

The effect of nutrition education on balanced-nutrition knowledge and macronutrient intake among adolescent

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ABSTRACT

Counseling on balanced nutrition is unknown among the wider community, especially school students. Therefore, it is necessary to socialize the delivery of messages and principles regarding balanced nutrition. The study analyzed comics and booklets on increasing knowledge level of nutrition and macronutrient intake in adolescents. The study employed a quasi-experimental design, which pre-test and post-test intervention compared to control. The sample of this study was junior high school students selected based on the inclusion and exclusion criteria. The respondent in this study was 150 students of junior high school in Palembang, Indonesia. Paired t-test and ANOVA test as well as regression correlation were used as statistical analysis. The results showed differences in knowledge of the balanced nutrition and macronutrient intake after comic intervention compared to booklets and no intervention.

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1. INTRODUCTION

Indonesia faces triple burden of nutritional problems such as stunting, obesity, and micronutrient deficiency such as anemia. Based on Indonesia basic research in 2018, data shows that 25.7% of adolescents aged 13-15 years and 26.9% of adolescents aged 16-18 have a concise nutritional status. Besides, 8.7% of adolescents aged 13-15 years and 8.1% are aged 16-18 years with thin and fragile conditions. In contrary, the prevalence of overweight and obesity is 16.0% in adolescents aged 13-15 years and 13.5% in adolescents aged 16-18 years [1]. Adolescents' nutritional status is a crucial thing to anticipate and prevent under and overnutrition. The nutritional status of adolescents is influenced by eating behavior. Adolescents prefer to consume fatty, sweet, and fast food, which trigger overweight problem [2].

Knowledge of nutrition in adolescents is affected by attitudes and behavior in choosing food at school or home, determining whether a person understands the benefits of the nutritional content in self food consumed. The knowledge of nutrition regarding balanced nutrition is essential as awareness about nutrition in adolescents [3]. Furthermore, sufficient knowledge of balanced nutrition is needed to achieve optimal nutrition in adolescents [4]. Nutrition education is significantly increasing in adolescent nutrition knowledge to eliminate bad eating habits and nutritional problems. Nutrition knowledge has increased in adolescents after nutritional education [5].

The effects of nutrition counseling interventions using animation media increased the knowledge and the attitudes about anemia in high school adolescents in Bandar Lampung City, Indonesia in 2017 [6]. The previous study found a significant difference between knowledge level and nutritional attitudes before (pre-test) and after (post-test) nutrition information intervention by comic media among obese children at

elementary school [7]. Likewise, Darni and Agustina [8] suggested that nutrition education through “comics on my plate” jargon affected nutrition knowledge in elementary school children.

Indonesia has regulated people's diet habits by the general guidelines for balanced nutrition, replacing the four healthy five perfect jargon [9]. However, the information about balanced nutrition is still not well known among Indonesian. The previous study suggested that 40.7% of students stated they had received balanced nutrition information. Therefore, it is necessary to giving information about balanced nutrition. Various health education methods such as comic media and booklets can be accepted by students. Without appropriate methods and attractive media, students will not experience a learning process to enhance their understanding of nutrition knowledge, so nutrition education using the right media is very important [10].

Comics provide entertainment as well as learning media for adolescents. Comic books present simple stories and are written in everyday language. It is easy to understand by various groups, both children and adults. Multiple studies have shown that comics attractively convey messages easily and increase knowledge [11], [12]. In Indonesia, the average energy intake among the 13-15 years (pre-adolescent age) was 67.9-84.7%. There is 54.5% of pre-adolescents consumed energy below the minimum requirement. The average energy consumption of the population aged 16-18 years (adolescence) ranges from 69.5 to 84.3%. There are 54% of the youth population consumed below the minimum requirement of energy intake [13]. We hypothesize that media education comic and book pocket is correlated to knowledge and macronutrient intake in adolescents. This study aimed to determine the effect of comics and booklet on knowledge of balanced nutrition and macro nutrient intake in adolescents.

2. RESEARCH METHOD

This research was a quasi-experiment using the control group's pre-post-test design. Quasi-experiment is an experiment that aims to determine a symptom or effect caused by a particular intervention. We adjust as sample formulas (n) as [14]:

$$n = \frac{Z_{1-\alpha/2}^2 P(1-P)N}{d^2(N-1) + Z_{1-\alpha/2}^2 P(1-P)}$$

Based on these formulas, the proportion of study (d) is 0.5, the precision value (p) is 10%, $Z_{1-\alpha/2}$ is the error rate in the specified statistic, which is 1.96. This study located in two schools. The number of samples was 150 students who divided into three groups: comic intervention, booklets intervention, and without intervention. Each group consisted of 50 students, respectively. The systematic random sampling technique was used to determine the sample.

There are several inclusion criteria of the respondents such as: i) students at least level VIII in the junior high school; ii) willing as participants in this study to completion; iii) physically and mentally healthy; iv) and able to communicate and interact in research activities. Knowledge level data was obtained by using a questionnaire. The nutritional intake data of respondents was obtained from a 24-hour food recall form. Both data were obtained before and after the intervention.

Furthermore, the statistical analysis was bivariate and used the paired t-test statistical test. The difference of average knowledge score and macronutrient intake both pre-test and post-test in all groups used ANOVA test. In addition, analysis of association comics and booklet groups to knowledge and macronutrient intake used the correlation-regression test. Statistical decisions were taken by looking at the value at the 95% confidence level. All participants had signed informed consent, and the research was approved for its ethical license number 301/KEPK-PTKMKS/XI/2016.

3. RESULTS AND DISCUSSION

3.1. Characteristic of respondent

In this study, we divided respondents into three groups: comic intervention group, booklet intervention, and control without treatment, with 50 peoples in each group. Respondents aged 12 to 15 years old, and respondents' genders were 50% male and 50% female as presented in Table 1.

3.2. The difference of knowledge and macronutrient intake before and after treatment among adolescents

In the adolescent group who were given comic intervention, it was found that there was a significant increase in knowledge of balanced nutrition (median pre-post min=6±10, max=17±25; p=0.0001) and there was a significant increase in the quality of macro energy intake, namely from 1,178±1,336 kcal becomes 22.71±29.06 kcal; SD=267.91±311.58 (p=0.003), a protein supply, namely from 34±37 g to 84±93 g;

SD=13.26±13.81 g (p=0.000), fat intake from 14±16 g to 71±81 g; SD=13.72±13.85 g (p=0.000), and carbohydrate intake from 160±330 g to 207±302 g; SD=37.28±28.36 g (p=0.000) as shown in Table 2. In this study, the adolescents group, who were given the booklet intervention, it was found that there was a significant increase in knowledge of balanced nutrition (pre-post median min=7±11, max=19±24; p=0.000) and there was a significant increase in the quality of macro energy intake, namely from 1067±1153kcal to 20.54±24.35 kcal; SD=297.93±385.68 (p-value=0.000), protein supply, namely from 19±26 g to 103±106 g; SD=18.96±17.01 g (p=0.001), fat intake from 20±23 g to 60±62 g; SD=8.91±9.72 g (p=0.000), and carbohydrate intake from 200±213 g to 291±299 g; SD=20.22±20.61 g (p=0.000) as presented in Table 2.

Table 1. Respondent's characteristics distribution

| Variable | Comic intervention | | Booklet intervention | | Control | | Total | |
|--------------------|--------------------|------|----------------------|------|---------|------|-------|------|
| | n | % | n | % | n | % | n | % |
| Age (years) | | | | | | | | |
| 12 | 19 | 38.0 | 16 | 32.0 | 22 | 44.0 | 57 | 38.0 |
| 13 | 18 | 36.0 | 18 | 36.0 | 17 | 34.0 | 53 | 35.3 |
| 14 | 10 | 20.0 | 11 | 22.0 | 8 | 16.0 | 29 | 19.3 |
| 15 | 3 | 6.0 | 5 | 10.0 | 3 | 6.0 | 11 | 7.3 |
| Gender | | | | | | | | |
| Man | 25 | 50.0 | 20 | 40.0 | 19 | 38.0 | 64 | 42.7 |
| Women | 25 | 50.0 | 30 | 60.0 | 31 | 62.0 | 86 | 57.3 |
| Total | 50 | 100 | 50 | 100 | 50 | 100 | 150 | 100 |

Table 2. The analysis of differences before and after intervention in knowledge and micronutrient intake of adolescents

| Variable | Min value | Max value | SD | p-value t-test |
|-------------------------|-------------|-------------|---------------|-------------------|
| | Pre±Post | Pre±Post | Pre±Post | |
| Comic | | | | |
| Knowledge | 6±10 | 17±25 | 2.76±4.66 | 0.000* |
| Energy intake (kcal) | 11.78±13.36 | 22.71±29.06 | 267.91±311.58 | 0.003* |
| Protein Intake (g) | 34±37 | 84±93 | 13.26±13.81 | 0.000* |
| Fat intake (g) | 14±16 | 71±81 | 13.72±13.85 | 0.000* |
| Carbohydrate intake (g) | 160±330 | 207±302 | 37.28±28.36 | 0.000* |
| Booklet | | | | |
| Knowledge | 7±11 | 19±24 | 2.94±3.62 | 0.000* |
| Energy intake (kcal) | 10.67±1.153 | 20.54±24.35 | 297.93±385.68 | 0.000* |
| Protein Intake (g) | 19±26 | 103±106 | 18.96±17.01 | 0.001* |
| Fat intake (g) | 20±23 | 60±62 | 8.91±9.72 | 0.000* |
| Carbohydrate intake (g) | 200±213 | 291±299 | 20.22±20.61 | |
| Control | | | | |
| Knowledge | 6±6 | 22±18 | 3.49±2.49 | 0.302 |
| Energy intake (kcal) | 731±678 | 21.45±20.99 | 430.55±379.72 | 0.478 |
| Protein Intake (g) | 17±19 | 103±91 | 19.02±15.72 | 0.336 |
| Fat intake (g) | 14±15 | 34±38 | 4.35±4.37 | 0.107 |
| Carbohydrate intake (g) | 201±200 | 268±279 | 16.64±20.48 | 0.313 |

N: number of samples; SD=standard deviation; *p-value<0.05

This study is inline with previous study that found a significant difference in the mean pre and post-test after comic education media among senior high school students with a p-value of 0.000 [15]. Likewise, another study stated that knowledge and attitudes about healthy snacks in primary school students at East Pontianak increased after giving nutrition education about healthy snack foods using comic media [16]. Besides, nutritional counseling by booklet media four times a row can increase vegetables and fruit consumption and reduce fast-food consumption in obese adolescents [17].

The booklet nutrient has proven effective to improving students' knowledge in schools and can be used as an alternative for teachers in the learning process in schools [18]. Kurdanti *et al.* [19] showed significant differences in knowledge about balanced nutrition guidelines between before and after counseling used pop-up books, cards, and leaflets media in students. Similar to Lendra and Marlenywati [20], they confirmed that the education media was increased adolescent knowledge from 11.70 to 16.23% after intervention (p=0.000). The study stated that there are two indicators to improve students' perceptions of the information presented and students' perceptions of the knowledge obtained from the information presented [21]. Adolescent is an proper group for receiving education and promotion using attractive media that can increase message absorption, generate interest in learning, and be easy to understand [22]. Besides, adolescents improve their knowledge by exploring relevant and credible sources. It is involving various parties such as schools, parents, and environment [23].

3.3. The effect of interventions on knowledge and macro-nutrient intake in adolescence

The ANOVA test was used to analyze the difference of the effect between comic books and booklets with the level of knowledge and macronutrient intake among adolescents. It was found the comic books and booklets were significantly increased the average score of knowledge about balanced nutrition in adolescents ($p < 0.01$). Regarding macronutrient intake, it was found that knowledge of energy, fat, and carbohydrate intake significantly increased after comic and booklet intervention ($p < 0.01$); however, it was not significant in knowledge of protein intake ($p > 0.05$) as presented in Table 3.

Table 3. Differences in knowledge and macronutrient support between adolescents treated with comic, booklet and control (no intervention)

| Media (n=50) | Mean±SD | 95% CI | p-value |
|--------------------------------|----------------|----------------|---------|
| Knowledge | | | |
| Comic | 6.46±11.67 | 3.14–9.78 | 0.000* |
| Booklet | 5.12±3.37 | 4.06–6.18 | |
| Control | 0.50±2.80 | -0.30–1.30 | |
| Macro-nutrient | | | |
| Energy intake (kcal) | | | |
| Comic | 69.31±236.04 | 2.22–136.39 | 0.001* |
| Booklet | 274.50 ±329.87 | 180.75–368.25 | |
| Control | 19.51±455.43 | -109.92–148.95 | |
| Protein intake (g) | | | |
| Comic | 6.32±4.67 | 4.99–7.65 | 0.117 |
| Booklet | 2.84±8.74 | 0.36–5.33 | |
| Control | 0.55±22.00 | -5.71–6.80 | |
| Fatty intake (g) | | | |
| Comic | 9.79±12.95 | 6.11–13.47 | 0.000* |
| Booklet | 9.27±7.97 | 7–11.53 | |
| Control | 0.23±4.06 | -0.93–1.38 | |
| Carbohydrate intake (g) | | | |
| Comic | 36.15±49.35 | 22.12–50.18 | 0.000* |
| Booklet | 14±17.57 | 9.01–19 | |
| Control | 1.45±13.10 | -2.28–5.17 | |

n: sample size; SD= standard deviation; CI= confident interval; *p-value<0.05; ANOVA test

Based on correlation-regression analyze of the relationship and the variables that have influence most dominant change in the knowledge and micronutrient intake in adolescent. The results of statistical tests (correlation-regression test) show that the intervention of comics and booklets has a strong relationship to knowledge of balanced nutrition in adolescents (respectively, comic $r=0.559$; booklet $r=0.509$; $p=0.000$). Knowledge of micronutrient intake among adolescents with comic and booklet intervention had a strong relationship to changes in fat intake (respectively, comic $r=0.516$, $p=0.000$; booklet $r=0.269$, $p=0.007$) and carbohydrates (respectively, comic $r=0.394$, $p=0.000$; booklet $r=0.204$, $p=0.042$), but not energy and protein intake as shown in Table 4.

Table 4. The association of comic and booklet with knowledge and macronutrients intake among adolescents

| Variable | r | p-value |
|-----------------------------|-------|---------|
| Knowledge | | |
| Comic | 0.559 | 0.000* |
| Booklet | 0.509 | 0.000* |
| Macronutrient intake | | |
| Energy (kcal) | | |
| Comic | 0.087 | 0.387 |
| Booklet | 0.187 | 0.062 |
| Protein (g) | | |
| Comic | 0.041 | 0.685 |
| Booklet | 0.061 | 0.545 |
| Fat (g) | | |
| Comic | 0.416 | 0.000* |
| Booklet | 0.269 | 0.007* |
| Carbohydrate (g) | | |
| Comic | 0.394 | 0.000* |
| Booklet | 0.204 | 0.042* |

r: correlation-regression test; *p-value<0.05

The comic media is used not only for institutional but also for professional health as supporting materials in health education strategies promotion. The comics media can be increased satisfaction and describe a technology interesting comprehensive [24]. Adolescents have an unbalanced diet and unhealthy physical activity patterns compared to other age groups. This behavior causes obesity and increases the risk of metabolic-related diseases such as type II diabetes, coronary heart disease, hypertension, hyperlipidemia, and certain cancers [25].

There is a close relationship between food advertising such as magazines, comics, and cinemas with the diet of children and adolescents in several countries [26]. Nutrition information by booklet media effectively expands nutrition on elementary school children because it can generate interest and enthusiasm for primary school learning [27].

Zeng *et al.* [28] evaluated the effect of nutrition education on young soccer athletes in China and compared the effectiveness of nutrition education with comics and a combination of guidance from teachers and comics. The manga comics could be a helpful format to demonstrate positive health beliefs in youth [29]. Health promotion and education for adolescents have been driven at the school level through various interventions to increase adolescent knowledge. Media literacy education can improve adolescent critical thinking to obtain nutritional information and improve the quality of nutritional intake [30]. It has demonstrated that food photography booklets can be a helpful tool for estimating portion sizes in adolescent age groups [31].

In this study, there was an increase in the average energy consumption score in the intervention group because students who received balanced nutrition in counseling used comic and booklet media, which was carried out four times. An increase in energy and protein intake before and after the students' intervention after nutrition education [32]. This study suggested that significantly increased macronutrient energy, fat, and carbohydrate intake after the comic intervention. Also, macronutrient energy, fat, and protein significantly increased after booklet intervention. The current study suggested an increased micronutrient intake such as fat and protein after being given comics media in nutrition education [8]. Pakhri *et al.* [33] suggested that there were significant differences between energy ($p=0.005$) and protein ($p=0.002$) intake of students before and after given nutrition education of junior high school students in Makassar.

4. CONCLUSION

There are differences regarding knowledge of the balanced nutrition and macronutrient intake for comic intervention group compared to booklet intervention group and control group (without intervention). The comic and the booklet affected the knowledge and intake of macronutrients among adolescents. Comic and booklet are effective in increasing knowledge and macronutrient intake among them.

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