which has a good attitude toward IYCF counseling practice. The practice of IYCF counseling

will be ineffective if the counselors have problems in their ability to communicate, inappropriate knowledge, and failure to provide need-based advice were important gaps in the counseling skills of *Posyandu* counselors. In this study, we suggested that *Posyandu* counselors need to improve their practical ability to elevate their role as agents of change in public health studies.

The limitation of this study is that it does not compare the level of knowledge, attitudes, and practical skills of *Posyandu* counselors who have received IYCF training with counselors who have not received the training. Thus, this study has not been able to determine whether IYCF training has a significant effect on the ability of a Posyandu counselor to provide IYCF counseling.

CONCLUSIONS

Posyandu counselors' knowledge showed a low average score of 76.2. The value of the attitude of counselors from the Likert scale was 46.25, and the practice of counselors was 68.8. *Posyandu* counselors with poor attitudes are most likely to give poor IYCF counseling practices 8,5 times greater than those with a good attitude. The multivariate analysis in this study indicates that the level of education, knowledge, and attitude has a significant relationship with the practice of IYCF counseling. Therefore, the level of education, knowledge, and attitude of *Posyandu* counselors in IYCF counseling practice is an essential factor that can support the improvement of children's nutritional status.

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The effect of nutrition counseling on nutritional status for breast cancer patients in dr. Sardjito Hospital, Indonesia

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ABSTRACT

Background: *Nutrition counseling in breast cancer (BC) patients show long-term adherence to a dietary pattern and affect nutritional status and quality of life (QOL).*
Objective: *We evaluated the effects of nutrition counseling for nutrient intake dan nutritional status improvement among breast cancer patients.*
Materials and Methods: *This research was conducted in a pre-experimental design; one group pretest-postest design was conducted on 45 BC patients who underwent radiotherapy for five weeks in the Radiotherapy Unit, dr. Sardjito Hospital, Indonesia. Training fieldworkers demonstrated nutrition counseling to 45 participants using a nutrition booklet for BC patients and a food model as an intervention technique. Continuous nutrition counseling was given three times: weeks 1, 3, and 5 of radiotherapy. To obtain nutritional status, we examined anthropometry, biochemical, physical, dietary, and Patient-Generated Subjective Global Assessment (PG-SGA) questionnaire.*
Results: *Most of the participants had a body mass index (BMI) ≥25 kg/m^2 (62.2%). After the participants received nutrition counseling, there were increases in energy intake, protein, carbohydrate, vitamin A, vitamin C, and vitamin E amounted to 124.54 kcal, 8.12 g (p=0.01), 5.84 g, 234.43 mg, 0.042 mg, and 0.44 mg, respectively. Intake of fruits and vegetables improved on the first, third, and fifth week (1.44, 2.36, and 4.03 portion/day, respectively) (p=0.001). Handgrip strength (HGS) showed slight improvement (p=0.081). However, HGS ameliorated from 15.85 kgs in the early to 16.97 kgs in the end stage of therapy. Bodyweight decreased 0.28 kg; however, there were no changes in PG-SGA score, hemoglobin (Hb), and albumin levels.*
Conclusion: *Nutrition counseling improves patients' nutrition intake despite no significant alteration in nutritional status. In addition, nutrition counseling for breast cancer patients during radiotherapy is essential to maintain and improve nutrient intake and nutritional status. In the long-term period, it might be affected to improve quality of life.*

Keywords*: Breast cancer, nutrition counseling, nutritional status, radiotherapy*

BACKGROUND

Cancer is a malignant tumor marked by rapid and uncontrolled cell growth and damaged the other tissues[1]. Breast cancer (BC) develops in the mammary glands, milk ducts, and other breast tissues[2]. More than 1 million new cases of BC per year are the most common cancer among women. Hence, 21.4% of all tumors in women are breast cancer, more than 8–9% of women once in their lives experience breast cancer. It has become the fifth leading cause of cancer and the second leading cause of death in developing countries after lung cancer. In Asian countries, the number of reported BC cases is equivalent to that of developed countries such as Europe and Canadian[3]. For example, the prevalence of breast cancer in Indonesia was 1.4% or approximately 347792 people[4]. Based on GLOBOCAN (IARC), the incidence of breast cancer was 43.3%, and the percentage of death was 12.9%[5]. This data shows that breast cancer had a percentage of death lower than the incidence so that if cancer can be detected and treated early, the chance of healing will be higher[6]. Risk factors for breast cancer include age, hormonal factors such as early age at menarche, late age of menopause, late age at first pregnancy, nulliparity and use of hormonal therapies, family history or genetic, and personal factors such as personal history, findings from previous breast biopsies, postmenopausal obesity, lack of exercise, and alcohol use[7].

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Treatments for breast cancer include surgery, chemotherapy, immunotherapy, radiotherapy, or a combination of several therapies[8]. Radiotherapy has side effects such as nausea and vomiting, mucositis, dry throat, and dysphagia. These symptoms can decrease nutrition intake, notably energy, protein, and micronutrients, which affect nutritional status[9-12]. Some studies have shown that radiotherapy increases the incidence of malnutrition, as indicated by weight loss. Due to indications of links between better survival after breast cancer, both the American Institute for Cancer Research (AICR) and the American Cancer Society (ACS) currently suggest the maintenance of healthy body weight and the achievement of a dietary pattern rich in fruits and vegetables and whole grains for long-term disease-free living for BC patients[13]. Among food components, fruits and vegetables attract greater attention to reduce the risk of BC[14]. The association was observed between intake of fresh fruits and vegetables and risk of breast cancer, in which the higher fruits and vegetable intake, the lower risk of BC[14]. The fruits and vegetables contain antioxidants as anti-cancer drugs such as vitamin C, folate, fiber, carotenoids, phytosterols, flavonoids, other phytochemicals, and protease inhibitors[14].

Nutritional status assessment methods that can be used are *Body Mass Index* (BMI), *Middle Upper Arm Circumference* (MUAC), body fat percentage, handgrip strength, hemoglobin and albumin serum, and *Patient-Generated Subjective Global Assessment* (PG-SGA). The PG-SGA is a gold standard method used explicitly for cancer patients and recommended by the *American Dietetic Association* (ADA)[12].

Cancer and the side effects of cancer treatment are also associated with reduced quality of life. Therefore, quality of life assessment combined with therapy is necessary to improve a patient's quality of life and survival. European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C30 (EORTC QLQ-C30) is the most common tool to measure the quality of life in oncology patients[15].

Therefore, nutrition education for BC patients is being evaluated. It has been shown that long-term adherence to a dietary pattern is a challenge in studies investigating the relationship between diet and disease, notably in BC[16]. Another previous study revealed a clinically significant improvement in dietary changes, especially in fruit and vegetable consumption, and reduction of red meat after nutrition education intervention.[17] Sardjito hospital is the central hospital in Central Java, Indonesia, that treats many cases of BC. 1033 cases in 2009 increased to 1420 cases in 2013, and 856 of these had undergone radiotherapy. Although several previous studies showed significant findings of the effectiveness of nutrition counseling in BC patients, there were some limitations. There were limited assessment parameters, such as only using anthropometric or cross-sectional methods; hence, we can not measure the effect of nutrition counseling intervention. Our research was conducted to assess the effectiveness of nutrition counseling that promotes increased food intake, especially energy, carbohydrate, protein, fat, and vitamin A, B, C as antioxidants and the change of nutritional status during radiotherapy.

MATERIALS AND METHODS

The Study Design and Populations

Between August–December 2016, we carried out this pre-experimental study with one group pretest and posttest design in Unit Radiotherapy, Dr. Sardjito Hospital, Yogyakarta Province, Indonesia. We selected the area since Dr. Sardjito Hospital is the biggest hospital in the province, so that the participants could represent any living areas. Participants were selected using the purposive sampling method. The study population consisted of females more than 18 years of age, diagnosed with breast cancer without metastases, who would like to undergo radiotherapy in 1 package for five weeks (25 times of therapy), able to communicate well, and signed the informed consent. This study did not include participants' body weight and height who could not be measured. The study participants (n=45) fulfilling all criteria above were performed by signing the informed consent.

Ethical Approval

Informed consent was obtained from all individual participants included in the study. The present study was conducted according to the Declaration of Helsinki principles[18]. The Ethical Committee approved this study of the Faculty of Medicine, Universitas Gadjah Mada, Indonesia, and the approval number was KE/FK/894/EC/2016.

Nutrition Counseling

Trained nutritionists to execute nutrition counseling. We performed nutrition counseling in the typical room in Radiotherapy Unit Dr. Sardjito Hospital, Yogyakarta, Indonesia while, the subject was waiting for their therapy turns. We brought a nutrition booklet about maintaining a healthy diet and overcoming the side effects of radiotherapy for breast cancer patients. We also used fruit packages as a food model and fresh fruits containing antioxidants, such as papaya, banana, grape, and orange during counseling sessions to describe what the patients should consume accurately. The nutrition counseling was given three-session, in the first, third, and fifth week of therapy. Each nutrition counseling session takes 25–30 minutes for explicating counseling goals, explaining the importance of management diet for BC patients, listening to their grievances about diet and health, and rendering some feedback. We gave motivation to all participants while giving nutrition counseling.

We monitored any progression based on nutrition assessments for every counseling session in the first 15 minutes. We noted nutrition intake using 24-hours food recall to obtain the amount of nutrition intake. The intake is quiet enough if it meets the minimum 80% of the individual requirement, according to the energy requirement by 32 kcal/kg ideal body weight, protein by 1 g/kgBB, fat by 25% of total energy expenditure, carbohydrate by difference, vitamin A 500 µg, vitamin C 75 mg and vitamin E 15 mg[19]. We also measured nutritional status based on parameter anthropometric (BMI, MUAC, and body fat percentage), physical (handgrip strength/HGS), and *patient Generated–Global Subjective Assessment* (PG-SGA) and quality of life using EORTC QLQ-C30. Secondary data was recorded to elicit biochemical data (hemoglobin/Hb and albumin serum levels). We informed all the data interpretation to the subject and provided some suggestions to improve or maintain their health.

Dietary Assessment

We interviewed each subject to obtain dietary data using 24-hours food recall. The interview was conducted in each counseling session, represented the day before therapy in the first week, on therapy in the third week, and after therapy in the fifth week. We analyzed the intake of energy, protein, carbohydrate, fat, vitamin A, C, and E. The total amount of nutrition intake was performed using nutrisurvey. Fruits and vegetables as antioxidants were also qualitatively analyzed to observe the difference between the early and end of the study.

Anthropometric Measurements

To obtain nutritional status based on the anthropometric parameter, we measured height to the nearest 0.1 cm using a locally constructed height stick. Participants were asked to remove their footwear, then stand up against the vertical plane with the head, scapula bone, hip, calf, and heel on the plane, and look straight ahead. Weight and body fat mass were measured in light clothing nearest 0.1 kg using Omron Karada Scan HBF-358 digital weighing scale. Participants were asked to stand up straight without holding on to any object and not carry anything that affected weight. MUAC was measured in centimeters at the midpoint between the acromion and olecranon using *Medline*. All the measurements were examined two times with 1-minute intervals. The two measurements' mean value was considered the participant's value. Yogyakarta Meteorologycal Agency calibrated all the tools mentioned above in April 2016.

World Health Organization (WHO) definitions of threshold values were used for classifying Body Mass Index (BMI) and waist circumference (WC). Body mass index (kg/m^2) was calculated as weight (kg) divided by the square of the height (m^2) and classified into four categories: < 18.5 kg/m^2 is underweight, 18.5–24.9 kg/m^2 is normal, 25.0–29.9 kg/m^2 is overweight and ≥ 30 kg/m^2 is obesity[19]. Body fat mass was grouped into four categories as follows: under fat (<21%), normal (21-33%), overweight (33.1-39%), and obesity (>39%)[19].

Biochemical Analysis, Physical Measurements, Patient-Generated – Subjective Global Assessment (PG-SGA) *and Quality of Life (QOL)*

The hemoglobin and albumin serum levels were measured in the hospital clinical laboratory using spectrophotometry, bromscerol green, and *Enzyme-Linked Immunosorbent Assay* (ELISA). The category of hemoglobin was grouped into two as follows: <12 g/dL is low and ≥12–15 g/dL is normal while, for albumin was grouped into two as follows: <4 is low and ≥4 is average.

We measured physical ability using the HGS. At the time of anthropometric measurement, after completing all measurements above, the participants were asked to grab a hand dynamometer with the

arm position perpendicular to the axial[20-21]. Next, handgrip strength was measured twice with 2 minutes interval using a hand dynamometer. Finally, participants were asked to squeeze the handgrip as hard as possible using the right hand, and the values were recorded in kilograms[20-21]. We grouped the value of HGS into two categories: ≤10 kg is poor and >10 is good. The PG-SGA evaluates malnutrition based on several criteria such as short-term weight loss history, dietary intake, symptoms relating to nutrition, and a functional and physical examination. A score of 0–3 means well-nourished (PG-SGA A), a score of 4–8 means moderately malnourished (PG-SGA B), and a score ≥9 means severely malnourished (PG-SGA C)[22].

Quality of life (QOL) was determined using questionnaire EORTC QLQ-C30, which consists of five functional scales, which are physical (PF), role (RF), cognitive (CF), emotional (EF), and social functioning scales, and three symptom scales (fatigue, pain, and nausea/vomiting), a global health/QOL scale, and several single items for the assessment of additional symptoms commonly reported by cancer patients (e.g., dyspnea, appetite loss, sleep disturbance, constipation, and diarrhea), as well as the perceived financial impact of the disease and treatment. All items are scored on 4-point Likert scales, ranging from 1(not at all) to 4 (very much). In addition, all functional scales and individual item scores are transformed to a 0–100 scale with higher values indicating a higher functioning in functional scales and an increased presence of symptoms in symptom scales[15].

Data Analysis

Descriptive frequency analysis measured the characteristic of respondents, the adequacy of food intake, the prevalence of malnutrition, and quality of life. In addition, the difference in food intake and nutritional status between the measurement at first and last week of radiotherapy were analyzed using paired t-test, Wilcoxon test, and McNemar test.

RESULTS

Participants characteristics

Most of the participants were between 30-50 years of age (51,1%) and had a history of surgery and chemotherapy (Table 1).

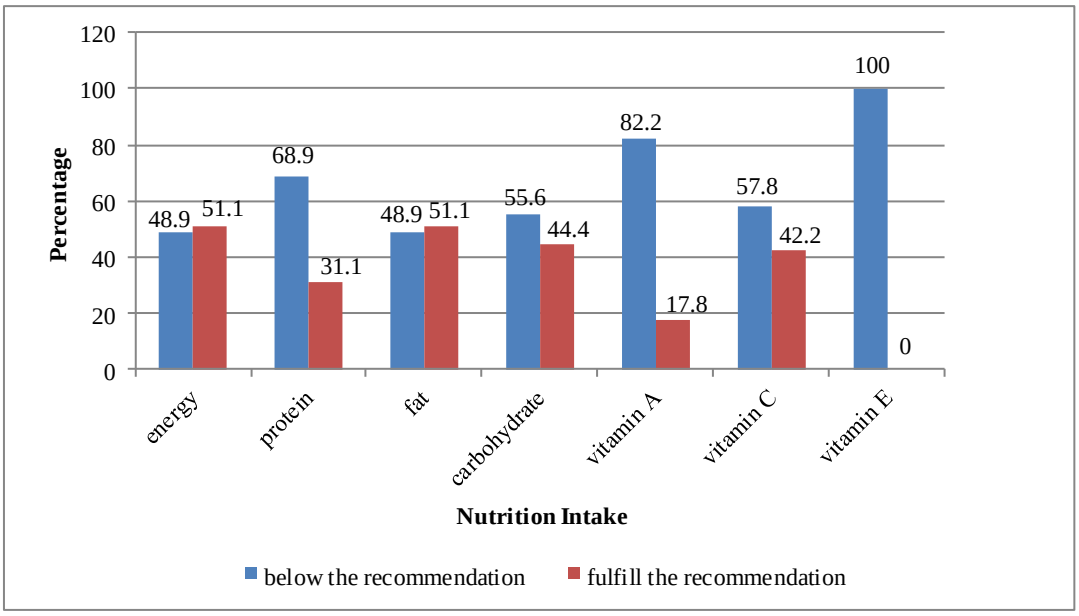
Table 1. Participants Characteristics

Variable	n	%
Age		
Adult (30-50 years old)	23	51.1
Elderly (>50 years old)	22	48.9
Stage of Disease		
Early-stage (0, I, II)	13	28.9
Regional spread (IIIa, IIIb, IV)	13	28.9
Unknown	19	42.2
History of Surgery		
Yes	41	91.1
No	4	8.9
History of Chemotherapy		
Yes	45	100
No	0	0
Total	**45**	**100**

Overview of the Nutrition Intake and Nutritional Status

Nutrition Intake

More than 50% of participants have a low intake of protein, carbohydrate, vitamin A, C, and E in the early study (Graphic 1).



Graphic 1. Nutrition Intake in the Early of Study

Nutritional Status

MUAC, HGS, hemoglobin, albumin, and PG-SGA at early of the study were as below (Table 2).

Table 2 showed that most participants were well-nourished at early radiotherapy. Based on BMI, 31.1% of participants were well-nourished, and 44.4% were obese. According to the Application of Clinical Nutrition, the standard of MUAC for an adult woman is 28.5 cm[23]. MUAC is good if it meets at least 90% of the standard, 26.65 cm, and 80% of participants met this standard. Body fat percentage showed that 48.5% of participants were average, and 37.8% were overweight. Handgrip strength showed that 77.8% were good. Based on albumin serum, 90.6% of participants were average, as did 60% based on hemoglobin index. However, mostly, participants had a high level of malondialdehyde or MDA (53.3%). The PG-SGA showed that 73.3% were well-nourished (PG-SGA A).

Quality of Life

Overview of the quality of life measured by EORTC QLQ-C30 showed in table 3 as below. Quality of life

Overview of the nutritional status measured by BMI,

assessment is essential to measure the effect of cancer and the treatment on a patient's life and survival. Based on the table, most participants have a good quality of life (70%).

The Effects of Nutrition Counseling on the Changes of Nutrition Intake

Significant increases were found in protein, fat, and fruits and vegetable consumption at the end of the study. However, intake of energy, carbohydrate, vitamin A, C, and E did not significantly increase, as we mentioned in Graphic 2 and Table 4 below.

The effects of Nutrition Counseling on the Changes of Nutritional Status

The anthropometric and biochemical index after counseling tends to be unchanged in all therapy as presented in Graphic 3 and Graphic 4.

Table 2. Overview of the Nutritional Status and Quality of Life at Early of Study

Variable	n (%)
BMI[1] (kg/m^2)	
Underweight (<18.5)	3 (6.7)
Well-nourished (18.5 – 24.9)	14 (31.1)
Overweight/Obesity (≥25.0)	28 (62.2)
MUAC[1] (cm)	
Poor (<25.65 cm)	9 (20.0)
Good (≥25.65 cm)	36 (80.0)
Body fat mass	
Underfat (<21%)	4 (8.9)
Normal (21-33%)	22 (48.9)
Overweight (33.1-39%)	17 (37.8)
Obesity (>39%)	2 (4.4)
HGS[1] (kg)	
Poor (≤10 kg)	10 (22.2)
Good (>10 kg)	35 (77.8)
Albumin serum[2] (mg/dl)	
Low	2 (6.3)
Normal	30 (93.7)
Hemoglobin[2] (mg/dl)	
Low	11 (28.9)
Normal	27 (60.0)
PG-SGA[1]	
PG-SGA A	33 (73.3)
PG-SGA B	10 (22.2)
PG-SGA C	2 (4.4)

[1]BMI: Body Mass Index, MUAC: Mid Upper Arm Circumference, HGS: Handgrip Strength, PG-SGA: Patient Generated-Subjective Global Assessment

[2]Albumin serum was only 32 subjects, and hemoglobin was only 38 since we used secondary data by following the hospital's blood test schedule for BC patients. Therefore, some patients were not assessed until the study finished, especially for the new admission patients.

Table 3. Quality of Life[1]

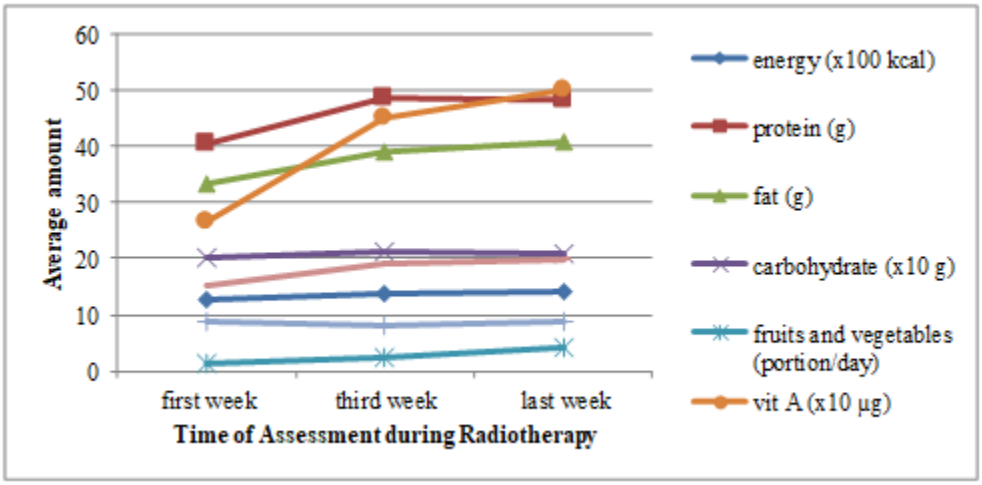
Quality of Life	n	%
Good	28	70
Poor	12	30
Total	**40**	**100**

[1]Number of subjects was only 40 since several subjects had experienced metastases; hence they were moved to another ward for more intensive treatment.

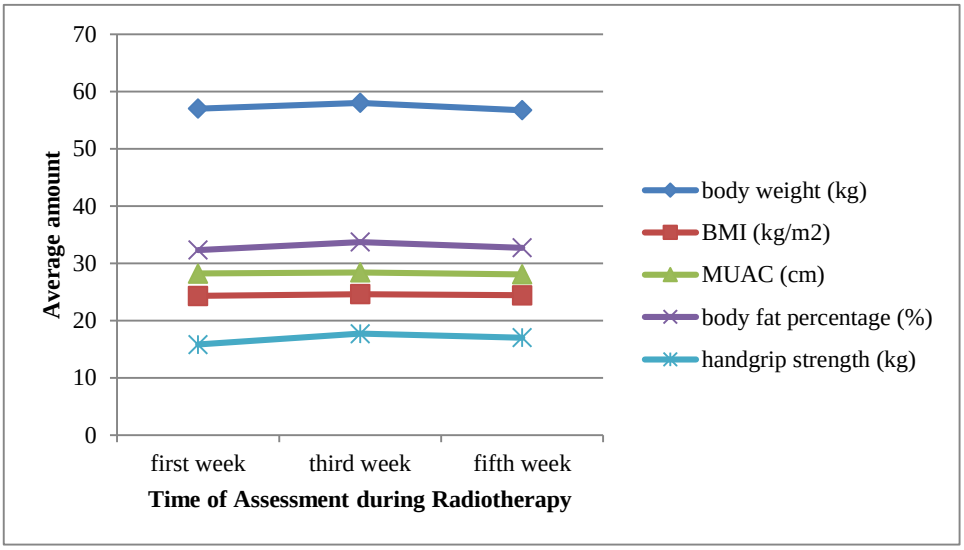
Table 4. Statistical Analysis of Nutrition Intake in the Early and the End of Therapy

Nutrition Intake	Early of Therapy	End of Therapy	p
	Mean (SD)	Mean (SD)	
Energy (kcal)*	1272.14 (398.63)	1396.68 (406.74)	0.073
Protein (g)**	40.27 (16.46)	48.39 (16.42)	0.010[1]
Fat (g)**	33.39 (15.69)	41.04 (17.65)	0.008[1]
Carbohydrate (g)*	202.10 (74.03)	207.94 (74.02)	0.650
Fruits and Vegetables (portion/day)*	1.44 (1.42)	4.03 (2.24)	0.001[1]
Vitamin A (µg)**	266.08 (274.52)	500.51 (1077.94)	0.379
Vitamin C (mg)**	88.43 (90.46)	88.45 (157.33)	0.336
Vitamin E (mg)**	1.53 (1.62)	1.97 (1.62)	0.076

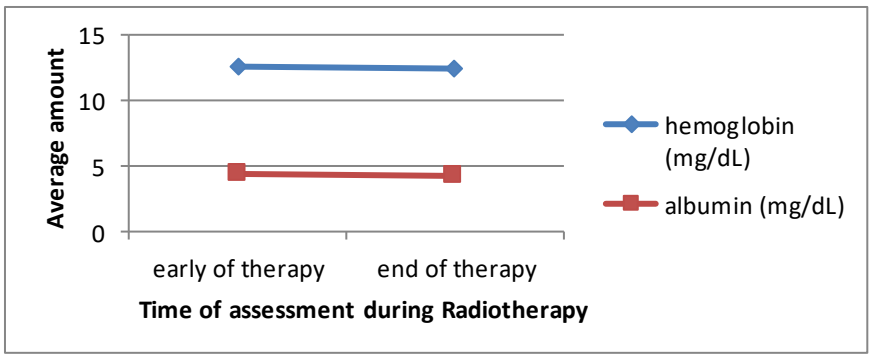
**paired t-test, **Wilcoxon test, [1]p<0.05*



Graphic 2. The Changes of Nutrition Intake during Radiotherapy



Graphic 3. The Changes of Anthropometric Index during Radiotherapy



Graphic 4. The Changes of Hemoglobin and Albumin Index during Radiotherapy

Based on Table 5, body weight, BMI, HGS, MUAC, body fat percentage, hemoglobin, and albumin index were not significant changes at the end of the study. However, bodyweight, MUAC, and albumin were decreased while HGS rose at the end of the study.

Tabel 5. Statistical Analysis of Nutritional Status in the Early and the End of Therapy

Nutrition Intake	Early of Therapy	End of Therapy	p
	Mean (SD)	Mean (SD)	
Body weight (kg)*	57.00 (10.91)	56.72 (10.80)	0.075
BMI[1] (kg/m^2)*	24.33 (4.28)	24.40 (4.24)	0.621
HGS[1] (kg)*	15.85 (8.78)	16.97 (6.18)	0.081
MUAC[1] (cm)**	28.20 (5.01)	28.06 (5.34)	0.352
Body fat percentage (%)**	32.29 (7.20)	32.71 (7.01)	0.576
Hemoglobin (mg/dL)*	12.59 (0.98)	12.53 (0.61)	0.346
Albumin (mg/dL)*	4.37 (0.32)	4.30 (0.14)	0.838

**paired t-test, **Wilcoxon test, [1]BMI: Body Mass Index, HGS: Handgrip Strength, MUAC: Mid Upper Arm Circumference*

Table 6 served the participants who had an excellent handgrip strength at the early study increase after counseling, as did the participants based on PG-SGA. Nevertheless, one subject changes the score from PG-SGA B turn to PG-SGA C.

Table 6. Statistical Analysis of Handgrip strength and PG-SGA after Counseling

Parameters	Total Participants		p
	At the early of therapy	At the end of therapy	
Handgrip strength (kg)**			
Poor	10	6	0.219
Good	35	39	
PG-SGA*			
PG-SGA C	2	3	1.000
PG-SGA B	10	8	
PG-SGA A	33	34	

**Marginal homogeneity test, **McNemar test*

DISCUSSION

Most of the participants had an intake of nutrition below the dietary recommendation. More than 48% of participants had a low energy intake, protein, fat, and carbohydrate. The participants who had an intake of vitamin A below the dietary recommendation were 82,2%, and vitamin C was 57,8%, and vitamin E was 100%. Based on the early study data, the measurements of BMI, MUAC, body fat percentage, handgrip strength, and PG-SGA presented that most of the participants were well-nourished and tended to be overweight. The hemoglobin and albumin index of participants were mainly normal. At the end of the study, there were some significant and no significant changes in nutritional status and nutritional intake.

Several studies have shown that malnutrition increased in patients treated with radiotherapy who had a low intake of food[11-13]. In addition, there was a significant decrease in body weight, albumin level, and nutritional status based on PG-SGA between the early and the end of radiotherapy[11]. Therefore, nutrition counseling was expected to prevent the decreased nutritional status of a patient.

The nutritional status indirectly by the culture, environment, counseling, employment, or health

facilities and was directly influenced by food intake and the disease [24-25]. The food intake was influenced by appetite, swallowing ability, and absorption in the body[26]. In cancer, radiation or chemical therapy affects an appetite and causes nausea, vomit, stomatitis, dry throat, and dysphagia. This effect leads to disruption of food intake and decreases the nutritional status[9]. The nutritional status in cancer patients was influenced by the severity of the disease, the ability of the patient to survive, and the side effects of its therapy[27]. Obesity is the risk of cancer and has been associated with an increased and worse prognosis for malignances[28].

As mentioned in Table 4, we found significant improvement in protein, fat, and fruit and vegetable consumption after the nutrition counseling session. Protein and fat increased up to 8 grams/day, and fruit and vegetable increased up to 2.5 portions/day. Vitamin A, C, and E are essential for cancer patients treated with radiotherapy. The current research has shown that consuming nutrients in fruits, vegetables, the source of carbohydrates, protein, and fat, will reinforce the body against cancer. Consumption of vitamins, minerals, other phytochemicals, and antioxidants also increases the immune system against carcinogens or toxins, leading to cell damage and oxidative stress. In cancer patients, there are changes in carbohydrates, protein, and fat in the body. Hypermetabolism occurs because the cancer cells increase the glucose needs as energy. It leads to protein turnover and increases lipolysis[29].

Concerning the increase of nutrient intake in this study, there were no significant changes in body weight and nutritional status parameters such as BMI, MUAC, body fat percentage, and handgrip strength between the early and the end of therapy. However, after counseling, the average difference of body weight was 0.28 kg, the average difference of MUAC was 0.14 cm, and the average difference of body fat percentage was 0.42%. In addition, there was an increase of well-nourished patients based on handgrip strength and PG-SGA after counseling.

Index of hemoglobin and albumin between the early and the end of therapy was decreased but not significant. The average difference of hemoglobin index was 0.07 mg/dl, as did the albumin index was 0.08 mg/dl. Most participants had an average level of hemoglobin and albumin. The patient treated with radiotherapy should have an average hemoglobin level to prevent lack of oxygen in the blood, leading to optimal ionization during radiation[30-31]. The low albumin index is related to the increase in mortality. The low intake of protein causes increases endothelial blood vessel permeability due to cell damage or in an acute condition, leading to a decrease of albumin synthesis in the liver[10, 32, 33].

Nutritional status in cancer patients determines to quality of life in the future. Well-nourished patients have better body function and do not appear many symptoms of diseases. In contrast, malnourished patients have lower physical, cognitive and social conditions, and more disease symptoms. These physical, cognitive, social, and symptomatic conditions are a dimension of the quality of life so that cancer patients with good nutritional status have a better quality of life[34].

Nutrition counseling aims to overcome the nutritional problems of the patient that affect the food intake. Counselor also calculated the nutrient needs and applied them in the daily menu recommendations. This study shows that there was a significant increase in protein and fat intake after counseling. The intake of energy, carbohydrate, vitamins A, C, and E was increased but not statistically significant. This means that nutrition counseling has a considerable effect on the patient's intake. The previous studies showed that nutrition counseling also increased the consumption of fruits and vegetables, decreased the consumption of red meat, and there were no changes in body weight and the increase of glutathione[16, 34].

CONCLUSION

There was a significant increase in protein and fat intake after counseling, but the increase in energy, carbohydrate, vitamin A, C, and E was insignificant. In addition, there was no significant difference in body weight, nutritional status based on BMI, MUAC, handgrip strength, albumin and hemoglobin level, and PG-SGA after counseling. The average measurement of body weight, MUAC, hemoglobin, and albumin decreased; however, BMI, body fat percentage, and handgrip strength tended to increase.

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Risk factor of growth faltering in infants aged 2-12 months

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ABSTRACT

Background: *Growth faltering is a condition of growth disturbance that marked by slower growth velocity compared with previous growth chart. Growth faltering can cause effects in immune response, cognitive, & physical and psychomotor disturbance, behavioral disorder, learning problems, higher risk of infection and mortality.*
Objectives: *To analyze risk factor of growth faltering in infant aged 2-12 months.*
Materials and Method*s: A case control study was conducted in Public Health Center in Semarang city. Subject were infants aged 2 until 12 months with growth faltering. Variables were divided to exclusive breastfeeding, mother's education, mother's employment, social economic status, infection, mother's nutrition and gestational age. Anthropometric and questionnaire data were obtained and analyzed among 116 infants. Statistic test used Chi square and multivariate analysis.*
Results*: Chi-square analysis showed that breastfeeding (p=0.016) and gender (p=0.04) had a significant relationship with growth faltering in infant 2-12 months. Under standard parent's income (p=0.809), Acute Respiratory Tract Infection (ARTI) (p=0.377), diarrhea (p=0.243), mother's nutrition (p=1.00), gestational age (p=0.77), low mother's education (p=0.83) and working mother (p=0.26) didn't have a significant relationship with growth faltering in infant aged 2-12 months. Multivariate analysis showed that gender (p=0.035) and breastfeeding (p=0.019) were the most influencing variable to growth faltering. In 2-6 group, breastfeeding pattern had significant relationship with growth faltering (p=0.77)*
Conclusions*: Breastfeeding and gender were risk factors of growth faltering in infant aged 2-12 months. Further research needed on how to prevent growth faltering in first 1000 days of life so it may avoid stunting in later life.*

Keywords*: Risk; growth faltering; infants*

BACKGROUND

Growth faltering is a growth disorder characterized by a slower growth rate compared to the previous growth curve.[1] One way to identify growth faltering is to compare the weight growth curve (weight for age curve). Usually growth faltering occurs in infants aged 3-12 months.[2] According to Smith in Clinical Pediatric Dietetics, 5-10% of children less than 5 years of age in America experience growth faltering.[3] Based on the results of National Health Survey 2013 regarding the nutritional status of toddlers according to weight-age and height-age, 19.6% of children under five in Indonesia are thin and very thin. Meanwhile in Central Java, 11.1% toddlers were very thin and thin.[4] According to the Semarang City Health Profile in 2013, the number of children under the red line according to growth chart were 1,502 children (1.7%) of the 86,515 children who came and were weighed (D) at the community based preventative and promotive care (*Posyandu)* and from 801 cases of malnutrition, 32 cases of malnutrition among children under five found in 2013.[5]

Growth faltering causes short-term effects, namely disruption of the immune response; stunted cognitive, physical, and psychomotor growth; behavioral problems, learning difficulties, increased risk of infection; and infant mortality.[6,7,8] Meanwhile, the long-term effects of growth faltering are emotional and intellectual disorders, risk of chronic disease, metabolic syndrome, macrovascular disease in middle age, and the incidence of low birth weight (LBW).

Growth faltering is caused by an imbalance between energy intake and biological needs for growth.[3] Lack of energy intake can be related to feeding difficulty, inadequate food and / or social emotional problems between parents and children[9], other diseases or eating patterns . The diet includes breastfeeding, age at first complementary feeding, appetite, oral dental

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health, parental knowledge of energy needs for growth, and difficulty eating. The biological need for growth can be increased by the presence of other illnesses such as gastrointestinal disease, neurological disorders, or congenital heart disease[3].

Growth faltering considered as the beginning of stunting that still a major concern in Indonesia. Early detection and intervention on growth disturbance can prevent stunting in later life. Growth faltering most common found in age 3 until 6 months. Finding the risk factor of growth faltering in early life will have a lot of advantages in managing undernutrition. Based on this, it is necessary to further investigate the risk factors for growth faltering, especially in children aged 2-12 months, which is the golden age of the first 1000 days of life.

MATERIALS AND METHODS

This study is a case-control study which was conducted at Halmahera Public Health Center Semarang. The case is infant aged 2-12 months with growth faltering. Inclusion criteria include infants aged 2-12 months, experiencing growth faltering, parents willing to take part in the study. Exclusion criteria were chronic disease or congenital abnormalities. Subject needed was 40 subject in each group. Subjects were collected by consecutive sampling in Public Health Center. Hundred and sixteen subjects were participated in this study, and all of the subjects completed the protocol. Data analysis includes descriptive analysis and hypothesis testing. Data were taken by anthropometric measurements on infants. Anthropometric measurements taken are measurements of body weight, body length and head circumference. Body weight measurements using Laica ® with 10 gram accuracy, body length measured using infantometer in the Public Health Center with 0.1 cm accuracy. The measurement was done by health workers and researcher. Interviews was done by researcher to fill out questionnaires. The results of anthropometric measurements are then plotted on the WHO 2006 curve, on the weight-for-age curve, if there is an increase in body weight that does not match the curve, it is said that the child is experiencing growth faltering. The data obtained from the questionnaire including date of birth, birth weight and birth length, and food recall. Hypothesis testing used the Chi-square test, Fisher exact and multivariate analysis. The p value is considered significant if $p < 0.05$ with a confidence interval of 95%. This research was approved by the Health Research Ethics Commission (KEPK), Faculty of Medicine, Diponegoro University / Dr. Kariadi Semarang (No. 055 / EC / FK-RSDK / 2016).

RESULT

During the study, there were 116 subjects who met the research criteria. Subjects consisted of 41 infants aged 2-6 months and 17 infants aged 7-12 months who experienced growth faltering as a case group and 58 infants with growth line directions N1 or N2 as a control group. Some of the subjects were obtained from *Puskesmas* Halmahera and some from *Posyandu* in the working area of *Puskesmas* Halmahera.

Table 1. Characteristics of Research Subjects

Characteristics	Growth Faltering	
	Yes	No
Gender		
Female (n,%)	31 (53.4)	20 (34.5)
Male (n,%)	27 (46.6)	38 (65.5)
Age (mean, SD) months	5.52±2.98	5.4±2.76
Birth Length (mean±SD) cm	48.17±2.72	48.69±3.19
Birth Weight (mean±SD) kg	3039.3±361.7	3119.4±425.1
Weight (mean±SD) gram	6.54±1.42	6.98±1.57
Length (mean±SD) cm	63.83±6.15	63.86±6.06
Head circumference (mean±SD) cm	42.0±2.19	41.8±2.84
WLZ (mean±SD)	-0.5±1.64	-0.2±2.12
HAZ (mean±SD)	-0.59±1.74	-0.64±1.77

In table 1, there are 58 infants who experienced growth faltering, with 31 infants were girls and 27 infants were boys. The mean age when experiencing growth faltering was 5.52 ± 2.98 months, with the status of nutrition

was good nutrition based on weight for length z score (WLZ) more or equal than -2 SD .

Table 2. Parent's Characteristics

Characteristics	Growth Faltering		p
	yes	No	
Father's age (mean±SD) years	32.47±6.52	32.86±6.27	0.590[a]
Mother's age (mean±SD) years	28.66±6.12	29.84±5.41	0.334[a]
Mother's education			
Low	15	14	0.83[b]
High	43	44	
Mother's employment			
Employed	21	27	0.26[b]
Unemployed	37	31	
Father's education			
Low	20	12	0.097[b]
High	38	46	

[a]Chi-square test [b]Independent t-test

From Table 2, it is shown that mothers with high education can still have children with growth faltering, but it was less when the father has a higher education eventhough it is not significant.

Table 3. Risk factors for growth faltering infants aged 2-6 months

Risk factor	**Growth Faltering**		***P***	**OR (95% CI)**
	Yes	**No**		
Breastfeeding patterns				
Schedule	9	1	0.014[a]	10.97(1.32-91.22)
On demand	32	39		
Breastfeeding administration				
Bottle	13	7	0.138[b]	2.19(0.77-6.24)
Direct	28	33		

[a] Fisher's exact test [b]Chi-square test

In table 3, scheduled breastfeeding is a risk factor for growth faltering with p 0.014. It is shown that most mothers give breastmilk to infants based on their hungry cues.

Table 4. Risk factors for growth faltering infants aged 7-12 months

Risk factor	**Growth Faltering**		***P***	**OR (95% CI)**
	Yes	**No**		
Complementary foods of breastmilk type				
Home made	16	18	0.486[a]	0.47(0.33-0.67)
Manufacturer	1	0		
Complementary foods of breastmilk frequency				
Less	11	6	0.063[b]	3.67(0.91-14.82)
Adequate	6	12		
Complementary foods of breastmilk age				
Incorrect	8	4	0.122[b]	3.1(0.72-13.44)
Correct	9	14		

[a]Fisher's exact test [b]Chi-square test

At the age of 7-12 months, both types of complementary foods, the frequency of complementary foods and the age of complementary feeding are not risk factors for growth faltering.

Table 5. Risk factors for growth faltering infants aged 2-12 months

Risk factor	Growth Faltering		*P*	OR (95% CI)
	Yes	No		
Age				
≤6 months	41	40	0.84[a]	1.09 (0.49-2.34)
> 6 months	17	18		
Gender				
Female	31	20	0.04[a]	0.46 (0.22-0.97)
Male	27	38		
Exclusive breastfeeding				
No	46	34	0.016[a]	2.71 (1.19-6.16)
Yes	12	24		
Parents' income				
Below Regional Minimum Wage	11	10	0.809[a]	1.12(0.44-2.89)
Above Minimum Regional Wage	47	48		
ARTI (Acute Respiratory Tract Infection)				
Common	8	5	0.377[a]	1.69(0.52-5.53)
Less	50	53		
Diarrhea				
Common	3	0	0.243[b]	2.06(1.7-2.48)
Less	55	58		
Mother's arm circumference				
Less	2	3	1.00[b]	0.66(0.11-4.07)
Adequate	56	55		
Gestational age				
Preterm	6	7	0.77[a]	0.84(0.26-2.67)
Aterm	52	51		
Mother's education				
Low	15	14	0.83[b]	1.09(0.47-2.54)
High	43	44		
Mother's employment				
Employed	21	27	0.26[b]	0.65(0.31-1.37)
Unemployed	37	31		

[a] Chi-square test [b]Fisher's exact test

Table 6. Multivariate analysis

	Variable	Coefficient	*p*	OR(95% CI)
Step 1	Gender	-0.845	0.035	0.43 (0,19-0,94)
	Breastfeeding	1.018	0.019	2,71 (1,19-6,16)
	Diarrhea	20.795	0.999	2,06 (1,7-2,48)
	Constant	-0.277	0.494	

DISCUSSION

The direction of the growth line is viewed through the WHO curve for body weight by age to detect any irregular bending of the growth line. Growth faltering can occur at any age during the growing period. Growth faltering has a multifactorial cause, both external and internal to the individual. Growth faltering, especially that which occurs in the first 1000 days of life has a negative impact on children's growth and development later in life. [10,11] Disturbance in early life is related to the ability to attend school too late, which has a high predictive value of income in adulthood. Nutritional intake is very important at this age to meet the growing needs of growth. In this study, it was found that the average age of growth faltering was between 3 until 7 months. Research conducted with data collection in 54 countries, found that the average age of growth faltering was at the age of 3 months and decreased rapidly until the age of 12 months, slower until the age of 18-19 months and grew rapidly after that. [12] From this study, we found that growth faltering is more often in female infants than boys. This can be caused by patriarchy culture in this area, so male infants will get more attention including nutrition intake. The other cause could be that male infants get hungry easier so feeding intensity will be more often than female infants. This study found that the absence of exclusive breastfeeding has a significant relationship with the incidence of growth faltering in infants aged 2-12 months with a p value of 0.016.Infants that didn't received exclusive breastfeeding are more prone to infection. Infection can deteriorate nutrition intake and causing growth faltering, especially in infants aged less than six months. Growth faltering most common in infants aged 3 until 5 months, this can be caused when in that ages, mothers has to return to work and education about how to breastfeed during work still scarcely given by the health workers, and this can cause infants could not have the nutrition needed to maintain appropriate growth. Infants who are not exclusively breastfed have a higher risk of experiencing growth faltering than infants who are exclusively breastfed.[13] This is consistent with a study in Mexico which states that the incidence of growth faltering can be prevented by exclusive breastfeeding. Breastfeeding can improve growth by preventing infection and improving nutritional intake at the time of infection. [14, 15, 16] In addition, breastfeeding alone is sufficient to meet the needs of infants up to 6 months old because of the composition of the milk that adjusts with the infant's needs.

The results of this study also indicate that the time pattern of breastfeeding has a significant relationship with growth faltering in infants aged 2-6 months. Infants who are breastfed on a regular basis have a higher risk of experiencing growth faltering when compared to babies who are breastfed on-demand. Research by Ksenia Bystrova shows that infants who are treated in combination, and who are breastfed on-demand, have better growth than infants who are treated separately. [17] On-demand breastfeeding, which means that it is tailored to the wishes of the baby, has been shown to affect the duration of breastfeeding becomes longer. Infants can adjust their needs, if they are hungry, they will breastfeed more often and for longer, thus stimulating the prolactin reflex to produce more milk. The more often the mother breastfeeds, the more milk production will be. Sufficient milk production to meet the needs of the baby is what can lead to better baby growth. On the other hand, on scheduled breastfeeding, mothers tend to limit the frequency of breastfeeding, which can lead to decreased milk production. From other studies, it was found that the provision of a scheduled diet was associated with the well-being of the worse mother, but worse cognitive and academic output in children [18].

Other factors such as nutritional status, maternal occupational education level, socioeconomic, incidence of Acute Respiratory Tract Infection (ARTI) did not show a significant relationship with the incidence of growth faltering in infants aged 2-12 months. The nutritional status of breastfeeding mothers can affect milk production. [19] However, other studies have shown that the composition of breast milk is not sensitive to maternal factors, including nutritional status, in the early months of breastfeeding. [20] Previous studies have revealed that even though mothers know the importance of breastfeeding exclusive breastfeeding, but the rate of exclusive breastfeeding is still suboptimal, due to many other factors that can affect the good achievement of exclusive breastfeeding. [21, 22] Lack of knowledge of mothers on proper

nutrition will reduce nutritional intake in children. The level of education does not guarantee the mother's knowledge of breastfeeding or the infant's growth. Based on the results of the interviews, it appears that mothers with high or low education mostly feel that breastfeeding alone is not enough for their baby's growth. Research in China states that education on correct infant feeding practices can increase growth, reduce the incidence of anemia in infants aged 6-12 months, and improve nutritional status in children under 5 years of age in developing countries. [23, 24]

Research in Isfahan compared growth in children with working and non-working mothers. There was a significant difference between the two groups in the growth of children aged 12-30 months, but no significant difference was found at the age of 0-12 months. [25] This is in accordance with the results of the study that there was no significant relationship between maternal occupation and the incidence of growth faltering in infants aged 2-12 months.

There is no significant relationship between socioeconomic and growth faltering in infants aged 2-12 months in the results of this study. Similar results were obtained in England, which states that social characteristics have only a slight effect on infant weight gain. [26] Research in Japan states that infants who come from low-income families have a higher risk of growth faltering. [27] On the other hand another, in the middle economic status group there was also growth faltering with an amount that was not much different. Meanwhile, in the highest economic status group, the risk of growth faltering is lower, but still has the same basic pattern of causes of growth faltering as the lower economic status. Therefore, growth faltering can occur in all economic status. Research in 50 low-income countries states that growth faltering is influenced by the overlapping effect of poverty, less varied diets, infectious environments, poor hand washing habits and poor knowledge. low regarding the principles of nutrition and hygiene. [28]

In this study, we found that there was no significant relationship between diarrhea and the incidence of growth faltering in infants aged 2-12 months. In this area, access to health facility such as Public Health center is reachable and there was routine community based preventative and promotive care every month, so that infants can be routinely checked for their health concern. It is well known that acute infections such as acute respiratory infections and diarrhea are the leading causes of mortality, especially in developing countries. The results of previous studies found that diarrhea is a major determinant of poor growth in children. [29] Acute infection itself can affect growth due to the possibility of decreased appetite, restrictions on food given due to local culture and the presence of malabsorption of the nutrients provided.

In this study, the first age of complementary foods was not associated with the incidence of growth faltering. The first age of giving complementary foods in this study, especially at the age of 2-4 months, was given mashed bananas. According to WHO, complementary foods given at less than 6 months of age do not affect the increase in infant growth and complementary foods before 6 months of age tend to replace breastmilk given. [30] A systematic review states that complementary feeding at 4 months of age can reduce the incidence of anemia in infants. [31] Research in Germany states that late complementary foods increase the risk of allergies and the risk of inadequate energy intake because breast milk cannot meet the needs of babies over 6 months. [32] Apart from the first time introducing complementary foods, of course, the quality of complementary foods that contain enough macro and micronutrients also play an important role in meeting the nutritional needs of infants.

Based on consistency, complementary foods are divided into sufficient or insufficient consistency. The consistency is sufficient if it matches the consistency that should be at the age, namely at the age of 6 months of milk porridge, 7-9 months of rice and milk, 9-12 months of crushed and chopped food, 12-24 months of family food. [30] The statistical results of this study indicate that the consistency of complementary foods is not associated with growth faltering at 7-12 months of age. The consistency of age-appropriate complementary foods can help babies to adapt to family food later at the age of 1 year. The introduction of foods with an age-inappropriate consistency will result in difficulty eating at a later date.

Periodic measurements of weight and height are more relevant than measuring body weight alone to detect growth disorders. The ability of both health workers and cadres in conducting growth screening is needed so that there is no delay in intervention.

CONCLUSION

From the this study, it can be concluded that non exclusive breastfeeding and female sex are risk factors for growth faltering in infants aged 2-12 months, and the timing of breastfeeding is a risk factor for growth faltering in infants aged 2-6 months. The importance of exclusive breastfeeding and on demand breastfeeding can reduce the rate of growth faltering in infants. Further research needed on how to prevent growth faltering in first 1000 days of life so it may avoid stunting in later life.

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The Effect of Breastfeeding Calendar Training on Knowledge and Attitudes of Mothers in Exclusive Breastfeeding

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ABSTRACT

Background: *Lactating mothers were successful in giving exclusive breastfeeding as much as 42% based on SDKI (Survei Demografi Kesehatan Indonesia) in 2012. This is depend on the support of husbands and families as well as health workers. Thus, the husband or family should remind and motivate mothers as well as monitor the breastfeeding activity every day for 6 months using breastfeeding calendar.*
Objectives: *This study aimed to determine the increase in knowledge and attitudes of mothers in providing exclusive breastfeeding after the exclusive breastfeeding calendar training.*
Materials and Methods: *The research design used a quasi-experimental one group pre-test post-test design. This research was conducted on mothers who had babies (age 0-12 months) in Pasawahan Village and Pasawahan Kidul Village, Pasawahan District, Purwakarta Regency in April to November 2018, with 96 respondents. The sampling technique was conducted by purposive sampling. Data were collected by giving questionnaires to respondents, before and after the breastfeeding calendar training were given. The Wilcoxon test was used for the analysis of the data in this study.*
Results: *The results showed that there were differences in the knowledge of mothers before and after training on breastfeeding calendar (p <0,000) and there were differences in the attitudes of mothers before and after the training on breastfeeding calendar (p <0,000).*
Conclusions: *There was an increase in knowledge and changes in the attitude of mothers towards exclusive breastfeeding after being given the breastfeeding Calendar training. Therefore, suggestions for health workers, especially midwives and nutrition workers, can use the breastfeeding calendar as an educational medium to increase husband and family support in exclusive breastfeeding.*

Keywords*: Attitude; Exclusive breastfeeding; Knowledge; breastfeeding calendar*

BACKGROUND

One of the MDGs' goals is to end hunger, to achieve food security, to improve nutrition, and to encourage sustainable agriculture. The MDGs target by 2030 is to demolish all forms of malnutrition, including to achieve the international target of 2025 in reducing stunting.[1]
The stunting rate in Purwakarta Regency, West Java, is 30.1% based on Pemantauan Status Gizi (PSG) or Nutritional Status Survey data in 2017, stunting is a condition of failure to thrive in children under five as a result of chronic malnutrition so that the child's height does not match their age. Stunting prevention efforts must be done in every life cycle. Efforts to prevent stunting are carried out at 1000 HPK (first day of life), starting from pregnancy until the child is 2 years old. One of the efforts to prevent stunting is by giving babies exclusive breastfeeding. Lactating mothers were successful in giving exclusive breastfeeding as much as 42% based on SDKI (Survei Demografi Kesehatan Indonesia) in 2012.[2] One of the factors of exclusive breastfeeding failure is the lack of support from the environment around the mother.[3]

The success of this activity is influenced by the support of husband and wife, so that when the mother is breastfeeding, it can put the baby to sleep longer.[4] Therefore, when a mother starts breastfeeding, she will regulate milk production.[5] Other than that, husbands who attend childbirth

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preparation classes will have a positive effect on breastfeeding and contribute to a woman's breastmilk production.[4] Thus, the success of breastfeeding is highly dependent on the support the mother receives from her husband.[6]

When the mother starts breastfeeding, this process will indirectly regulate milk production.[5] Couples support in breastfeeding affects the success of breastfeeding, thus making the baby sleep longer. Husbands who attend childbirth preparation classes will have a positive effect on breastfeeding and provide exclusive breastfeeding.[4] Thus, the success of breastfeeding is highly dependent on the support the mother receives from her husband.[6]

Based on the results of a research conducted in Bali, mothers who provide exclusive breastfeeding tend to receive support from their husbands and families. In addition, mothers get supports from health workers to provide exclusive breastfeeding.[7] Emotional support is focused on respect, admiration, and love. This can raise awareness of the difficulties of breastfeeding practice and increase patience in breastfeeding so as to increase respect and appreciation for nursing mothers.[8]

Thus, the husband must also have knowledge about breastfeeding so that we need some media to receive information about how mother's body anatomy and physiology support breastfeeding, including knowing other important functions of a woman's breasts and the health benefits of breastfeeding. Husbands must have knowledge about breastfeeding in order to be able to support mothers during this practice. Therefore, we need a medium of information about how the anatomy of the body and physiology of breastfeeding mothers, including knowing other important functions of a woman's breast and the health benefits of breastfeeding.[9]

Promotion of breastfeeding through the media will affect the attitude of mothers to breastfeed their babies.[10] Especially for working mothers, they need a handful of information on how to provide exclusive breastfeeding. In addition, on how to deal with barriers to breastfeeding such as breast dams. Mother needs support from husband or family. Under these conditions, a breastfeeding calendar is required to monitor breastfeeding activity in 6 months. Husbands or families can provide a reminder, motivate, and increase the knowledge of mothers to give breastfeeding every day for 6 months using breastfeeding calendar.[11]

Therefore, this study aims to determine the increase in knowledge and attitudes of mothers in giving exclusive breastfeeding after breastfeeding calendar training.

MATERIALS AND METHODS

The research design used was a quasi-experimental one group pre-test post-test design. This research was conducted by providing training on exclusive breastfeeding and the use of the breastfeeding calendar. Respondents were given a pre-test and post-test before and after breastfeeding calendar training.

This research was conducted on mothers who have babies (0-12 months old) in Pasawahan Village and Pasawahan Kidul Village, Kec. Pasawahan, Purwakarta Regency from April to November 2018 with a population 135 mother. The sampling technique was carried out by purposive sampling. The samples in this study were 96 respondents who met the inclusion and exclusion criteria. The sample size was obtained through the calculation of the minimum sample for cross sectional research, with the proportion of exclusive breastfeeding for Purwakarta in 2017 of 55.08% and an error rate of 0.1. The inclusion criteria in this study are mothers who were willing to fill out the informed consent form. The exclusion criteria in this study were mothers who were not present at the time of data collection. Samples were taken from villages with the most number of babies in a sequence until the desired sample size was obtained. There are two research variables in this study. Firstly, the independent variables in this study were the knowledge and attitudes of mothers in exclusive breastfeeding. Secondly, the dependent variable is breastfeeding calendar training.

This training was conducted within 1 day in the form of providing material about 1000 HPK, exclusive breastfeeding, problems and handling of breastfeeding, as well as how to use the breastfeeding calendar. The resource person for this training is a research team who also acts as an enumerator in data collection. Data were collected by giving questionnaires to respondents before and after being given training using breastfeeding

calendar as a training medium. This breastfeeding calendar is a calendar that came with educational material, including the differences between exclusive breastfeeding and formula milk, the benefits and content of breast milk, a good and proper breastfeeding position, ways to express and store breast milk, breast care, and the role of fathers in exclusive breastfeeding. The questionnaire was made based on the results of the Focus Group Discussion (FGD) which made the questionnaire from the results of the research conducted by research team entitled The Initiation of Exclusive Breastfeeding Calendar to Increase Exclusive Breastfeeding.[11] The questionnaire was given to 50 mothers who have toddlers in the village Marga Asih, Kec. Pasawahan, Kab. Purwakarta. Then the validity test with Pearson correlation and reliability test with Cronbach's Alpha were executed and the result showed a value of 0.736> 0.7 so the questionnaire declared reliable. The questionnaire contains knowledge and attitudes of mothers about exclusive breastfeeding and the use of the exclusive breastfeeding calendar. Data analysis was in the form of bivariate data using the Wilcoxon test of the SPSS program version 15.0. This research has obtained research ethics permit with no. 367/UN6.KEP/EC/2018 from the e-commission of research ethics at the University of Padjadjaran.

RESULTS

Based on table 1. that breastfeeding mothers who participated in the breastfeeding calendar training had characteristics that included ages between 20-35 years of 72.9, mothers who had children> 1 (multipara) by 56.2%, with high school education of 42.7% , and mothers not working by 77.1%.

Table 1. Characteristics of Breastfeeding Mothers in Breastfeeding Calendar Training

Mother characteristics	n	%
Age		
< 20 years old	4	4,2
20-35 years old	70	72,9
> 35 years old	22	22,9
Total	**96**	**100**
Parity		
Primipara	38	39,6
Multipara	54	56,2
Grande multipara	4	4,2
Total	**96**	**100**
Education		
Do not finish Primary School	5	5,2
Primary School	13	13,5
Junior High School	32	33,3
Senior High School	41	42,7
College	5	5,2
Total	**96**	**100**
Profession		
Does not work	74	77,1
Work	13	13,5
Other	9	9,4
Total	**96**	**100**

Table 2. Differences in knowledge of mothers before and after being given Breastfeeding Calendar Training

	N	Median (minimum-maksimum)	Z	P
Knowledge before being given breastfeeding calendar training	96	81 (33-100)	6,133	0,000

Knowledge after being given breastfeeding calendar training	96	90 (62-100)

Based on table 2. there are differences in the knowledge of mothers before and after being given training on the breastfeeding calendar with a value of $p < 0.05$ and value of $z > 1,96$.

Table 3. Differences in attitudes of mothers before and after being given Breastfeeding Calendar Training

	N	Median (minimum-maksimum)	Z	P
Attitude before being given breastfeeding calender training	96	73 (50-100)	6,382	0,000
Attitude after being given breastfeeding calendar training	96	75 (66-100)		

Based on table 3, there are differences in the attitudes of mothers before and after being given training on breastfeeding calendar with the value of $p < 0,05$ and value of $Z > 1,96$.

DISCUSSION

Based on table 1, breastfeeding mothers who participated in the breastfeeding calendar training had characteristics that included ages between 20-35 years of 72.9. This shows that most of the respondents are in the healthy reproductive age range. Healthy reproductive age in women is 20-35 years old, so that women have reached a mental maturity level in undergoing the reproductive process properly. Mothers who had children> 1 (multipara) by 56.2% because parity greatly affects the acceptance of one's knowledge. Thus, the more experiences a mother has in having children, the easier the acceptance of knowledge will be. Experience is a source of knowledge to obtain the truth of knowledge by repeating the knowledge obtained in solving problems faced in the past.[12]Mother have high school education of 42.7% because education will make someone motivated to be curious, seek experience, and organize experiences so that the information received will become knowledge. High education makes a mother more able to think rationally about the benefits of exclusive breastfeeding and more easily exposed to information compared to those with low education.[13] Mothers not working by 77.1% so it is different from working mothers where efforts to provide exclusive breastfeeding often experience obstacles due to the short period of maternity and childbirth leave. Thus, before exclusive breastfeeding ends perfectly, the mother must return to work.[14]The results of this study are in line with the research conducted in the Puskesmas Nelayan, it was found that the characteristics of breastfeeding mothers who provide exclusive breastfeeding with the majority of mothers aged 20-35 years, high school education, and not working.[15]

In addition, based on the results of research conducted in British Columbia and Alberta (areas urban), that the number of mothers who breastfeed exclusively is higher than in New Brunswick, Newfoundland, and Quebec (areas rural). Breastfeeding mothers who provide exclusive breastfeeding have characteristics, including age, education and occupation. Therefore, increasing age and education of breastfeeding mothers living in British Columbia and Alberta have higher success in exclusive breastfeeding compared to nursing mothers living in New Brunswick, Newfoundland, and Québec.[16]

Based on table 2. there are differences in the knowledge of mothers before and after being given training on the breastfeeding calendar with a value of $p <0.000$. Knowledge is the result of knowing someone after sensing an object.[17] The object referred to in this study is the breastfeeding calendar. Increased knowledge in the training process shows that the breastfeeding calendar can be used as a medium for education and monitoring of exclusive breastfeeding by families, especially the role of husbands.[11]

The results of this study are in line with research conducted in the city of Padang that there is an increase in the knowledge of breastfeeding mothers,

before and after getting promotion about exclusive breastfeeding through extension methods.[10]

Health promotion is carried out by health professionals, especially midwives in the form of training given to mothers to improve maternal and child health.[18]One of the materials in this training explains that breastfeeding has a unique health aspect and it is important that breast milk is a unique substance. Breast milk contains antiseptics which help to complement the immune system of immature babies. Some of the benefits of breast milk for babies are disease preventions, such as respiratory, stomach, intestinal, middle ear, and urinary tract infections. Breastfeeding babies tend to reduce the incidence of chronic diseases such as juvenile diabetes and asthma in babies at risk.[19]

Figure 1. Exclusive Breastfeeding Calendar

Figure 2. Educational Media

One of the roles of health workers is to carry out health promotion on exclusive breastfeeding as a source of information for breastfeeding mothers. In addition, health workers must provide optimal support to breastfeeding mothers.[20]

Thus, health promotion media is needed to increase the knowledge and attitudes of mothers in breastfeeding. Breastfeeding has a major role in public health to improve the health of babies and mothers. Thus, mothers who provide exclusive breastfeeding are an action to promote the initiation and implementation of breastfeeding practices, especially for groups of breastfeeding mothers who do not exclusively breastfeed. Therefore, an effective program by making strategies to overcome the obstacles to exclusive breastfeeding practices.[21]

Health workers play a role in health promotion of exclusive breastfeeding. Additionally, health workers must also provide optimal support to breastfeeding mothers.[20] So a health promotion media is needed to increase the knowledge and attitudes of mothers in breastfeeding. The breastfeeding calendar acts as a health promotion medium.[11]

Breastfeeding has a major role in public health to improve the health of babies and mothers. Mothers who provide exclusive breastfeeding are an action to promote the initiation and implementation of breastfeeding practices, especially in groups of breastfeeding mothers who do not provide this practice. This program is an effective strategy in overcoming barriers to implementing exclusive breastfeeding.[21]

Mother's knowledge about exclusive breastfeeding and the attitude of breastfeeding mothers in exclusive breastfeeding is not optimal. Mother's understanding of information about exclusive breastfeeding will determine the breastfeeding mothers exclusively. Mother's

knowledge, mother's education level, and the child's age will affect the mother exclusively in breastfeeding. Health workers must carry out health promotions aimed at providing motivation and helping mothers to overcome obstacles during this practice.[22]

Health education interventions were found to have succeeded in increasing knowledge and practice of exclusive breastfeeding. Hence, health education is recommended to increase the practice of exclusive breastfeeding among mothers.[23]

Based on table 3, there are differences in the attitudes of mothers before and after being given training on ASI calendar with a value of p <0.000. Attitude is an evaluative response to an object, namely the response of the evaluation process to a stimulus in the form of good and bad, positive and negative, pleasant and unpleasant judgments which then crystallizes as a potential reaction to the object.[24]

The trigger factor in giving exclusive breastfeeding to babies is knowledge, attitudes and behavior of the mother, where most of them still do not understand the benefits of exclusive breastfeeding. Maternal health status, family support and staff assisting in the childbirth process provide as reinforcing factors for exclusive breastfeeding for babies.[25]

According to Skinner (1983) quoted from his book *Notoatmodjo* demonstrated that knowledge or cognitive is a very essential domain for the formation of one's actions (overt behavior). Before a person adopts a new behavior, a sequential process occurs within the person, that is awareness, where the person realizes in the sense of knowing in advance of the stimulus (object), interest (feeling attracted) to the stimulus or object. Thus by this, the attitude of the subject has begun to emerge**.**[26]

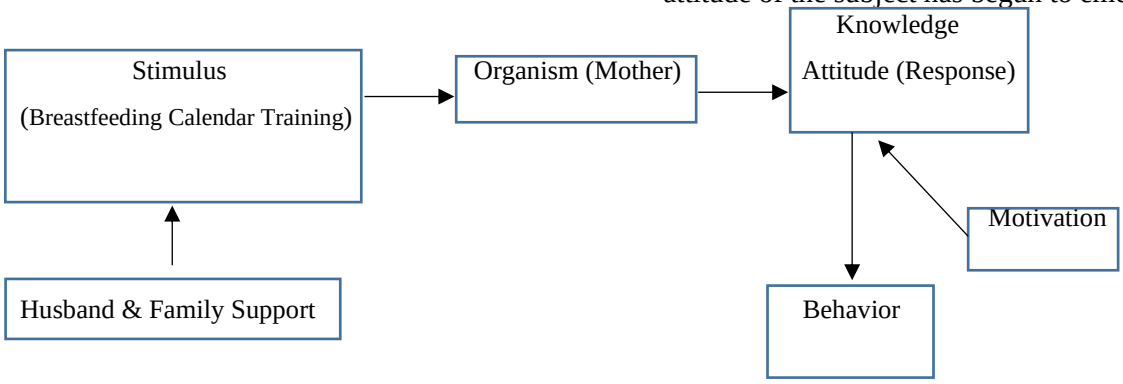

Figure 3. Theory of Stimulus-Organism-Response, Skiner 1983[26]

Increased knowledge and attitudes of mothers regarding exclusive breastfeeding is a response to providing stimuli to mothers in the form of breastfeeding calendar training reinforced by the support received. Behavior will be manifested from existing knowledge and attitudes which are strengthened by the mother's motivation.[26]

In addition to the level of knowledge, mother's belief plays a significant role in the decision of mothers to practice exclusive breastfeeding. Maternal beliefs about the impact of exclusive breastfeeding on maternal health, physical appearance, and ability to engage in other activities. This has been shown to have the strongest association with early cessation of exclusive breastfeeding. Overcoming this belief has contributed to a more effective promotion of exclusive breastfeeding in rural Kenya.[27]

Husbands have a role in exclusive breastfeeding, such as involvement in seeking information about breastfeeding and making decisions to provide food. Therefore, health workers also have an important role to play in providing information to fathers, especially about breastfeeding practices, such as how to support breastfeeding mothers and dealing with problems in breastfeeding, so that it can help mothers to successfully provide exclusive breastfeeding.[28]

This is supported by the results of research conducted in Jambrana District that mothers who get good support from their husbands can provide more exclusive breastfeeding. Moreover, mothers

who get good support from health workers can provide more exclusive breastfeeding.[7]

In order to have the motivation to breastfeed, a mother must receive strong support from the surrounding environment to succeed.[8] The breastfeeding calendar is an educational media and support for mothers in exclusive breastfeeding. Through the breastfeeding calendar, husbands or families can increase knowledge and provide support for mothers to successfully breastfeed exclusively.[11]

The breastfeeding calendar media provides an advantage, namely that it can increase the concern of husbands and families because they can help monitor breastfeeding by filling in a calendar that is affixed to the wall. However, the disadvantages of the breastfeeding calendar cannot remind husbands and families if they forget to fill out the breastfeeding calendar. Thus, for further research, the breastfeeding calendar will be developed in the form of an application so that it can remind husbands and families and mothers in breastfeeding. In addition, suggestions for health workers, especially midwives and nutrition workers, to be able to use the breastfeeding calendar as an educational medium to increase husband and family support in exclusive breastfeeding.

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The effect of whey protein on malondialdehyde, aerobic capacity, and leg muscle explosive power in basketball athletes

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ABSTRACT

Background: *High-physical activity, including aerobic capacity and leg muscle explosive power, can cause stress oxidative and decrease the performance of athletes. Whey protein contains essential amino acids that were beneficial to decreased malondialdehyde (MDA) levels.*
Objective: *To analyze the effect of whey protein on MDA level, aerobic capacity, and leg muscle explosive power in basketball athletes.*
Materials and Methods: *Randomized controlled trial using pre- and post-test design was conducted on 12 male athletes aged 16-18 years at PPLOP Central Java Basketball Club. The treatment group received 30 grams of whey protein, and the control group received 30 grams of chocolate powder as a placebo for 28 days. MDA levels were measured through Elisa methods. Aerobic capacity was measured by 20 meters sprint. Leg muscle explosive power was measured by vertical jump. Data were analyzed by an independent t-test.*
Results: *The mean MDA levels before intervention in the whey protein group were 182.36 (±59.05), and the mean after the intervention was 171.83 (±5.46). The mean before the aerobic intervention capacity was 36.95 (±5.84), and the mean after the intervention was 49.75 (±3.53). The mean leg muscle explosive was 83.50 (±21.58), and the mean after the intervention was 87.33 (±16.68). There were no effect of whey protein on MDA levels (p>0,05), aerobic capacity (p>0,05) and leg muscle explosive power (p>0,05).*
Conclusion: *Whey protein for 28 days had no effect on MDA levels, aerobic capacity, and leg muscle explosive power*

Keywords: *whey protein; MDA levels; aerobic capacity; and leg muscle explosive power*

BACKGROUND

Basketball is a high-intensity intermittent sport. This sport involves various types of physical activity, namely aerobic and anaerobic.[1] In basketball, practice is needed, especially in improving physical condition because the physical condition is one of the factors that significantly determines the athletes' performance.[2] The components of physical conditions that have an essential role in basketball sports activities, both as a supporting element in a particular movement or the main element in the effort to achieve perfect movement techniques, are power explosiveness and aerobic capacity. Aerobic capacity is related to high-intensity workouts [3,] whereas explosive power is the maximum force used in the shortest possible time. The power of leg muscles is required for lay-up and jump short techniques. [4]

The physiological impact of high-intensity physical exercise on basketball athletes can increase the production of reactive oxygen species (ROS), which can cause imbalance and tissue damage [5.] The part of the cell that is prone to damage is cell membrane lipids. This process of membrane breakdown is called lipid peroxidation. One of the products of lipid peroxidation is malondialdehyde (MDA). MDA is an aldehyde derivative that can act as a secondary toxic messenger and trigger oxidative injury. Therefore, the level of MDA in the body can be used as an indicator of oxidative stress.[6] Oxidative stress damages cells and tissues, which are a significant factor in muscle fatigue and underperformance of athletes, leading to decreased glutathione concentrations. Maintaining glutathione status is proven to minimize oxidative stress and improve athletes' performance,[7] giving whey protein.

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Whey protein contains long-chain amino acids (BCAAs), including leucine, valine, and isoleucine which can play an antioxidant mechanism.8 Research on a high-protein diet containing BCAAs can reduce oxidative stress caused by high-intensity exercise in rats.[9]Amino acids in milk protein contain cysteine and taurine, reducing glutathione concentration during exercise. This mechanism is known through increased glutathione concentration caused by increased plasma antioxidant capacity, namely an increased aerobic metabolism without causing damage due to accumulated ROS.[10] In addition, whey protein can reduce muscle fatigue. The reduction in muscle fatigue during resistance training is the result of an increase in muscle buffer capacity during endurance sports. [11]

Previous studies of whey protein on improved performance in athletes show performance in the treatment group with a value of P = 0.001. In contrast, there was no improvement in performance in the placebo group.[12] Other studies have shown that administration at a dose of 30 grams in 300 ml can affect the total serum protein alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and creatine kinase (CK) .[13]

This study analyzes whey protein on malondialdehyde levels, aerobic capacity, and leg muscle explosive power in basketball athletes at PPLOP Central Java.

MATERIALS AND METHODS

This was an experimental study with a randomized controlled trial design with pretest-posttest groups. This research was approved by the ethics commission No. 541/EC/KEPK/FK UNDIP/XII/2019. This research was conducted at *Pusat Pendidkan dan Latihan Olaharaga Pelajar* (PPLOP) Central Java. Subjects in this study were 12 basketball athletes divided into two groups, namely the treatment group, which was given 30 grams of whey protein. The control group was given 30 grams of cocoa powder for 28 days. This study's variables were MDA measurement, aerobic capacity, and leg muscle explosive power. Data collection was carried out two times. Namely, pre and post-intervention were carried out in the control group and placebo with each (n = 6 subjects in the whey group and n = 6 subjects in the placebo group). The data obtained were analyzed statistically using the SPSS version 21 program; data with normal distribution was stated by mean (±SD) while data with abnormal distribution was stated by median (min-max). Statistical differences were analyzed using independent t-test and paired t-test (data with normal distribution), and Wilcoxon, Mann Whitney (data with abnormal distribution). Intake data were obtained from the average 24-hour recall carried out two times in the control and placebo groups. MDA levels, aerobic capacity, and leg muscle explosive power were measured two times. The samples used to measure MDA levels were blood serum, aerobic capacity using multistage fitness, and leg muscle explosive power measured by jumping upright on a scaled board. MDA levels in blood serum were analyzed using the Thiobarbituric Acid Reactive Substances (TBARS) test method spectrophotometrically at a wavelength of 454 with maximum absorbance. Aerobic capacity and explosive power write the numbers according to at PPLOP standard. The research subjects are the athlete basketball men aged 16-18 years in PPLOP Java Central. The requirement to follow the practice of physical five times a week with a duration of 1.5 hours per workout, not taking supplements of antioxidants such as vitamin C, vitamin E during the intervention, did not exist, willing to follow the study through informed consent from the beginning of the study until the end.

RESULTS

Subject Characteristics

A total of 12 athletes from PPLOP Central Java were the subjects in this study. Subject characteristics data consisted of age, weight, height, BMI, Z-score (BMI / U), and physical activity. There was no significant difference in the data on subject characteristics (p> 0.05).

Tabel 1. Subject Characteristics in Both Groups

Data Characteristics	Whey Protein		Control		*p*
	Mean±SD	Minimum-Maximum	Mean ±SD	Minimum-Maximum	
Age (years)	17,33±1,366	16,00-19,00	16,33±0,516	16,00-17,00	0,240[b]
Weight (kg)	72,32±5,51	62,60-77,90	73,30±8,63	63,30-85,70	0,819[a]
Height (cm)	183,33±3,67	179,00-190,0	183.33±3.67	179,00-190,0	0,100[a]
BMI for age (kg/m^2)	21,28±1,53	19,50-23,40	22,85±1,54	21,20-25,00	0,107[a]
Z-Score (BMI/Age)	0,14±0,63	-0,50-0,92	0,32±0,72	-0,46-1,23	0,655[a]

Physical Activity (unit)	1,83±0,63	1,80-1,86	1,80±0,023	1,78-1,83	0,134[a]

[a:] Independent *t-test*, [b:] *Mann-Whitney*

The level of adequacy is obtained from the amount of intake in one day compared to individual needs and is calculated in percent. Table 2 shows no significant difference in energy intake, protein, fat, and carbohydrates (P> 0.05).

Table2. Adequacy Level of Nutrient Intake in Both Groups

Adequacy Level of Nutrient Intake	*Whey* Protein n=6		Control n=6		*p*
	Mean±SD	Minimum-Maximum	Mean±SD	Minimum-Maximum	
Energy (%)	68,33±5,58	60,70-75,30	67,31±7,95	58,53-77,42	0,802
Protein (%)	76,45±13,23	54,29-89,28	78,89±11,12	64,27-77,42	0,820
Fat (%)	79,68±13,35	64,58-95,30	73,86±7,65	63,64-82,90	0,376
Carbohydrate (%)	70,66±10,96	57,10-80,97	64,76±7,45	54,11-76,01	0,301

independent *t-test*

Malondialdehyde Levels, Aerobic Capacity, Leg Muscle Explosive in Both Groups

Tabel 3. MDA Levels, Limb Muscle Explosive Power, and Aerobic Capacity Before and After Intervention

Variable	Kelompok	n	Before	After	△	*P*
			Rerata±SD	Rerata±SD		
MDA levels (ng/ml)	*Whey* protein	6	182,36±59,05	171,83±53,46	10,55±6,56	0,011[a]
	Kontrol	6	195,17±48,75	190,46±48,26	-4,69±3,22	0,016[a]
	p		0,691[c]	0,540[c]	0,078[c]	
Aerobic Kapasity (ml/kg/min)	Whey Protein	6	36,95±5,84	49,75±3,53	12,80±5,97	0,003[a]
	Control	6	36,43±4,61	48,57±2,44	12,13±4,39	0,001[a]
	p		0,868[c]	0,515[c]	0,830[c]	
Leg Muscle Explosive (cm)	*Whey* protein	6	83,50±21,58	87,33±16,68	4,33±6,37	0,157[a]
	Control	6	64,33±8,91	73,00±9,57	8,67±11,69	0,140[b]
	p		0,065[d]	0,132[d]	0,444[c]	

[a:] Paired *t-test*, [b:] *Wilcoxon*, [c:] Independent *t-test*, *d Mann-Whitney*

Malondialdehyde levels, aerobic capacity, and leg muscle explosive power baseline by statistical Independent t-test and Mann-Whitney in the *whey* protein group and the control group are presented in Table 4.3. The test used was the independent t-test having the same conditions (p =>0.05) and after the intervention was not significant (p >0.05).

DISCUSSION

Research has not shown a significant effect before and after the intervention. There was no possible effect due to the short study time (28 days). In line with studies conducted on experimental animals, whey protein was not affected for four weeks to improve athletes' performance (p = <0.05).[14-15] In addition, high physical activity causes inflammation in athletes to be a factor. Sub-maximal exercise can increase neutrophils, reduce lymphocytes. 84 Previous studies have stated that high physical activity can cause inflammation with increased neutrophils, a secondary source of free radical production that can reduce an athlete's performance.[16]

On the other hand, this study has not been proven to increase the explosive power of leg muscles in either the whey protein group or the control group. Optimal explosive power is obtained progressively through training. There was no increase in the explosive power of the leg muscles because, during the study, there was no additional special training. Subjects only received appropriate

training from the PPLOP institution. We recommend that the subject be given additional training to increase the explosive power of the leg muscles, namely by adding a training method with training circuits and plyometric exercises, in line with the research that the training method with training circuits can increase the explosive power of the leg muscles in athletes ($p = <0.05$)[17,] as well as athletes with high motor skills given the plyometric training method resulted in a high increase in explosive power ($p = <0.05$) [18]

Physicological factors, including stress factors and levels of anxiety in athletes, are caused by training and high demands. Therefore, the level of anxiety in athletes plays an essential role in determining achievement. In addition, the level of anxiety tends to be higher in competitive sports than in relatively non-competitive sports. In competitive sports, athletes are expected to win with high demands.[19] The research results in line with athletes measuring the level of anxiety associated with performance in athletes mention anxiety.

The study results show no effect on leg muscle explosive power performance because most athletes have the low aerobic capacity (36.0) and low explosive category athletes (60, cm). The researcher uses category standards used in institutions. PPLOP Central Java. It affects athletes' performance because the athlete's training period at PPLOP is different. Some are old and have just joined PPLOP. In line with the research, the performance of the training period of fewer than six months is still low because it is not used to the training being undertaken.[20]

The difference in value (Δ) for the decrease in MDA levels increased aerobic capacity in the whey protein group. Decreased malondialdehyde levels can also be triggered by the higher content of BCAAs, such as leucine, valine, isoleucine compared to other protein products.65 Whey protein is easily digested so that it has the characteristics of increasing the ability to stimulate muscle protein synthesis and repair skeletal tissue.[21] This study is also in line with research testing the antioxidant whey protein in cell culture using the C2C12 myoblasts technique. It has been shown that whey protein increases antioxidant capacity against oxidative stress and whey protein stimulates increased GSH, CAT / SOD enzyme activation, and inhibition of lipid peroxidation. The intervention of whey protein before and after for 60 days can reduce oxidative stress and increase endurance in athletes.[22]

CONCLUSION

There was an effect before and after 30 grams of whey protein for 28 days on decreasing malondialdehyde levels and increasing aerobic capacity.

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Red dragon fruit juice in reducing ros levels and insulin resistance In rats with type 2 diabetes mellitus model

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ABSTRACT

Background: *The peel of red dragon fruit (Hylocereus polyrhizus) had been proven to have a total polyphenol content and total flavonoids 2 to 3 times more than its flesh. These components could reduce oxidative stress and maintain the function of pancreatic beta cells, which could affect blood sugar levels.*

Objectives: *This study aimed to test the red dragon fruit juice using peel and flesh to reduce oxidative stress and insulin resistance in T2DM model rats.*

Materials and Methods: *This study was a true experimental study with a randomized controlled trial, with a Matching Pretest Post-test Control Group Design. We used 21 white male rats (Rattus norvegicus) Wistar strain which was divided into three groups: (P1) negative control group (induced Streptozotocin + Nicotinamide induction), (P2) positive control group (given Streptozotocin + Nicotinamide and given Metformin HCl induction 0,9 mg/kg BW, and (P3) Red Dragon fruit group (induced Streptozotocin + Nicotinamide and given Red Dragon Fruit juice 3.6 ml / 200 g BW / day given for 14 days. The data were analyzed using a one-way ANOVA test, paired t-test, and Post Hoc.*

Results: *After 14 days of intervention, the average HOMA-IR levels were as follows: negative control group (Mean=8.32; SD=0.26), positive group (Mean 4.89; SD=0.29), and the Red Dragon Fruit intervention group (Mean=4.65; SD=0.30). The average MDA levels were as follows: control group (Mean = 9.08; SD = 0.68), positive group (Mean=3.34;SD=0.22), and the red dragon fruit intervention group (Mean = 3.05; SD = 0.47). Both the Metformin group and the Red Dragon Fruit group had low HOMA-IR and MDA levels compared to the negative control group.*

Conclusions: *When administered alone, red dragon fruit and metformin effectively reduced HOMA-IR and MDA levels in rats with type 2 DM. Red dragon fruit can be used as an alternative to metformin because of its effectiveness in reducing plasma HOMA-IR and MDA.*

Keywords: *HOMA-IR; Red Dragon Fruit; Type 2 Diabetes Mellitus*

BACKGROUND

Red Dragon fruit (RDF) is a fruit source that is rich in natural antioxidants, namely betacyanin, flavonoids, polyphenols, ascorbic acid, and also fiber [1]. The main antioxidant content in RDF is flavonoids. Flavonoids have a polyphenolic structure which is found in many fruits [2]. Increasing RDF flesh consumption leaves the skin that is currently not used optimally. Apart from the flesh, RDF skin can also be used as an alternative because of its nutritional content and antioxidant effects [3]. The total content of polyphenols and flavonoids from 80% methanol extract of RDF skin is three times higher than RDF flesh. The total phenolic content extracted from the skin and flesh is 14.82 ± 1.07 and 4.91 ± 0.55 mg Gallic Acid Equivalent (GAE) / 100g [4].

In type 2 diabetes mellitus (T2DM), hyperglycemia is caused by the inability of Insulin to mobilize blood glucose into cells due to insulin receptor resistance [5]. Hyperglycemia increases the auto-oxidation of glucose from free radicals. In hyperglycemia conditions, the formation of free radicals or Reactive Oxygen Species (ROS) comes from glucose oxidation, on-enzymatic glycosylation of proteins, and oxidative degradation of glycolic proteins [6]. The increase in intracellular glucose causes an abundance of electron donors to be generated during the Kreb cycle, thereby pushing the potential of the inner mitochondrial membrane upward - a condition associated with mitochondrial dysfunction and increased production of ROS [7]. In addition, ROS will increase the expression of Tumour Necrosis Factor-α (TNF-α) and exacerbate oxidative stress. TNF-α can result in insulin resistance through decreased autophosphorylation (auto-phosphorylation) of insulin receptors [8,9]. These oxidative stress markers can be measured using Malondialdehyde (MDA) [10].

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Insulin resistance impairs the ability of muscle cells to take up and store glucose and triglycerides, which results in high levels of glucose and triglycerides circulating in the blood [11]. One of the biomarkers used to measure insulin resistance is the Homeostatic Model Assessment of Insulin Resistance (HOMA-IR). HOMA-IR measures insulin resistance (IR) based on the value of fasting blood glucose and plasma insulin levels [12].

Hypoglycemic effects of flavonoids are by regulating carbohydrate digestion, insulin signaling, insulin secretion, glucose uptake, and adipose deposition [13]. Flavonoids work by targeting many molecules involved in regulating multiple pathways, such as increasing β cell proliferation, promoting insulin secretion, reducing apoptosis, and increasing hyperglycemia by regulating glucose metabolism in the liver [14]. Red dragon fruit skin makes up 22% of all RDF, usually thrown away.

Two-thirds of the fruit consumed is whole fruit, and one-third is 100% fruit juice. One hundred percent of consumption of fruit juice treatments with several health benefits, such as reduced levels of lipid profiles and reduced obesity [15]. A meta-analysis study has proven that an alternative way to consume the right amount of fruit is by drinking, such as consuming fruit juices, especially on glycemic control [16]. Therefore, in this study, the authors are interested in using both skin and flesh of RDF to determine their effectiveness in reducing ROS and insulin resistance in T2DM model rats.

MATERIALS AND METHODS

Experiment Protocols

The Red Dragon Fruit (*Hylocereus polyrhizus*) is obtained from Tawangmangu and the same plantation to maintain variety homogeneity. The maintenance and treatment of experimental animals were carried out at the Laboratory of the Center for Food and Nutrition Studies, Gadjah Mada University, Yogyakarta. The antioxidant test was conducted at the Sebelas Maret University Nutrition and Food Lab. Preparation and observation of examination of levels of fasting blood glucose, serum insulin, and plasma MDA were carried out at the integrated Research and Testing Institute of Gajah Mada University, Yogyakarta. All chemicals used have met lab analysis standards. The ethics committee approved this study of The Health Research Ethics Committee of Faculty Medicine Universitas Sebelas Maret for medical research, protocol number 465/UN27.06/KEPK/EC/2019.

Sample Size and Study Design

This study is a true experimental study with a randomized controlled trial, with a Matching Pretest Post-test Control Group Design. This study used white male rats (*Rattus norvegicus*) Wistar strain as research objects with three treatment groups: 1 negative control group, one positive control group, and one treatment group. The sample size for each group was determined based on the provisions of the Institutional Animal Care and Usse Committee (IACUC) (2002): at least six rats in one study group. Each group added 20% for the probability of dropping out. The sampling technique was simple random sampling to obtain seven rats in each group. This study used three treatment groups, so that the total sample of this study was 21 rats.

Dosages

The dose of juice therapy used in humans corresponds to 1 glass of juice consumed daily by adult individuals with an average weight of 200 ml [17]. Higher fruit and vegetable juices consumption was associated with higher-quality diets and better compliance with the French National Plan for Nutrition and Health. Making 200 ml of RDF juice requires 274 grams (both flesh and peel). The conversion dose for a rat was 0.018, so the dose for the sample was 3.6 ml/200g BW/day, which was given by sonde for 14 days. The maximum volume of fluid administration for white rats weighing 200 grams is 5ml so that the volume of juice given is appropriate.

The reference material used in this study was metformin HCl. The usual dose of metformin HCl used to reduce blood glucose levels is 500 mg - 1700 mg per day in humans with a bodyweight of 70 kg given orally in a single dose [18]. Metformin is a biguanide compound that is still used as an oral hypoglycemic drug in Indonesia which works to reduce blood glucose levels by improving glucose transport to muscle cells. In addition, this drug can improve glucose uptake by 10-40%). In this study, there are three groups: (P1) negative control group (induced Streptozotocin + Nicotinamide induction), (P2) positive control group (given Streptozotocin + Nicotinamide and given Metformin HCl 0 induction, 9 mg/kg BW, and (P3) Red Dragon fruit group (induced Streptozotocin + Nicotinamide and given Red Dragon Fruit juice 3.6 ml / 200 g BW / day given for 14 days.

Biological Experiment Protocols

Rats were obtained from Inter-University Center (IUC) Nutrition of Gadjah Mada University in pre-clinical service and experimental animal development. Rats were kept in a particular room placed in clean polypropylene cages with seven rats

per large cage which were then given transparent dividers so that one rat occupied one small cage. The food was a standard Comfeed feed consisting of 70% corn starch, 10% casein corn oil, 4% salt mixture, 1% vitamin mixture, and 5% cellulose. The study was started by preparing 24 male Wistar rats aged 8-10 weeks, body weight ± 180 grams and adapted for seven days in the cage, then randomized into three groups. Diabetic rats were induced by giving 230 mg/kg Nicotinamide (NA), then 15 minutes later given 65 mg/kg Streptozotocin (STZ) in cold citrate buffer, pH 4.5, intraperitoneally to male rats, which previously did not need to be fastened. Hyperglycemia confirmed after 48 hours of STZ-NA administration was characterized by an increase in fasting blood glucose levels. Therefore, rats with blood glucose levels of 180 mg/dL were considered diabetic and were included in the study.

Measurement Instruments

A sampling of test animal blood is part of a series of in vivo studies. In this study, blood sampling in rats used the Plexus Retro-Orbital method in the eyes [19]. Measurement of MDA levels from blood samples of Wistar rats was examined quantitatively using the thiobarbituric acid-reactive substance (TBARS) kit. Measurement of plasma insulin levels from blood samples of Wistar rats that were examined quantitatively. Rat Enzym-Linked Immunosorbent Assay (ELISA) Insulin kit DRG brand no EIA catalog 2048. r. The amount of glucose contained in the blood of Wistar rats was examined quantitatively by the Enzymatic Colorimetric Test GOD-PAP (Glucose Oxidase Phenol 4-Aminophenazone) method, which was carried out before being given treatment (pre-test) and at the time after being given treatment (day 14). The homeostasis model assessment-insulin resistance (HOMA-IR) is a validated and widely used method to measure insulin resistance from fasting glucose and Insulin.

HOMA-IR : $\frac{Fasting\ blood\ glucose\ levels\ \left(\frac{mg}{dL}\right) x\ insulin\ level\ \left(\frac{ng}{mL}\right)}{405}$ 20

Statistical Analysis

The data were coded and analyzed using SPSS for Windows version 20. This study used paired T-test for normal data with 95% significance. Data that were not normally distributed were analyzed using Mann Whitney U Test. If the value of p <0.05, there was a significant difference between variables, and if p> 0.05 means that there was no statistical difference in the effect before and after the intervention. The different effects of those three groups were analyzed using the parametric statistical test, one-way ANOVA for normally distributed data, and homogeneous data, then continued with the Post Hoc test .

RESULT

Tabel 1. Chemical Compositions of Red Dragon Fruit Juice per 3,6 ml

Sample	Test	Analysis Parameters			
		Reducing Sugar [1)] (% wb)	**Antioxidants [2)] (% wb)**	**Total Phenol [3)] (% wb)**	**Anthocyanins [4)] (ppm wb)**
RDF	I	8.29	2.29	0.064	147.84
	II	8.46	2.50	0.061	135.90
	Average	8.37	2.39	0.063	141.87

Source: Primary Data (2019)

1) *Nelson Somogyi;* 2) *Spektrofotometri;* 3) *Spektrofotometri;* 4) *Giusti & Worlstad*

The chemical and antioxidant composition of Red Dragon Fruit juice has been investigated, and the results are recorded in Table 1. Table 1 shows the reduced sugar content of 8.37% wb; Antioxidants 2.39% wb; Total Phenol as much as 0.063% wb and anthocyanin content in 3.6 ml of RDF juice as much as 141.87 ppm wb.

Tabel 2. The Effect of RDF Juice on Fasting Blood Glucose Levels

Group	Duration		Δ Fasting Blood Glucose (mg/dL)	p^a
	Day-0 (*mean* ± *SD*) mg/dL	**Day-14 (*mean* ± *SD*) mg/dL**		
P1	272.69 ± 9.53	275.03 ± 8.69	2.33 ± 2.92	0.080

P2	282.49 ± 7.35	116.95 ± 7.32	-165.54 ± 8.89	< 0.001*
P3	276.25 ± 8.84	112.42 ± 6.69	-163.82 ± 13.65	< 0.001*
p [b]	0.090	< 0.001*	< 0.001*	

Source: Primary Data (2019)
*) There is a significant difference; [a]) (p < 0.05) *Paired T-Test ;* [b]) (p < 0.05) *One Way Anova*

One Way-Anova is a comparative test used to test the difference in the mean (average) of data for more than two groups. The difference in the mean effect of RDF juice on Fasting blood glucose (FBG) levels can be seen in Table 2. Table 2 shows the mean FBG after being tested with One Way-Anova and Paired T-Test. Before administering the intervention, mean values of FBG levels were compared among the three study groups, and it was not statistically significant (Day-0), indicating that randomization had achieved the intended goal. However, both the Metformin group (P2) and the RDF group (P3) had lower FBG levels (p=<0.01) than the negative control group (P1), and the mean difference in their partners was statistically significant. After the One Way-Anova test, the three groups were statistically significant (Day-14; Δ Fasting Blood Glucose). Therefore, a further test was carried out to determine which group was different (Table 6).

Tabel 3. The Effect of RDF Juice on Insulin Levels

Group	**Duration**		**Δ Insulin Plasma (pg/ml)**	***p*** [a]
	Day-0 (*mean* ± *SD*) pg/ml	**Day-14 (*mean* ± *SD*) pg/ml**		
P1	414,01 ± 6,07	409,90 ± 2,92	-4,10 ± 5,47	0,095
P2	413,55 ± 2,97	549,88 ± 4,90	136,32 ± 6,48	< 0,001*
P3	414,92 ± 4,33	548,66 ± 7,70	133,74 ± 6,22	< 0,001*
p [b]	0,160	< 0,001*	< 0,001*	

Source: Primary Data (2019)
*) There is a significant difference ; [a]) (p < 0.05) *Paired T-Test ;* [b]) (p < 0.05) *One Way Anova*

Table 3 shows the difference in mean Insulin after being tested by One Way-Anova and Paired T-Test. Before administering the intervention, the mean scores of insulin levels were compared among the three study groups. It was not statistically significant (Day-0), indicating that randomization had achieved the intended goal. Both the Metformin group (P2) and the RDF group (P3) had lower Insulin levels than the negative control group (P1), and the mean difference in their partners was statistically significant. After the One Way-Anova test, the three groups were statistically significant (Day-14; Δ Insulin Plasma). A further test was carried out to find out which group was different (Table 6).

Tabel 4. The Effect of RDF Juice on MDA Level

Group	**Duration**		**Δ MDA Plasma (nmol/ml)**	***P*** [a]
	Day-0 (*mean* ± *SD*) pg/ml	**Day-14 (*mean* ± *SD*) pg/ml**		
P1	8,98 ± 0,69	9,08 ± 0,68	0,09 ± 0,10	0,061
P2	8,77 ± 0,66	3,34 ± 0,22	-5,43 ± 0,62	< 0,001*
P3	9,25 ± 0,32	3,05 ± 0,47	-6,20 ± 0,50	< 0,001*
P [b]	0.658	< 0.001*	< 0.001*	

Source: Primary Data (2019)
*) There is a significant difference ; [a]) (p < 0.05) *Paired T-Test ;* [b]) (p < 0.05) *One Way Anova*

Table 4 shows the difference in mean MDA after being tested with One Way-Anova and Paired T-Test. Before administering the intervention, mean MDA levels were compared across the three study groups, and it was not statistically significant, indicating that randomization had achieved its intended goal. Both the Metformin group (P2) and the RDF group (P3) had lower MDA levels than the negative control group (P1), and the mean difference in their partners was statistically significant. After the One Way-Anova test, the three groups were statistically significant (Day-14; Δ MDA Plasma). A further test was carried out to find out which group was different (Table 6).

Tabel 5. Effect of Red Dragon Fruit Juice on HOMA-IR Level

Group	Duration		Δ HOMA-IR	*P* [a]
	Day-0 (*mean* ± *SD*) pg/ml	Day-14 (*mean* ± *SD*) pg/ml		
P1	8.35 ± 0.19	8.32 ± 0.26	-0.03 ± 0.12	0.460
P2	8.65 ± 0.25	4.89 ± 0.29	-3.75 ± 0.09	< 0.001*
P3	8.49 ± 0.28	4.65 ± 0.30	-3.83 ± 0.08	< 0.001*
p [b]	0.067	< 0.001*	< 0.001*	

Source: Primary Data (2019)
*) There is a significant difference; [a]) (p < 0.05) *Paired T-Test* ;[b]) (p < 0.05) *One Way Anova*

Table 5 shows the difference in mean HOMA-IR after being tested with One Way-Anova and Paired T-Test. Before administering the intervention, the mean scores of HOMA-IR levels were compared among the three study groups. It was not statistically significant, indicating that randomization had achieved its intended goal. Both the Metformin group (P2) and the RDF group (P3) had lower HOMA-IR levels than the negative control group (P1), and the mean difference in their partners was statistically significant. After the One Way-Anova test, the three groups were statistically significant (Day-14; Δ HOMA-IR). A further test was carried out to find out which group was different (Table 6).

Tabel 6. Effect of Red Dragon Fruit Juice on Mean Difference Group Pair

Group Pair		Mean Different			
Group I	Group II	FBG	Insulin	MDA	HOMA-IR
P1	P3	< 0.001*[a]	< 0.001*[a]	0,002*[b]	< 0.001*[a]
P2	P3	0,655 [b]	1.000 [a]	0.229 [a]	1.000 [a]

Source: Primary Data (2019)
*) There is a significant difference; [a]) (p < 0.05) *Post hocTest* ; [b]) (p < 0.05) *Mann-Whitney*

Table 6 shows a difference with the mean at P1 and P2 with a significance of <0.001. This indicates that both Metformin (P1) and RDF juice (P3) can reduce GDP, MDA, HOMA-IR and increase Insulin compared to P1. When the mean P2 is compared with the mean P3 group, the result is >0.005, which means that RDF dose (P2) had the same effect as Metformin (P3) in reducing GDP, MDA, HOMA-IR, and increasing Insulin in T2DM model rats.

DISCUSSION

One way-ANOVA only provides conclusions about whether there are differences between three or more data groups, while which groups are different cannot be concluded. To solve which group has differences in one-way ANOVA, a Post Hoc follow-up test is carried out. The result shows that the mean difference is not statistically significant between P2 and P3 in FGB (p=0,655), Insulin (p=1.000), MDA (p=0.229), and Insulin level (p=1.000). This study proves that the provision of red dragon fruit (peel and flesh) with the dose of 3.6 ml / 200 gr BW / day had the same effect as Metformin HCl in reducing FGB, MDA, HOMA-IR also increase Insulin level (table 6). The assessment of insulin resistance is complex and challenging to apply. The Homeostasis

Model Assessment-Insulin Resistance (HOMA-IR), which uses fasting glucose and Insulin parameters, is a validated and widely used insulin resistance index.

Fasting Blood Glucose Level

The FBG levels in the T2DM model rats after STZ-NA induction increased above 200 mg/dl in all groups. This illustrates the condition of hyperglycemia due to the provision of STZ causing cell damage β Langerhans pancreas which results in decreased insulin secretion resulting in T2DM (21). In comparison, Nicotinamide (NA) is a vitamin B3 (niacin) derivative with antioxidant capacity that reduces the cytotoxic action of STZ and protects β cells against STZ. STZ is transported into the B-cells via the GLUT2 glucose transporter and causes DNA damage leading to increased activity of poly (ADP-ribose) polymerase (PARP-1) to repair DNA (22). However, the overactivity of this enzyme results in depletion of intracellular NAD (+) and ATP, and insulin-secreting cells undergo necrosis. Therefore, the protective action of NA is to inhibit PARP-1 activity. Therefore, NA inhibits this enzyme, preventing the depletion of NAD (+) and ATP in STZ-exposed cells [23].

The hypoglycemic effect of RDF is obtained from the main antioxidant components in RDF peel and flesh, namely flavonoids. Flavonoids, especially quercetin, are potent inhibitors of GLUT 2 in the intestinal mucosa, a pathway for glucose and fructose absorption in the intestinal membrane. This inhibitory mechanism is noncompetitive. A recent systematic review and meta-analysis of animal studies showed that quercetin decreases serum glucose levels at doses of 10, 25, and 50 mg/kg of body weight [24]. This results in a reduction in the absorption of glucose and fructose from the intestine to decrease blood glucose levels [25].

Apart from Quentin, one of the flavonoid compounds that play a role in the mechanisms involved in hypoglycemia and its protective activity against diabetes complications is the Rutin compound [26]. This compound is proven to be in the RDF, and its content is higher than white dragon fruit (4). In testing on T2DM model rats that STZ insulated, oral administration at a dose of 5-10 mg/kg significantly decreased FBG levels (27,28). Nature et al. reported that common effects (50 and 100 mg/kg) on FBG and glycosylated hemoglobin were comparable to pioglitazone. This is due to receptor agonists activated by proliferation [29]. Jadhav and Puchchakayala [30] observed that among rutin, boswellic acid, ellagic acid, and quercetin, rutin was the most active flavonoid in increasing glucose tolerance and lowering FBG. Furthermore, they found that rutin (100 mg/kg), comparable to glibenclamide (10 mg/kg), lowered plasma glucose in diabetic and normoglycemic rats [31]. Rutin's mechanism in reducing glucose absorption from the small intestine is by inhibiting α-glucosidase and α-amylase, which are involved in carbohydrate digestion [30–32].

Insulin Level

Increased blood glucose (hyperglycemia) and free fatty acids stimulate the formation of reactive oxygen species (ROS), reactive nitrogen species (RNS), and oxidative stress. This can interfere with pancreatic beta-cell function and insulin resistance to worsen diabetes conditions [33]. The increase in plasma insulin levels is caused by the antioxidant flavonoids present in the peel and flesh of RDF. Flavonoids have a mechanism in inhibiting phosphodiesterase so that cAMP levels in pancreatic β cells increase. This will stimulate insulin secretion through the Ca pathway. In addition, this increase in cAMP levels will cause the closure of the K + ATP channels in the plasma membrane of β cells. This situation causes membrane depolarization and opens Ca channels depending on the voltage, thereby accelerating the entry of Ca ions into the cell. The increase in Ca ion in the cytoplasm of β cells will cause insulin secretion by β cells of the pancreas [34–36].

One of the flavonoid compounds that play a role in the mechanism involved in the antihyperglycemic effect and its protective activity against diabetes complications is the Rutin compound (vitamin P) [26]. Routine can stimulate insulin secretion from beta cells and increase glucose uptake by tissues. In isolated mouse pancreatic islets, the routine significantly increased insulin secretion [37.] In mouse beta cells, rutin has been shown to increase glucose-induced insulin secretion and maintain glucose-sensing ability in high glucose conditions [38]. In rat beta cells, rutin increased glucose-induced insulin secretion, and rutin also demonstrated a role for insulin-mimetics in rat soleus and diaphragm muscles [32,38]. It stimulates glucose transport into muscle via activation of the synthesis and translocation of the GLUT-4 transporter. Like the insulin signaling pathway, phosphoinositide 3-kinase (PI3K), protein kinase C, and mitogen-activated protein kinase (MAPK) are involved in routine intracellular transduction, leading to a stimulatory effect on tissue glucose uptake [38]. Rutin also increases PPARγ expression, increasing insulin resistance and glucose uptake in skeletal muscle and adipose tissue [32].

Insulin Resistance (HOMA-IR)

Insulin resistance is an abnormal physiological condition that occurs when Insulin from pancreatic β cells cannot trigger signal transduction pathways in target organs such as the liver, muscle, and adipose tissue. Loss of insulin sensitivity is commonly associated with persistent hyperglycemia (diabetes) [39]. Insulin resistance impairs PI3K / Akt activation of skeletal muscle and adipose tissue, leading to decreased expression and translocation of GLUT4, resulting in impaired glucose uptake. Deficits in hepatic insulin signaling release FOXO1 back into the nucleus to promote expression of PEPCK and G6P genes, promoting gluconeogenesis and reducing activation of Glucokinase/Glycogen Synthase Kinase (GK and GSK), which suppress glycogen synthesis [40]. Based on the research, flavonoids can increase the expression of Akt, AMPK, GLUT4, and adiponectin in skeletal muscle tissue [41] and increase levels of IRS1 and GLUT4 mRNA in skeletal muscle tissue [42] resulting in increased insulin resistance in skeletal muscle tissue. Also can increase GK activity in liver tissue [43] and increase GSK mRNA levels in liver tissue resulting in an increase in insulin resistance in the liver [42].

The HOMA-IR value was inversely proportional to plasma insulin levels and directly proportional to FBG levels. The results showed the value of insulin resistance (HOMA-IR), then the uptake and use of glucose by the body's cells were disrupted. As a result, the glucose levels in the blood increased. Flavonoids can reduce insulin concentration and improve glucose tolerance through adipocytokine regulation, including increased serum adiponectin [44]. Flavonoids have also been shown to stimulate adipocyte differentiation and increase glucose transport in adipocytes by inducing PPARg-mediated adiponectin expression and translocation of GLUT4 in 3T3-L1 adipocytes [45]. Previous research also revealed that intake of flavonoids could reduce insulin resistance levels [46].

MDA Level

MDA levels in the T2DM model rats after STZ-NA induction increased in all groups compared to controls. This indicates that the induction of STZ-NA succeeded in increasing Reactive Oxygen Species (ROS) levels in the T2DM model rats. The source of oxidative stress in T2DMs is due to a shift in the balance of redox reactions due to changes in carbohydrate and lipid metabolism, which will increase ROS formation from glycation and lipid oxidation reactions, thereby reducing the antioxidant defense system [47].

The effect of decreasing plasma MDA levels can be caused by antioxidant flavonoids in the RDF peel and flesh. One of the flavonoids content, namely betacyanin, which is a pigment of RDF, has a high antioxidant effect and plays a role in reducing ROS levels to provide a protective effect on diabetic rat pancreatic cells. [25].

Hyperglycemia in T2DM can produce intracellular reactive oxygen/nitrogen species (ROS / RNS) excess. Experiments on diabetic animals prove that giving rutin can increase antioxidant status in various tissues by increasing non-enzymatic antioxidant status (reducing glutathione) and enzymatic antioxidant status (Superoxide dismutase and catalase) [29,48,49]. Rutin contains many OH substitutions so that it has a sufficient effect in reducing free radical levels [26]. Analysis of the structure-function relationship shows the importance of Bring and 3'-OH and 4'-OH groups to free radicals that work on the effect of Rutin [50]. Because of this group, rutin tends to give electrons to free radicals, converting them into more stable radical intermediates and inhibiting further free radical reactions [50].

CONCLUSIONS

The administration of RDF fruit juice intervention for 14 days significantly reduced FBG, MDA, HOMA-IR levels and significantly increased plasma insulin levels in the T2DM rats model. RDF fruit juice can be an alternative therapy to reduce ROS and insulin resistance in the T2DM rats model. Long duration follow-up studies are required before application in diabetic patients.

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Effectiveness of Parental Assistance in Providing Food on Nutritional Intake Among Children with Malnutrition

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ABSTRACT

Background: *Prevalence of stunting continues to affect 21.3% of children aged <5 years worldwide. The problem of malnutrition in children is caused by several factors, such as poor access to nutritious food, recurrent infections, and inadequate practice of offering food and care for mothers and children during the first 1,000 days.*

Objectives: *The purpose of the study was to know the effectiveness of feeding parenting style assistance to mothers of toddlers in increasing the nutritional intake of under-nutrition children*

Materials and Methods: *This study used a quasi-experimental design with a pre-test and post-test control group design approach. The population in this study was toddlers with malnutrition (according to weight/height). The sample size for each group was 35 mothers. The sample was divided into two groups. The first group was given parental assistance consisting of nutrition education and food processing guidance for the toddler for 3 months (the intervention group) and the second group was given health education about balanced nutrition for children under five (the control group). Collecting data had used a checklist of identity, nutritional status, and semi-quantitative food frequency questionnaire. Data were analyzed using paired t-test, p-value <0.05 for the 95% confidence interval.*

Results: *The nutritional intakes of children under five showed a significant difference between the group of mothers under five who were given intensive assistance (the intervention group) and the group that was only given nutrition education for children under five (the control group). The differences in nutritional intakes seen in macronutrients were the difference in calorie intake (p-value: 0.042; CI: 4.005-213.543) and protein intake (p-value: 0.040; CI: 0.197-8.065). The differences in micronutrient intakes were seen in the increase in consumption of vitamin E (p-value: 0.000; CI: 0.446-4.416), sodium (p-value: 0.000; CI: 61.859-193.741), potassium (p-value: 0.005; CI: 70.743-373.102), calcium (p-value: 0.000; CI: 51.851-137.863), and phosphor (p-value: 0.041; CI: 2.133-99.604).*

Conclusion*: Food parenting assistance for mothers of toddlers was effective in increasing toddler nutrition*

Keywords: *Food parenting assistance; Toddler; Nutrition; Malnutrition*

BACKGROUND

Stunting is a physical manifestation of chronic malnutrition and has shown higher rates of suboptimal development, morbidity, and mortality in young children, with frequent occurrences later in life [1]. The prevalence of stunting worldwide had decreased from 1990 to 2018. However, it was predicted that it would be increased to 21.3% in children aged <5 years worldwide. The burden of stunting is almost entirely in low-income countries where there is an increase, an excess of childhood infections, and an inadequate diet [2]. The problem of malnutrition in children is caused by several factors, such as poor access to nutritious food, recurrent infections, and inadequate practice of offering food and care for mothers and children during the first 1,000 days, from conception to the age of two[3]. The results of Rodiger's assessment (2020) in his research state the determinants of stunting which consist of basic determinants and direct determinants. The basic determinants are 1) household income asset index and 2) parental education, particularly maternal education. The underlying determinants are: 1) sanitary sewage, 2) clean water, 3) bed nets, 4) vaccination coverage, 5) attendance at antenatal polyclinic visits, 6) optimal breastfeeding practices, and 7) household food security. The direct determinants of stunting are: 1) decreased fertility, 2) birth spacing, 3) maternal height, 4) birth weight babies, 5) dietary diversity, and 6) incidence of diarrhea[2].

Controlling the practice of offering children's meals (guarding and pressure to eat) has been theorized to predict an increase in the child's weight status[4]. Infant and young child feeding (IYCF) has major implications for a child's survival, health,

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growth, and development. Cook, et. al (2020) also reported that age-appropriate IYCF practice especially complementary foods - was significantly associated with increased height-for-age z-score (HAZ) and decreased likelihood of stunting ($p < .05$). Also, age-appropriate IYCF practice - in isolation - made a modest statistical contribution to the rapid and sustained decline in age-specific linear growth of children from 1996-2016. A complemented multisectoral nutrition strategy - integrating and optimizing IYCF practice- is essential to further accelerate progress in dealing with childhood linear growth disorders. In addition, a special focus is needed on improving IYCF practices that have not shown significant progress over the past two decades: exclusive breastfeeding (EBF), a minimum acceptable diet, and providing minimal bottle feeding[5]. Therefore, researchers modified mentoring for mothers of children under five in training mothers to prepare and provide food for under-nutrition children. The aim of the assistance given to mothers of toddlers is to make efforts to prevent wasting and stunting in malnourished toddlers by preparing mothers of toddlers in terms of knowledge and skills in preparing economical and nutritious food for their toddlers.

MATERIALS AND METHODS

This study used a quasi-experimental design with a pre-test and post-test control group design approach. This research had passed the ethical test with the number :155/KEPK-FKM/UNIMUS/2019. This study used a simple random technique with an estimation approach where the population size was 90 mothers who had toddlers with malnutrition at Kedungwuni II Health Center. The malnutrition based on height/age indicators The calculation of the sample size is calculated using an alpha value approach of 0.05, 80% power based on Ayu SD's research (2008) previously obtained the mean (SD) of each item. The sample size was determined by simple random sampling. The sample size for each group was 35 mothers with under-five children. The sample was divided into two groups, namely the group that was given parental assistance consisting of nutrition education and food processing guidance for the toddler for 3 months (the intervention group) and the group that was given health education about balanced nutrition for children under five (the control group). In this study, inclusion and exclusion criteria were determined in determining the sampling. Inclusion criteria are mothers who have toddlers aged 1-3 years whose parents are permanent residents in Kedungwuni II Public Health Center, Pekalongan Regency. Meanwhile, the exclusion criteria were mothers whose children under five are malnourished and have congenital disabilities and chronic illness; mothers who are not willing to be respondents; mothers whose children under five are stunted and certain food allergies (including dropouts), mothers who do not comply with the intervention rules (not followed-up). The sampling technique was taken by making a serial number of respondents according to the list provided by Kedungwuni II Public Health Center. Researchers make numbers and draw random numbers that come out of their names and make them as respondents in the study. The enumerator collected data according to the name given by the researcher in the toddler class and continued with assistance to mothers who were willing to become research respondents in the toddler class organized by the researcher. Assistance is carried out in three face-to-face sessions, namely by providing education and training to prepare food according to the child's age followed by home visits. Home visits are carried out to monitor activities of supplementary feeding and to evaluate the achievements of Mothers with under-five children. Evaluation of the effect of the intervention was carried out after (follow-up) three months, by looking at differences in nutritional intake of children before mentoring and after mentoring.

Collecting data were using a checklist of identity, nutritional status checklist, and semi-quantitative food frequency instruments. While the tools used in the weight assessment were baby scales and microtoise to measured height. Data were analyzed using an independent t-test on the mean difference of infant nutritional intake between the control and intervention groups. The level of significance used in this test was p-value <0.05 for the 95% confidence interval.

RESULTS

The results of the research on 70 respondents who have participated in the toddler class for 3 consecutive months in two different groups are as follows:

Tables 1 and 2 show that most mothers of toddlers are housewives, who have a lot of time with their children and have a great opportunity to prepare food for their children. With the provision of higher education, education will be easier to do. The level of understanding is directly proportional to the level of education.

Table 3 shows the nutritional intake of children under five before and after Parental Assistance was carried out. This table shows a change in nutritional

intake for children under five, especially in the intake of macronutrients in energy, protein, and fats.

Table 4 shows that some of the nutritional intakes of children under five showed a significant difference between the group of mothers under five who were given intensive assistance (the intervention group) and the group that was only given nutrition education for children under five (the control group).

Table 1 Characteristic of Toddlers and Mother Toddlers

Variable	Intervention		Control		p-value
	n	%	n	%	
Gender					
Male	12	34	20	57	0.055
Female	23	66	15	43	
Breastfeeding History					
Exclusive	25	71	19	54	0.138
Not Exclusive	10	29	16	46	

Table 2 Characteristic of Mother Toddlers

Variable	Intervention		Control		p-value
	n	%	n	%	
Mother's educational level					
Lower secondary education	4	12	8	23	0.205
Upper secondary education	31	88	27	77	
Mother's working status					
Workers	6	17	10	29	0.255
Housewife	29	83	25	71	

Table 3 Comparison of Differences in Nutritional Intake of Children Under Five Before And After Intervention In The Intervention Group

Variable	Before	After	p-value	CI 95%
	Mean ± SD	Mean ± SD		
Energy	697±242.768	906.983±263.576	0.005	-350.898 – (-69.067)
Protein	20.04±9.69	27.663±9.806	0.005	-12.779 – (-2.466)
Fat	25.217±11.537	32.663±12.245	0.018	-13.549 – (-1.341)
Vitamin A	387±234.605	406.703±193.103	0.699	-119.086-80.756
Vitamin E	0.994±1.163	2.223±1.572	0.001	-1.949- (-0.508)
Vitamin B1	17.08±100.386	0.16±0.082	0.326	-17.573 – 51.413
Vitamin B2	0.217±0.207	0.188±0.211	0.586	-0.077-0.134
Vitamin B6	17.2±100.538	0.246±0.030	0.325	-17.596 – 51.505
Vitamin C	29.691±99.725	10.017±16.170	0.261	-7.616-7.428

Table 4 Comparison of the difference in nutritional intake of children under five in the intervention group with the control group

Variable	Intervention	Control	p-value	CI 95%
	ΔMean ± SD	ΔMean ± SD		
Energy	106.883±178.905	1.891±188.517	0.042	4.005-213.543
Protein	3.971±6.280	0.160±7.368	0.040	0.197-8.065
Fat	3.903±1.369	0.18±1.605	0.123	-1.156-9.321
Carbohydrate	14.645±25.811	0.400±26.574	0.057	0.480- 29.692
Vitamin A	1.349±155.576	8.257±187.648	0.896	-114.086-100.269
Vitamin E	0.720±0.828	0.106±0.691	0.000	0.446-4.416
Vitamin B1	0.014±0.091	0.009±0.082	0.824	-0.046-0.058
Vitamin B2	0.014±0.142	7.930±0.153	0.739	-0.101-0.072
Vitamin B6	0.008±0.008	0.029±0.125	0.359	-0.118-0.044
Vitamin C	-1.091±11.669	0.997±12.651	0.979	-7.616-7.428
Sodium	116.76±141.68	-11.04±19.387	0.000	61.859-193.741

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Potassium	209.46±251.27	-12.462±272.485	0.005	70.743-373.102
Calcium	81.914±87.044	-12.948±79.826	0.000	51.851-137.863
Magnesium	0.108±20.965	7.328±22.397	0.280	-21.227-6.352
Phosphorus	60.394±81.572	9.526±87.223	0.041	2.133-99.604
Iron	0.454±0.935	0.071±1.046	0.190	-0.199-0.964
Zinc	0.014±0.862	-0.011±0.910	0.922	-0.503-0.555

The differences in nutritional intakes seen in macronutrients were the difference in calorie intake (p-value: 0.042; CI: 4.005-213.543) and protein intake (p-value: 0.040; CI: 0.197-8.065). The differences in micronutrient intakes were seen in the increase in consumption of vitamin E (p-value: 0.000; CI: 0.446-4.416), sodium (p-value: 0.000; CI: 61.859-193.741), potassium (p-value: 0.005; CI: 70.743-373.102), calcium (p-value: 0.000; CI: 51.851-137.863), and phosphor (p-value: 0.041; CI: 2.133-99.604).

DISCUSSION

This study shows the differences in nutritional intake of children under five whose mothers receive nutrition training for toddlers with groups that are given nutrition education for toddlers only. This can be seen in the difference between nutrients consumed by toddlers before and after the intervention. The difference can be seen in the calorie intake of toddlers whose mothers are given assistance in parenting for toddlers with toddlers whose mothers are given nutrition education for toddlers only (p-value: 0.005; -350.898 – (-69.067)).

Improvement of childcare practices, especially at the end of mentoring nutrition is closely related to increasing the knowledge that mothers hold a dominant role in childcare. That is, nutritional messages and health-related childcare can be implemented by mothers as babysitters[6]. The toddler family assistance program conducted by Purwanti, Rachma, et al. (2020) shows an increase in the knowledge of mothers under five about exclusive breastfeeding and complementary breastfeeding that is following toddler nutrition, increased awareness of mothers to monitor the growth and development of toddlers through posyandu, increased maternal skills in making the F-100 increase the nutritional intake of children under five (seen from simulation activities and home visits), and the consumption of a more diverse diet for toddlers and an increase in energy, carbohydrate, protein, and fat intake [7]. Other research shows that there was a significant difference in knowledge before and after the Mother Smart Grounding (MSG) program (p = 0.000), there was a significant difference in attitude (p = 0.000), and there was a significant difference in motivation (p = 0.000). The MSG program is an educational package in the form of counseling conventional, booklet distribution, and demonstration of healthy snacks made from local moringa (Moringa oleifera)[8].

Inadequate nutritional intake is a direct cause of malnutrition in toddlers. Arifin (2012) said that toddlers with toddler nutrition less risk 2.6 times more stunted than toddlers with good toddler nutrition. This research has shown that there was a different protein intake of toddlers whose mothers are given assistance in parenting for toddlers with toddlers whose mothers are given nutrition education for toddlers only (p-value: 0.040; CI: 0.197-8.065)[9.] This is in line with the research results of Cahya and Sulistyaningsih which suggest that protein is associated with incidence stunting (p-value 0.002). Protein works in carrying out body regulations and new DNA forms for the body. Long-term protein deficiency will disrupt regulations body and growth hormone can distraction that it can cause nutritional disorders such as stunting[10, 11].

Several micronutrients showed a significant influence between vitamin and mineral intake between groups of toddlers whose mothers were provided with nutritional parenting and those whose mothers were only given nutrition education for toddlers. The study showed an increase in the amount of vitamin E intake in children under the intervention group amounting to 0.720 (p-value: 0.000; CI: 0.446-4.416). Vitamin E functions as an antioxidant which functions to increases body immunity. Lack of vitamin E will cause red blood cells to be easily damaged, damage to muscles and nerves to impaired intestinal absorption. In infants and toddlers who are deficient in vitamin E, it can inhibit growth and development so that the developmental stage cannot match the age it should be [12.] The results showed no significant difference in the consumption of vitamins A, B1, B2, B6, and C. This study is not in line with that research done by doing fortification micronutrients, including vitamins B1, B6, and B12 in toddlers who have an infection. Research result states that there is a decrease in disease infections in toddlers who get extra micronutrients[13.] While the taken amount of vitamin C insufficient amount can prevent the occurrence of infection. Low intake of vitamin C

represents risk factors for infection, especially in the area which are endemic to parasitic infections [14].

Several minerals important in the growth and development of children are the target of increasing intake in this study. This proved to be a significant difference in the intake of minerals such as sodium, potassium, and calcium which are important for skeletal growth. Sodium functions in the balance of body fluids maintain acid-base balance, regulates muscle and nerve sensitivity, plays a role in glucose absorption, and is a means of transporting nutrients through the membrane, especially the intestinal wall [12]. Sodium is a mineral that is needed in large quantities in the body, including during growth. While potassium is a macromineral that plays a key role in fluid balance, muscle contraction, and nerve function [15]. Potassium deficiency results in sluggishness and no appetite so that the role of potassium in increasing children's daily consumption is very important.

Apart from these two macro minerals, the most popular macro-mineral in preventing stunting is calcium. Calcium plays a role in the formation of bones, teeth, regulates blood clotting, catalyzes biological reactions, coordinates muscle contraction, increasing cell membrane transport, accelerates the transmission of stimuli, and activates certain enzymes[12]. Studies in China on boys' ages under 6 years proved that there is a link between stunted intake and intake of low fat and protein. The study also reported being stunted in men ages 2–5 years associated with other macronutrients such as protein as well as micronutrients such as calcium and riboflavin[16]. Increased phosphorus intake also serves to increase growth, especially in preventing stunting. Phosphorus functions in forming the main structure of bones together with calcium. Phosphorus is found in milk like calcium. But it is also abundant in other foods such as meat, fish, eggs, poultry, nuts, and seeds so children usually get a lot of phosphorus in their diet[15].

CONCLUSIONS

There were a significant difference in the nutritional intake of children under five whose mothers were provided nutritional parenting style assistance with groups of toddlers whose mothers were only given health education about toddler nutrition both in calorie intake, macronutrients, and micronutrients.

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Correlation of dietary intake and physical activity with nutritional status, body composition and hand grip strength in elderly

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ABSTRACT

Background: *Increased life expectancy has both positive and negative impacts. Elderly group are prone to nutritional issues and body function disorder such as sarcopenia. Factors including dietary intake and physical activity are contributors of sarcopenia.*

Objectives: *The purpose of this study is to analyze the correlation of dietary intake and physical activity with nutritional status, body composition and hand grip strength (HGS) in elderly.*

Materials and Methods: *The study was held on July-October 2020 at the Panti Wredha Dharma Bakti Surakarta. This was a cross-sectional study of 54 elderly subjects. Subjects were selected by purposive sampling method. The data included height was measured using microtoise, while weight and body composition was measured using Bioelectrical Impedance Analyzer (BIA). Dietary intake was obtained through comstock observation. Physical activity was measured by the International Physical Activity Questionnaire. Hand grip strength values was measured by hand grip dynamometer. Data normality analyzed by Kolmogorov-Smirnov test. Bivariate test analyzed by Rank Spearman test.*

Results: *Energy, carbohydrate and fat intake had no correlation with nutritional status, total body fat percentage, subcutaneous fat percentage and skeletal muscle mass percentage (p value > 0.05), but there was a relationship between energy (p value = 0.33), carbohydrate (p value = 0.016) and fat intake (p value = 0.047) with visceral fat percentage. Physical activity had relation with nutritional status (p = 0.048) but had no relationship with total body fat percentage, visceral fat percentage, subcutaneous fat percentage and skeletal muscle mass percentage. Protein intake also had no relationship with HGS value (p value> 0.05).*

Conclusions: *Dietary intake only correlated with visceral fat percentage, but had no correlation with other body composition parameters. Physical activity correlated with nutritional status, but had no correlation with all of body composition parameters. Protein intake also had no correlation with HGS.*

Keywords: *Nutritional status; dietary intake; body composition; HGS; physical activity*

BACKGROUND

Globally, Indonesia has the fifth-largest elderly population in the world. Population projection data in 2019 shows 27.5 million elderly or 10.3% from the whole population and predicted to grow into 57 millions in 2045 or 17.9% from total population in Indonesia.[1] Central Java is province with the second-largest elderly population after Yogyakarta Special Region. In 2015, elderly population in Central Java reached 11.7% and grows to 12.59% in 2017.[2] This shows the increasing life expectancy of the elderly population in the world, including Indonesia.[3] According to population projection data in 2010-2035, Indonesia will experience an ageing period, where 10% of Indonesian population will be 60 years old. In 2004 to 2015 there was an increased life expectation rate in Indonesia from 68.6 to 70.8 years old and projected to be 72.2 years old in 2030-2035.[4]

The growing number of elderly populations has both positive and negative impact. Elderly will make positive contribution if they are healthy, physically active, and productive. While the negative impacts are when elderly has deteriorating health condition and chronic diseases.[2] The age-related decline in metabolic rate will make elderly more prone to diseases.[5,6] Elderly are specific population prone to nutritional status abnormality (over or undernutrition) and body composition changes.[7]

Ageing will affect changes in energy intake due to impaired glucose homeostasis, hormonal, gustatory and olfactory system.[8] Basal metabolic rate (BMR) studies in elderly shows a 1-2% decline yearly and substantially 5% less than younger age.[9] All of the above contributes to nutritional status changes in elderly.

Increasing age is associated with the loss of muscle mass which occurs continuously and consistently, also the gain of body fat composition. In adult, muscle mass makes up 45% of total body weight, while in elderly decreases to 27%. This will

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attributes to the decreased energy requirement for 5% every 10 years.[10] Moreover, ageing in elderly will affect clinically to body function, such as the increasing risk of sarcopenia. Sarcopenia is a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength and it is strictly correlated with age, gender and physical activity.[11]

Nutritional issues in elderly should be addressed by adequate nutrition intake and focusing on physical activity as the body function are declining. Increased physical activity will improve health outcomes, while inactivity will impose elderly to diseases.[5] Gerontologists and geriatricians stated that nutrition holds 30-50% role in achieving and maintaining optimum health condition in elderly. Certain nutrient needs are increased due to rapidly occurring degradation process.[6] Several studies shows there is a significant correlation between energy intake consumption with nutritional status in elderly. In elderly, body protein need is not decreased, even higher than adults. But several studies shows most of elderly experiencing protein consumption deficit.[10] Based on mentioned above background, authors are interested in identifying correlation between dietary intake and physical activity with nutritional status, body composition and hand grip strength value in elderly.

MATERIALS AND METHODS

This study was performed in July to October 2020 in Panti Wredha Dharma Bakti Surakarta. This is an observational-analytic study with cross-sectional design. Sample size for this study was calculated using population proportion estimation with minimum 50 subjects sample size. Subjects were pre-screened, then 54 subjects eligible to inclusion criteria was chosen using purposive sampling method. Inclusion criteria of this study are elderly living in Panti Wredha Dharma Bakti Surakarta from July to October 2020 >60 years old, able to communicate effectively, and gave consent to participate. Exclusion criteria for this study is if subject resigns when the study took place. This study had been approved by Health Research Ethics Committee of Medical Faculty Diponegoro University Number 55/EC/KEPK/FK-UNDIP/V/2020.

Independent variables in this study are dietary intake (energy, fat, carbohydrate, protein) and physical activity. Dietary intake data was obtained from Comstock visual observation converted to *ukuran rumah tangga* (URT), then analyzed using Nutrisurvey 2007. Energy, fat, protein, and carbohydrates requirement was calculated from Recommended Daily Allowance (RDA) 2019 adjusted by age group.[12] Dietary intake was considered 'adequate' when intake was meeting 80-110% requirement, considered 'more' if surpass 110% and 'less' if not meeting 80% requirement. Physical activity data was obtained from calculated daily physical activity including last 7 days exercise. Physical activity was scored using International Physical Activity Questionnaire (IPAQ). Physical activity score was calculated according to IPAQ scoring protocol. Physical activity score was classified as 'low' if under 600, 'moderate' if 600-2999 and 'high' if $\geq$ 3000.

Dependent variable in this study are body mass index (BMI), hand grip strength (HGS) and body composition parameters consist of percent fat mass, visceral fat, subcutaneous fat, and skeletal muscle mass. Body mass index value was obtained from weight divided by square height. Body mass index is categorized as underweight if <18.5 kg/m^2, normal if 18.5-22.9 kg/m^2, overweight if 23-24.9 kg/m^2, obesity grade I if 25-29.9 kg/m^2, obesity grade II if $\geq$ 30 kg/m^2. Body composition measured by OMRON (Karada Scan) model HBF 375. All procedures were carried out according to manufacturer instructions. Percent fat mass is categorized as normal if 20-30 % for women and 20 % for man. Visceral fat is categorized as normal if 0.5-9.5 %. Subcutaneous fat is categorized as normal if 20-29.9 % for women and 10-19.9 % for men. Skeletal muscle mass is categorized as normal if 23.9-29.9% for women and 32.9-38.9 % for men.

Hand grip strength is a measure of muscular strength or the maximum force/tension generated by one's forearm muscles. Hand grip strength value was measured by hand grip dynamometer. Univariate data analysis in this study was used to describe each study variables characteristic. Data normality was analyzed by Kolmogorov-Smirnov test. Bivariate data analysis was done using Spearman Rank test. Bivariate analysis was used to identify correlation between each variable in this study.

RESULTS

Subjects characteristic

Subjects characteristic table shows average of subjects age is 71.96 years old. Subjects' nutritional status by BMI is 23.37 kg/cm^2, there was underweight elderly subject with BMI 15.08 kg/cm^2 and obese elderly subject with BMI 36.86 kg/cm^2.

The result of this study shows that most of the subjects has normal nutritional status (37%) but 50% of them has obesity and are overweight. While based on percent fat, there are 63% subjects are overweight

and obese. Most subjects (66.7%) has low physical activity score, only 1 subjects was found to be highly active. More than half subjects (66.7%) has low hand grip strength (HGS) value. Most of the subjects hare normal visceral and subcutaneous fat, but all subjects have low skeletal muscle mass. Majority of the subjects (72.2%) has adequate dietary intake.

Correlation of dietary intake and physical activity and body composition

Fat percentage in this study has no correlation with energy, carbohydrate, fat intake and physical activity. Instead, energy, fat, and carbohydrate intake has positive correlation in the same direction, just physical activity alone has negative correlation direction. After analysis, visceral fat has significant correlation with dietary intake irrespective of energy, fat, or carbohydrate intake, while physical activity has no correlation with visceral fat. In this study, dietary intake (energy, fat, carbohydrate) has no significant correlation with subcutaneous fat and skeletal muscle mass ($p > 0.05$).

Correlation of dietary intake and physical activity with BMI and HGS

This study shows that BMI has no significant correlation with energy intake, but correlates in positive direction for 0.259. Inversely, this study shows a significant correlation between BMI and fat and carbohydrate intake, and physical activity. Handgrip strength value also does not significantly correlate with protein intake, but correlates in positive direction for 0.235.

Table 1. Subjects Characteristic

Variable	Min	Max	Mean ±SD
Age (years)	59	92	71.90±8.44
Weight (kgs)	28.30	101.20	56.30±13.55
Height (cm)	137.68	169	153.41±6.50
Body Mass Index (kg/cm^2)	15.08	36.86	23.30±4.16
Physical activity (score)	120	3986	1100.10±871.17
HGS (kg)	2.60	34.60	16.60±6.78
Percent Fat (%)	13.60	49.20	33.40±8.02
Percent Visceral Fat (%)	0.50	30	8.50±5.37
Percent Subcutaneous Fat (%)	10.60	37.20	25.10±5.95
Percent Skeletal Muscle Mass (%)	13	31.10	22.90±3.71
Energy intake (kcal)	1489	1887	1610±110
Carbohydrate intake (g)	265	313	270.90±11.31
Fat intake (g)	30	47	35.70±5.06
Protein intake (g)	41	74	50.7±9.01

Table 2. Distribution and Frequency of BMI, Physical Activity, HGS, Body Composition and Dietary Intake

Characteristic	N	%
BMI		
Underweight	7	13
Normal	28	37
Overweight	10	18.50
Obese I	14	25.90
Obese II	3	5.60
Physical activity		
Low	36	66.70
Moderate	17	31.50
High	1	1.90
HGS		
Normal	18	33.30
Low	36	66.70
Percent fat		

Ideal	20	37

Characteristic	N	%
Overweight	25	46.30
Obese	9	16.70
Percent visceral fat		
Normal	36	66.70
High	15	27.80
Very High	3	5.60
Percent subcutaneous fat		
Low	8	14.80
Normal	26	48.10
High	7	13
Very hight	13	24.10
Percent skeletal muscle mass		
Low	54	100
Energy intake		
Low	1	1.90
Adequate	39	72.20
High	14	25.90
Fat intake		
Low	2	3.70
Adequate	18	33.30
High	34	63
Protein intake		
Low	22	40.70
Adequate	27	50
High	5	9.30
Carbohydrate intake		
Low	29	53.70
Adequate	25	46.30

Table 3. Correlation of Dietary Intake and Physical Activity with Body Composition Parameters

Variable	R	P Value*
Percent Fat		
Energy intake	0.188	0.174
Fat intake	0.239	0.081
Carbohydrate intake	0.017	0.901
Physical activity	-0.036	0.796
Percent Visceral Fat		
Energy intake	0.291	0.033*
Fat intake	0.272	0.047*
Carbohydrate intake	0.328	0.016*
Physical activity	0.242	0.078
Percent Subcutaneous Fat		
Energy intake	0.009	0.947
Fat intake	-0.023	0.872
Carbohydrate intake	-0.105	0.450
Physical activity	0.161	0.246
Percent Skeletal Muscle Mass		
Energy intake	-0.151	0.275
Fat intake	-0.219	0.111
Carbohydrate intake	0.110	0.429
Physical activity	0.179	0.195

Rank Spearman Test *Significant ($p<0.05$)

Table 4. Correlation of Dietary Intake and Physical Activity with Nutritional Status and HGS

Variable	R	P Value*
BMI		
Energy intake	0.259	0.059
Fat intake	0.275	0.044*
Carbohydrate intake	0.289	0.034*
Physical activity	0.270	0.048*
HGS		
Protein intake	0.235	0.087

Rank Spearman test *Significant (p<0.05)

DISCUSSION

Subjects of this study are 54 elderly in Panti Wredha Dharma Bakti Surakarta. Result of this study shows 50% BMI of the subjects are overweight and obese. Thirteen percent elderly are underweight, and the rest are within normal weight. Other studies on elderly in Semarang also shows 50% elderly are overweight, 7.5% are underweight and 42.5% are normal.[13] Based on percent total fat, there are 63% elderly with obesity and overweight. Other study on elderly in Puskesmas Sukawati also shows 77.8% subjects are obese. Overweight or obesity is predominantly caused by excess calories from eating more than energy requirement and the lack of physical activity.[14]

This study shows 66.7% elderly has low score of physical activity, 31.5% elderly has moderate score and only 1.9% elderly has high score. Low physical activity in elderly is caused by limited daily activities in the environment. A study on elderly in Karangjati also shows 70.6% of the subjects has low activity level. Elderly over 70 years of age indeed engaged in less physical activity as much as 64.8%.[15] Low or moderate physical activity is associated with declining cognitive function, especially memory and language function. Physical activity are known to improve executive function, directing attention, thinking speed, working memory, and short/long term memory.[16]

Handgrip strength value for most of the elderly (66.7%) were low, only 33.3% of the subjects has normal HGS value with average 16.61±6.78 kg. A study on elderly in Semarang also shows 63.8% subjects has low grip strength. Hand grip strength is one of important indicator in diagnosing sarcopenia in elderly.[17] Decreased grip strength in ageing is associated with muscle type transformation, muscle fiber composition changes, and excitation-contraction (EC) process, genetic factor, and oxidative stress (increased IL-6 and pro-apoptosis cytokine TNF-α).[18] Decreased type II muscle fiber which plays role in anaerobic metabolism is main mechanism in lower grip strength in elderly. Less neurotropic factor as serotonergic, cholinergic, adrenergic, dopaminergic, acid-aminobutyric, and glutaminergic system caused hypo excitability in the cortex, decreased motoric coordination and cortical plasticity which affect motoric work.[19] Based on the European Working Group on Sarcopenia in Older People (EWGSOP), grip strength is a valid and reliable parameter of measuring muscle strength in diagnosing sarcopenia.[20] Sarcopenia is a geriatric condition which characterized with the loss of muscle mass and declining muscle function caused by less physical activity, caloric intake, more fibrotic progressivity, muscle metabolic changes, inflammation and oxidative stress.[21]

Bivariate analysis in this study shows BMI is significantly correlates with fat and carbohydrate intake but not with energy intake. A study on 214 elderly in Yogyakarta shows dietary intake (energy, carbohydrate, fat, protein) correlates with nutritional status.[22] Dietary intake is a direct factor in determining one's nutritional status.[23] If an elderly consume more than 3500 kcal of energy, the excess of calories will produce 0.45 kg of fat. Excess calories of 1000 kcal per day will add 1 kg of fat per week. Chronic excess calories will result in weight gain.[24] One with inadequate dietary intake will have 3.2 times higher risk of being malnourished, compared to subjects with adequate dietary intake.[25] A study on elderly in Puskesmas Rambung Kota Binjai in 2019 also shows BMI significantly correlated with energy intake. Although inversely correlated, this study also has positive correlation with the value of 0.259. Inadequate energy intake occurs overtime will caused decreased body weight while excess energy intake will increased body fat deposit and weight gain.[26]

Energy, fat, and carbohydrate intake in this study is significantly correlated with percent visceral fat. A study on 624 elderly in Japan shows different result where energy, fat, carbohydrate and protein do not have significant correlation with visceral fat accumulation.[17] A study in 81 elderly in Puskesmas Jagir Surabaya also shows same result. Elderly does not likely to be obese and centrally obese. Visceral fat is body fat deposited in the middle of the body and covering internal organs. A study shows that obese people tend to have more visceral fat.[27]

This result shows that dietary intake does not correlate with body composition parameters (percent body fat, subcutaneous fat, and skeletal muscle mass). Dietary intake positively correlated with body fat percentage. Body fat percentage will be lower if the dietary intake is subsided and energy expenditure is increased through physical activity.[28] Although the result of this study is not correlated significantly but energy, carbohydrate and fat intake has correlation in positive direction with percent body fat. A study in 167 subjects also show similar result, energy, carbohydrate and fat intake are not correlated with subcutaneous fat tissue.[29]

Hand grip strength value in this study does not have significant correlation with protein intake. This result is similar to a study on 4123 elderly in the States, where dietary intake with ≥25 gram and ≥30 gram protein does not correlates with grip strength. Nevertheless, a high protein consumption correlates positively with grip strength in female subjects.[22] Although not correlates significantly, protein intake and HGS has correlation in positive direction (r=0.235).

In this study, physical activity correlates significantly with BMI. Physical activity is one of important determinants of BMI. Excess energy intake if not accompanied by balanced energy expenditure through physical activity will results in weight gain. Lifestyle changes also influence population eating pattern that will refer to high dense calorie, fat, cholesterol and sedentary activity also play role.[30] Most elderly subjects in this study has low physical activity which contributes to the high number of overweight and obesity in BMI.

This study showed that physical activity was not significantly correlated with body composition parameters (percent body fat, visceral fat, subcutaneous fat and skeletal muscle mass). A study in 60 scholar subjects also showed a similar result. This result is different with previous study, which physical activity in working days correlates with BMI and body fat. The higher one's physical activity, the better the nutritional status. Based on the literature, physical activity is more influential to body composition than weight loss. The average loss of visceral fat is 44%.[31] Physical activity is able to increase fatty acids oxidation in skeletal muscle mass, mitochondrial volume, and adipocytes lipolysis to fatty acids, and fatty acids transport into cells. Besides, physical activity yields more energy contribution from fatty acids deposited in adipocytes.[32]

CONCLUSIONS

Dietary intake only correlates with visceral fat percentage, but has no correlation with other body composition parameters. Physical activity correlates with nutritional status, but has no correlation with all of body composition parameters. Protein intake also has no correlation with HGS

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Catfish Oil (Pangasius hypophthalmus) effect to ferritin and sTfR in iron deficiency anemia

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ABSTRACT

Background: *Iron deficiency anemia is a micronutrient problem and the prevalence is still high. Catfish oil (Pangasius hypophthalmus) is a natural source of heme iron which can improve body iron levels.*
Objectives: *This study was aimed to examine and analyze the effect of catfish oil on ferritin and sTfR levels in male wistar rats with iron deficiency anemia models.*
Materials and Methods: *This study was conducted on male wistar rats which were divided into groups C- (standard feed), C+ (standard feed but had the iron removed), X1 (standard feed without iron but was supplemented with catfish oil), X2 (standard feed without iron but was supplemented with ferrous sulfate) for 14 days. Ferritin and sTfR levels were measured before and after intervention using ELISA.*
Results: *The study showed an increase ferritin levels in X1 (21.87 ng/ml ±0.76), X2 (24.47 ng/ml ±0.54) and there was no significant difference between the two (p=0.069; p>0.05); a decrease in C- (0.25 ng/ml ±0.43), C+ (0.32 ng/ml ±0.059) (p=0.00; p<0.05). The sTfR levels decreased before and after intervention (p=0.00; p<0.05) in C+ (0.24 µ/mL ±0.99), X1 (60.66 µ/mL ±0.29), X2 (62.10 µ/mL ±0.90) and increased in C- (0.40 µ/mL ±0.97).*
Conclusions: *The study indicates ferritin levels increased in the rats receiving catfish oil is not different from the rats that received ferrous sulfate and sTfR levels decreased significantly in wistar rats with iron deficiency anemia receiving catfish oil although the results were not as good as ferrous sulfate supplementation.*

Keywords: *Catfish oil (Pangasius hypophthalmus); Ferritin; Iron Deficiency Anemia; sTfR*

BACKGROUND

Iron is key to the body's metabolism, namely tissue oxygenation through red blood cells. The absorption of iron in the body is regulated in the small intestine, stored in cells in the form of ferritin, and transported by transferrin. Transferrin that binds to iron will be captured by soluble transferrin serum receptors (sTfR) on the surface of cells.[1,2] Therefore, measuring the serum ferritin level is a sensitive and specific test to diagnose iron deficiency anemia. However, serum ferritin levels require additional examination in the form of checking sTfR levels, especially in iron deficiency anemia sufferers who experience chronic infection or inflammation. This is because sTfR is not affected by infectious conditions.[3] Iron deficiency anemia can result in, among others, low birth weight (LBW) in infants, decreased iron reserves in infants, anemia in newborn, the impairment of brain growth and development, and inhibition in the production and breakdown of transmitter compounds needed to deliver stimulated messages from one neuron cell to another affecting the work of the brain.[3]

The data of Riskesdas (Basic Health Research) for Indonesia in 2013 about anemia in children 12-59 months show that 28.1% and 70% of anemia in children in Central Java is microcytic hypochromic anemia caused by iron deficiency.[4] Iron deficiency anemia can be prevented by consuming foods rich in iron and iron supplements. The daily iron requirement for children aged two years is 7 mg per day.[6] Several studies have seen that the use of iron

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supplementation syrups is effective in reducing anemia but has disadvantages such as causing digestive problems and overdose.[5–8] Athe et al declare that potential extraction of natural iron sources from foods high in iron, such as fish, is still being carried out.[6] Patin fish (Pangasius hypophthalmus) contains various nutrients and is affordable, making it widely cultivated. Patin fish has higher iron content than other freshwater fish.[10] One of the processed patin fish (Pangasius hypophthalmus) that contains many nutrients is catfish oil. This oil is obtained from the extraction of patin fish meat. Current researches related to fish mostly determines the potential content of macronutrients such as protein, fat and rarely looks at the micronutrients on fish in dealing with nutritional problems.[11] Previous studies indicate that catfish oil contains essential compounds for tissue synthesis, such as albumin, zinc (Zn), copper (Cu), and iron (Fe).[12] The aim of this study to determine the effect of catfish oil (Pangasius hypophthalmus) on ferritin and soluble transferrin serum receptor (sTfR) levels in male wistar rats with iron deficiency anemia models.

MATERIALS AND METHODS

The research was carried out in February-March 2020. Initial research was in the form of making catfish oil which was carried out at the Food Technology Laboratory of the Department of Nutrition, Diponegoro University, Semarang, continued with elemental Fe content analysis at the Integrated Laboratory of Diponegoro University Semarang, analysis of the quality of catfish oil (number peroxide and free fatty acid levels) at LPPT UGM, and intervention research on experimental animals at the PSPG PAU UGM Yogyakarta Animal Laboratory for 21 days, from acclimatization to blood collection for the post test. Research on experimental animals has been approved by the Health Research Ethics Committee of the Faculty of Medicine, Undip with the ethical clearance number 161/EC/H/KEPK/FK-UNDIP/XII/2019

Catfish Oil Extraction

The catfish oil (Pangasius hypophthalmus) processed using the wet rendering method.[13] The meat of patin fish (Pangasius hypophthalmus) was taken and steamed for 30 minutes at a temperature of 95°C.[14] The fish must be fresh and processed immediately because spoiled fish has a cathepsin enzyme that can accelerate spoilage so that the quality of fish oil will be affected.[15] It was then pressed using a hydraulic press IWT (International Wrench & Tools) EC-HP-20T at 1378 Pa.

Catfish Oil Purification

The water and oil of the patin fish were separated using a separatory funnel Schoot Duran 250 ml. The catfish oil (Pangasius hypophthalmus) was purified using the Suseno's modification method by adding 3% of adsorbent in the form of bentonite from the amount of oil at a temperature of 29°C.[16] The oil was then centrifuged with Eba200 Hettich Centrifuge at 6,500 rpm 10°C for 10 minutes to obtain refined catfish oil. Refined catfish oil was stored in dark glass bottles Taiso 15 mL, tightly closed, and not exposed to direct sunlight so that it is safe from oxidative changes. Yield in the process of catfish oil from catfish meat was 12%.

Catfish Oil Analysis Procedure

Refined catfish oil was duplo tested for value of free fatty acid, peroxide value, and elemental Fe. The method for calculating free fatty acid levels was putting 5 g of refined catfish oil in Erlenmeyer, then 25 mL of hot neutral alcohol and 1 mL of PP indicator were added. It was stirred until homogeneous and titrated with 0.05 N NaOH solution until it turned pink for 30 seconds. The method of calculating the peroxide value was putting 5 g of catfish oil in a 100 mL flat flask. Then added 30 mL of chloroform (3: 2) acetic acid solution, shake until all dissolved. 0.5 mL of saturated KI solution added and let stand in 1 minute. 30 mL of distilled water added then titrated with Na2S2O3 until the yellow color disappears. 0.5 mL of 1% starch solution added until the blue color was gone. Elemental Fe of catfish oil measured using XRF Spectrophotometry WDXRF Rigaku Supermini 200.

Experimental Animals

In this experimental study, randomized pre-post-test design with a control group on white wistar rats (Rattus novergicus) was used. The rats used were male rats aged 4 weeks with a body weight of 150-200 grams, healthy, and active. Exclusion criteria were rats with infection and bleeding. Mice that bleed and died during the study will be dropped out. However, none of the mice bleeding or died during

the study. The samples were randomly divided into four groups, namely groups C- (negative control), C+ (positive control), X1 (treatment 1), and X2 (treatment 2) consisting of 6 rats, respectively.[17] Implementation of experimental animals begins with 14-day induction in wistar rats from the C+, X1, and X2 groups to create iron deficiency anemia rats by giving standard feed without iron, followed by 14 days of intervention. Selection of 14 days according to the metabolism of iron in the body.[18] Group C- received standard feed (AIN 93M), C+ received standard feed with the iron removed, X1 received standard feed with the iron removed and supplemented with catfish oil of 0.0039 ml/day, and X2 received standard feed without iron supplemented with ferrous sulfate of 0.126 mg/day. All rats took ad libitum.[19] The standard feed used is AIN 93 M composed of (% body weight) 46.75% of corn starch, 14% of casein, 15.5% of dextrin, 1% of vitamin mix, 5% of sugar, 3.5% of solca floc-40, 1% of soybean oil, 0.3% of mineral mix, 0.25% of L-Cystine, and 7% of choline bitartrate.

Dose of iron given per day to the rats was adjusted to the daily requirement of iron for two years old, namely 7 mg per day. Then it converted to the dose in rats, which is multiplied by 0.018 (7 mg x 0.018 = 0.126 mg). The amount of catfish oil needed to meet the iron needs of rats is 3.5575 mg (Fe requirement: percentage of elemental fe in catfish oil = 0.126 mg: 3.5418% = 3.5575 mg). Ari Ridha Amril et al states that the density of catfish oil is 0.8924 g/ml so that 3.5575 mg is equal to 0.0039 ml (3.5575 mg x 0.8924: 1000 = 0.0039 ml).[20]

Research on experimental animals was carried out after obtaining permission from the Health Research Ethics Commission (KEPK) of the Faculty of Medicine at Diponegoro University Semarang. Ferritin and sTfR levels were measured before and after the intervention using the ELISA kit Elx 800 ELISA reader model with a wavelength of 450 nm and an mg/mL unit.[21] The data were analyzed using the SPSS 22 program with the Shapiro-Wilk test to determine the normality of data distribution and Paired t-test to determine differences in ferritin and sTfR levels before and after the intervention. ANOVA test followed by Post-hoc Bonferroni was performed to analyze the difference in the effect of the four groups.

RESULTS

Fe Elemental Analysis of Catfish Oil

There are several methods of refining fish oil. Before determining the method to be used in this study, the fe elemental test of catfish oil with several methods was carried out. The method tested for its elemental content was the Suseno modification method and the Hastarini modification method. Fe elemental analysis aims to determine the iron content in catfish oil.

Table 1. The results of Fe Elemental Analysis by Suseno modification method and Hastarini modification method

Mineral Name	Suseno modification method Content (%)	Hastarini modification method Content (%)
Silicone	2,8 ± 1,1	2,5 ± 0,26
Phosphor	0,5 ± 0,1	0,36 ± 0,02
Potassium	3,1 ± 0,15	2,1 ± 0,26
Fe Elemental	3,54 ± 0,22	1,4 ± 0,22

The difference between Suseno modification and Hastarini modification was the level of bentonite use in purification, namely the Suseno modification method uses 3% bentonite while Hastarini uses 1% bentonite. Bentonite is a clay that contains more than 85% montmorillonite, brownish in color, has 100-180 mesh of particles, in the form of a powder. The absorption property of bentonite is due to the pore space of its mineral bonds so it is often used as an absorbent material for various purposes, both wet and dry.[16] Fe Elemental in catfish oil Suseno modification method higher than catfish oil Hastarini modification method. This is in line with research conducted by Sari Rodiah Nurbaya et al which states that the best fish oil refining results use the Suseno modification method. The percentage of bentonite used in the Suseno modification method

is higher when compared to the Hastarini modification method so that it affects impurities that are bound to bentonite. The amount of lost impurities causes higher iron content in catfish oil purified using the Suseno modification method.[22]

The Quality of Catfish Oil

The quality of catfish oil was analyzed by looking at the percentage of free fatty acids and the value of peroxides then compared with the standards issued by IFOS (International Fish Oil Standards).

Table 2. Comparison of catfish oil parameters with IFOS standards

Parameter	Value of purified catfish oil	IFOS Standard
Free Fatty Acid	0,29 ± 0,07	< 1,5 %
Peroxide Value	10,59 ± 0,04	< 5 meq/kg

The low level of free fatty acids in catfish oil in this study shows that catfish oil has good quality, but it had higher peroxide value than the International Fish Oil (IFOS) standard, which was 10.59 meq/kg. The addition of bentonite in the purification stage can reduce the free fatty acid levels in catfish oil because it can absorb the non-glyceride components of free fatty acids. It also causes maximum absorption of impurity components, which can allow natural antioxidants to be absorbed so that the oxidation stability of fish oil is affected especially in peroxide number result.[16]

Experimental Animals Results

Ferritin Level

The ferritin levels in rats were measured before and after the intervention. Based on the Shapiro Wilk test with p>0.05, the data were normally distributed.

Table 3. Differences in Rat Ferritin Levels before and after Intervention

Group / Marker	C-	C+	X1	X2	p[1]
Ferritin Level (ng/mL)					
Pre	61.94 ± 0.86[b, c, d]	37.34 ± 1.00[a, d]	36.10 ± 0.84[a]	35.33 ± 0.48[a, b]	0.001
Post	61.69 ± 0.72[b, c, d]	37.02 ± 0.96[a, c, d]	57.98 ± 1.34[a, b]	59.81 ± 0.45[a, b]	0.001
Δ	-0.25 ± 0.43[c, d]	-0.32 ± 0.059[c, d]	21.87 ± 0.76[a, b, d]	24.47 ± 0.54[a, b, c]	0.001
p	0.001	0.001	0.001	0.001	

Four groups of rats (n = 6 each groups) consist C-: control healthy, C+: control iron deficiency anemia, X1: catfish oil (Pangasius hypophthalmus) of 0.0039 ml/day treatment, X2: ferrous sulfate of 0.126 mg/day treatment; p = value between pre and post treatment were analysed using Paired t-test; p[1] = value between all groups were analysed using one-way ANOVA test with post hoc Bonferroni [a] = p<0.05 compared as C-, [b] = p<0.05 compared as C+, [c] = p<0.05 compared as X1, [d] = p<0.05 compared as X2. Δ changes between pre and post value. Significant if p < 0.05.

The highest mean ferritin level after the treatment in C- of 61.69 ± 0.72. X1 and X2 have increased ferritin levels while the ferritin levels of C- and C+ decreased. This confirms that standard feed and standard feed with the iron removed cannot increase ferritin levels in rats. X2 that received iron supplements in the form of ferrous sulfate has the most significant increase in ferritin levels before and after the treatment. X1 rats supplemented with catfish oil have increased ferritin levels but still less than X2. The results of the Paired- T-Test on the ferritin levels before and after the treatment for each group show a significant difference with P=0.001 (P<0.05).

The mean difference in ferritin levels for each group after the treatment shows in table 3. The mean ferritin levels of X2 and C- are significantly different but not too much, namely 1.88; p = 0.013. Likewise, X1 has a significantly different value from C- with not too far difference, namely 3.7; p = 0.00. The mean ferritin levels of X1 and X2 are not significantly different (p = 0.069; p > 0.05), but the mean ferritin level of X1 is less than X2. This indicates that the supplementation of catfish oil has a similar effect to ferrous sulfate in increasing ferritin levels. Compared with C-, the order of interventions from the most to the least effective is X2, X1, and C+.

Soluble Transferrin Serum Receptor (sTfR) Level

The sTfR levels were analyzed before and after the treatment in all groups. The sTfR level data were tested for normality using Shapiro Wilk, and the results of the distribution of sTfR levels were normal with $p > 0.05$.

The results of Paired T-Test show a significant difference in sTfR levels before and after the treatment with $P = 0.00$ ($P < 0.05$). Table 5 shows a decrease in sTfR levels of C+, X1, and X2 and an increase in the sTfR level of C-. The most significant decrease in sTfR levels was found in X2. The decrease in sTfR levels of X1 is also quite significant but less than that of X2.

There is a significant difference in the sTfR levels of each group after the treatment with $p < 0.05$. The largest difference is between C- and C+ (-63.38) and the smallest between C- and X2 (1.83). The difference in sTfR levels between X1 and X2 is not too significant. The order of mean difference of sTfR levels, compared with C-, from the highest to the lowest is C+, X1, and X2; it means that the order of interventions from the most to the least effective in reducing sTfR levels is X2, X1, and C+.

Table 4. Differences in sTfR before and after Intervention

Group / Marker	C-	C+	X1	X2	p^1
sTfR Level (µ/mL)					
Pre	6.87 ± 0.25 [b, c, d]	70.89 ± 0.49 [a]	71.30 ± 0.43 [a]	71.20 ± 0.48 [a]	0.001
Post	7.27 ± 0.29 [b, c, d]	70.65 ± 0.52 [a, c, d]	10.37 ± 0.45 [a, b, d]	9.10 ± 0.50 [a, b, c]	0.001
Δ	0.40 ± 0.97 [c, d]	-0.24 ± 0.99 [c, d]	-60.66 ± 0.29 [a, b, d]	-62.10 ± 0.90 [a, b, c]	0.001
p	0.001	0.001	0.001	0.001	

Four groups of rats (n = 6 each groups) consist C-: control healthy, C+: control iron deficiency anemia, X1: catfish oil (Pangasius hypophthalmus) of 0.0039 ml/day treatment, X2: ferrous sulfate of 0.126 mg/day treatment; p = value between pre and post treatment were analysed using Paired t-test; p^1 = value between all groups were analysed using one-way ANOVA test with post hoc Bonferroni [a] = $p<0.05$ compared as C-, [b] = $p<0.05$ compared as C+, [c] = $p<0.05$ compared as X1, [d] = $p<0.05$ compared as X2. Δ changes between pre and post value. Significant if $p < 0.05$.

DISCUSSION

Fish is a source of heme that has economic value so that it can be an alternative in fulfilling iron needs. 100 grams of catfish contains 1.6 mg of iron. Meanwhile, humans, especially children, need 7 mg of iron per day.[1,10] Therefore, to meet these needs, children should consume a very large amount of fish. Matthew S Wheal et al. in their study show that the iron in fish is mostly heme of around 20% to 90% and bioavailability of 23%, meaning that humans can absorb iron in the form of heme from fish by 4.6% to 20.7%.[23] The processed fish products in the form of fish oil were used in the study because it has higher iron than fish meat.

The iron content in the catfish oil (Pangasius hypophthalmus) purified by the Suseno's modification was 3.5%. The density of catfish oil based on the study of Ari Ridha Amril et al. analyzing the bio-lubricant synthesis of patin fish waste oil was 0.8924 g/ml, meaning that 1 ml of catfish oil (Pangasius hypophthalmus) contains 31.15 mg of iron (3.5 % x 0.89 g: 1000 = 31.15 mg).[16,22]

This study demonstrates that giving catfish oil can increase ferritin levels due to its heme content although it is not as significant as iron supplementation in the form of ferrous sulfate. This study shows that giving catfish oil can increase ferritin levels because of its heme content, although its value is not higher than iron supplementation in the form of ferrous sulfate. This is in line with the previous study by Fu-Rong Wang et al. in their study on extracting squid ink melanin-Fe for the treatment of iron deficiency anemia in rats showed that there was an increase in ferritin levels in rats with iron deficiency after supplemented with squid ink melanin-Fe.[24] The bioavailability of heme iron is higher than non-heme iron, thereby accelerating the increase in ferritin levels as more iron is absorbed. Besides, non-heme iron sources in plant-based foods contain substances that inhibit iron absorption, such as phytic acid, calcium, and

polyphenols. Iron reserves in people consuming heme are higher than those consuming non-heme iron.[25] Timmer et al. through their study also stated that there were differences in ferritin levels between people who consume heme iron every day and those who consume non-heme; the more heme is consumed, the higher the ferritin levels will be.[26] Another study by Isabel Young et al. stated that food intake rich in heme (beef, mutton, poultry, and fish) can maintain ferritin levels.[27]

Deficiency anemia is characterized by a lack of iron in erythropoiesis activity, high levels of serum transferrin receptors, low levels of ferritin, and decreased levels of Hb. This study shows that the serum transferrin receptor levels in iron deficiency anemia are high. The mechanism is in the small intestine where the amount of iron absorbed is adjusted to the body's needs. The body's need for iron is determined by DMT-1 and ferroportin levels found in the villi of the duodenum. Iron deficiency anemia causes an increase in DMT-1 expression resulting in the increased mechanism of transferrin receptor activity. Transferrin receptors are commonly used as a parameter of erythropoiesis activity.[21]

There was a significant decrease in sTfR levels in the group of rats that received iron supplements in the form of ferrous sulfate and catfish oil (Pangasius hypophthalmus) in this study. In the early phase of iron deficiency anemia, iron reserves in the liver, spinal cord, and spleen decreased, but the sTfR levels were still stable. In the second phase, iron levels decrease while sTfR levels increaseConsumption of heme foods can increase ferritin levels and reduce sTfR levels because the need for iron is fulfilled.[21,24,29] Less food intake containing heme iron, such as red meat, poultry, and fish, high intake of non-heme iron from plants, and the high consumption of foods containing substances inhibiting iron absorption causes iron deficiency anemia. This was put forward by Nils Milman in his study showing that 54% of the food intake containing heme iron, such as meat and fish, in women of childbearing age in Europe from 1993 to 2015 was still below the daily iron requirement.[30] Giving catfish oil can be an alternative in reducing sTfR levels because a previous study states that consumption of ferrous sulfate can disrupt good bacteria in the large intestine, increase infection and inflammation in the digestive tract, and increase free radicals from unabsorbed ferrous iron sulfate. When iron enters the body, some will be absorbed in the upper gastrointestinal tract and some other will enter the large intestine and react to superoxide and hydrogen peroxide causing free radicals through the Fenton reaction.[31] A similar study was conducted by Fu Rong Wang et al. stated that the treatment group that received squid ink melanin-Fe experienced a decrease in sTfR levels and had fewer side effects than the group receiving ferrous sulfate.[24] This shows that the use of natural Fe sources is safer.[31]

The other study conducted by Al-Alimi et al. stated that the prevalence of iron deficiency anemia among college students in Yemen was 30.4% due to the lack of iron intakes, such as red meat, fish, or poultry.[32] Lack of iron-rich intake is often associated with family income, eating habits, and lifestyle. Nanna Roos et al. stated that the habit of consuming fish cooked into soup by poor rural Cambodians around the Mekong river can meet 36% of the daily needs of iron in women of childbearing age. Fish cooked into soup has an iron bioavailability of 25%. This further confirms a great potential in the development of processed fish products as a source of natural iron.[33]

CONCLUSIONS

Giving catfish oil (Pangasius hypophthalmus) influences ferritin and soluble transferrin serum receptors (sTfR) levels. Ferritin levels increase while sTfR levels decrease significantly in male wistar rats with iron deficiency anemia given catfish oil although the results are were not higher than iron supplementation in the form of ferrous sulfate. However, the values of the ferritin level increase and sTfR level decrease in the rats receiving catfish oil are not much different from those receiving ferrous sulfate. It is recommended that further research regarding the bioavailability of iron in catfish oil (Pangasius hypophthalmus) and levels of iron in the tissues that store iron be conducted.

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Evaluating the food consumption among Indonesian young adults lived in a different environment

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ABSTRACT

***Background**: Indonesian young adults who live abroad usually buy meals from café or catering. These meals tend to be less nutritious, including high fat, low fiber, and high carbohydrate.*
***Objective**: This study aimed to investigate the pattern of food consumption among young Indonesian adults who lived in a different environment.*
***Materials and Methods**: A cross-sectional observational study was carried out with 497 participants (73 men and 420 women). Data were collected using a validated food frequency questionnaire (FFQ) of 78 food groups. In addition, the Mann-Whitney U test was conducted to compare consumption patterns among study participants who lived in a different environment (Malang city, East Java, Indonesia, and Taipei City, Taiwan). Furthermore, the Chi-Square test and Fisher's exact test analyzed the consumption level by gender.*
***Results**: Our study indicated no significant differences between food consumption of Indonesian young adults in Malang city, Indonesia, and Taipei City, Taiwan (p=0.623). Meanwhile, beverage (tea) was significantly different between gender in the home country (p=0.005). In contrast, participants who lived abroad showed significantly different consumption levels of fast food (instant noodle) and plant protein source (tofu) across gender (p=0.01 and p=0.02).*
***Conclusion**: The present study showed that fruits were often changed into juices, especially more frequent in a home country than abroad. Meanwhile, several food items, including beverages (tea), fast food, and plant protein source (tofu), showed significant differences across gender.*

***Keywords**: food consumption; young adults; Indonesian-style diet*

BACKGROUND

Indonesian students who study abroad are experiencing many changes in order to adapt to the new environment, including a change in eating habits[1]. A previous study by Doo and Kim (2017) indicated that changing dietary habits among international students might increase the risk of obesity[2]. One cross-sectional study described that International students tended to fulfill their requirement of energy intake by purchasing meals from stores[3]. However, as dining out is becoming a trend, studies found that frequent dine-out eating habit was closely linked to obesity[4]. The more frequent having away-from-home meals, the more prevalent obesity[5]. According to previous investigations, meals are usually characterized by high energy content, total fat, saturated fat, and low micronutrient compositions [3,4]. In addition, a previous study conducted in the United States indicated that caloric intake from adults who frequently eat out was higher than participants who consume at-home meals in daily habit[6]. Moreover, a study by Larson et al. (2011) reported that frequent fast-food consumption was associated with a higher risk of getting overweight/obese in young adults[7]. In Indonesia, several observational studies had reported that dining out significantly elevated the risk of having higher body mass index (BMI) status[8,9]. A study in 148 adolescents showed that local street food consumption (> 300 kcal) contributed 3.2 times to obesity[9].

According to World Health Organization (WHO), overweight and obesity are defined as abnormal or excessive fat accumulation that adversely affects nearly all body's physiological functions and comprises a significant public health threat[10]. A general population measure of overweight and obesity is the BMI, calculated by dividing a person's weight (in kilograms) by the square of a person's height (in meters)[11]. The Indonesian Ministry of Health specifies a BMI ≥25 kg/m^2 as overweight, while BMI ≥27 kg/m^2 as obese [12]. The globalization of food systems that produce more processed and affordable food, nutrient-poor meals, and beverages has been identified as a significant reason for increased obesity worldwide[13]. In Indonesia, the

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prevalence of obesity among young adults was high among men (6.7%) and women (15%) [14]. Therefore, to prevent obesity, understanding possible differences in the living environment in the association between dietary patterns and obesity is essential.

Evidence from observational studies is limited regarding the most favorable consumption pattern to be healthy or unhealthy. Therefore, the objective of this study is to investigate the association between eating away from home and obesity and to evaluate the food consumption among Indonesian young adults in the home country and abroad.

MATERIALS AND METHODS

Study design

The cross-sectional survey recruited 497 Indonesian young adults aged 17-42 years. Our participants were divided into two groups, following their current living places. We collected data for living abroad participants from Indonesian people who resided in Taipei city, Taiwan (n=100) and living in their home country from Indonesian people who resided in Malang city (n= 397). This study was conducted from September to October 2016.

Dietary assessment

FFQ consisted of 10 sections comprised of 78 food items. Participants had to indicate the frequency of consumption of each food item during the last three months period. Frequency was measured in standard portions per day/week/month/rarely. There were six frequencies assessed 'more than one times a day' valued as 1,'1 times a day' valued as 2, '4-6 times a week' valued as 3, '1-3 times a week' valued as 4,' 1-3 times a month' valued as 5, and 'never' valued as 6.

Food items were divided into staple food, fast food, animal protein sources, plant protein sources, dairy products, fruits, vegetables, snacks, beverages, and supplements. The staple food group comprised white rice, corn rice, red rice, noodle, sweet potato, cassava, bread, and potato. The fast-food group comprised cereal havermout, instant noodle, spaghetti, burger, french fries, pizza, nuggets, sausage, sardines, kebab, and fried chicken. Animal protein sources comprised beef, lamb, chicken, pork, egg, salted egg, innards, fish, salted fish, shrimp, and squid. Plant protein sources comprised mushrooms, tofu, Tempe, long bean, bean sprouts, and red beans. Vegetables comprised broccoli, carrot, mustard, tomato, spinach, kale, chayote, cabbage, papaya leaves, and lettuce. Fruits comprised apple, orange, guava, tomato cherry, banana, kiwi, dragon fruit, mango, melon, watermelon, pineapple, pear, blackberry, papaya, longan, and yoke. Dairy products comprised whole cream milk, skimmed milk, soy milk, yogurt, ice cream, cheese, and mayonnaise. The snack group comprised traditional cake, rice cake, mochi, moon cake, packaging food, frying food, meatball, sweet cake, pudding, chocolate, and candy. Beverages comprised fruit juices, soft drinks, coffee, tea, bubble tea, and alcohol. Supplements comprised honey, omega-3, vitamin C, vitamin B complex, and iron.

Ethics

A panel of experts reviewed a self-administered questionnaire. Prior to the commencement of research, ethical approval was obtained from the IRB of Poltekkes Kemenkes Malang with the register no.190/KEPK-POLKESMA/2016. Written consent was obtained from all participants.

Statistical analysis

Statistical analyses were performed using SPSS software version 25.0. Descriptive statistics were used to describe the distribution of the variables. The Wilcoxon Mann Whitney U test was conducted to compare consumption patterns in Malang and Taipei. Two-tailed statistical significance was set at $p < 0.05$. The comparison of level consumption and gender were assessed with the Chi-Square test and Fisher's exact test.

RESULTS

Food frequency in the home country

Figure 1 showed that young adults who lived in a home country (Malang city, Indonesia) tended to consume white rice more than once a day as the main staple food (n=319, 80.4 %). The fast-food group frequently consumed instant noodles around 1 – 3 times a week (n=136, 34.3 %). Favorite animal protein sources for Indonesian young adults were chicken (n=105, 26.4 %) and egg (n=129, 32.5 %) approximately 4 – 6 times a week. Malang city consumed Tempe (n=136, 34.3%) and tofu (n=131, 32.9%) as plant protein sources 4 – 6 times a week. The vegetable group consumed mustard (n=96, 24.2%) approximately 4 – 6 times a week. Moreover, they were seldom consuming apple, orange, banana, watermelon, and melon (n=130, 32.7%; n=138, 34.8%; n=111, 28%; n=127, 32%; n=126, 31.7%; respectively) around 1 – 3 times a month. For dairy products, ice cream (n=159, 40.1%), cheese (n=117, 29.5%), and full cream milk (n=101, 25.4%) became their favorite to consume in 1 – 3 times a month. Their favorite snacks group was packaging food, frying food, and meatball (n=121, 30.5%; n=123, 30.9%; n=138, 34.8%; respectively), consumed around 1 – 3 times a week. Furthermore, they consume juices (n=128, 32.2%) as their beverage 1 – 3 times a week. Last, they almost neither consumed honey (n=253, 63.7%) nor supplements (n=390, 98.2%).

Food frequency in abroad

In Figure 2, Indonesian young adults who lived abroad (Taipei City, Taiwan) consumed white rice (n=64, 64%) as their main staple food more than once a day. They also consumed instant noodles (n=42, 42%) as their favorite fast food approximately 1 – 3 times a week. They tended to consume chicken (n=35, 35%) and egg (n=32, 32%) around 1 – 3 times a week in animal protein sources. They frequently consumed tofu (n=34, 34%) as a plant protein source approximately 4 – 6 times a week. Vegetables group such as spinach, mustard, carrot, and tomato (n=32, 32%; n=35, 35%; n=35, 35%; n=32, 32%; respectively) were consumed around 1 – 3 times a week as well as fruit group such as banana (n=30, 30%). Most of them seldom consumed dairy products, especially ice cream (n=45, 45%) 1 – 3 times a month. For snacks, packaging food (n=35, 35%) was their favorite to consume

around 1 – 3 times a week. Tea (n=22, 22%) and its product such as bubble tea (n=27, 27%) became their favorite beverage to consume 1 – 3 times a week. Last, they did not consumed honey (n=69, 69%) even supplements (n=71, 71%).

Comparison of food consumption in the home country and abroad

Table 1 showed no significant differences between food consumption of Indonesian young adults in Malang city and Taipei city (p=0.623). However, there were significant differences in consumption of pizza, sausage, nugget, spaghetti, chicken, egg, fish, shrimp, squid, tofu, tempeh, long beans, bean, kale, mustard, chayote, banana, watermelon, melon, yogurt, soy milk, frying food, traditional food, meatball, juices, tea, coffee, and bubble tea (p<0.01, respectively). Of fast food, pizza and spaghetti were more favorites in Taipei (1 - 3 times a month) than in Malang. On the other hand, young Malang adults consumed sausages and nuggets more frequently than in Taipei. Moreover, chicken and egg were less consumed (1 – 3 times a week) in Taipei than in Malang. They who lived abroad tended to consume seafood such as shrimp and squid 1 – 3 times a month than others who lived in their home country, but not for fish. In Taipei, tofu was more prevalent (4 – 6 times a week) than time. Nevertheless, young adults in Malang city more often consumed vegetables at least 1 – 3 times a week than Taipei, but the opposite for fruits. The favorite fruit of young adults who lived in Taipei was bananas (1 – 3 times a week). On the other hand, yogurt and soy milk were more often consumed (1 – 3 times a month) in Taipei than in Malang. Of snacks, frying food, and meatballs were often consumed (1 – 3 times a week) in the home country. The favorite beverage in Malang city was juices (1 – 3 times a week). However, tea and bubble tea were more frequently consumed in Taipei city (1 – 3 times a week) and coffee (1 – 3 times a month).

Characteristic of level consumption according to gender in the home country and abroad

Table 2. Staple food (white rice) is habitually consumed among Indonesian who live both in the home country (87.7% for women, 90% for men) and abroad (74.6% for women, 89.2% for men). In the home country, women had a higher intake of fruit (banana 11.5%), dairy products (full cream milk 14.2%), and snack (packaging food 19.9%) compared to men. While the proportion of staple food (white rice 90%), fast food (instant noodle 12.5%), an animal protein source (egg 37.5%), a plant protein source (tofu 50%), vegetable (mustard 22.5%), and beverage (tea 20%) among men was higher than women. Level consumption of beverage (tea) was significantly different between gender (p=0.005), but not in others.

Furthermore, abroad (Table 2), women tend to have a higher proportion of animal protein (egg 19%), a plant protein source (tofu 20.6 %), vegetable (mustard 19%), snacks (packaging food 12.7%), beverage (tea 12.7%) than men. In contrast, the proportion of staple food (white rice 89.2%), fast food (instant noodle 10.8%), fruit (banana 8.1%), and dairy product (full cream milk 16.2%) consumption was higher among men than women. Furthermore, level consumption of fast food (instant noodle) and plant protein source (tofu) were significantly different between gender (p=0.01 and p=0.02).

DISCUSSION

This study was based on a socio-demographic characteristic of participants in the previous study [15,16.] In total, 397 participants lived in Malang city, while 100 participants lived in Taipei city as overseas students. This result shows no significant differences between the food consumption of Indonesian young adults in Malang city, Indonesia and Taipei city, Taiwan does not expect from the authors' hypothesis. Eating patterns describe how people eat at the level of an eating occasion and may include a range of indicators such as frequency, timing, skipping of meals, and frequency and timing of snacks [15]. An Indonesian-style diet consists of staple food, animal or plant protein sources, but sometimes with vegetables and fruits. Rice, especially white rice, is a typical starchy food eaten by Indonesian people. The important role of diet in preventing non-communicable diseases (e.g., cardiovascular disease and some cancers) is well documented [16]. Current dietary advice was framed around the amount and types of food populations should consume rather than considering eating patterns[17]. A recent study showed that animal protein sources were less consumed in Taipei. It might be because of the limited access to halal food and fear of eating non-halal food[18]. Because of that, they prefer seafood such as shrimp and squid.

Pizza and spaghetti were also more prevalent in Taipei city. The previous study indicated that high consumption of carbohydrate sources and a high dietary GI is associated with good sleep, especially good sleep duration. Meanwhile, higher noodle consumption is associated with poor sleep quality. The effects of starchy foods on sleep may differ according to their GI values. Diets with a high GI, especially those with high rice, may contribute to good sleep [19]. Despite this, consuming enough fruits and vegetables as a healthy dietary pattern could reduce the risk of obesity [20, 21].

Moreover, limiting energy-dense food, low-nutrient food, and sugary drinks could also decrease heart disease 22 and type 2 diabetes [23, 24]. However, young adults did not consume enough fruits and vegetables [25]. In this study, Indonesian young adults consumed fruits and vegetables once a week. Moreover, they frequently consumed frying food, meatballs, coffee, and tea or bubble tea. In addition, they often ate energy-dense food, low-nutrient food, and sugary drinks[26,27].

The tea consumption and instant noodle and tofu are significantly different among gender. This case may prove that men drinking tea are more habitual than women in both cities. On the contrary, Demura et al. [28]found more young females drank tea than males. In addition, men's instant noodles and tofu consumption are more different than women abroad. According to Huh et al. (2017), males are also more likely to consume instant noodles. Subjects who frequently consumed instant noodles had lower-income, more physical activity, and were more likely smokers[29]. The present study showed that fruit juice had become the favorite healthy beverage of young adults in

their home country. In large parts of the world, food consumption has changed over the last decades towards higher intakes of processed and energy-rich foods, including beverages[30]. Lately, great attention has been given to health aspects of beverage consumption, investigating the association between specific beverages and the development of metabolic diseases[31].

Additionally, a previous review study on children reported that consuming 100% juice provided beneficial nutrients and a higher overall diet quality[31]. In vitro study showed that fiber retention in the fruit smoothies might positively affect glycemic response and may contribute to daily fiber requirements[32]—consumption of juice and tea associated with beneficial lifestyle characteristics including healthy food choices [31]. On the other hand, Snack behaviors seemed to be more variable and might represent a more significant opportunity for improving overall dietary profiles [33].

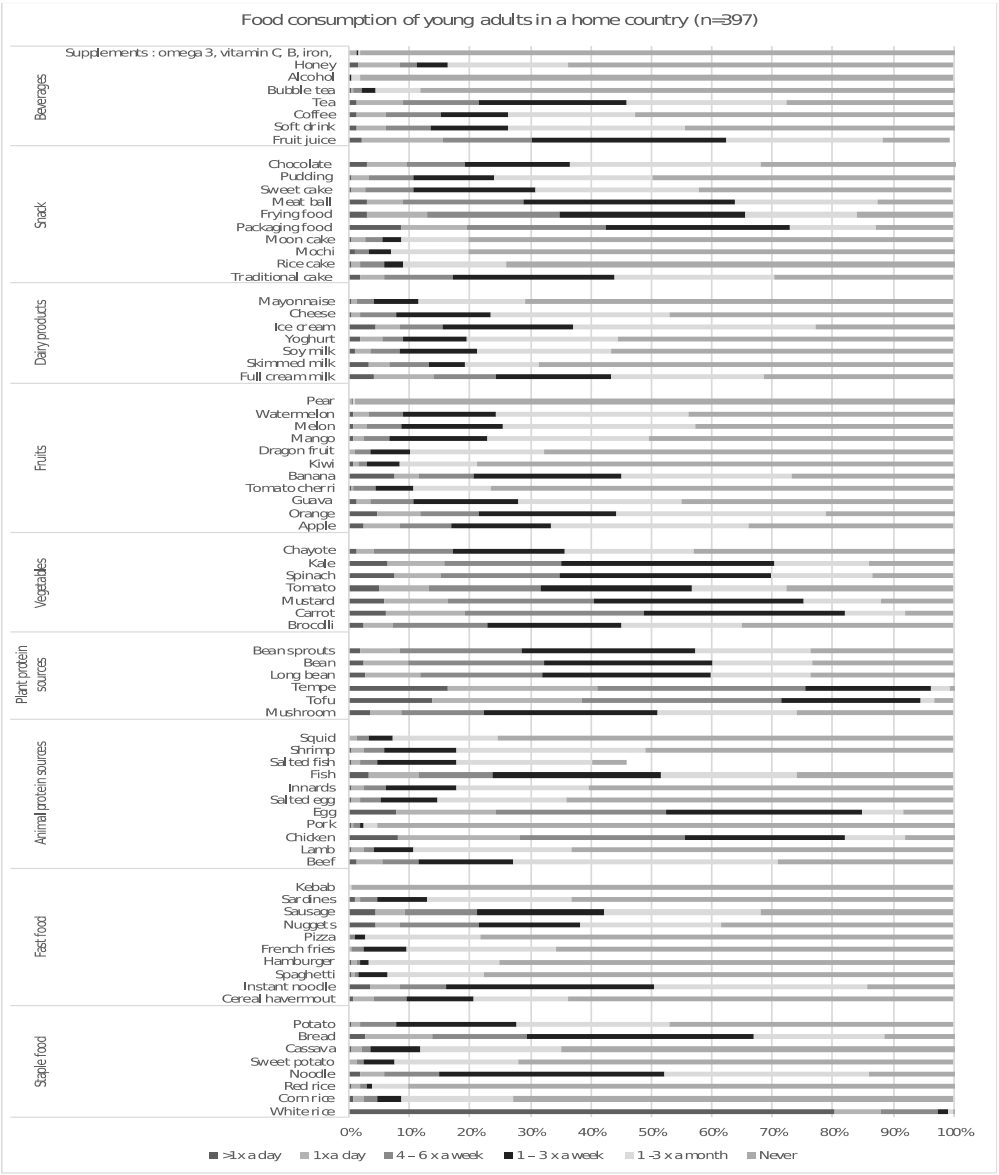

Figure 1. Food frequency in the home country (n=397)

Successful promotion of fruits and vegetable intake in young adults might require a constellation of efforts that influence young adults' eating behaviors[34]. The development of multi-context or multilevel interventions needs to be considered. In particular, more effort was necessary to improve home and school neighborhood environments to promote adolescents' healthy eating behaviors. In addition, parents' education through nationwide and local campaigns might be continually implemented[35].

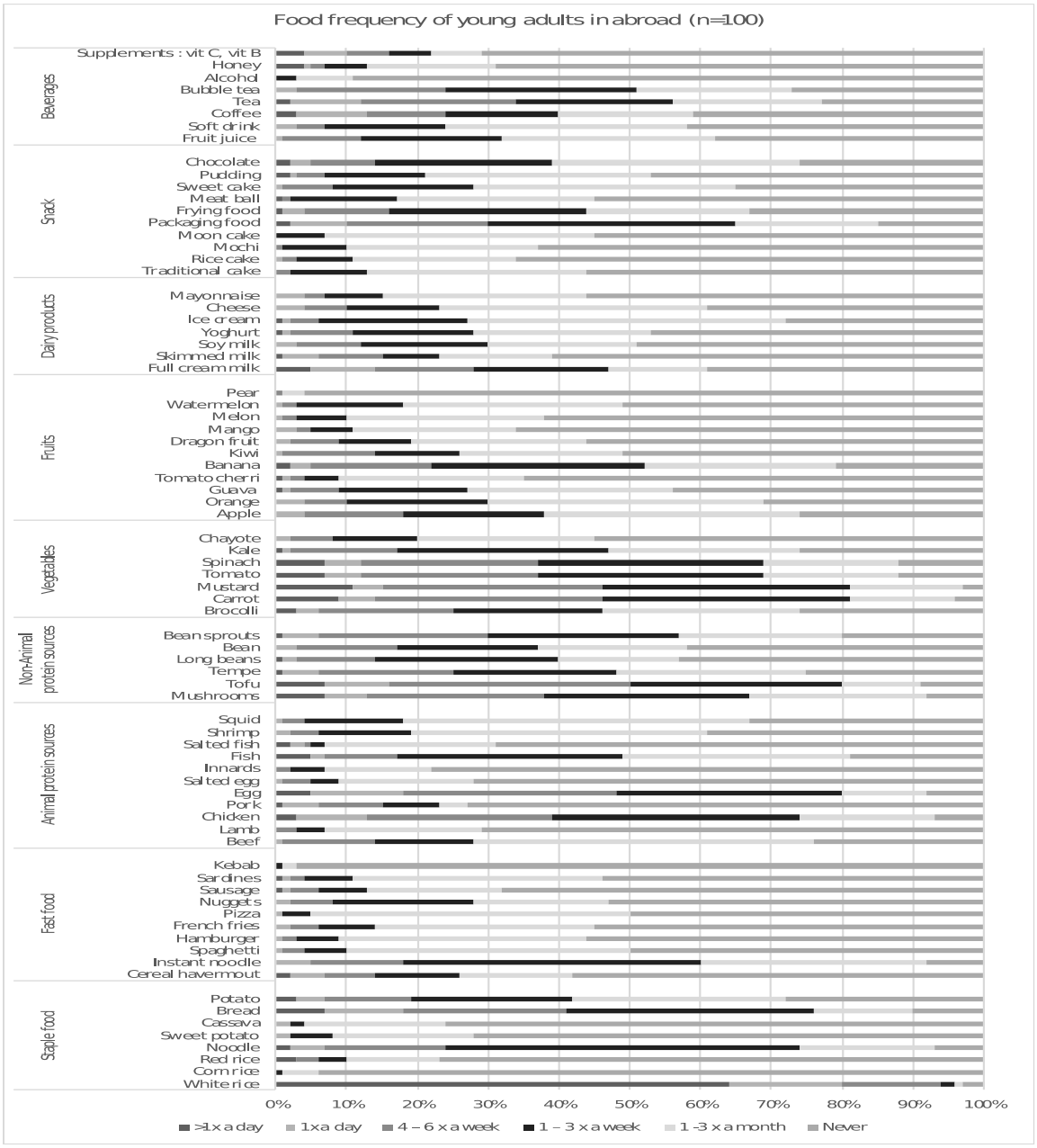

Figure 2. Food frequency in abroad (n=100)

There were limitations associated with the assessment of dietary intake. Even though FFQ were commonly used to infer dietary patterns and dietary intake in epidemiological studies, they were prone to inherent error and limited in their ability to assess all dietary components. Although 78 foods were considered within FFQ, other food consumed may have been missed. There were also drawbacks of dietary pattern analysis, including consolidation of the food items into groups, choosing the number of factors to be retained, selecting the rotation method, and naming the factor identified[36]. As this was a cross-sectional study, dietary patterns were only assessed at a single time point. Therefore we were unable to account for temporal changes over some time.

However, other studies had used comparable methods and highlighted the reproducibility of dietary patterns over time [37]. The importance of adjusting for energy misreporting when examining relations between eating patterns, nutrient intakes, and diet quality[33].

CONCLUSIONS

This study presents no significant difference in food consumption among Indonesian young adults in Malang and Taipei. Overall, they seldom consumed healthy food such as yogurt, vegetables, and fruits. However, consuming fruits is often changed into juices,

especially more frequent in Malang city than Taipei city. Furthermore, the level of beverage consumption (tea) was significantly different between gender in the home country. Whereas, abroad, level consumption of fast food (instant noodle) and plant protein source (tofu) were significantly different between gender.

Table 1. The comparison of food consumption in home country (Indonesia) and abroad (Taiwan) (n=497)

Food Items	Home Country (n=397)			Abroad (n=100)			p-value
	Median	IQR	Min-Max	Median	IQR	Min-Max	
Staple food							
White rice	1	1 - 1	1 - 6	1	1 - 2	1 - 6	> 0.05
Bread	4	3 - 5	1 - 6	4	3 - 4	1 - 6	> 0.05
Noodle	4	4 - 5	1 - 6	4	4 - 5	1 - 6	> 0.05
Potato	5	4 - 6	1 - 6	5	4 - 6	1 - 6	> 0.05
Corn rice	6	5 - 6	1 - 6	6	6 - 6	4 - 6	> 0.05
Red rice	6	6 - 6	1 - 6	6	6 - 6	1 - 6	> 0.05
Sweet potato	6	5 - 6	2 - 6	6	5 - 6	2 - 6	> 0.05
Cassava	6	5 - 6	1 - 6	6	6 - 6	2 - 6	> 0.05
Fast food							
Cereal havermout	6	5 - 6	1 - 6	6	4 - 6	1 - 6	> 0.05
Instant noodle	4	4 - 5	1 - 6	4	4 - 5	1 - 6	> 0.05
Pizza	6	6 - 6	3 - 6	5	5 - 6	3 - 6	< 0.01*
Sausage	5	4 - 6	1 - 6	6	5 - 6	1 - 6	< 0.01*
Nugget	5	4 - 6	1 - 6	6	4 - 6	1 - 6	< 0.01*
Sardines	6	5 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Spaghetti	6	6 - 6	1 - 6	5.5	5 - 6	2 - 6	< 0.01*
Hamburger	6	5.5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
French fries	6	5 - 6	2 - 6	6	5 - 6	2 - 6	> 0.05
Kebab	6	6 - 6	5 - 6	6	6 - 6	4 - 6	> 0.05
Animal protein sources							
Chicken	3	2 - 4	1 - 6	4	3 - 5	1 - 6	< 0.01*
Egg	3	3 - 4	1 - 6	4	3 - 4	1 - 6	< 0.01*
Beef	5	4 - 6	1 - 6	5	4 - 5	1 - 6	> 0.05
Innards	6	5 - 6	1 - 6	6	6 - 6	1 - 6	> 0.05
Fish	4	4 - 6	1 - 6	5	4 - 5	1 - 6	< 0.01*
Shrimp	6	5 - 6	1 - 6	5	5 - 6	1 - 6	< 0.01*
Salted fish	6	5 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Squid	6	6 - 6	1 - 6	5	5 - 6	2 - 6	< 0.01*
Lamb	6	5 - 6	1 - 6	6	5 - 6	3 - 6	> 0.05
Pork	6	6 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Salted egg	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Plant protein sources							
Mushroom	4	4 - 6	1 - 6	4	3 - 5	1 - 6	> 0.05
Tofu	3	2 - 4	1 - 6	3.5	3 - 4	1 - 6	< 0.01*
Tempe	3	2 - 3	1 - 6	5	3.25 - 5.75	1 - 6	< 0.01*
Long bean	4	3 - 5	1 - 6	5	4 - 6	1 - 6	< 0.01*
Bean sprouts	4	3 - 5	1 - 6	4	3 - 5	1 - 6	> 0.05
Bean	4	3 - 5	1 - 6	5	4 - 6	2 - 6	< 0.01*
Vegetables							
Spinach	4	3 - 5	1 - 6	4	3 - 5	1 - 6	> 0.05
Kale	4	3 - 5	1 - 6	5	4 - 6	1 - 6	< 0.01*
Mustard	3	3 - 4.5	1 - 6	4	3 - 4	1 - 6	< 0.01*
Carrot	4	3 - 4	1 - 6	4	3 - 4	1 - 6	> 0.05
Brocolli	5	4 - 6	1 - 6	5	3.25 - 6	1 – 6	> 0.05
Tomato	4	3 - 6	1 - 6	4	3 - 5	1 - 6	> 0.05
Chayote	5	4 - 6	1 - 6	6	5 - 6	2 - 6	< 0.01*
Fruits							
Apple	5	4 - 6	1 - 6	5	4 - 6	1 - 6	> 0.05

Food Items	Home Country (n=397)			Abroad (n=100)			p-value
	Median	**IQR**	**Min-Max**	**Median**	**IQR**	**Min-Max**	
Orange	5	4 - 5	1 - 6	5	4 - 6	1 - 6	> 0.05
Banana	5	4 - 6	1 - 6	4	4 - 5	1 - 6	< 0.01*
Watermelon	5	5 - 6	1 - 6	6	5 - 6	2 - 6	< 0.01*
Melon	5	4 - 6	1 - 6	6	5 - 6	2 - 6	< 0.01*
Guava	5	4 - 6	1 – 6	5	4 - 6	1 - 6	> 0.05
Tomato cherri	6	6 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Kiwi	6	6 - 6	1 - 6	6	4 - 6	2 - 6	> 0.05
Dragon fruit	6	5 - 6	2 - 6	6	5 - 6	2 - 6	> 0.05
Mango	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Pear	6	6 - 6	2 - 6	6	6 - 6	3 - 6	> 0.05
Dairy products							
Ice cream	5	4 - 5	1 - 6	5	4 - 6	1 - 6	> 0.05
Cheese	5	5 - 6	1 - 6	5	5 - 6	2 - 6	> 0.05
Full cream milk	5	4 - 6	1 - 6	5	3 - 6	1 - 6	> 0.05
Yogurt	6	5 - 6	1 - 6	5	4 - 6	1 - 6	< 0.01*
Skimmed milk	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Soy milk	6	5 - 6	1 - 6	5	4 - 6	2 - 6	< 0.01*
Mayonnaise	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Snacks							
Packaging food	4	3 - 5	1 - 6	4	3 - 5	1 - 6	> 0.05
Frying food	4	3 - 5	1 - 6	5	4 - 6	1 - 6	< 0.01*
Sweet cake	5	4 - 6	1 - 6	5	4 - 6	2 - 6	> 0.05
Traditional cake	5	4 - 6	1 - 6	6	5 - 6	3 - 6	< 0.01*
Meatball	4	3 - 5	1 - 6	6	5 - 6	1 - 6	< 0.01*
Pudding	5	5 - 6	1 - 6	5	5 - 6	1 - 6	> 0.05
Chocolate	5	4 - 6	1 - 6	5	4 - 6	1 - 6	> 0.05
Rice cake	6	5 - 6	1 - 6	6	5 - 6	2 - 6	> 0.05
Mochi	6	6 - 6	1 - 6	6	5 - 6	3 - 6	> 0.05
Moon cake	6	6 - 6	1 - 6	6	5 - 6	4 - 6	> 0.05
Beverages							
Juices	4	3 - 5	1 - 6	5	4 - 6	2 - 6	< 0.01*
Softdrink	5	4 - 6	1 - 6	5	5 - 6	2 - 6	> 0.05
Tea	5	4 - 6	1 - 6	4	3 - 5	1 - 6	< 0.01*
Coffee	6	4 - 6	1 -6	5	4 - 6	1 - 6	< 0.01*
Bubble tea	6	6 - 6	1 - 6	4	4 - 6	2 - 6	< 0.01*
Alcohol	6	6 - 6	4 - 6	6	6 - 6	4 - 6	> 0.05
Honey	6	5 - 6	1 - 6	6	5 - 6	1 - 6	> 0.05
Supplements	6	6 - 6	2 - 6	6	5 - 6	1 - 6	> 0.05

*Statistical analysis was using Wilcoxon Mann Whitney U-test with significant p-value set at < 0.05.
P-value between home country and abroad was 0.62.
FFQ code: 1 is for more than one times a day, 2 is for one times a day, 3 is for 4-6 times a week, 4 is for 1-3 times a week, 5 for is 1-3 times a month, 6 is for never.

Table 2. Characteristic of level consumption according to gender in home country (Indonesia) and abroad (Taiwan) (n=497)

Level consumption	**Home country (n=397)**			**Abroad (n=100)**		
	Women (n=357)	**Men (n=40)**	**p-value**	**Women (n=63)**	**Men (n=37)**	**p-value**
	n (%)	**n (%)**		**n (%)**	**n (%)**	
Staple food (white rice)			0.99			0.22
High	313 (87.7)	36 (90)		47 (74.6)	33 (89.2)	
Moderate	40 (11.2)	4 (10)		13 (20.6)	3 (8.1)	

Level consumption	Home country (n=397)			Abroad (n=100)		
	Women (n=357)	**Men (n=40)**	**p-value**	**Women (n=63)**	**Men (n=37)**	**p-value**
	n (%)	**n (%)**		**n (%)**	**n (%)**	
Low	4 (1.1)	0		3 (4.8)	1 (2.7)	
Fast food (instant noodle)			0.35			0.01*
High	29 (8.1)	5 (12.5)		1 (1.6)	4 (10.8)	
Moderate	147 (41.2)	19 (47.5)		32 (50.8)	23 (62.2)	
Low	181 (50.7)	16 (40)		30 (47.6)	10 (27)	
Animal protein source (Egg)			0.07			0.7
High	81 (22.7)	15 (37.5)		12 (19)	6 (16.2)	Chi-s
Moderate	219 (61.3)	22 (55)		40 (63.5)	22 (59.5)	
Low	57 (16)	3 (7.5)		11 (17.5)	9 (24.3)	
Plant protein source (Tofu)			0.35			0.02*
High	133 (37.3)	20 (50)		13 (20.6)	3 (8.1)	
Plant protein source (Tofu)			0.35			0.02*
Moderate	204 (57.1)	18 (45)		34 (54)	30 (81.1)	
Low	20 (5.6)	2 (5)		16 (25.4)	4 (10.8)	
Vegetable (Mustard)			0.24			0.32
High	56 (15.7)	9 (22.5)		12 (19)	3 (8.1)	
Moderate	208 (58.3)	25 (62.5)		39 (62)	27 (73)	
Low	93 (26)	6 (15)		12 (19)	7 (18.9)	
Fruit (Banana)			0.99			0.58
High	41 (11.5)	4 (10)		2 (3.2)	3 (8.1)	
Moderate	120 (33.6)	14 (35)		31 (49.2)	16 (43.2)	
Low	196 (54.9)	22 (55)		30 (47.6)	18 (48.7)	
Dairy product (Full cream milk)			0.88			0.82
High	51 (14.2)	5 (12.5)		8 (12.7)	6 (16.2)	
Moderate	103 (28.9)	13 (32.5)		22 (34.9)	11 (29.7)	
Low	203 (56.9)	22 (55)		33 (52.4)	20 (54)	
Snack (Packaging food)			0.95			0.45
High	71 (19.9)	7 (17.5)		8 (12.7)	2 (5.4)	
Moderate	190 (53.2)	22 (55)		35 (55.6)	20 (54.1)	
Low	96 (26.9)	11 (27.5)		20 (31.7)	15 (40.5)	
Beverage (Tea)			0.005*			0.07
High	28 (7.8)	8 (20)		8 (12.7)	4 (10.8)	
Moderate	127 (355.7)	19 (47.5)		22 (34.9)	22 (59.5)	
Low	202 (56.6)	13 (32.5)		33 (52.4)	11 (29.7)	

p-value was from the Chi-Square test and Fisher's exact test.
*Significant p-value set at < 0.05

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Defining food literacy and dietary patterns among senior high school students in Malang City, East Java

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ABSTRACT

Background: *Food literacy is a collection of interrelated knowledge, skills, and behavior required to plan, manage, select, prepare, and eat food for further meeting dietary requirements and determining dietary intake. In Indonesia, 93.6% of all adolescents aged 10 years or over consumed an inadequate amount of fruits and vegetables and more than half often consumed food rich in sugar, fat and salt. Only one-third of students always had breakfast, only 3,81% always brought their own food to school. Adolescence has been considered as a nutritionally critical period of life. Improve the health promotion is important to prevent malnutrition and risk of chronic disease.*

Objectives: *The study aimed to investigate the association of food literacy and dietary patterns among senior high school students in Malang, East Java.*

Materials and Methods: *The cross-sectional study determined food literacy level and dietary patterns among senior high school students using a questionnaire as the instrument. This study recruited 464 students aged from 14 to 18 years old. Demographic characteristics of adolescents and their parents, adolescent food literacy, and dietary intake data were self-report collected. The height was measured using stature meter and weight using electronic scale to determine the BMI-for-age. The research was conducted from July to September 2015 in Malang, East Java.*

Results: *Out of 464 adolescents, 59.9% were females, and female adolescents had a better food literacy ($P < .001$) and higher dietary pattern scores ($P < .05$). Adolescents whose family had higher income or higher percentage of income spent on food consumed more vegetables ($P < .05$) and dairy products ($P < .05$), and had higher dietary pattern scores ($P < .05$) compared with those whose family had lower income or lower percentage of income spent on food. The perception of food literacy ($r = 0.187$, $P < .001$), the behavior of food literacy ($r = 0.333$, $P < .001$), and overall food literacy ($r = 0.329$, $P < .001$) were positively correlated with dietary pattern scores.*

Conclusions: *Food literacy is positively associated with dietary patterns in adolescents. Nutrition education is suggested to implement as a guide in healthy food choices for adolescent.*

KEYWORDS: *food literacy; dietary intake; anthropometric data; adolescent; Indonesia*

BACKGROUND

Food literacy has been influenced by health professionals, nutritionist, and home economists, and fundamentally aims to achieve personal health-related goals.[1] Food literacy was defined as the concept that empowers individuals, households, communities, or nations to protect diet quality through changing and strengthening dietary resilience over time. Food literacy is a collection of interrelated knowledge, skills, and behavior required to plan, manage, select, prepare, and eat food for further meeting dietary requirements and determining dietary intake.[1,2] Food literacy could affect the quality of dietary intake and health status.[3] Low literacy level of nutritional knowledge among adolescents in Minnesota, USA was associated with poor decision making on the maintenance of energy balance and healthy body weight in adulthood.[4] Additionally, better nutritional knowledge and more frequent food preparation in adolescents were correlated with healthy dietary practices.[5,6]

In regard to eating habits in Indonesia, 93.6% of all adolescents aged 10 years or over consumed an inadequate amount of fruits and vegetables and more than half often consumed food rich in sugar, fat and salt. Data from the Indonesian Global School Health Survey in 2015 showed that only one-third of students always had breakfast, only 3,81% always brought their own food to school and more than half teenagers consumed fast food at least once per week.[7] Daily dietary intake as dietary patterns of an individual is crucial in health promotion throughout the lifespan.[8] However, the diversity of dietary patterns could be varied in different countries. Dietary patterns of school children and adolescents in 42 developing countries were limited in

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diversity, primarily a plant-based diet, but limited in the intake of fruit and vegetables, which resulted in insufficient energy and micronutrient intake.[9] The healthy diet is one of the most important factors for maintaining ideal body weight and preventing chronic disease.[10,11] Dietary patterns such as fruit and vegetables,[12] dairy products,[13] and whole grains[14] have been considered to reduce the risk of chronic disease, whereas saturated fat intake was associated with greater risk of chronic disease.[12]

Adolescence has been considered as a nutritionally critical period of life because of rapid physical growth and development as well as a change of lifestyle and dietary habits that can affect both nutrient intake and needs.[15] Malnutrition, particularly under-nutrition, was prevalent in adolescents which may lead to the retardation of growth and intellectual capacity.[16,17] Limited evidence has demonstrated the impact of food literacy on dietary patterns in adolescents. Therefore, this study aimed to investigate determine the association between food literacy and dietary patterns among adolescents in Malang City, East Java.

MATERIALS AND METHODS

The study design was a cross-sectional survey using a questionnaire to define the food literacy and dietary patterns among adolescents in Malang City, East Java, Indonesia. This study recruited the students aged 14 to 18 years old from 6 senior high schools in Indonesia. There were a total of 530 students aged 14 to 18 years old from 6 senior high schools in Malang City, East Java After excluding 66 students who did not complete the questionnaire, 464 students participated in this study. The research approved by Brawijaya University Institutional Review Board (No. 465/EC/KEPK/088/2015).

All participants were provided the informed consent form under their parents or guardian signature. This study used a questionnaire to collect data among adolescents from July to September 2015 in Malang City, East Java. The questionnaire was comprised of 4 parts: demographic characteristics, food literacy, dietary patterns, and anthropometric measurements.

The demographic characteristics such as gender, age, parental education, parental employment, family income, and the person who took the responsibility for cooking at home were collected by self-report in the questionnaire. The employment status was classified as part-time (<8 h per day) or full-time (≥8 h per day). The cutoff family income of 3,000,000 Indonesian Rupiah (IDR) was the monthly regional minimum wages in Malang city, East Java.

The food literacy questionnaire included the perception of food literacy with 8 questions and the participants' behavior regarding food literacy with 26 questions. The four components of food literacy including planning and management, selection, preparation, and eating from empirical research were identified, and the best aligned questions with these components were selected.[1] The questionnaire started with proposing the suitable scale or questionnaire items using a series of validity and reliability processes. The content validity was evaluated by 5 panel nutrition experts who provided content and format feedback during the development of questionnaire based on components of food literacy.[1,2] The questionnaire was then tested to the face validity by 10 students aged 14-18 years using forum group discussion with the participants to establish how the target group understood questions. The pilot study was conducted to the participants (n = 31) who completed the questionnaire, and the questionnaire was revised based on feedback response to examine the performance of each question. Cronbach's alpha was used to assess the reliability of the internal consistency. The acceptable values of Cronbach's alpha for internal consistency were ranged from 0.71 to 0.84.[18]

The perceived importance of food literacy was categorized as unimportant, somewhat unimportant, neutral, somewhat important, and very important. The scores were assigned as 1 to 5 from unimportant to very important. The minimum and maximum scores of the perception of food literacy were 8 and 40, respectively. The response frequency of participants' behavior regarding food literacy was classified as never, 1-2 times, 3-4 times, 5-6 times, and 7 times per week, and the scores were assigned accordingly as 1 to 5 from never to 7 times per week. The minimum and maximum scores of the behavior on food literacy were 26 and 130, respectively. Therefore, the total minimum and maximum scores of food literacy including perception and behavior were 34 and 170, respectively.

Dietary patterns in the past three months were determined using a validated semi-quantitative food frequency questionnaire (FFQ). All food items were adopted from Indonesian dietary guideline represented by four-layer food groups in a rice cone-like shape, locally known as *Tumpeng Gizi Seimbang*. A rounded pyramid-like shape represents the principle of balanced nutrition made up of different food groups.[19] The individual food items from 24-h recall were also collected from 50 senior high school students to add other food list by a trained person.

The FFQ included 6 food groups: cereals with 13 food items, vegetables with 20 food items, legumes with 6 food items, meat with 18 food items, fruit with 10 food items, and dairy products with 2

food items. The dietary intake frequency of 69 food items in the FFQ included 6 categories: never, 1 to 3 times a month, once a week, 2 to 4 times a week, 5 to 6 times a week, and 7 times or more a week. The score of each food item was assigned as 0 to 5 from the lowest frequency (never) to the highest frequency (7 times or more a week). The score of the dietary intake was then calculated by summing the score for each food item. The total score of all 6 food-groups was ranged from 0 to 345, and the cutoff point was the median of 172 in this study. The score ≥172 or <172 was defined as a good or a poor dietary pattern, respectively.

The anthropometric data including height, body weight, and body mass index (BMI) of adolescents were determined. Height in centimeter (cm) measured using stature meter with accurately record to the nearest 0,1cm. The measurer put the scale correctly in the wall and participant have to stand with feet flat against the flat surface while head, shoulders, buttocks and heel touching the wall. Measurer's eyes were at the same level as the headpiece to get the height measurement. Body weight in kilogram (kg) measured using an electronic scale accurately record to the nearest 0.1kg. The measurer placed the scale on firm flooring and participant should stand with both feet in the center of the scale without shoes and heavy clothing. BMI (kg/m^2) was calculated as body weight (kg) divided by the square of height in meters (m^2). After BMI is calculated for adolescent, it is plotted by age on a gender specific growth chart. WHO AnthroPlus was used to calculate BMI-for-age among adolescents using Z-score. Underweight, overweight, and obesity were defined as BMI-for-age Z-score <-2 standard deviation (SD), >+1 SD, and >+2 SD, respectively.[20,21]

All statistical analyses were performed using SPSS Statistics version 22.0 (IBM Corp., Armonk, NY). [1] The normality test was done by the Shapiro-Wilk test and the data were analyzed using nonparametric measurements due to a skewed distribution. Mann-Whitney U and Kruskal-Wallis tests were used to compare the median between the groups. Chi-square test was performed to compare the distribution of age groups, parental education, parental employment, family income, the percentage of income spent on food, cooking responsibility, and BMI weight status between males and females. Spearman's rank correlation coefficient was used to assess the relationship between food literacy and dietary patterns. After normalization by log transformation, the association between food literacy and dietary patterns was determined using the multivariate linear regression analysis. The *P*-values <.05 were considered statistically significant.

RESULTS

The demographic characteristics of adolescents and their parents are presented in Table 1. Out of 464 adolescents, 59.9% were female, and 71.3% aged 16 to 18 years old. Parents' demographic information showed that over half of parents (fathers and mothers) had university-level education (66.8% vs. 59.5%), and 95.0% of participants' fathers and 56.3% of their mothers had a part-time or full-time job. The results found that 55.2% of participants' household had a monthly family income of ≥3,000,000 IDR. In addition, 55.0% of household spent 50% or more on food. Mothers (81.7%) were the main responsible person for cooking in the family. There were no significant different in demographic characteristic such as parents education level, employment status and family income for all participants (P>.01). The anthropometric data showed that the prevalence of underweight, overweight, and obesity was 23.3%, 10.1%, and 4.1%, respectively. The distribution of weight status was significantly different between males and females (*P* = .01). The prevalence of underweight, overweight, and obesity was 26.9%, 14.0% and 4.8% in males, and 20.9%, 7.5%, and 3.6% in females.

The median scores of food literacy and dietary intake are summarized in Table 2. The median scores of food literacy in the perception of food literacy and behavior of food literacy were 30 and 64, and the overall median score of food literacy was 94. The median scores of dietary intake in cereals, vegetables, legumes, meat, fruit, and dairy products were 19, 26, 9, 25, 12, and 5, respectively, and the overall median score of dietary intake was 97.5.

The results in Table 3 showed that adolescents aged from 16 to 18 years consumed more cereals (*P* = .04), vegetables (*P* = .01), and legumes (*P* = .05), and had higher dietary intake scores (*P* = .03) compared with those aged 14 to 15 years. Female adolescents had better perception of food literacy (*P* < .001), behavior of food literacy (*P* < .001), and overall food literacy (*P* < .001) than males. In addition, female adolescents consumed more vegetables (*P* = .03) and fruit (*P* = .03), and had higher dietary intake scores (*P* = .04) compared with males. The intrapersonal may influences such as psychological and biological influence adolescents eating behaviors and food choice. Factor influencing eating behavior of adolescents need to be better understood to develop effective nutrition intervention including possible difference in male and female adolescents.[22]

Table 1. Demographic characteristics of participants

Characteristics	Total (n = 464)	Male (n = 186)	Female (n = 278)	*P*-value
	n (%)	n (%)	n (%)	
Age, years				0.62
14-15	133 (28.7)	51 (27.4)	82 (29.5)	
16-18	331 (71.3)	135 (72.6)	196 (70.5)	
Father's education				
Primary	15 (3.2)	4 (2.1)	11 (4.0)	0.04
High school	139 (30.0)	47 (25.3)	92 (33.1)	
University	310 (66.8)	135 (72.6)	175 (62.9)	
Mother's education				0.02
Primary	19 (4.1)	3 (1.6)	16 (5.7)	
High school	169 (36.4)	62 (33.3)	107 (38.5)	
University	276 (59.5)	121 (65.1)	155 (55.8)	
Father's employment				
None	23 (5.0)	11 (5.9)	12 (4.3)	0.70
Part-time job	130 (28.0)	53 (28.5)	77 (27.7)	
Full-time job	311 (67.0)	122 (65.6)	189 (68.0)	
Mother's employment				0.94
None	203 (43.7)	81 (43.5)	122 (43.9)	
Part-time job	89 (19.2)	37 (19.9)	52 (18.7)	
Full-time job	172 (37.1)	68 (36.6)	104 (37.4)	
Family income, IDR[a]				
<3,000,000	208 (44.8)	78 (41.9)	130 (46.8)	0.30
≥3,000,000	256 (55.2)	108 (58.1)	148 (53.2)	
Percentage of income spent on food				0.81
<50%	209 (45.0)	85 (45.7)	124 (44.6)	
≥50%	255 (55.0)	101 (54.3)	154 (55.4)	
Cooking responsibility				0.61
Mother	379 (81.7)	154 (82.8)	225 (80.9)	
Maid/others	85 (18.3)	32 (17.2)	53 (19.1)	
BMI, kg/m^2				0.01
Underweight (Z < -2SD)	108 (23.3)	50 (26.9)	58 (20.9)	
Normal weight	290 (62.5)	101(54.3)	189 (68.0)	
Overweight (Z > +1SD)	47 (10.1)	26 (14.0)	21 (7.5)	
Obese (Z > +2SD)	19 (4.1)	9 (4.8)	10 (3.6)	

[a]1 USD = 14,347.3 IDR (Indonesian Rupiah).

Adolescents whose fathers had higher education level consumed more vegetables compared with those whose fathers had primary education (P = .02). Adolescents whose family had higher income or higher percentage of income spent on food consumed more vegetables (P < .05) and dairy products (P < .05), and had higher dietary intake scores (P < .05) compared with those whose family had lower income or lower percentage of income spent on food. Parents with higher education and income level more likely affect the availability and knowledge of healthier food such as vegetable and dairy product. Also in the level of self-efficacy to eat healthy food were noted in some higher educational level. The facilitation from the parents more likely acted as mediators to consume healthy food.[23]

A significant positive correlation was found between food literacy and dietary intake (Table 4). The perception of food literacy, behavior of food literacy, and overall food literacy were positively correlated with the intake of cereals, vegetables, legumes, meat, fruit, and dairy products. The perception of food literacy (r = 0.187, P < .001), the behavior of food literacy (r = 0.333, P < .001), and overall food literacy (r = 0.329, P < .001) were also positively associated with dietary intake scores.

The association between food literacy and dietary patterns using the multivariate linear regression analyzes after the log transformation of food literacy data is shown in Table 5. The results revealed that the perception of food literacy (β = 0.40, P = .001), the behavior of food literacy (β = 0.32, P = .002), and food literacy (β = 0.35, P = .001) were positively correlated with dietary intake scores. The concept of food literacy is not just nutrition knowledge; it includes skills and behaviors in ways

that meet nutrition guideline. Food literacy builds upon the work that has been done around the relationship between food knowledge and food choice. Food literacy may play a role in shaping dietary intake.[22]

DISCUSSION

Female adolescents had not only better food literacy, but also higher scores of dietary patterns compared with male adolescents in this study. A previous study demonstrated that nutritional knowledge was significantly associated with a higher dietary pattern score.[24] Personal knowledge in nutrition was considered as an important factor by both males and females across different levels of habitual intake.[25] Similarly, the differences in food literacy between genders were also reported in the previous studies.[17,26] Female adolescents had better nutritional knowledge, and male adolescents showed good nutritional practice.[17] Additionally, premenopausal women had a better dietary intake in terms of energy distribution from macronutrients and a higher eating-related self-determination index than men.[26] Different aspect of adolescents' food consumption behavior may be influenced by different factors, which may vary between males and females. Educational and treatment strategies need to be specific to both genders.[27]

Dietary intake scores were positively associated with family income and the percentage of income spent on food. Consistent with a previous study in Malaysia, low socioeconomic status and low household income led to limited access to an adequate diet.[21] Food prices had a greater effect on dietary consumption in low-income countries and in poorer households.[28] A high-quality diet or a nutritionally adequate diet was, in general, consumed by better educated and more affluent people with higher socioeconomic status.[29,30] Dietary patterns could be varied by sex, ethnicity, income, and education. The present study also reported that the adolescents whose fathers had higher education consumed more vegetables compared with those whose fathers had lower education. Similar to a previous study, children and adolescents whose parents had a higher education level had significantly better dietary intake of vegetables, fruit, and dairy products.[31] Study showed that higher parental education level and higher income had the strongest mediators such as availability, knowledge and self efficacy about healthy food.[32]

The present study pointed out that food literacy was positively correlated with dietary intake scores. Both the perception of food literacy and the behavior of food literacy exerted a positive influence on dietary intake scores. Consistent with a previous study, higher nutritional knowledge scores were associated with a healthy dietary pattern.[33] Contrarily, low nutritional knowledge resulted in an unhealthy eating habit.[34,35] Additionally, positive behavior on food literacy such as more frequent food preparation was correlated with a healthy dietary pattern toward more vegetables and fruit in adolescents.[34] A healthy dietary pattern could be attributed to the improvement of nutritional knowledge in children and young adolescents.[36]

Food literacy education could positively influence dietary behavior and long-term health among adolescents.[37] The link between food literacy and dietary patterns is clearly highlighted in this study as a significant strength. To the best our knowledge, this is the first study in Indonesia to determine the relationship between food literacy level and dietary patterns among adolescents. However, the present study has some limitations. First, the study was conducted in the senior high schools in Malang, East Java that may limit generalization to other community settings and populations in Indonesia. Second, the cross-sectional design of the present study just indicated the association between the study variables, but did not infer any causality from the current findings.

Table 2 Median scores of food literacy and dietary intake

	Median	Interquartile
Food literacy	94.00	85.00-102.00
Perception of food literacy	30.00	27.00-32.00
Behavior of food literacy	64.00	57.00-71.00
Dietary intake	97.50	74.25-124.00
Cereals	19.00	15.00-24.00
Vegetables	26.00	17.00-37.00
Legumes	9.00	6.00-12.00
Meat	25.00	19.00-33.00
Fruit	12.00	8.00-18.00
Dairy products	5.00	3.00-6.00

Table 3 Comparisons of food literacy and dietary intake scores in participant subgroups

Characteristics	Perception of food literacy *P*-value Median	Behavior of food literacy *P*-value Median	Food literacy *P*-value Median	Cereals *P*-value Median	Vegetables *P*-value Median	Legumes *P*-value Median	Meat *P*-value Median	Fruit *P*-value Median	Dairy products *P*-value Median	Dietary intake *P*-value Median
Age, years	0.40	0.69	0.90	0.04	0.01	0.05	0.54	0.52	0.76	0.03
14-15	29.00	64.00	94.00	18.00	24.00	8.00	25.00	13.00	5.00	95.00
16-18	30.00	63.00	94.00	20.00	27.00	9.00	25.00	12.00	5.00	99.00
Gender	<0.001	<0.001	<0.001	0.35	0.03	0.15	0.48	0.03	0.53	0.04
Male	29.00	62.00	92.00	19.50	24.50	9.00	24.00	10.50	5.00	96.00
Female	31.00	65.00	95.00	19.00	27.00	8.00	26.00	12.00	5.00	99.00
Father's education	0.56	0.61	0.51	0.32	0.02	0.95	0.67	0.54	0.82	0.79
Primary	30.00	62.00	92.00	18.00	22.00	10.00	26.00	12.00	5.00	95.00
High school	30.00	63.00	93.00	20.00	24.00	10.00	24.00	13.00	5.00	97.00
University	30.00	64.00	94.00	19.00	26.00	10.00	25.00	12.00	5.00	98.00
Mother's education	0.38	0.93	0.67	0.45	0.13	0.34	0.66	0.19	0.16	0.18
Primary	30.00	65.00	95.00	21.00	28.00	10.00	26.00	13.00	4.00	29.50
High school	30.00	64.00	94.00	20.00	27.00	9.00	24.00	12.00	4.00	30.00
University	31.00	64.00	95.00	20.00	27.00	9.00	25.00	12.00	5.00	30.00
Father's employment	0.79	0.24	0.29	0.64	0.79	0.38	0.11	0.45	0.12	0.54
None	30.00	65.00	97.00	22.00	23.00	7.00	19.00	10.00	4.00	96.00
Part-time job	29.50	62.00	92.00	19.00	27.50	9.00	26.00	11.50	5.00	98.00
Full-time job	30.00	64.00	94.00	19.00	26.00	9.00	25.00	12.00	5.00	99.00
Mother's employment	0.87	0.88	0.94	0.53	0.71	0.35	0.62	0.94	0.35	0.54
None	29.00	63.00	94.00	20.00	25.00	8.00	24.00	12.00	5.00	96.00
Part-time job	30.00	62.00	93.00	20.00	25.00	9.00	26.00	12.00	5.00	97.00
Full-time job	30.00	64.00	94.00	21.00	25.00	9.00	25.00	12.00	5.00	98.00
Family income, IDR[a]	0.60	0.83	0.89	0.65	0.03	0.95	0.91	0.40	0.01	0.02
<3,000,000	30.00	63.00	94.00	20.00	25.00	8.00	25.00	11.00	4.50	96.00
≥3,000,000	30.00	64.00	93.50	19.00	27.00	9.00	25.00	12.00	6.00	99.00
% of income spent on food	0.09	0.14	0.10	0.20	0.04	0.30	0.02	0.30	0.03	0.02
<50%	29.00	63.00	93.00	19.00	24.00	8.00	24.00	11.00	4.00	94.00
≥50%	30.00	64.00	94.00	20.00	28.00	9.00	26.00	12.00	5.00	100.00
Cooking responsibility	0.39	0.70	0.45	0.12	0.52	0.11	0.70	0.26	0.60	0.17
Mother	30.00	64.00	94.00	20.00	26.00	9.00	25.00	12.00	5.00	99.00
Maid/others	29.00	63.00	92.00	19.00	26.00	8.00	26.00	12.00	5.00	97.00

[a]1 USD = 14,347.3 IDR (Indonesian Rupiah).

Table 4 Correlation coefficient (r) between food literacy and dietary intake

	PFL 1	**BFL 2**	**FL 3**	**Cereals 4**	**Vegetables 5**	**Legumes 6**	**Meat 7**	**Fruit 8**	**Dairy products 9**	**Dietary intake 10**
1	1.000									
2	0.461***	1.000								
3	0.673***	0.960***	1.000							
4	0.078	0.170***	0.172***	1.000						
5	0.196***	0.298***	0.300***	0.444***	1.000					
6	0.081	0.164***	0.153***	0.360***	0.524***	1.000				
7	0.118*	0.282***	0.267***	0.505***	0.589***	0.473***	1.000			
8	0.207***	0.289***	0.300***	0.484***	0.549***	0.396***	0.490***	1.000		
9	0.084	0.180**	0.170***	0.280***	0.235***	0.236***	0.350***	0.277***	1.000	
10	0.187***	0.333***	0.329***	0.684***	0.856***	0.637***	0.810***	0.749***	0.411***	1.000

Abbreviations: PFL, perception of food literacy; BFL, behavior of food literacy; FL, food literacy.
*$P < .05$; **$P < .01$; ***$P < .001$.

Table 5 Association between food literacy and dietary patterns using the multivariate linear regression analysis after the log transformation

	β	**95% CI**	***P*-value**
Log10 Perception of food literacy	0.40	0.33-0.74	0.001
Log10 Behavior of food literacy	0.32	0.28-0.68	0.002
Log10 Food literacy	0.35	0.14-0.76	0.001

Abbreviation: CI, confidence interval.

CONCLUSIONS

The present study indicated that food literacy might influence adolescents' dietary intake. In conclusion, a significant positive correlation is found between food literacy and dietary patterns. Female adolescents have a higher food literacy level and better dietary patterns with more vegetables and fruit intake than male adolescents. Dietary patterns are also positively associated with household socioeconomic status. Nutrition education in food literacy is suggested to guide adolescents in choosing healthy foods. Further researches are needed to investigate the association between food literacy and nutritional status among adolescents with bigger community setting and population in Indonesia. The other methods to find direct causality between variables could be determined in the future.

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Counselor's Knowledge, Attitude and Practice of Infant and Young Child Feeding (IYCF) Counselling

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ABSTRACT

Background: *It needs an effort to reduce the prevalence of undernutrition with the proper IYCF practices. IYCF promotion and counseling activities for caregivers can increase the success of IYCF implementation and reduce the prevalence of malnutrition.*
Objectives: *The objective of this study was to determine the association between the level of education, knowledge, and attitude of Posyandu counselors on IYCF practice in the Parongpong District of West Bandung Regency.*
Materials and Methods: *This research used a cross-sectional study with a consecutive sampling technique. The data collection was conducted from June until August 2020, involving 67 respondents. The dependent variable was Posyandu counselor practice; meanwhile, the independent variables were knowledge and attitude. Descriptive analysis was conducted to describe the characteristics of the respondents, and the multivariate test used multiple logistic regression.*
Results: *Bivariate analysis showed that only level of education had a significant association with a p-value of 0.024. Further analysis using a multivariate test showed that the variables that significantly related to the practice of IYCF counseling were the level of education, knowledge, and attitude, which were controlled by the confounding variable for the period of being a counselor.*
Conclusion: *The level of education, knowledge, and attitude of Posyandu counselors in IYCF counseling practice was an essential factor that can improve children's nutritional status.*

Keywords: *IYCF; knowledge; Posyandu counselor*

BACKGROUND

Nutritional problems result from internal factors with cultural and socio-economic conditions in the community. The term Double Burden of Malnutrition (DBM) is the coexistence of overnutrition (overweight and obesity) alongside undernutrition (stunting and wasting) at all levels of the population, where many of these events are found in poor and middle-income countries (low-income and middle-income countries / LMICs). A study in 2019 showed that Indonesia is a country with the most considerable incidence of DBM in the world [1]. Nutritional problems can occur in every stage of the life cycle, starting from babies, infants, children, adults, and the elderly. However, the most critical periods of human life are the periods of intense growth and development stages (the first 1000 days of a child's life) [2]. Stunting in the childhood period is one of the significant factors that hinder human development, and globally affects around 162 million children under the age of 5 [3]. A child is classified as stunting if the length or height according to their age is lower than the applicable standards [4]. The prevalence of stunting in Indonesia is the fifth largest in the world. Indonesia Basic Health Research Data (*Riskesdas*) in 2018 showed the prevalence of stunting (body height/ age) was 30.8 %, whereas the number of short toddlers was 19.3 %, and very short toddlers were 11.5%. West Java is one of the provinces with a stunting rate of 31.1%, and in West Bandung Regency, the number has reached 13.23% [5].

The lack of nutritional intake commonly causes growth failure conditions in children under five for a long time and recurrent infections. In contrast, these two factors are influenced by inadequate knowledge, especially in the first 1000 days of a child's life [6]. The 1000 days period is a critical factor in stunting children under five years and has a long-term effect [7]. Stunting in children, especially in children under two years of age, causes long-term effects such as lower body height as an adult, economic level/income, school achievement, and the risk of developing chronic disease as an adult [8].

Nutritional problems can affect all aspects of life, especially the economic aspect and individual health status in the future. Efforts to reduce the prevalence of malnutrition can be made with adequate

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and proper Infant and Young Child Feeding (IYCF). The practice of IYCF starts with the early initiation of breastfeeding, followed by giving exclusive breast milk and providing appropriate complementary feeding [9]. However, the lack of knowledge and practical skills to provide adequate additional feeding for infants and children can affect the nutritional status of children and contribute to the high prevalence of stunting [10] [11]. IYCF promotion and counseling for caregivers are known to increase the success of IYCF implementation and reduce the number of malnutrition cases [12]. Implementing IYCF counseling is also known to have an indirect effect on improving children's nutritional status, such as reducing the incidence of malnutrition and stunting in children [13].

The delivery of information about IYCF practice by health workers or counselors is often considered ineffective and inadequate so that caregivers do not acquire adequate knowledge [14]. Various indicators such as lack of information regarding IYCF techniques/practices and lack of nutrition counseling materials for children who are not breastfed are known to affect the success of the IYCF program [10]. Good IYCF promotion and counseling can help caregivers make the right decision to provide nutritious food for their children. *Posyandu* in Indonesia is an integrated health service post that provides primary health service, especially for children and pregnant women. Adequate knowledge of *Posyandu* counselors in the IYCF counseling practice is an essential factor that can improve children's nutritional status. Currently, there is not much research in Indonesia that study the level of IYCF knowledge, attitudes, and practices of *Posyandu* counselor. A study in India shows that parents will implement better IYCF practices when counseling from counselors who have higher knowledge [15]. This study aims to determine the association between the level of education, knowledge, and attitude of *Posyandu* counselors on IYCF practice in the Parongpong District of West Bandung Regency.

MATERIALS AND METHODS

This study used a cross-sectional design with a consecutive sampling technique. All counselors are invited, and those present are taken as study samples. There are 67 *Posyandu* counselors involved in this study from 56 *Posyandu* in three villages in Parongpong District. Data for the *Posyandu* counselors were obtained through the Nutrition Driving Team (Tim Penggerak Gizi) from the Parongpong Community Health Center. The inclusion criteria in this study are the *Posyandu* counselor who can communicate in the Indonesian language and can read well; meanwhile, the exclusion criteria are the counselor absent during the data collection process and did not fill all the questions in the questionnaire. First, descriptive analysis was conducted to describe the characteristics of the respondents. In the next stage, the chi-square bivariable test was used to determine the relationship between two categoric variables, where significant variables showed a significance value of $p < 0.05$. Furthermore, a multivariate test is carried out to determine which variables meet the logistic regression equation model. Logistic regression is a method of predictive analysis carried out when the dependent variable in testing is binary. This study has been approved by the Medical and Health Research Ethics Committee (MHREC) Faculty of Medicine, Public Health, and Nursing Universitas Gadjah Mada, KE/FK/0994/EC/2020.

RESULTS

1. Respondent Characteristic

The research was conducted in the Parongpong District of West Bandung Regency. A total of 67 *Posyandu* counselors participated in this study. A descriptive analysis of the respondents is presented in

The average age of *Posyandu* counselors was 43.18 years old, with the oldest being 63 years old. Most of them were graduated from high school (47.8%) and worked as housewives (97%). *Posyandu* counselors have an average monthly income of IDR 2,046,296.3, with the lowest income of IDR 600,000. On average, the counselors had worked for 7.8 years, and the counselors who had worked the longest were 34 years. Most *Posyandu* counselors have not received IYCF training (73.1%). The measurement results based on the questionnaire showed that the counselor's average score for knowledge was 76.2, the average attitude score was 46.25, and the average practice score was 68.8.

2. Bivariate Test

A bivariable test was conducted on the IYCF counseling practice and other variables in this study. Table 2 summarizes the result of the bivariable test. Knowledge, attitude, and IYCF practice were divided into two categories with a cut-off point from the median score. The results showed that only the education variable had a significant relationship with IYCF counseling practice, with a value of 0.024, $p < 0.05$.

The results of data analysis in Table 2 show that almost all variables did not meet the

requirements for multivariate analysis, except for the education and attitude variables which have a p-value less than 0.25. However, since the other variables are also considered essential variables, the researcher decided to include all the variables for the multivariate logistic regression test.

The next step is carried out by conducting an interaction test and a confounding test. The results show that there is no interaction between the variables.

Tabel 1. Respondent Characteristic

Variable	Mean	SD	Min	Max
Age	43.18 year	9.2 year	25 year	63 year
Education (n, %)				
Primary School	18 (26,9 %)			
Junior High School	7 (10.4%)			
Senior High School	32 (47.8%)			
College	10 (14.9%)			
Occupation (n, %)				
Housewife	65 (97%)			
Entrepreneur	1 (1.5%)			
Lecturer	1 (1.5%)			
Monthly income (n=54)	IDR 2,046,296.3	IDR 1,427,157.5	IDR 600,000	IDR 8,000,000
Service period	7.9 year	7.8 year	1 year	34 year
IYCF Training (n, %)				
No	49 (73.1%)			
Yes	18 (26.9%)			
Knowledge	76.2	0.76	30	100
Attitude	46.25	0.79	1	7
Practice	68.8	17.38	8	76

Table 2. Bivariable Test of IYCF Counseling Practice

Variable	IYCF Counseling Practice		total	p-value
	Poor	Good		
Age	43.18	9.2	43.18	0.784
Education (n, %)				0.024
Primary School	4(22.2)	14(77.8)	18 (26,9 %)	
Junior High School	2 (28.6)	5 (71.4)	7 (10.4%)	
Senior High School	19 (59.4)	13 (40.6)	32 (47.8%)	
College	7 (70)	3 (30)	10 (14.9%)	
Occupation (n, %)				0.366
Housewife	31 (47.7)	34 (52.3)	65 (97%)	
Entrepreneur	1 (100)	0	1 (1.5%)	
Lecturer	0	1 (100)	1 (1.5%)	
Service period	7.9	7.8		0.432
< 1 year	3 (33.3)	6 (66.7)	9 (13.4%)	
1-10 year	23 (53.5)	20 (46.5)	43 (64.2%)	
> 10 year	6 (40)	9 (52.2)	15 (22.4%)	
IYCF training (n, %)				0.378
No	25 (51)	24 (49)	49 (73.1%)	
Yes	7 (38.9)	11 (61.1)	18 (26.9%)	
Knowledge (n, %)				0.389
Poor	18 (52.9)	16 (47.1)	34 (50.7%)	
Good	14 (42.4)	19 (57.6)	33 (49.3%)	
Attitude (n, %)				0.194
Poor	13 (59.1)	9 (40.9)	22 (32.8%)	
Good	19 (42.2)	26 (57.8)	45 (67.2%)	

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3. Logistic Regression Model

The results of the multivariate logistic regression test are presented in Table 3. The results of the multivariate analysis showed that the education level, knowledge, and attitude had a significant relationship with the practice of IYCF counseling, controlled by the service period.

Table 3. Fix Model from Multivariate Logistic Regression Test

Variable	B	P-value	OR	95% CI	
				Lower	Upper
Education		0.022			
Junior High School	-1.386	0.095	0.25	0.049	1.275
Senior High School	-3.824	0.002	0.02	0.002	0.244
College	-21.483	0.999	0.00	0.000	.
Service period		0.170			
1-10 year	-2.161	0.077	0.1	0.010	1.268
>10 year	-1.413	0.301	0.2	0.017	3.541
Knowledge	1.744	0.027	5.7	1.216	26.924
Attitude	2.140	0.010	8.4	1.666	43.356

Based on the analysis, the most dominant variable was attitude. This result also showed that the attitude variable's Odds Ratio (OR) value was 8.5. This result indicated that *Posyandu* counselors with poor variables are most likely to give poor IYCF counseling practices 8.5 times greater than Posyandu counselors with a good attitude toward IYCF counseling practice. The other result was that the Odds Ratio (OR) value of the knowledge variable was 5.7. This result shows that *Posyandu* counselors with a lack of IYCF knowledge have a 5.7 times greater possibility to conduct poor IYCF counseling practice.

DISCUSSION

The Convention on the Child's Rights states that every child has the right to receive good nutrition. Providing optimal infant and child feeding (IYCF) in the first 1000 days of life can prevent the mortality rate for children under five years by up to 20% [16]. About 60% of death in children under five years old are directly or indirectly related to malnutrition [17]. Malnutrition cases in children can be caused by parents' lack of understanding about providing nutritious food for children [18]. A study in 2012 revealed that the lack of knowledge and practical ability to provide supplementary feeding for infants and children could affect the nutritional status of children and further contribute to the highly increasing number of stunting in the world [19]. Community health workers (CHWs) are well-established as change agents for promoting health attitude change among community members. However, their knowledge and counseling skills play an essential role in promoting optimal infant and young child feeding practices (IYCF)[16]. Counseling ability is a skill that must be possessed by a counselor in translating knowledge of IYCF into messages or interpreting existing IYCF practices to provide suggestions or advice for the caregiver [20].

The average age of *Posyandu* counselors is 43 years, which can be categorized as an adult person [21]. Adults have a greater responsibility because they deal with a broad group of people. Counselors' experience and age are related to their ability to provide information and understanding related to IYCF for mothers in their environment. Research by Faridi et al. (2020) states a correlation between the counselor's age and the implementation of the IYCF in Pandeglang, Banten. Senior counselors and counselors who are over 35 years old tend to be more active in assisting mothers in implementing PMBA compared to younger counselors [22].

Posyandu counselors' knowledge showed an average score of 76.2, so it can be concluded that most of the *Posyandu* counselors have poor knowledge of IYCF, especially about infant feeding and basic knowledge of breastfeeding. According to Kohli and Chahda (2017), if the score for the subject's knowledge of IYCF is more than 80, the subject is considered to have a good level of IYCF knowledge [16]. *Posyandu* counselors are health promotion agents and positively impact health practices in the community [23]. The practice of IYCF for the caregiver in the community, including the practice of breastfeeding, introduction to complementary feeding, the suitability of the amount,

frequency, and variety of foods, is influenced by the knowledge, abilities, attitude, and motivation of health counselors played an essential role in conveying IYCF messages to caregiver [14 16 24 25]. In practice, the success of IYCF for children under five is inseparable from the ways the counselors explain the appropriate IYCF practice and grid. Contento (2011) explains that the success of external factors such as the availability of food and the role of counselors is one of the environmental factors that affect the practice of IYCF from caregiver to the children. The ability of counselors to build communication is highly dependent on empathy, the ability to listen, and pay attention to the child's feeding history [26].

In addition to knowledge, we also measured the attitude and practices aspect of *Posyandu* counselors regarding breastfeeding and complementary feeding. The analysis results showed that 52.9% of *Posyandu* counselors had poor knowledge of IYCF counseling practice, and 59.1% had a poor attitude toward IYCF counseling practice. Attitude parameters in this study were collected through agreeing and disagreeing statements regarding the practice of IYCF based on the counselors' opinions of the material or concepts of IYCF practice. This value becomes a benchmark that the counselors' low attitudes regarding IYCF were affected by the lack of knowledge from the counselors (Table 1). Therefore, counselors' attitude data is obtained from practice when giving IYCF counseling to caregivers. In addition to the knowledge aspect, the results of this study also show that the attitude aspect shows a low score. This is presumably because the practice of IYCF counseling for mothers in the community has not been carried out routinely and focuses on measuring children's nutritional status without giving a proper IYCF education to children's caregivers.

The IYCF program has been proven to reduce the number of morbidity and mortality. Health workers have a significant role in providing education and support for caregivers regarding breastfeeding and infant feeding [27]. The results of the descriptive analysis showed that most *Posyandu* counselors only graduated from high school and worked as housewives. *Posyandu* counselors in Indonesia are not health workers who can provide health counseling practice. They are generally individuals who have received training and knowledge from the Community Health Center (Puskesmas). Therefore, the level of knowledge, practice, and attitude of *Posyandu* counselors is minimal. World Health Organization (WHO) and the Indonesian Ministry of Health has various guidelines covering the implementation of IYCF counseling activities [5 28 29]. However, not all *Posyandu* counselors have access to received adequate IYCF training. In this research, we found that most *Posyandu* counselors have not received IYCF training (73.1%). IYCF training is a critical factor that ensures the community's successful implementation of IYCF practices. IYCF training makes Posyandu counselors manage to provide appropriate counseling to the community and help the caregivers provide nutritious and good food for babies and children [30].

The multivariate analysis in this study indicates that the level of education, knowledge, and attitude has a significant relationship with the practice of IYCF counseling. We find evidence for an association between health worker compliance and client health attitudes; however, small effect sizes suggest that attitude change is multifactorial and affects factors beyond care quality. Improvements to the technical quality of care may contribute to desired health outcomes. Health worker compliance may impact caregiver attitude through pathways other than the mediating pathway of IYCF knowledge. Health worker counseling compliance was significantly and positively associated with health worker knowledge. IYCF practiced at the age of 6-24 months must be done correctly and appropriately. Feeding errors during this period can lead to malnutrition and stunting. The role of counselors is needed to prevent the chain of nutritional problems that occur in society. According to Notoatmojo (2007) in Wahyuningsih and Handayani (2015), educational factors can influence a person's knowledge, which states that a person's education will make it easier to process information. However, the statistical analysis results show that the level of education does not affect one's knowledge, as well as with service period, so it requires further analysis or study whether it has nothing to do with or is there other factors that influence it [31]. The IYCF training is a crucial factor in the implementation of counseling. Even though a counselor has a high level of education, if they have never received IYCF training, their ability to carry out IYCF counseling becomes very limited [32].

Based on table 3, the result showed that *Posyandu* counselors with a lack of IYCF knowledge have a 5.7 times greater possibility to conduct poor IYCF counseling practice. Other results showed that the attitude variable's Odds Ratio (OR) value was 8.5. This result indicated that *Posyandu* counselor with poor attitude is most likely to give poor IYCF counseling practices 8.5 times greater than Posyandu counselor, which has a good attitude toward IYCF counseling practice. The practice of IYCF counseling

will be ineffective if the counselors have problems in their ability to communicate, inappropriate knowledge, and failure to provide need-based advice were important gaps in the counseling skills of *Posyandu* counselors. In this study, we suggested that *Posyandu* counselors need to improve their practical ability to elevate their role as agents of change in public health studies.

The limitation of this study is that it does not compare the level of knowledge, attitudes, and practical skills of *Posyandu* counselors who have received IYCF training with counselors who have not received the training. Thus, this study has not been able to determine whether IYCF training has a significant effect on the ability of a Posyandu counselor to provide IYCF counseling.

CONCLUSIONS

Posyandu counselors' knowledge showed a low average score of 76.2. The value of the attitude of counselors from the Likert scale was 46.25, and the practice of counselors was 68.8. *Posyandu* counselors with poor attitudes are most likely to give poor IYCF counseling practices 8,5 times greater than those with a good attitude. The multivariate analysis in this study indicates that the level of education, knowledge, and attitude has a significant relationship with the practice of IYCF counseling. Therefore, the level of education, knowledge, and attitude of *Posyandu* counselors in IYCF counseling practice is an essential factor that can support the improvement of children's nutritional status.

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The effect of nutrition counseling on nutritional status for breast cancer patients in dr. Sardjito Hospital, Indonesia

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ABSTRACT

Background: *Nutrition counseling in breast cancer (BC) patients show long-term adherence to a dietary pattern and affect nutritional status and quality of life (QOL).*
Objective: *We evaluated the effects of nutrition counseling for nutrient intake dan nutritional status improvement among breast cancer patients.*
Materials and Methods: *This research was conducted in a pre-experimental design; one group pretest-postest design was conducted on 45 BC patients who underwent radiotherapy for five weeks in the Radiotherapy Unit, dr. Sardjito Hospital, Indonesia. Training fieldworkers demonstrated nutrition counseling to 45 participants using a nutrition booklet for BC patients and a food model as an intervention technique. Continuous nutrition counseling was given three times: weeks 1, 3, and 5 of radiotherapy. To obtain nutritional status, we examined anthropometry, biochemical, physical, dietary, and Patient-Generated Subjective Global Assessment (PG-SGA) questionnaire.*
Results: *Most of the participants had a body mass index (BMI) ≥25 kg/m^2 (62.2%). After the participants received nutrition counseling, there were increases in energy intake, protein, carbohydrate, vitamin A, vitamin C, and vitamin E amounted to 124.54 kcal, 8.12 g (p=0.01), 5.84 g, 234.43 mg, 0.042 mg, and 0.44 mg, respectively. Intake of fruits and vegetables improved on the first, third, and fifth week (1.44, 2.36, and 4.03 portion/day, respectively) (p=0.001). Handgrip strength (HGS) showed slight improvement (p=0.081). However, HGS ameliorated from 15.85 kgs in the early to 16.97 kgs in the end stage of therapy. Bodyweight decreased 0.28 kg; however, there were no changes in PG-SGA score, hemoglobin (Hb), and albumin levels.*
Conclusion: *Nutrition counseling improves patients' nutrition intake despite no significant alteration in nutritional status. In addition, nutrition counseling for breast cancer patients during radiotherapy is essential to maintain and improve nutrient intake and nutritional status. In the long-term period, it might be affected to improve quality of life.*

Keywords*: Breast cancer, nutrition counseling, nutritional status, radiotherapy*

BACKGROUND

Cancer is a malignant tumor marked by rapid and uncontrolled cell growth and damaged the other tissues[1]. Breast cancer (BC) develops in the mammary glands, milk ducts, and other breast tissues[2]. More than 1 million new cases of BC per year are the most common cancer among women. Hence, 21.4% of all tumors in women are breast cancer, more than 8–9% of women once in their lives experience breast cancer. It has become the fifth leading cause of cancer and the second leading cause of death in developing countries after lung cancer. In Asian countries, the number of reported BC cases is equivalent to that of developed countries such as Europe and Canadian[3]. For example, the prevalence of breast cancer in Indonesia was 1.4% or approximately 347792 people[4]. Based on GLOBOCAN (IARC), the incidence of breast cancer was 43.3%, and the percentage of death was 12.9%[5]. This data shows that breast cancer had a percentage of death lower than the incidence so that if cancer can be detected and treated early, the chance of healing will be higher[6]. Risk factors for breast cancer include age, hormonal factors such as early age at menarche, late age of menopause, late age at first pregnancy, nulliparity and use of hormonal therapies, family history or genetic, and personal factors such as personal history, findings from previous breast biopsies, postmenopausal obesity, lack of exercise, and alcohol use[7].

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Treatments for breast cancer include surgery, chemotherapy, immunotherapy, radiotherapy, or a combination of several therapies[8]. Radiotherapy has side effects such as nausea and vomiting, mucositis, dry throat, and dysphagia. These symptoms can decrease nutrition intake, notably energy, protein, and micronutrients, which affect nutritional status[9-12]. Some studies have shown that radiotherapy increases the incidence of malnutrition, as indicated by weight loss. Due to indications of links between better survival after breast cancer, both the American Institute for Cancer Research (AICR) and the American Cancer Society (ACS) currently suggest the maintenance of healthy body weight and the achievement of a dietary pattern rich in fruits and vegetables and whole grains for long-term disease-free living for BC patients[13]. Among food components, fruits and vegetables attract greater attention to reduce the risk of BC[14]. The association was observed between intake of fresh fruits and vegetables and risk of breast cancer, in which the higher fruits and vegetable intake, the lower risk of BC[14]. The fruits and vegetables contain antioxidants as anti-cancer drugs such as vitamin C, folate, fiber, carotenoids, phytosterols, flavonoids, other phytochemicals, and protease inhibitors[14].

Nutritional status assessment methods that can be used are *Body Mass Index* (BMI), *Middle Upper Arm Circumference* (MUAC), body fat percentage, handgrip strength, hemoglobin and albumin serum, and *Patient-Generated Subjective Global Assessment* (PG-SGA). The PG-SGA is a gold standard method used explicitly for cancer patients and recommended by the *American Dietetic Association* (ADA)[12].

Cancer and the side effects of cancer treatment are also associated with reduced quality of life. Therefore, quality of life assessment combined with therapy is necessary to improve a patient's quality of life and survival. European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C30 (EORTC QLQ-C30) is the most common tool to measure the quality of life in oncology patients[15].

Therefore, nutrition education for BC patients is being evaluated. It has been shown that long-term adherence to a dietary pattern is a challenge in studies investigating the relationship between diet and disease, notably in BC[16]. Another previous study revealed a clinically significant improvement in dietary changes, especially in fruit and vegetable consumption, and reduction of red meat after nutrition education intervention.[17] Sardjito hospital is the central hospital in Central Java, Indonesia, that treats many cases of BC. 1033 cases in 2009 increased to 1420 cases in 2013, and 856 of these had undergone radiotherapy. Although several previous studies showed significant findings of the effectiveness of nutrition counseling in BC patients, there were some limitations. There were limited assessment parameters, such as only using anthropometric or cross-sectional methods; hence, we can not measure the effect of nutrition counseling intervention. Our research was conducted to assess the effectiveness of nutrition counseling that promotes increased food intake, especially energy, carbohydrate, protein, fat, and vitamin A, B, C as antioxidants and the change of nutritional status during radiotherapy.

MATERIALS AND METHODS

The Study Design and Populations

Between August–December 2016, we carried out this pre-experimental study with one group pretest and posttest design in Unit Radiotherapy, Dr. Sardjito Hospital, Yogyakarta Province, Indonesia. We selected the area since Dr. Sardjito Hospital is the biggest hospital in the province, so that the participants could represent any living areas. Participants were selected using the purposive sampling method. The study population consisted of females more than 18 years of age, diagnosed with breast cancer without metastases, who would like to undergo radiotherapy in 1 package for five weeks (25 times of therapy), able to communicate well, and signed the informed consent. This study did not include participants' body weight and height who could not be measured. The study participants (n=45) fulfilling all criteria above were performed by signing the informed consent.

Ethical Approval

Informed consent was obtained from all individual participants included in the study. The present study was conducted according to the Declaration of Helsinki principles[18]. The Ethical Committee approved this study of the Faculty of Medicine, Universitas Gadjah Mada, Indonesia, and the approval number was KE/FK/894/EC/2016.

Nutrition Counseling

Trained nutritionists to execute nutrition counseling. We performed nutrition counseling in the typical room in Radiotherapy Unit Dr. Sardjito Hospital, Yogyakarta, Indonesia while, the subject was waiting for their therapy turns. We brought a nutrition booklet about maintaining a healthy diet and overcoming the side effects of radiotherapy for breast cancer patients. We also used fruit packages as a food model and fresh fruits containing antioxidants, such as papaya, banana, grape, and orange during counseling sessions to describe what the patients should consume accurately. The nutrition counseling was given three-session, in the first, third, and fifth week of therapy. Each nutrition counseling session takes 25–30 minutes for explicating counseling goals, explaining the importance of management diet for BC patients, listening to their grievances about diet and health, and rendering some feedback. We gave motivation to all participants while giving nutrition counseling.

We monitored any progression based on nutrition assessments for every counseling session in the first 15 minutes. We noted nutrition intake using 24-hours food recall to obtain the amount of nutrition intake. The intake is quiet enough if it meets the minimum 80% of the individual requirement, according to the energy requirement by 32 kcal/kg ideal body weight, protein by 1 g/kgBB, fat by 25% of total energy expenditure, carbohydrate by difference, vitamin A 500 µg, vitamin C 75 mg and vitamin E 15 mg[19]. We also measured nutritional status based on parameter anthropometric (BMI, MUAC, and body fat percentage), physical (handgrip strength/HGS), and *patient Generated–Global Subjective Assessment* (PG-SGA) and quality of life using EORTC QLQ-C30. Secondary data was recorded to elicit biochemical data (hemoglobin/Hb and albumin serum levels). We informed all the data interpretation to the subject and provided some suggestions to improve or maintain their health.

Dietary Assessment

We interviewed each subject to obtain dietary data using 24-hours food recall. The interview was conducted in each counseling session, represented the day before therapy in the first week, on therapy in the third week, and after therapy in the fifth week. We analyzed the intake of energy, protein, carbohydrate, fat, vitamin A, C, and E. The total amount of nutrition intake was performed using nutrisurvey. Fruits and vegetables as antioxidants were also qualitatively analyzed to observe the difference between the early and end of the study.

Anthropometric Measurements

To obtain nutritional status based on the anthropometric parameter, we measured height to the nearest 0.1 cm using a locally constructed height stick. Participants were asked to remove their footwear, then stand up against the vertical plane with the head, scapula bone, hip, calf, and heel on the plane, and look straight ahead. Weight and body fat mass were measured in light clothing nearest 0.1 kg using Omron Karada Scan HBF-358 digital weighing scale. Participants were asked to stand up straight without holding on to any object and not carry anything that affected weight. MUAC was measured in centimeters at the midpoint between the acromion and olecranon using *Medline*. All the measurements were examined two times with 1-minute intervals. The two measurements' mean value was considered the participant's value. Yogyakarta Meteorologycal Agency calibrated all the tools mentioned above in April 2016.

World Health Organization (WHO) definitions of threshold values were used for classifying Body Mass Index (BMI) and waist circumference (WC). Body mass index (kg/m^2) was calculated as weight (kg) divided by the square of the height (m^2) and classified into four categories: < 18.5 kg/m^2 is underweight, 18.5–24.9 kg/m^2 is normal, 25.0–29.9 kg/m^2 is overweight and ≥ 30 kg/m^2 is obesity[19]. Body fat mass was grouped into four categories as follows: under fat (<21%), normal (21-33%), overweight (33.1-39%), and obesity (>39%)[19].

Biochemical Analysis, Physical Measurements, Patient-Generated – Subjective Global Assessment (PG-SGA) *and Quality of Life (QOL)*

The hemoglobin and albumin serum levels were measured in the hospital clinical laboratory using spectrophotometry, bromscerol green, and *Enzyme-Linked Immunosorbent Assay* (ELISA). The category of hemoglobin was grouped into two as follows: <12 g/dL is low and ≥12–15 g/dL is normal while, for albumin was grouped into two as follows: <4 is low and ≥4 is average.

We measured physical ability using the HGS. At the time of anthropometric measurement, after completing all measurements above, the participants were asked to grab a hand dynamometer with the

arm position perpendicular to the axial[20-21]. Next, handgrip strength was measured twice with 2 minutes interval using a hand dynamometer. Finally, participants were asked to squeeze the handgrip as hard as possible using the right hand, and the values were recorded in kilograms[20-21]. We grouped the value of HGS into two categories: ≤10 kg is poor and >10 is good. The PG-SGA evaluates malnutrition based on several criteria such as short-term weight loss history, dietary intake, symptoms relating to nutrition, and a functional and physical examination. A score of 0–3 means well-nourished (PG-SGA A), a score of 4–8 means moderately malnourished (PG-SGA B), and a score ≥9 means severely malnourished (PG-SGA C)[22].

Quality of life (QOL) was determined using questionnaire EORTC QLQ-C30, which consists of five functional scales, which are physical (PF), role (RF), cognitive (CF), emotional (EF), and social functioning scales, and three symptom scales (fatigue, pain, and nausea/vomiting), a global health/QOL scale, and several single items for the assessment of additional symptoms commonly reported by cancer patients (e.g., dyspnea, appetite loss, sleep disturbance, constipation, and diarrhea), as well as the perceived financial impact of the disease and treatment. All items are scored on 4-point Likert scales, ranging from 1(not at all) to 4 (very much). In addition, all functional scales and individual item scores are transformed to a 0–100 scale with higher values indicating a higher functioning in functional scales and an increased presence of symptoms in symptom scales[15].

Data Analysis

Descriptive frequency analysis measured the characteristic of respondents, the adequacy of food intake, the prevalence of malnutrition, and quality of life. In addition, the difference in food intake and nutritional status between the measurement at first and last week of radiotherapy were analyzed using paired t-test, Wilcoxon test, and McNemar test.

RESULTS

Participants characteristics

Most of the participants were between 30-50 years of age (51,1%) and had a history of surgery and chemotherapy (Table 1).

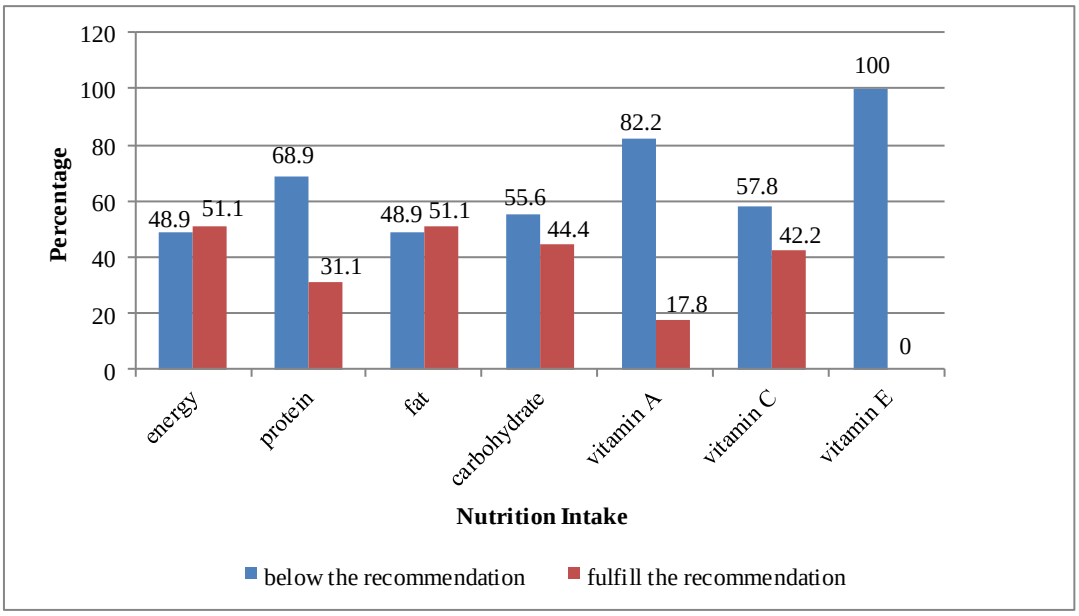
Table 1. Participants Characteristics

Variable	n	%
Age		
Adult (30-50 years old)	23	51.1
Elderly (>50 years old)	22	48.9
Stage of Disease		
Early-stage (0, I, II)	13	28.9
Regional spread (IIIa, IIIb, IV)	13	28.9
Unknown	19	42.2
History of Surgery		
Yes	41	91.1
No	4	8.9
History of Chemotherapy		
Yes	45	100
No	0	0
Total	**45**	**100**

Overview of the Nutrition Intake and Nutritional Status

Nutrition Intake

More than 50% of participants have a low intake of protein, carbohydrate, vitamin A, C, and E in the early study (Graphic 1).



Graphic 1. Nutrition Intake in the Early of Study

Nutritional Status

MUAC, HGS, hemoglobin, albumin, and PG-SGA at early of the study were as below (Table 2).

Table 2 showed that most participants were well-nourished at early radiotherapy. Based on BMI, 31.1% of participants were well-nourished, and 44.4% were obese. According to the Application of Clinical Nutrition, the standard of MUAC for an adult woman is 28.5 cm[23]. MUAC is good if it meets at least 90% of the standard, 26.65 cm, and 80% of participants met this standard. Body fat percentage showed that 48.5% of participants were average, and 37.8% were overweight. Handgrip strength showed that 77.8% were good. Based on albumin serum, 90.6% of participants were average, as did 60% based on hemoglobin index. However, mostly, participants had a high level of malondialdehyde or MDA (53.3%). The PG-SGA showed that 73.3% were well-nourished (PG-SGA A).

Quality of Life

Overview of the quality of life measured by EORTC QLQ-C30 showed in table 3 as below. Quality of life

Overview of the nutritional status measured by BMI,

assessment is essential to measure the effect of cancer and the treatment on a patient's life and survival. Based on the table, most participants have a good quality of life (70%).

The Effects of Nutrition Counseling on the Changes of Nutrition Intake

Significant increases were found in protein, fat, and fruits and vegetable consumption at the end of the study. However, intake of energy, carbohydrate, vitamin A, C, and E did not significantly increase, as we mentioned in Graphic 2 and Table 4 below.

The effects of Nutrition Counseling on the Changes of Nutritional Status

The anthropometric and biochemical index after counseling tends to be unchanged in all therapy as presented in Graphic 3 and Graphic 4.

Table 2. Overview of the Nutritional Status and Quality of Life at Early of Study

Variable	n (%)
BMI[1] (kg/m^2)	
Underweight (<18.5)	3 (6.7)
Well-nourished (18.5 – 24.9)	14 (31.1)
Overweight/Obesity (≥25.0)	28 (62.2)
MUAC[1] (cm)	
Poor (<25.65 cm)	9 (20.0)
Good (≥25.65 cm)	36 (80.0)
Body fat mass	
Underfat (<21%)	4 (8.9)
Normal (21-33%)	22 (48.9)
Overweight (33.1-39%)	17 (37.8)
Obesity (>39%)	2 (4.4)
HGS[1] (kg)	
Poor (≤10 kg)	10 (22.2)
Good (>10 kg)	35 (77.8)
Albumin serum[2] (mg/dl)	
Low	2 (6.3)
Normal	30 (93.7)
Hemoglobin[2] (mg/dl)	
Low	11 (28.9)
Normal	27 (60.0)
PG-SGA[1]	
PG-SGA A	33 (73.3)
PG-SGA B	10 (22.2)
PG-SGA C	2 (4.4)

[1]BMI: Body Mass Index, MUAC: Mid Upper Arm Circumference, HGS: Handgrip Strength, PG-SGA: Patient Generated-Subjective Global Assessment

[2]Albumin serum was only 32 subjects, and hemoglobin was only 38 since we used secondary data by following the hospital's blood test schedule for BC patients. Therefore, some patients were not assessed until the study finished, especially for the new admission patients.

Table 3. Quality of Life[1]

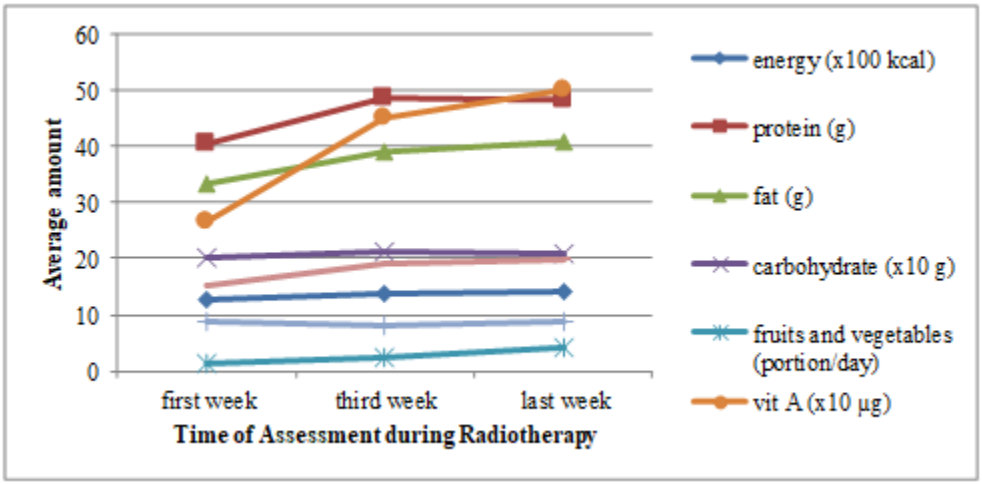
Quality of Life	n	%
Good	28	70
Poor	12	30
Total	**40**	**100**

[1]Number of subjects was only 40 since several subjects had experienced metastases; hence they were moved to another ward for more intensive treatment.

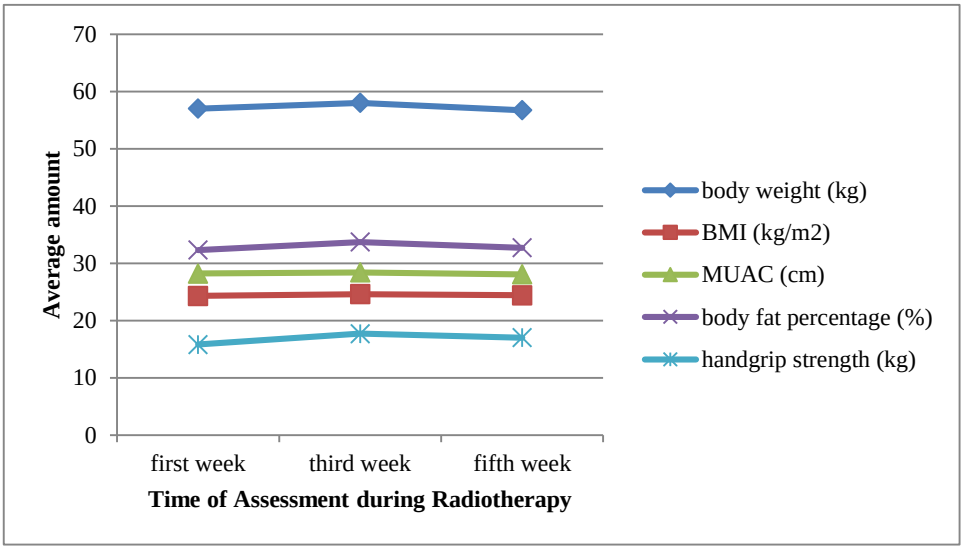
Table 4. Statistical Analysis of Nutrition Intake in the Early and the End of Therapy

Nutrition Intake	Early of Therapy	End of Therapy	p
	Mean (SD)	Mean (SD)	
Energy (kcal)*	1272.14 (398.63)	1396.68 (406.74)	0.073
Protein (g)**	40.27 (16.46)	48.39 (16.42)	0.010[1]
Fat (g)**	33.39 (15.69)	41.04 (17.65)	0.008[1]
Carbohydrate (g)*	202.10 (74.03)	207.94 (74.02)	0.650
Fruits and Vegetables (portion/day)*	1.44 (1.42)	4.03 (2.24)	0.001[1]
Vitamin A (µg)**	266.08 (274.52)	500.51 (1077.94)	0.379
Vitamin C (mg)**	88.43 (90.46)	88.45 (157.33)	0.336
Vitamin E (mg)**	1.53 (1.62)	1.97 (1.62)	0.076

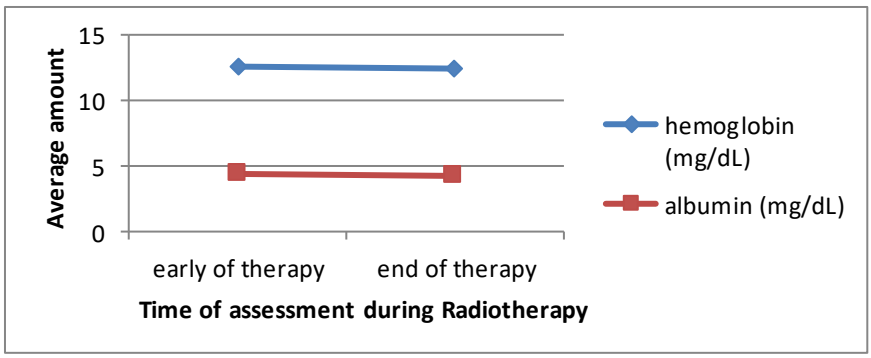
**paired t-test, **Wilcoxon test, [1]p<0.05*



Graphic 2. The Changes of Nutrition Intake during Radiotherapy



Graphic 3. The Changes of Anthropometric Index during Radiotherapy



Graphic 4. The Changes of Hemoglobin and Albumin Index during Radiotherapy

Based on Table 5, body weight, BMI, HGS, MUAC, body fat percentage, hemoglobin, and albumin index were not significant changes at the end of the study. However, bodyweight, MUAC, and albumin were decreased while HGS rose at the end of the study.

Tabel 5. Statistical Analysis of Nutritional Status in the Early and the End of Therapy

Nutrition Intake	Early of Therapy	End of Therapy	p
	Mean (SD)	Mean (SD)	
Body weight (kg)*	57.00 (10.91)	56.72 (10.80)	0.075
BMI[1] (kg/m^2)*	24.33 (4.28)	24.40 (4.24)	0.621
HGS[1] (kg)*	15.85 (8.78)	16.97 (6.18)	0.081
MUAC[1] (cm)**	28.20 (5.01)	28.06 (5.34)	0.352
Body fat percentage (%)**	32.29 (7.20)	32.71 (7.01)	0.576
Hemoglobin (mg/dL)*	12.59 (0.98)	12.53 (0.61)	0.346
Albumin (mg/dL)*	4.37 (0.32)	4.30 (0.14)	0.838

**paired t-test, **Wilcoxon test, [1]BMI: Body Mass Index, HGS: Handgrip Strength, MUAC: Mid Upper Arm Circumference*

Table 6 served the participants who had an excellent handgrip strength at the early study increase after counseling, as did the participants based on PG-SGA. Nevertheless, one subject changes the score from PG-SGA B turn to PG-SGA C.

Table 6. Statistical Analysis of Handgrip strength and PG-SGA after Counseling

Parameters	Total Participants		p
	At the early of therapy	At the end of therapy	
Handgrip strength (kg)**			
Poor	10	6	0.219
Good	35	39	
PG-SGA*			
PG-SGA C	2	3	1.000
PG-SGA B	10	8	
PG-SGA A	33	34	

**Marginal homogeneity test, **McNemar test*

DISCUSSION

Most of the participants had an intake of nutrition below the dietary recommendation. More than 48% of participants had a low energy intake, protein, fat, and carbohydrate. The participants who had an intake of vitamin A below the dietary recommendation were 82,2%, and vitamin C was 57,8%, and vitamin E was 100%. Based on the early study data, the measurements of BMI, MUAC, body fat percentage, handgrip strength, and PG-SGA presented that most of the participants were well-nourished and tended to be overweight. The hemoglobin and albumin index of participants were mainly normal. At the end of the study, there were some significant and no significant changes in nutritional status and nutritional intake.

Several studies have shown that malnutrition increased in patients treated with radiotherapy who had a low intake of food[11-13]. In addition, there was a significant decrease in body weight, albumin level, and nutritional status based on PG-SGA between the early and the end of radiotherapy[11]. Therefore, nutrition counseling was expected to prevent the decreased nutritional status of a patient.

The nutritional status indirectly by the culture, environment, counseling, employment, or health

facilities and was directly influenced by food intake and the disease [24-25]. The food intake was influenced by appetite, swallowing ability, and absorption in the body[26]. In cancer, radiation or chemical therapy affects an appetite and causes nausea, vomit, stomatitis, dry throat, and dysphagia. This effect leads to disruption of food intake and decreases the nutritional status[9]. The nutritional status in cancer patients was influenced by the severity of the disease, the ability of the patient to survive, and the side effects of its therapy[27]. Obesity is the risk of cancer and has been associated with an increased and worse prognosis for malignances[28].

As mentioned in Table 4, we found significant improvement in protein, fat, and fruit and vegetable consumption after the nutrition counseling session. Protein and fat increased up to 8 grams/day, and fruit and vegetable increased up to 2.5 portions/day. Vitamin A, C, and E are essential for cancer patients treated with radiotherapy. The current research has shown that consuming nutrients in fruits, vegetables, the source of carbohydrates, protein, and fat, will reinforce the body against cancer. Consumption of vitamins, minerals, other phytochemicals, and antioxidants also increases the immune system against carcinogens or toxins, leading to cell damage and oxidative stress. In cancer patients, there are changes in carbohydrates, protein, and fat in the body. Hypermetabolism occurs because the cancer cells increase the glucose needs as energy. It leads to protein turnover and increases lipolysis[29].

Concerning the increase of nutrient intake in this study, there were no significant changes in body weight and nutritional status parameters such as BMI, MUAC, body fat percentage, and handgrip strength between the early and the end of therapy. However, after counseling, the average difference of body weight was 0.28 kg, the average difference of MUAC was 0.14 cm, and the average difference of body fat percentage was 0.42%. In addition, there was an increase of well-nourished patients based on handgrip strength and PG-SGA after counseling.

Index of hemoglobin and albumin between the early and the end of therapy was decreased but not significant. The average difference of hemoglobin index was 0.07 mg/dl, as did the albumin index was 0.08 mg/dl. Most participants had an average level of hemoglobin and albumin. The patient treated with radiotherapy should have an average hemoglobin level to prevent lack of oxygen in the blood, leading to optimal ionization during radiation[30-31]. The low albumin index is related to the increase in mortality. The low intake of protein causes increases endothelial blood vessel permeability due to cell damage or in an acute condition, leading to a decrease of albumin synthesis in the liver[10, 32, 33].

Nutritional status in cancer patients determines to quality of life in the future. Well-nourished patients have better body function and do not appear many symptoms of diseases. In contrast, malnourished patients have lower physical, cognitive and social conditions, and more disease symptoms. These physical, cognitive, social, and symptomatic conditions are a dimension of the quality of life so that cancer patients with good nutritional status have a better quality of life[34].

Nutrition counseling aims to overcome the nutritional problems of the patient that affect the food intake. Counselor also calculated the nutrient needs and applied them in the daily menu recommendations. This study shows that there was a significant increase in protein and fat intake after counseling. The intake of energy, carbohydrate, vitamins A, C, and E was increased but not statistically significant. This means that nutrition counseling has a considerable effect on the patient's intake. The previous studies showed that nutrition counseling also increased the consumption of fruits and vegetables, decreased the consumption of red meat, and there were no changes in body weight and the increase of glutathione[16, 34].

CONCLUSION

There was a significant increase in protein and fat intake after counseling, but the increase in energy, carbohydrate, vitamin A, C, and E was insignificant. In addition, there was no significant difference in body weight, nutritional status based on BMI, MUAC, handgrip strength, albumin and hemoglobin level, and PG-SGA after counseling. The average measurement of body weight, MUAC, hemoglobin, and albumin decreased; however, BMI, body fat percentage, and handgrip strength tended to increase.

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Risk factor of growth faltering in infants aged 2-12 months

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ABSTRACT

Background: *Growth faltering is a condition of growth disturbance that marked by slower growth velocity compared with previous growth chart. Growth faltering can cause effects in immune response, cognitive, & physical and psychomotor disturbance, behavioral disorder, learning problems, higher risk of infection and mortality.*
Objectives: *To analyze risk factor of growth faltering in infant aged 2-12 months.*
Materials and Method*s: A case control study was conducted in Public Health Center in Semarang city. Subject were infants aged 2 until 12 months with growth faltering. Variables were divided to exclusive breastfeeding, mother's education, mother's employment, social economic status, infection, mother's nutrition and gestational age. Anthropometric and questionnaire data were obtained and analyzed among 116 infants. Statistic test used Chi square and multivariate analysis.*
Results*: Chi-square analysis showed that breastfeeding (p=0.016) and gender (p=0.04) had a significant relationship with growth faltering in infant 2-12 months. Under standard parent's income (p=0.809), Acute Respiratory Tract Infection (ARTI) (p=0.377), diarrhea (p=0.243), mother's nutrition (p=1.00), gestational age (p=0.77), low mother's education (p=0.83) and working mother (p=0.26) didn't have a significant relationship with growth faltering in infant aged 2-12 months. Multivariate analysis showed that gender (p=0.035) and breastfeeding (p=0.019) were the most influencing variable to growth faltering. In 2-6 group, breastfeeding pattern had significant relationship with growth faltering (p=0.77)*
Conclusions*: Breastfeeding and gender were risk factors of growth faltering in infant aged 2-12 months. Further research needed on how to prevent growth faltering in first 1000 days of life so it may avoid stunting in later life.*

Keywords*: Risk; growth faltering; infants*

BACKGROUND

Growth faltering is a growth disorder characterized by a slower growth rate compared to the previous growth curve.[1] One way to identify growth faltering is to compare the weight growth curve (weight for age curve). Usually growth faltering occurs in infants aged 3-12 months.[2] According to Smith in Clinical Pediatric Dietetics, 5-10% of children less than 5 years of age in America experience growth faltering.[3] Based on the results of National Health Survey 2013 regarding the nutritional status of toddlers according to weight-age and height-age, 19.6% of children under five in Indonesia are thin and very thin. Meanwhile in Central Java, 11.1% toddlers were very thin and thin.[4] According to the Semarang City Health Profile in 2013, the number of children under the red line according to growth chart were 1,502 children (1.7%) of the 86,515 children who came and were weighed (D) at the community based preventative and promotive care (*Posyandu)* and from 801 cases of malnutrition, 32 cases of malnutrition among children under five found in 2013.[5]

Growth faltering causes short-term effects, namely disruption of the immune response; stunted cognitive, physical, and psychomotor growth; behavioral problems, learning difficulties, increased risk of infection; and infant mortality.[6,7,8] Meanwhile, the long-term effects of growth faltering are emotional and intellectual disorders, risk of chronic disease, metabolic syndrome, macrovascular disease in middle age, and the incidence of low birth weight (LBW).

Growth faltering is caused by an imbalance between energy intake and biological needs for growth.[3] Lack of energy intake can be related to feeding difficulty, inadequate food and / or social emotional problems between parents and children[9], other diseases or eating patterns . The diet includes breastfeeding, age at first complementary feeding, appetite, oral dental

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health, parental knowledge of energy needs for growth, and difficulty eating. The biological need for growth can be increased by the presence of other illnesses such as gastrointestinal disease, neurological disorders, or congenital heart disease[3].

Growth faltering considered as the beginning of stunting that still a major concern in Indonesia. Early detection and intervention on growth disturbance can prevent stunting in later life. Growth faltering most common found in age 3 until 6 months. Finding the risk factor of growth faltering in early life will have a lot of advantages in managing undernutrition. Based on this, it is necessary to further investigate the risk factors for growth faltering, especially in children aged 2-12 months, which is the golden age of the first 1000 days of life.

MATERIALS AND METHODS

This study is a case-control study which was conducted at Halmahera Public Health Center Semarang. The case is infant aged 2-12 months with growth faltering. Inclusion criteria include infants aged 2-12 months, experiencing growth faltering, parents willing to take part in the study. Exclusion criteria were chronic disease or congenital abnormalities. Subject needed was 40 subject in each group. Subjects were collected by consecutive sampling in Public Health Center. Hundred and sixteen subjects were participated in this study, and all of the subjects completed the protocol. Data analysis includes descriptive analysis and hypothesis testing. Data were taken by anthropometric measurements on infants. Anthropometric measurements taken are measurements of body weight, body length and head circumference. Body weight measurements using Laica ® with 10 gram accuracy, body length measured using infantometer in the Public Health Center with 0.1 cm accuracy. The measurement was done by health workers and researcher. Interviews was done by researcher to fill out questionnaires. The results of anthropometric measurements are then plotted on the WHO 2006 curve, on the weight-for-age curve, if there is an increase in body weight that does not match the curve, it is said that the child is experiencing growth faltering. The data obtained from the questionnaire including date of birth, birth weight and birth length, and food recall. Hypothesis testing used the Chi-square test, Fisher exact and multivariate analysis. The p value is considered significant if $p < 0.05$ with a confidence interval of 95%. This research was approved by the Health Research Ethics Commission (KEPK), Faculty of Medicine, Diponegoro University / Dr. Kariadi Semarang (No. 055 / EC / FK-RSDK / 2016).

RESULT

During the study, there were 116 subjects who met the research criteria. Subjects consisted of 41 infants aged 2-6 months and 17 infants aged 7-12 months who experienced growth faltering as a case group and 58 infants with growth line directions N1 or N2 as a control group. Some of the subjects were obtained from *Puskesmas* Halmahera and some from *Posyandu* in the working area of *Puskesmas* Halmahera.

Table 1. Characteristics of Research Subjects

Characteristics	Growth Faltering	
	Yes	No
Gender		
Female (n,%)	31 (53.4)	20 (34.5)
Male (n,%)	27 (46.6)	38 (65.5)
Age (mean, SD) months	5.52±2.98	5.4±2.76
Birth Length (mean±SD) cm	48.17±2.72	48.69±3.19
Birth Weight (mean±SD) kg	3039.3±361.7	3119.4±425.1
Weight (mean±SD) gram	6.54±1.42	6.98±1.57
Length (mean±SD) cm	63.83±6.15	63.86±6.06
Head circumference (mean±SD) cm	42.0±2.19	41.8±2.84
WLZ (mean±SD)	-0.5±1.64	-0.2±2.12
HAZ (mean±SD)	-0.59±1.74	-0.64±1.77

In table 1, there are 58 infants who experienced growth faltering, with 31 infants were girls and 27 infants were boys. The mean age when experiencing growth faltering was 5.52 ± 2.98 months, with the status of nutrition

was good nutrition based on weight for length z score (WLZ) more or equal than -2 SD .

Table 2. Parent's Characteristics

Characteristics	Growth Faltering		p
	yes	No	
Father's age (mean±SD) years	32.47±6.52	32.86±6.27	0.590[a]
Mother's age (mean±SD) years	28.66±6.12	29.84±5.41	0.334[a]
Mother's education			
Low	15	14	0.83[b]
High	43	44	
Mother's employment			
Employed	21	27	0.26[b]
Unemployed	37	31	
Father's education			
Low	20	12	0.097[b]
High	38	46	

[a]Chi-square test [b]Independent t-test

From Table 2, it is shown that mothers with high education can still have children with growth faltering, but it was less when the father has a higher education eventhough it is not significant.

Table 3. Risk factors for growth faltering infants aged 2-6 months

Risk factor	**Growth Faltering**		***P***	**OR (95% CI)**
	Yes	**No**		
Breastfeeding patterns				
Schedule	9	1	0.014[a]	10.97(1.32-91.22)
On demand	32	39		
Breastfeeding administration				
Bottle	13	7	0.138[b]	2.19(0.77-6.24)
Direct	28	33		

[a] Fisher's exact test [b]Chi-square test

In table 3, scheduled breastfeeding is a risk factor for growth faltering with p 0.014. It is shown that most mothers give breastmilk to infants based on their hungry cues.

Table 4. Risk factors for growth faltering infants aged 7-12 months

Risk factor	**Growth Faltering**		***P***	**OR (95% CI)**
	Yes	**No**		
Complementary foods of breastmilk type				
Home made	16	18	0.486[a]	0.47(0.33-0.67)
Manufacturer	1	0		
Complementary foods of breastmilk frequency				
Less	11	6	0.063[b]	3.67(0.91-14.82)
Adequate	6	12		
Complementary foods of breastmilk age				
Incorrect	8	4	0.122[b]	3.1(0.72-13.44)
Correct	9	14		

[a]Fisher's exact test [b]Chi-square test

At the age of 7-12 months, both types of complementary foods, the frequency of complementary foods and the age of complementary feeding are not risk factors for growth faltering.

Table 5. Risk factors for growth faltering infants aged 2-12 months

Risk factor	Growth Faltering		*P*	OR (95% CI)
	Yes	No		
Age				
≤6 months	41	40	0.84[a]	1.09 (0.49-2.34)
> 6 months	17	18		
Gender				
Female	31	20	0.04[a]	0.46 (0.22-0.97)
Male	27	38		
Exclusive breastfeeding				
No	46	34	0.016[a]	2.71 (1.19-6.16)
Yes	12	24		
Parents' income				
Below Regional Minimum Wage	11	10	0.809[a]	1.12(0.44-2.89)
Above Minimum Regional Wage	47	48		
ARTI (Acute Respiratory Tract Infection)				
Common	8	5	0.377[a]	1.69(0.52-5.53)
Less	50	53		
Diarrhea				
Common	3	0	0.243[b]	2.06(1.7-2.48)
Less	55	58		
Mother's arm circumference				
Less	2	3	1.00[b]	0.66(0.11-4.07)
Adequate	56	55		
Gestational age				
Preterm	6	7	0.77[a]	0.84(0.26-2.67)
Aterm	52	51		
Mother's education				
Low	15	14	0.83[b]	1.09(0.47-2.54)
High	43	44		
Mother's employment				
Employed	21	27	0.26[b]	0.65(0.31-1.37)
Unemployed	37	31		

[a] Chi-square test [b]Fisher's exact test

Table 6. Multivariate analysis

	Variable	Coefficient	*p*	OR(95% CI)
Step 1	Gender	-0.845	0.035	0.43 (0,19-0,94)
	Breastfeeding	1.018	0.019	2,71 (1,19-6,16)
	Diarrhea	20.795	0.999	2,06 (1,7-2,48)
	Constant	-0.277	0.494	

DISCUSSION

The direction of the growth line is viewed through the WHO curve for body weight by age to detect any irregular bending of the growth line. Growth faltering can occur at any age during the growing period. Growth faltering has a multifactorial cause, both external and internal to the individual. Growth faltering, especially that which occurs in the first 1000 days of life has a negative impact on children's growth and development later in life. [10,11] Disturbance in early life is related to the ability to attend school too late, which has a high predictive value of income in adulthood. Nutritional intake is very important at this age to meet the growing needs of growth. In this study, it was found that the average age of growth faltering was between 3 until 7 months. Research conducted with data collection in 54 countries, found that the average age of growth faltering was at the age of 3 months and decreased rapidly until the age of 12 months, slower until the age of 18-19 months and grew rapidly after that. [12] From this study, we found that growth faltering is more often in female infants than boys. This can be caused by patriarchy culture in this area, so male infants will get more attention including nutrition intake. The other cause could be that male infants get hungry easier so feeding intensity will be more often than female infants. This study found that the absence of exclusive breastfeeding has a significant relationship with the incidence of growth faltering in infants aged 2-12 months with a p value of 0.016.Infants that didn't received exclusive breastfeeding are more prone to infection. Infection can deteriorate nutrition intake and causing growth faltering, especially in infants aged less than six months. Growth faltering most common in infants aged 3 until 5 months, this can be caused when in that ages, mothers has to return to work and education about how to breastfeed during work still scarcely given by the health workers, and this can cause infants could not have the nutrition needed to maintain appropriate growth. Infants who are not exclusively breastfed have a higher risk of experiencing growth faltering than infants who are exclusively breastfed.[13] This is consistent with a study in Mexico which states that the incidence of growth faltering can be prevented by exclusive breastfeeding. Breastfeeding can improve growth by preventing infection and improving nutritional intake at the time of infection. [14, 15, 16] In addition, breastfeeding alone is sufficient to meet the needs of infants up to 6 months old because of the composition of the milk that adjusts with the infant's needs.

The results of this study also indicate that the time pattern of breastfeeding has a significant relationship with growth faltering in infants aged 2-6 months. Infants who are breastfed on a regular basis have a higher risk of experiencing growth faltering when compared to babies who are breastfed on-demand. Research by Ksenia Bystrova shows that infants who are treated in combination, and who are breastfed on-demand, have better growth than infants who are treated separately. [17] On-demand breastfeeding, which means that it is tailored to the wishes of the baby, has been shown to affect the duration of breastfeeding becomes longer. Infants can adjust their needs, if they are hungry, they will breastfeed more often and for longer, thus stimulating the prolactin reflex to produce more milk. The more often the mother breastfeeds, the more milk production will be. Sufficient milk production to meet the needs of the baby is what can lead to better baby growth. On the other hand, on scheduled breastfeeding, mothers tend to limit the frequency of breastfeeding, which can lead to decreased milk production. From other studies, it was found that the provision of a scheduled diet was associated with the well-being of the worse mother, but worse cognitive and academic output in children [18].

Other factors such as nutritional status, maternal occupational education level, socioeconomic, incidence of Acute Respiratory Tract Infection (ARTI) did not show a significant relationship with the incidence of growth faltering in infants aged 2-12 months. The nutritional status of breastfeeding mothers can affect milk production. [19] However, other studies have shown that the composition of breast milk is not sensitive to maternal factors, including nutritional status, in the early months of breastfeeding. [20] Previous studies have revealed that even though mothers know the importance of breastfeeding exclusive breastfeeding, but the rate of exclusive breastfeeding is still suboptimal, due to many other factors that can affect the good achievement of exclusive breastfeeding. [21, 22] Lack of knowledge of mothers on proper

nutrition will reduce nutritional intake in children. The level of education does not guarantee the mother's knowledge of breastfeeding or the infant's growth. Based on the results of the interviews, it appears that mothers with high or low education mostly feel that breastfeeding alone is not enough for their baby's growth. Research in China states that education on correct infant feeding practices can increase growth, reduce the incidence of anemia in infants aged 6-12 months, and improve nutritional status in children under 5 years of age in developing countries. [23, 24]

Research in Isfahan compared growth in children with working and non-working mothers. There was a significant difference between the two groups in the growth of children aged 12-30 months, but no significant difference was found at the age of 0-12 months. [25] This is in accordance with the results of the study that there was no significant relationship between maternal occupation and the incidence of growth faltering in infants aged 2-12 months.

There is no significant relationship between socioeconomic and growth faltering in infants aged 2-12 months in the results of this study. Similar results were obtained in England, which states that social characteristics have only a slight effect on infant weight gain. [26] Research in Japan states that infants who come from low-income families have a higher risk of growth faltering. [27] On the other hand another, in the middle economic status group there was also growth faltering with an amount that was not much different. Meanwhile, in the highest economic status group, the risk of growth faltering is lower, but still has the same basic pattern of causes of growth faltering as the lower economic status. Therefore, growth faltering can occur in all economic status. Research in 50 low-income countries states that growth faltering is influenced by the overlapping effect of poverty, less varied diets, infectious environments, poor hand washing habits and poor knowledge. low regarding the principles of nutrition and hygiene. [28]

In this study, we found that there was no significant relationship between diarrhea and the incidence of growth faltering in infants aged 2-12 months. In this area, access to health facility such as Public Health center is reachable and there was routine community based preventative and promotive care every month, so that infants can be routinely checked for their health concern. It is well known that acute infections such as acute respiratory infections and diarrhea are the leading causes of mortality, especially in developing countries. The results of previous studies found that diarrhea is a major determinant of poor growth in children. [29] Acute infection itself can affect growth due to the possibility of decreased appetite, restrictions on food given due to local culture and the presence of malabsorption of the nutrients provided.

In this study, the first age of complementary foods was not associated with the incidence of growth faltering. The first age of giving complementary foods in this study, especially at the age of 2-4 months, was given mashed bananas. According to WHO, complementary foods given at less than 6 months of age do not affect the increase in infant growth and complementary foods before 6 months of age tend to replace breastmilk given. [30] A systematic review states that complementary feeding at 4 months of age can reduce the incidence of anemia in infants. [31] Research in Germany states that late complementary foods increase the risk of allergies and the risk of inadequate energy intake because breast milk cannot meet the needs of babies over 6 months. [32] Apart from the first time introducing complementary foods, of course, the quality of complementary foods that contain enough macro and micronutrients also play an important role in meeting the nutritional needs of infants.

Based on consistency, complementary foods are divided into sufficient or insufficient consistency. The consistency is sufficient if it matches the consistency that should be at the age, namely at the age of 6 months of milk porridge, 7-9 months of rice and milk, 9-12 months of crushed and chopped food, 12-24 months of family food. [30] The statistical results of this study indicate that the consistency of complementary foods is not associated with growth faltering at 7-12 months of age. The consistency of age-appropriate complementary foods can help babies to adapt to family food later at the age of 1 year. The introduction of foods with an age-inappropriate consistency will result in difficulty eating at a later date.

Periodic measurements of weight and height are more relevant than measuring body weight alone to detect growth disorders. The ability of both health workers and cadres in conducting growth screening is needed so that there is no delay in intervention.

CONCLUSION

From the this study, it can be concluded that non exclusive breastfeeding and female sex are risk factors for growth faltering in infants aged 2-12 months, and the timing of breastfeeding is a risk factor for growth faltering in infants aged 2-6 months. The importance of exclusive breastfeeding and on demand breastfeeding can reduce the rate of growth faltering in infants. Further research needed on how to prevent growth faltering in first 1000 days of life so it may avoid stunting in later life.

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The Effect of Breastfeeding Calendar Training on Knowledge and Attitudes of Mothers in Exclusive Breastfeeding

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ABSTRACT

Background: *Lactating mothers were successful in giving exclusive breastfeeding as much as 42% based on SDKI (Survei Demografi Kesehatan Indonesia) in 2012. This is depend on the support of husbands and families as well as health workers. Thus, the husband or family should remind and motivate mothers as well as monitor the breastfeeding activity every day for 6 months using breastfeeding calendar.*
Objectives: *This study aimed to determine the increase in knowledge and attitudes of mothers in providing exclusive breastfeeding after the exclusive breastfeeding calendar training.*
Materials and Methods: *The research design used a quasi-experimental one group pre-test post-test design. This research was conducted on mothers who had babies (age 0-12 months) in Pasawahan Village and Pasawahan Kidul Village, Pasawahan District, Purwakarta Regency in April to November 2018, with 96 respondents. The sampling technique was conducted by purposive sampling. Data were collected by giving questionnaires to respondents, before and after the breastfeeding calendar training were given. The Wilcoxon test was used for the analysis of the data in this study.*
Results: *The results showed that there were differences in the knowledge of mothers before and after training on breastfeeding calendar (p <0,000) and there were differences in the attitudes of mothers before and after the training on breastfeeding calendar (p <0,000).*
Conclusions: *There was an increase in knowledge and changes in the attitude of mothers towards exclusive breastfeeding after being given the breastfeeding Calendar training. Therefore, suggestions for health workers, especially midwives and nutrition workers, can use the breastfeeding calendar as an educational medium to increase husband and family support in exclusive breastfeeding.*

Keywords*: Attitude; Exclusive breastfeeding; Knowledge; breastfeeding calendar*

BACKGROUND

One of the MDGs' goals is to end hunger, to achieve food security, to improve nutrition, and to encourage sustainable agriculture. The MDGs target by 2030 is to demolish all forms of malnutrition, including to achieve the international target of 2025 in reducing stunting.[1]
The stunting rate in Purwakarta Regency, West Java, is 30.1% based on Pemantauan Status Gizi (PSG) or Nutritional Status Survey data in 2017, stunting is a condition of failure to thrive in children under five as a result of chronic malnutrition so that the child's height does not match their age. Stunting prevention efforts must be done in every life cycle. Efforts to prevent stunting are carried out at 1000 HPK (first day of life), starting from pregnancy until the child is 2 years old. One of the efforts to prevent stunting is by giving babies exclusive breastfeeding. Lactating mothers were successful in giving exclusive breastfeeding as much as 42% based on SDKI (Survei Demografi Kesehatan Indonesia) in 2012.[2] One of the factors of exclusive breastfeeding failure is the lack of support from the environment around the mother.[3]

The success of this activity is influenced by the support of husband and wife, so that when the mother is breastfeeding, it can put the baby to sleep longer.[4] Therefore, when a mother starts breastfeeding, she will regulate milk production.[5] Other than that, husbands who attend childbirth

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preparation classes will have a positive effect on breastfeeding and contribute to a woman's breastmilk production.[4] Thus, the success of breastfeeding is highly dependent on the support the mother receives from her husband.[6]

When the mother starts breastfeeding, this process will indirectly regulate milk production.[5] Couples support in breastfeeding affects the success of breastfeeding, thus making the baby sleep longer. Husbands who attend childbirth preparation classes will have a positive effect on breastfeeding and provide exclusive breastfeeding.[4] Thus, the success of breastfeeding is highly dependent on the support the mother receives from her husband.[6]

Based on the results of a research conducted in Bali, mothers who provide exclusive breastfeeding tend to receive support from their husbands and families. In addition, mothers get supports from health workers to provide exclusive breastfeeding.[7] Emotional support is focused on respect, admiration, and love. This can raise awareness of the difficulties of breastfeeding practice and increase patience in breastfeeding so as to increase respect and appreciation for nursing mothers.[8]

Thus, the husband must also have knowledge about breastfeeding so that we need some media to receive information about how mother's body anatomy and physiology support breastfeeding, including knowing other important functions of a woman's breasts and the health benefits of breastfeeding. Husbands must have knowledge about breastfeeding in order to be able to support mothers during this practice. Therefore, we need a medium of information about how the anatomy of the body and physiology of breastfeeding mothers, including knowing other important functions of a woman's breast and the health benefits of breastfeeding.[9]

Promotion of breastfeeding through the media will affect the attitude of mothers to breastfeed their babies.[10] Especially for working mothers, they need a handful of information on how to provide exclusive breastfeeding. In addition, on how to deal with barriers to breastfeeding such as breast dams. Mother needs support from husband or family. Under these conditions, a breastfeeding calendar is required to monitor breastfeeding activity in 6 months. Husbands or families can provide a reminder, motivate, and increase the knowledge of mothers to give breastfeeding every day for 6 months using breastfeeding calendar.[11]

Therefore, this study aims to determine the increase in knowledge and attitudes of mothers in giving exclusive breastfeeding after breastfeeding calendar training.

MATERIALS AND METHODS

The research design used was a quasi-experimental one group pre-test post-test design. This research was conducted by providing training on exclusive breastfeeding and the use of the breastfeeding calendar. Respondents were given a pre-test and post-test before and after breastfeeding calendar training.

This research was conducted on mothers who have babies (0-12 months old) in Pasawahan Village and Pasawahan Kidul Village, Kec. Pasawahan, Purwakarta Regency from April to November 2018 with a population 135 mother. The sampling technique was carried out by purposive sampling. The samples in this study were 96 respondents who met the inclusion and exclusion criteria. The sample size was obtained through the calculation of the minimum sample for cross sectional research, with the proportion of exclusive breastfeeding for Purwakarta in 2017 of 55.08% and an error rate of 0.1. The inclusion criteria in this study are mothers who were willing to fill out the informed consent form. The exclusion criteria in this study were mothers who were not present at the time of data collection. Samples were taken from villages with the most number of babies in a sequence until the desired sample size was obtained. There are two research variables in this study. Firstly, the independent variables in this study were the knowledge and attitudes of mothers in exclusive breastfeeding. Secondly, the dependent variable is breastfeeding calendar training.

This training was conducted within 1 day in the form of providing material about 1000 HPK, exclusive breastfeeding, problems and handling of breastfeeding, as well as how to use the breastfeeding calendar. The resource person for this training is a research team who also acts as an enumerator in data collection. Data were collected by giving questionnaires to respondents before and after being given training using breastfeeding

calendar as a training medium. This breastfeeding calendar is a calendar that came with educational material, including the differences between exclusive breastfeeding and formula milk, the benefits and content of breast milk, a good and proper breastfeeding position, ways to express and store breast milk, breast care, and the role of fathers in exclusive breastfeeding. The questionnaire was made based on the results of the Focus Group Discussion (FGD) which made the questionnaire from the results of the research conducted by research team entitled The Initiation of Exclusive Breastfeeding Calendar to Increase Exclusive Breastfeeding.[11] The questionnaire was given to 50 mothers who have toddlers in the village Marga Asih, Kec. Pasawahan, Kab. Purwakarta. Then the validity test with Pearson correlation and reliability test with Cronbach's Alpha were executed and the result showed a value of 0.736> 0.7 so the questionnaire declared reliable. The questionnaire contains knowledge and attitudes of mothers about exclusive breastfeeding and the use of the exclusive breastfeeding calendar. Data analysis was in the form of bivariate data using the Wilcoxon test of the SPSS program version 15.0. This research has obtained research ethics permit with no. 367/UN6.KEP/EC/2018 from the e-commission of research ethics at the University of Padjadjaran.

RESULTS

Based on table 1. that breastfeeding mothers who participated in the breastfeeding calendar training had characteristics that included ages between 20-35 years of 72.9, mothers who had children> 1 (multipara) by 56.2%, with high school education of 42.7% , and mothers not working by 77.1%.

Table 1. Characteristics of Breastfeeding Mothers in Breastfeeding Calendar Training

Mother characteristics	n	%
Age		
< 20 years old	4	4,2
20-35 years old	70	72,9
> 35 years old	22	22,9
Total	**96**	**100**
Parity		
Primipara	38	39,6
Multipara	54	56,2
Grande multipara	4	4,2
Total	**96**	**100**
Education		
Do not finish Primary School	5	5,2
Primary School	13	13,5
Junior High School	32	33,3
Senior High School	41	42,7
College	5	5,2
Total	**96**	**100**
Profession		
Does not work	74	77,1
Work	13	13,5
Other	9	9,4
Total	**96**	**100**

Table 2. Differences in knowledge of mothers before and after being given Breastfeeding Calendar Training

	N	Median (minimum-maksimum)	Z	P
Knowledge before being given breastfeeding calendar training	96	81 (33-100)	6,133	0,000

Knowledge after being given breastfeeding calendar training	96	90 (62-100)

Based on table 2. there are differences in the knowledge of mothers before and after being given training on the breastfeeding calendar with a value of $p < 0.05$ and value of $z > 1,96$.

Table 3. Differences in attitudes of mothers before and after being given Breastfeeding Calendar Training

	N	Median (minimum-maksimum)	Z	P
Attitude before being given breastfeeding calender training	96	73 (50-100)	6,382	0,000
Attitude after being given breastfeeding calendar training	96	75 (66-100)		

Based on table 3, there are differences in the attitudes of mothers before and after being given training on breastfeeding calendar with the value of $p < 0,05$ and value of $Z > 1,96$.

DISCUSSION

Based on table 1, breastfeeding mothers who participated in the breastfeeding calendar training had characteristics that included ages between 20-35 years of 72.9. This shows that most of the respondents are in the healthy reproductive age range. Healthy reproductive age in women is 20-35 years old, so that women have reached a mental maturity level in undergoing the reproductive process properly. Mothers who had children> 1 (multipara) by 56.2% because parity greatly affects the acceptance of one's knowledge. Thus, the more experiences a mother has in having children, the easier the acceptance of knowledge will be. Experience is a source of knowledge to obtain the truth of knowledge by repeating the knowledge obtained in solving problems faced in the past.[12]Mother have high school education of 42.7% because education will make someone motivated to be curious, seek experience, and organize experiences so that the information received will become knowledge. High education makes a mother more able to think rationally about the benefits of exclusive breastfeeding and more easily exposed to information compared to those with low education.[13] Mothers not working by 77.1% so it is different from working mothers where efforts to provide exclusive breastfeeding often experience obstacles due to the short period of maternity and childbirth leave. Thus, before exclusive breastfeeding ends perfectly, the mother must return to work.[14]The results of this study are in line with the research conducted in the Puskesmas Nelayan, it was found that the characteristics of breastfeeding mothers who provide exclusive breastfeeding with the majority of mothers aged 20-35 years, high school education, and not working.[15]

In addition, based on the results of research conducted in British Columbia and Alberta (areas urban), that the number of mothers who breastfeed exclusively is higher than in New Brunswick, Newfoundland, and Quebec (areas rural). Breastfeeding mothers who provide exclusive breastfeeding have characteristics, including age, education and occupation. Therefore, increasing age and education of breastfeeding mothers living in British Columbia and Alberta have higher success in exclusive breastfeeding compared to nursing mothers living in New Brunswick, Newfoundland, and Québec.[16]

Based on table 2. there are differences in the knowledge of mothers before and after being given training on the breastfeeding calendar with a value of $p <0.000$. Knowledge is the result of knowing someone after sensing an object.[17] The object referred to in this study is the breastfeeding calendar. Increased knowledge in the training process shows that the breastfeeding calendar can be used as a medium for education and monitoring of exclusive breastfeeding by families, especially the role of husbands.[11]

The results of this study are in line with research conducted in the city of Padang that there is an increase in the knowledge of breastfeeding mothers,

before and after getting promotion about exclusive breastfeeding through extension methods.[10]

Health promotion is carried out by health professionals, especially midwives in the form of training given to mothers to improve maternal and child health.[18]One of the materials in this training explains that breastfeeding has a unique health aspect and it is important that breast milk is a unique substance. Breast milk contains antiseptics which help to complement the immune system of immature babies. Some of the benefits of breast milk for babies are disease preventions, such as respiratory, stomach, intestinal, middle ear, and urinary tract infections. Breastfeeding babies tend to reduce the incidence of chronic diseases such as juvenile diabetes and asthma in babies at risk.[19]

Figure 1. Exclusive Breastfeeding Calendar

Figure 2. Educational Media

One of the roles of health workers is to carry out health promotion on exclusive breastfeeding as a source of information for breastfeeding mothers. In addition, health workers must provide optimal support to breastfeeding mothers.[20]

Thus, health promotion media is needed to increase the knowledge and attitudes of mothers in breastfeeding. Breastfeeding has a major role in public health to improve the health of babies and mothers. Thus, mothers who provide exclusive breastfeeding are an action to promote the initiation and implementation of breastfeeding practices, especially for groups of breastfeeding mothers who do not exclusively breastfeed. Therefore, an effective program by making strategies to overcome the obstacles to exclusive breastfeeding practices.[21]

Health workers play a role in health promotion of exclusive breastfeeding. Additionally, health workers must also provide optimal support to breastfeeding mothers.[20] So a health promotion media is needed to increase the knowledge and attitudes of mothers in breastfeeding. The breastfeeding calendar acts as a health promotion medium.[11]

Breastfeeding has a major role in public health to improve the health of babies and mothers. Mothers who provide exclusive breastfeeding are an action to promote the initiation and implementation of breastfeeding practices, especially in groups of breastfeeding mothers who do not provide this practice. This program is an effective strategy in overcoming barriers to implementing exclusive breastfeeding.[21]

Mother's knowledge about exclusive breastfeeding and the attitude of breastfeeding mothers in exclusive breastfeeding is not optimal. Mother's understanding of information about exclusive breastfeeding will determine the breastfeeding mothers exclusively. Mother's

knowledge, mother's education level, and the child's age will affect the mother exclusively in breastfeeding. Health workers must carry out health promotions aimed at providing motivation and helping mothers to overcome obstacles during this practice.[22]

Health education interventions were found to have succeeded in increasing knowledge and practice of exclusive breastfeeding. Hence, health education is recommended to increase the practice of exclusive breastfeeding among mothers.[23]

Based on table 3, there are differences in the attitudes of mothers before and after being given training on ASI calendar with a value of p <0.000. Attitude is an evaluative response to an object, namely the response of the evaluation process to a stimulus in the form of good and bad, positive and negative, pleasant and unpleasant judgments which then crystallizes as a potential reaction to the object.[24]

The trigger factor in giving exclusive breastfeeding to babies is knowledge, attitudes and behavior of the mother, where most of them still do not understand the benefits of exclusive breastfeeding. Maternal health status, family support and staff assisting in the childbirth process provide as reinforcing factors for exclusive breastfeeding for babies.[25]

According to Skinner (1983) quoted from his book *Notoatmodjo* demonstrated that knowledge or cognitive is a very essential domain for the formation of one's actions (overt behavior). Before a person adopts a new behavior, a sequential process occurs within the person, that is awareness, where the person realizes in the sense of knowing in advance of the stimulus (object), interest (feeling attracted) to the stimulus or object. Thus by this, the attitude of the subject has begun to emerge**.**[26]

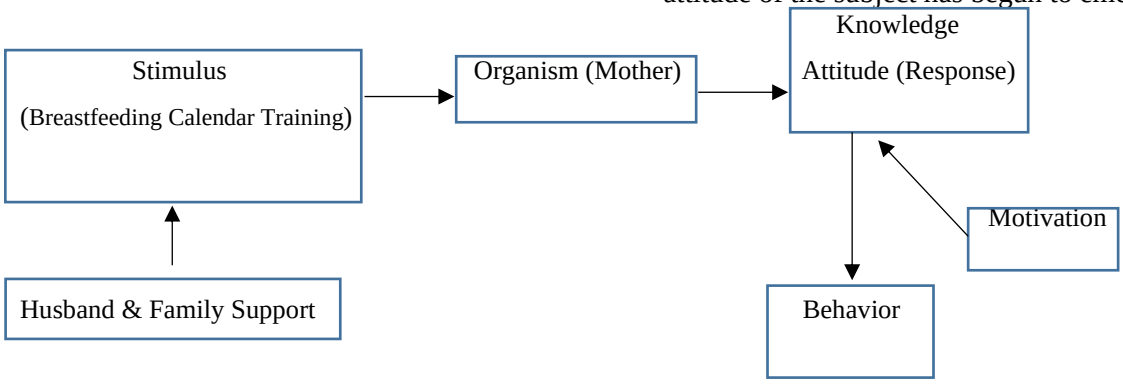

Figure 3. Theory of Stimulus-Organism-Response, Skiner 1983[26]

Increased knowledge and attitudes of mothers regarding exclusive breastfeeding is a response to providing stimuli to mothers in the form of breastfeeding calendar training reinforced by the support received. Behavior will be manifested from existing knowledge and attitudes which are strengthened by the mother's motivation.[26]

In addition to the level of knowledge, mother's belief plays a significant role in the decision of mothers to practice exclusive breastfeeding. Maternal beliefs about the impact of exclusive breastfeeding on maternal health, physical appearance, and ability to engage in other activities. This has been shown to have the strongest association with early cessation of exclusive breastfeeding. Overcoming this belief has contributed to a more effective promotion of exclusive breastfeeding in rural Kenya.[27]

Husbands have a role in exclusive breastfeeding, such as involvement in seeking information about breastfeeding and making decisions to provide food. Therefore, health workers also have an important role to play in providing information to fathers, especially about breastfeeding practices, such as how to support breastfeeding mothers and dealing with problems in breastfeeding, so that it can help mothers to successfully provide exclusive breastfeeding.[28]

This is supported by the results of research conducted in Jambrana District that mothers who get good support from their husbands can provide more exclusive breastfeeding. Moreover, mothers

who get good support from health workers can provide more exclusive breastfeeding.[7]

In order to have the motivation to breastfeed, a mother must receive strong support from the surrounding environment to succeed.[8] The breastfeeding calendar is an educational media and support for mothers in exclusive breastfeeding. Through the breastfeeding calendar, husbands or families can increase knowledge and provide support for mothers to successfully breastfeed exclusively.[11]

The breastfeeding calendar media provides an advantage, namely that it can increase the concern of husbands and families because they can help monitor breastfeeding by filling in a calendar that is affixed to the wall. However, the disadvantages of the breastfeeding calendar cannot remind husbands and families if they forget to fill out the breastfeeding calendar. Thus, for further research, the breastfeeding calendar will be developed in the form of an application so that it can remind husbands and families and mothers in breastfeeding. In addition, suggestions for health workers, especially midwives and nutrition workers, to be able to use the breastfeeding calendar as an educational medium to increase husband and family support in exclusive breastfeeding.

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