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The Impact of Nutrition Education and Physical Activity on Changes in Nutritional Status in Adolescents Overweight and Obesity

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ABSTRACT

Adolescent nutritional status determines adolescents' nutritional state and health into adulthood. Adolescents who experience more nutrition continuously can be at risk of degenerative diseases. Analyze the influence of nutrition education with media modules and physical activity on changes in nutritional status in overweight and obese adolescents. The research design was a quasi-experiment pre-post-intervention study. Of 38 respondents, the number of subjects consisted of two groups: the treatment and control groups. The treatment group was given nutrition education and physical activity, and the control group was not given any treatment. Data analysis using Independent sample test, Mann-Whitney test, Paired Sample test, and Wilcoxon test. Statistical test results showed the average treatment group decreased significantly in weight (2.38±0.65), BMI-for-age z-scores (0.23±0.47), waist circumference (-2.42±0.50 cm), and increased knowledge (26.84±7.67). In the control group, weight loss (-0.74±2.63) and BMI-for-age z-scores (-0.01±0.53), but waist circumference (0.10±0.93) and knowledge (4.47±6.21) increased both in the treatment group and in the control group. The results showed that there was a significant influence of nutritional education and physical activity interventions on weight loss (p=0.001), BMI-for-age z-scores (p=0.004), and waist circumference (0.004) in the treatment group and control group in adolescents. Nutritional education interventions using module media and physical activity effectively improve nutritional status in overweight and obese adolescents. Nutrition education with media modules containing balanced nutrition messages and the contents of my plate and physical activity with physical freshness gymnastics is one way to improve the nutritional status of adolescents.

1. INTRODUCTION

Overweight and obesity are excessive body fat stored in the body. Overweight and obesity are caused by

energy (calories) that enter more than energy (calories). The problems of overweight and obesity are rapidly rising in different parts of the world towards epidemic proportions. Overweight and obese showed an increase in a diet high in fat and sugar accompanied by decreased physical activity. In developed countries, obesity has become an epidemic by contributing 35% to pain and 15-20% to mortality. Obesity does not cause death directly, but it causes serious health problems that can increase the risk of type 2 diabetes mellitus, cardiovascular disease, kidney disease, cancer, and increasing premature mortality [1- 5].

In Indonesia, the prevalence of overweight and obesity aged 13-15 years from 10.8% in 2013 to 16% in 2018. East Kalimantan province is one of the provinces that experienced an increase in the prevalence of overweight and obesity in adolescents aged 13-15 years by 16.3% in 2013 (Riskesdas 2013) to 19.1% in 2018. In addition, there was an increase in non-communicable diseases, namely heart disease (1.2%) and stroke (4.7%) (Riskesdas 2018).

Overweight and obesity are conditions with multi-factor causes such as lifestyle influenced by environmental, behavioral, psychological, physiological, social, and genetic factors [8- 10]. Excess weight in adolescents is caused by energy intake that exceeds the needs or use of less energy and is related to a history of eating habits and frequency of high-calorie food intake and still insufficient knowledge of adolescent nutrition [11].

Some changes occur in adolescents, one of which is changing eating behavior, healthy eating behavior, and unhealthy eating behavior [12]. In research conducted at Public High School 1, Padang showed that teenagers are moftenofte with high fat and carbohydrates and rarely eat foods high in fiber [13]. Based on research conducted on adolescents in Pekanbaru City, 60.9% of respondents have eating behaviors in the lousy category caused by irregular eating behaviors [14].

Excessive food intake in adolescents is often motivated by adolescent ignorance of the food consumed. One of the causes of nutritional problems in adolescents is a lack of nutritional knowledge and eating habits, balanced nutrition, and lack of physical activity. Research conducted on adolescents aged 10-14 years in the United States shows adolescents tend to develop unhealthy eating habits and consume foods with unbalanced nutrition so that they are prone to gain weight that exceeds the threshold and even reach the category of obesity based on BMI-for-age [15].

Nutrition education and physical activity are one way to prevent weight gain early on through increasing knowledge about the importance of balanced nutrition for adolescents. In addition, the recommendation of the portion of the contents of My Plate is essential to know adolescents so as not to be overweight. Research conducted by [16] shows the influence of nutritional education media on balanced nutrition knowledge before and after intervention.

In addition, the advancement of technology today makes teenagers spend more time sitting for hours playing smartphones, playing computers, and watching TV so that less doing other activities such as playing football or other sports. According to [17], doing long physical activity is very helpful in preventing weight gain. Research proves that more nutritional and obese children have low physical activity and physical freshness levels. Inadequate physical activity causes more body fat to be accumulated in tissues, while low physical freshness can affect the physical health of overweight and obese children.

Excess nutrition in adolescents needs to get special attention so that adolescent health will be better in the future, so more prevention and nutrition management is needed in adolescents through nutrition education and physical activity. The nutrition education method is a method to increase knowledge and healthy eating

behavior in adolescents to give birth to good nutritional status. Nutrition education is more effective in increasing knowledge [18]. With the help of media, nutrition education will readily accept and understand the material presented. Nutrition education with lecture methods with modules/booklets is more effective in increasing adolescent nutrition knowledge than non-media lecture methods [19], [20]. Many media are used in nutrition education, one of the myouOneu. One of this research is the media module which contains messages about balanced nutrition and the contents of, My Plate, which serves one meal.

Nutrition education and physical activity are some of the delivery of nutrition messages in overweight teenagers. Nutrition education conducted with an exciting and readily accepted module media can affect adolescent knowledge. Nutrition education is essential to change food consumption behavior and increase knowledge in forming good eating habits to avoid more nutrition. This study aimed to analyze the influence of nutrition education with media modules and physical activity on changes in nutritional status in overweight and obese adolescents in Samarinda City.

2. Material and Method

The type of research used is a quasi-experiment pre-post intervention study. This research was conducted at Samarinda City Junior High School from November 2020 to January 2021.

The population in this study is students from Junior High School 2 and Junior High School 37. The method of taking the subject is purposive sampling that meets the inclusion and exclusion criteria. The inclusion criteria in this study are students in junior high school classes VII and VIII and overweight students with BMI-for-age z-scores, namely overweight Z-Score > + 1SD sd + 2SD and obesity Z-Score > + 2SD. Exclusion criteria are to use weight-loss medications or enroll in other weight loss programs, follow similar studies, and suffer from congenital disabilities that cause biases in anthropometric Some changes occur in adolescents, one of which is changing eating behavior, healthy eating behavior, and unhealthy eating behavior [12]. In research conducted at Senior High School 1, Padang showed that teenagers are moftenofte with high fat and carbohydrates and rarely eat foods high in fiber [13]. Based on research conducted on adolescents in Pekanbaru City, 60.9% of respondents have eating behaviors in the lousy category caused by irregular eating behaviors [14].

Based on the formula of extensive calculations of samples from intervention studies, several studies obtained the results of extensive calculations of different samples. The calculation of different samples was taken the highest that became the benchmark in sampling as many as 16 people to avoid dropping out, then added 20% so that a large sample of 19 people was obtained. The study consisted of two intervention groups and a control group. Each group consists of 19 people, so a total sample of 38 people.

Both the intervention and control groups were taken measurements of weight, height, BMI-for-age z-scores, and waist circumference. The data collected are characteristics of the subject (age and sex) and nutritional status (height, weight, BMI-for-age z-scores, waist circumference). Height data using stature meter (Microtoise), weight measurement using BIA (Bioelectric Impedance Analysis) SCALE HBF-375, and waist circumference using tape meters.

Nutrition education is provided by the lecture method assisted by props using a module medium that contains a balanced nutrition message and the contents of my plate and the media template of my plate that serves one meal. Nutritional education intervention is carried out one time per week for 45 minutes for 12 weeks (3 months), while physical activity in the form of physical fitness exercise with a frequency of 5 times per week with a duration of 30 minutes for 12 weeks (3 months).

Data analysis is average (mean), standard deviation (SD), and percentage. Differences between groups were analyzed with the Independent Samples test and Mann-Whitney test, while differences before and after were analyzed with the Paired Samples test and the Wilcoxon test. The results of statistical analysis are considered significant if the value of p<0.05.

3. Results

3.1 Characteristics of Research Subjects by Sex

Table 1. Subjects in the study were 38 overweight and obese people, an intervention group of 19 and a control group of 19. The characteristics of subjects by gender were male (65.8%) and female (34.2%). Based on the intervention group and control group, there were 14 (73.7%) and (57.9%) male, with 5 (26.3%) and 8 (42.1%) female.

Table 1. Characteristics of Subjects Based on Sex

Variable	Treatment (n=19)		Control (n=19)		Total	
	n	%	n	%	n	%
Sex						
Boy	14	73.7	11	57.9	25	65.8
Girls	5	26.3	8	42.1	13	34.2

Table 2. The average age of each intervention group and control group (was 12.26±0.56 years and 12.79±1.02 years). Students in the treatment group were slightly more accessible than the control group, but there was no significant difference between the treatment group and the control group (p=0.102). Similarly, height, weight, and BMI-for-age z-scores were no significant differences between the treatment and control groups (p=0.240). Waist circumference (p=0.06) and knowledge (p=0.001) differ between the treatment and control groups.

Table 2. Distribution of Subject Characteristics

Variable	Treatment (n=19)			Control (n=19)			*p*
	Min	Max	Mean±SD	Min	Max	Mean±SD	
Age (Years)	11	13	12.26±0.56	11	15	12.79±1.02	0.102[b)]
Height (cm)	150	174	158.78±7.86	136.5	164.0	153.95±7.08	0.240[a)]
Weight (kg)	55.50	89.50	158.78±7.67	50.10	78.00	58.65±7.47	0.943[a)]
BMI-for-age z-scores	1.0	2.5	1.71±0.38	1.0	2.4	1.56±0.42	0.629[a)]
Waist Circumference (cm)	80	98	87.47±4.98	60	100	78.63±11.53	0.006[b)]
Knowledge	50	70	57.89±5.08	50	70	56.05±4.59	0.001[b)]

Significant p value p<0.05; a) Indepent Samples Test; b) Mann-Whitney test

3.2 Differences in Nutritional Status Before and After Nutritional Education Interventions and Physical Activity

Table 3. Statistical test results showed that there were differences before and after nutritional education interventions and physical activity in weight (p=0.001), waist circumference (p=0.001), and knowledge (p=0.001) in the treatment group with a value (p <0.05). While in the control group, there was no difference before and after the intervention of nutrition education and physical activity in body weight (p=0.825), BMI-for-age z-scores (p=0.860), and waist circumference (p=0.630) in the treatment group with a value (p>0.05).

Table 3. Differences in Nutritional Status Before and After Nutritional Education Interventions and Physical Activity

Variable	Treatment (n=19)	Control (n=19)	*p*
	Mean±SD	Mean±SD	
Weight (kg)			
Before	68.62±8.33	58.65±7.47	0.943[a)]
After	66.24±8.41	57.90±7.60	0.603[a)]
p	0.001[c)]	0.825[d)]	
BMI-for-age z-scores			
Before	1.71±0.38	1.56±0.42	0.629[a)]
After	1.48±0.39	1.54±1.49	0.358[a)]
p	0.051[c)]	0.860[c)]	
Waist Circumference (cm)			
Before	87.47±4.98	78.63±11.53	0.006[b)]
After	85.05±4.89	78.73±11.97	0.114[b)]
p	0.001[c)]	0.630[c)]	
Knowledge			
Before	57.89±5.08	56.05±4.58	0.144[b)]
After	84.74±5.13	60.53±5.24	0.000[b)]
p	0.001[d)]	0.013[d)]	

Significant p-value p<0.05; [a)] Independent Samples test; [b)] Mann-Whitney test; [c)] Paired Samples test; [d)] Wilcoxon test

The statistical test results of both intervention groups showed no difference in weight (p=0.943 and p=0.603) and BMI-for-age z-scores (p=0.629 and p=0.358) before and after nutrition education and physical activity intervention (p>0.05).

3.3 Changes in Nutritional Status Before and After Nutrition and Physical Activity Education Interventions

Table 4. Changes in nutritional status before and after nutritional education and physical activity interventions in the treatment group decreased weight (-2.38±0.65 kg), BMI-for-age z-scores (-0.23±0.47), waist circumference (-2.42±0.50 cm), and increased knowledge (26.84±7.67). In the control group, weight loss (-0.74±2.63) and BMI-for-age z-scores (-0.01±0.53), but waist circumference (0.10±0.93) and knowledge (4.47±6.21) increased. Both the treatment group and the control group decreased significantly in weight (p=0.001), BMI-for-age z-scores (p=0.004), and waist circumference (p=0.001) with a value (p<0.05).

Table 4. Changes in Nutritional Status Before and After Nutritional Education and Physical Activity Interventions

Variable	Treatment (n=19)	Control (n=19)	*p*
	Mean±SD	Mean±SD	
Δ Weight (kg)	-2.38±0.65	-0.74±2.63	0.001[b)]
Δ BMI-for-age z-scores	-0.23±0.47	-0.01±0.53	0.004[b)]
Δ Waist Circumference (cm)	-2.42±0.50	0.10±0.93	0.001[b)]
Δ Knowledge	26.84±7.67	4.47±6.21	0.184[a)]

Significant p-value p<0.05; [a)] Independent Samples Test; [b)] Mann-Whitney test

4. Discussion

4.1 Effects of Nutrition Education and Physical Activity on Weight Changes

Nutrition education provided by lecture methods assisted by props using a media module contains a balanced nutrition message for teenagers and the contents of my plate and the media template contents of my plate that serves one meal. Moreover, physical activity intervention in gymnastics is physical freshness gymnastics. Nutritional education intervention is carried out once per week, duration of 45 minutes, for 12 weeks, while

physical activity intervention in the form of physical freshness gymnastics exercise, with a frequency of five times per week, duration of 30 minutes for 12 weeks, can lose weight from 68±8.33 kg to 66.24±8.41 kg with a change of sex (2.38±0.65 kg). The results showed an influence of nutrition education and physical activity on weight loss in the treatment and control groups. Both the treatment group and the control group, on average experienced weight loss, but the weight loss was more significant in the treatment group (2.38±0.65 kg) than in the control group (0.74±2.63 kg), so the results of statistical tests showed that there was an influence of nutritional education interventions and physical activity on weight loss in adolescents.

This research is in line with research conducted by [21], Physical activity intervention by doing aerobic exercise conducted for 12 weeks was effective in losing weight (5.77 kg). However, they differed in terms of duration carried out three times a week (90 minutes), while the control group was not effective in losing weight (0.90 kg) because it only got exercise education alone. Results of research with a system of review and meta-analysis by [22], In adolescents ages 6-18 years statistically showed a significant difference in weight loss (1.02 kg) compared to the control group.

Physical activity affects 1/3 of a person's energy expenditure for the average weight, but for those overweight, physical activity plays a role in burning calories. The more frequent exercise, the more calories burned. Exercise is essential for weight loss. Exercise should be done at least 150 minutes per week or 30 minutes per day (3-5 times per week). Doing exercise every day can already lose weight on average 2-3 kg. Overweight and obese have a 2-3 times risk of developing non-communicable diseases such as cardiovascular. In adolescents, the risk of more than twice the risk of dying from coronary heart disease during adulthood. Physical activity interventions may improve physical fitness and cardiovascular disease risk factors in overweight or obese teens [23].

Prevention of obesity should be early because, in childhood, overweight tends to continue into adulthood, especially if there is a history of offspring or hormonal disparity. Previous research results showed that weight loss of 5-10% of the initial weight within 6-12 months could lose by 1 kg/week is enough as a parameter of success in weight loss [24]. So one of the effective ways to lose adolescent weight is to be combined nutrition education and physical activity.

4.2 Effect of Nutrition Education and Physical Activity on BMI-for-age z-scores

The influence of nutrition education and physical activity on the BMI-for-age z-scores showed that the treatment and control groups decreased after the intervention. The average treatment group decreased BMI-for-age z-scores (-0.23±0.47) and the control group (-0.01±0.53), so the results of statistical tests showed there was an effect of nutrition education and physical activity on the decrease in BMI-for-age z-scores ($p=0.004$). However, the average before and after the intervention had no meaningful difference ($p>00.05$); although the control group decreased BMI-for-age z-scores, the value decrease was slightly compared to the treatment group. In line with research, [25], showed a significant decrease in BMI before and after nutrition education in the treatment and control groups ($p=0.001$ and $p=0.007$). Research [26], showed a decrease in BMI-score (0.19±0.28) in the treatment and physical fitness group increased by 11.5%, while in the control group, the decrease BMI-for-age z-scores (0.07±00.21) and a decrease in fitness of 1.8%. The results of statistical tests showed differences in changes in BMI-for-age z-scores and physical fitness in both groups ($p<0.05$). Research conducted by [27] showed that nutritional education has a good influence on the reduction of BMI percentiles in overweight adolescents with group extension and individual counseling methods ($p=0.010$ and $p=0.009$). While the study conducted by [28], also saw a decrease in BMI from (26.58±2.49 kg / m2 to 26.81±2.49 kg / m2) with a difference of change of (-0-23 kg / m2).

Nutritional education interventions carried out for 12 weeks can reduce BMI-for-age z-scores. Nutritional education interventions with media modules and physical activity with physical freshness gymnastics significantly affected the BMI-for-age z-scores in adolescents. The results of previous studies in Iran showed that health education for six weeks could reduce BMI in obese adolescents by (0.46±0.78 kg/m^2) [29]. The results of the study [30] showed that nutritional education interventions with booklets for four weeks with a frequency of one time a week (±20 minutes) showed that there was a significant difference in BMI in the treatment group, where the average decrease was (0.36±0.05 kg/m^2).

Physical activity intervention by doing physical freshness gymnastics with a duration offortimes/week) for 12 weeks can reduce BMI-for-age z-scores by (-0.23±0.47). [31] research conducted in adolescents aged 13-16 years in South Africa showed that physical activity interventions conducted twice per week and nutrition education once per week for ten weeks significantly decreased BMI (30.8±5.4 kg/m^2 to 29.8±5.7 kg/m^2, p<0.01). [32] said that nutrition education is one of the most successful school-based interventions to reduce BMI in obese adolescents. The 16-week study showed statistically significant changes in BMI in the intervention group (0.53±1.16, p=0.016) compared to the control group (0.51±1.57, p=0.063).

Nutrition education with media modules is made attractive so that teenagers can better understand the material contained in it. Modules contain messages in the form of narratives and are accompanied by compelling images supporting the success of educational delivery. This study used a media module that contained a balanced nutrition message and the contents of my plate once eaten. This study showed that providing nutrition education with a media module containing a balanced nutrition message, the contents of my plate once eaten, and the template of my plate and doing physical activity in the form of physical gymnastics can improve the nutritional status of adolescents. A continuous increase in BMI can increase the prevalence of the disease; therefore, the need for BMI supervision to address health problems with increased BMI [33]. Very light physical activity has a risk factor of 9.6 times more significant for causing obesity than light activity [34]. [35] showed a significant correlation between BMI-for-age z-scores with students' knowledge and physical activity.

4.3 The Effect of Nutrition Education and Physical Activity on Waist Circumference

The influence of nutrition education and physical activity on waist circumference is one way to measure the nutritional status of obese adolescents. The results showed a decrease in waist circumference in the treatment group (-2.42±0.50 cm) and in the control group increased (0.10±0.93 cm).teststests showed a significant difference in nutritional education interventions and physical activity against decreased waist circumference (p= 0.001). The average change in waist circumference in the treatment group before and after the intervention showed significant differences (p=0.001), while the control group had no difference before and after the intervention (p=0.630). [36] showed that measuring waist circumference is one way to identify weight habits that will impact adolescent health in adulthood. In line with the research, [30] that nutrition education through booklet media influences waist circumference in obese adolescents. Waist circumference measurement is one of the indicators to measure visceral adipose tissue. It is essential to know that it is not at risk for developing type 2 diabetes and cardiovascular disease that will harm the health of adolescents who are obese in adulthood [37].

Nutrition education with a media module contains a balanced nutrition message. The contents of my plate and physical activity with physical freshness gymnastics sports affect the waist circumference, which can help reduce the increase in waist circumference in overweight and obese adolescents. The change in waist circumference is caused because nutritional education and physical activity can be received well and applied at home; the knowledge provided and provided awareness about the health hazards for obese adolescents in

adulthood.

4.4 The Effect of Nutrition Education and Physical Activity on Adolescent Overweight and Obesity Knowledge

Nutrition education and physical activity are presenters of nutrition messages in overweight teenagers. Nutritional education interventions with attractive and readily accepted media can avoid boredom to increase adolescent knowledge. Nutrition education with media modules contains balanced nutrition messages and the contents of my plate, and physical activity with physical freshness gymnastics is one way to improve the nutritional status of adolescents.

The results of this study showed that there was an increase in knowledge in the treatment group from 57±5.08 to 84±5.13 and an increased in the treatment group (26±7.67), while in the control group from 56±4.58 to 60±5.54 and the number increased by (0.10±0.93). Statistical test results showed significant differences before and after nutritional education and physical activity interventions in the treatment and control groups (p=0,000 and p=0.013). However, judging by the change in knowledge difference, there was no significant difference before and after the intervention, in the treatment group or the control group, with a value (p=0.184), although there was no statistical difference. However, the value showed no difference because there was a more minor increase in the control group than in the treatment group. Providing nutritional education with module media effectively increases knowledge because it provides more information, is durable, can be stored, and read repeatedly compared to leaflets that present simple and easy to read but are easily damaged, making it challenging to read repeatedly. Information obtained through reading and listening and done repeatedly can increase adolescent knowledge [38]. This study showed a change in knowledge improvement after nutrition education with the module media. The effect of nutritional education on changes in adolescent knowledge is more effective if given to school-age children.

Nutrition education is provided by learning methods in class and delivered in the form of modules with the content of messages in the form of narratives and compelling images to support the successful delivery of nutritional education and increase the nutritional knowledge of the subject. Students feel bored if the module display presented is concise, not many pictures, and not colorful. The use of less varied learning resources causes students to be less motivated in the learning process, students feel bored and prefer to create their forums and chat with friends, and even some students use mobile phones during the learning process without regard to explanations from teachers. Research [39], using nutrition education media affects knowledge and attitudes of balanced nutrition and can improve balanced nutrition behavior for the better. With the help of media, nutrition education will quickly receive and understand the material delivered. Nutrition education with lecture methods with the help of modules is more effective in improving adolescent nutrition knowledge than non-media speaking methods [19], [20]. The advantages of the module media are information that is delivered in total, more detailed and precise, and educative. In addition, modules used as educational media can be taken home to be read repeatedly and stored. Nutrition education with a media module is arranged according to adolescents' needs and conditions and combined with images to attract the attention of teenagers and avoid teenage boredom in reading.

One of the factors that influence a person's knowledge is the media. Media serves to make it easier for someone to understand information that is considered complicated. This increase in knowledge and attitude shows success in providing nutrition education with lecture methods and booklet media [40]. Increased knowledge is gained from the learning process by utilizing all senses, where 13% of knowledge is acquired/transmitted through hearing and 35-55% through hearing and vision [41], [42].

Nutritional education interventions in this study, conducted for 12 weeks (3 months), once per week, can increase knowledge before and after nutritional education interventions in adolescents. This study is in line with [43] research, showing that there al.'a difference in increased knowledge before (52.69±10.34) and then (62.28±12.68) nutritional education interventions conducted for 12 weeks (1 time/week) using modules in the treatment group while the control group only once/month without modules. However, the [44] study showed that with physical education and nutrition interventions for eight weeks and six months, average knowledge scores were higher in the treatment group compared to the control group (3,798±1,289 and 3,778±1,246), significantly higher compared to the control group (T-test: 2,269; p=0,024). [28] research conducted for seven months using a media booklet can increase students' knowledge with an average score from (8.77±1.54) to (12.90±2.71).

One way to prevent excess weight is by providing nutritional education and physical activity so as not to impact degenerative diseases Nutrition education. Physical activity can improve adolescent nutritional status and prevent the risk of degenerative diseases or non-communicable diseases such as cardiovascular diseases associated with metabolic syndrome. Being overweight should be a significant primary concern, especially from childhood, because in childhood, overweight and obese children tend to continue into adulthood. If not prevented early on it can result in death.

5. Conclusion

There is an influence of nutrition education and physical activity on weight, BMI-for-age z-scores, waist circumference, and knowledge. Nutrition education with module media contains balanced nutrition messages and the contents of my plate, and doing physical activity with physical freshness gymnastics is one way to improve the nutritional status of adolescents so as not to have an impact on degenerative diseases. Overweight teenagers must still apply the knowledge given in everyday life, both for themselves, family, and friends, to live a healthy life.

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