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Dietary diversity score and adolescent obesity among West Sumaterans girl

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ABSTRACT

Backbround: Obesity develops from multifactorial factors. Adequacy and quality of food are associated with nutritional needs and health status. Studies on the relationship between dietary diversity scores (DDS) and obesity are inconsistent.

Objectives: This study aims to determine the comparison of dietary diversity scores and their relationship with obesity in adolescent girls

Methods: The participants in this cross-sectional research were 272 adolescent girls (110 obese and 162 normal) aged 12 to 18 years old in West Sumatera. Face-to-face interviews were conducted to determine their sociodemographics, personality traits, dietary diversity score [DDS], and anthropometrics. The DDS was calculated based on five dietary categories [grains/bread, vegetables, fruits, meats and meat substitutes, and dairy items] as well as weight status [BMI Z score]. An independent t test comparing mean DDS between obese and normal groups; an ANOVA test comparing anthropometry based on DDS, both with $p < 0.05$ significance level.

Result: The mean DDS on obesity is significantly lower than normal adolescents by 4.10 ± 1.5 versus 4.46 ± 1.52 p=0.042. Adolescents with lower DDS exhibited obesity of 83.3%, and the normal ones were 16.7%. On the other hand, adolescents with higher DDS showed obesity of 25.6%, and the normal ones were 74.4%. The prevalence of obesity is inversely associated with the dietary diversity score p= 0.012

Conclusion: There was a negatively significant association between dietary diversity score and obesity. In comparison to the normal groups, adolescent girls with obesity had a lower dietary diversity score.

KEYWORDS

Adolescent, dietary quality, nutritional status.

INTRODUCTION

Identification of risk factors for obesity in adolescents is the most appropriate way to intervene in obesity and reduce cardiovascular risk. The group of adolescent girls is a priority in obesity prevention because of the impact of obesity on adolescent girls, not only on the adolescents themselves but also on their offspring, such as the risk of giving birth to low birth weight babies. The decreasing prevalence of obesity in adolescent girls must continue to be developed to improve the quality of fetal health as the next generation. The majority of obesity in adolescent was range in 13-15 years in West Sumatra, dominated by the Minangkabau ethnic group, is almost the same as the national prevalence of 10.8%, which consists of 8.3% obese and 2.5% very obese[1].

Adolescents are a group that has the freedom to choose food, which is often influenced by peers and tends to select unhealthy foods[2]. Phenomenon that occur in developing counteris is the lack of variety in animal protein diet, lack of consumption of fruit and vegetables with a high amount of calories intake. The next problem is changing from traditional food to western food[3]. Snacks, irregular eating and increased consumption of junk food are frequent phenomena among adolescents in developed and developing countries[4].

Research on the Minangkabau ethnic group reports that this ethnic group has a different diet pattern from other ethnic groups in Indonesia. Generally, a meal consists of rice, fish, coconut, green vegetables, and chillies with minimal variation between lunch, dinner and breakfast[5]. Another study on

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adolescent girl of Minang ethnicity found that genetic factors also influenced eating habits and food preferences[6].

Good growth and development require nutritious food and balanced vitamins that include a variety of foods from various food groups (vegetables, fruits, whole grains, and animal source foods)[7]. Dietary diversity is a simplified method for assessing the adequacy and quality of food and is associated with nutritional requirements and overall health status. Food diversity consists of all food groups (grains, vegetables, fruit, meat, and dairy products), needed for growth and development[8]. Diet and food quality greatly determine the incidence of obesity in children[9]. Obesogenic foods increase the risk of being overweight (fatty cheese, sweetened soft drinks, processed foods, fast food, sweets, snacks, whole milk, and refined grains). In contrast, healthy foods do not cause obesity (low in sugar and fat and high in fibre/fruits, vegetables, whole grains, fish, nuts, and yoghurt)[10].

Based on observational studies, a meta-analysis of the relationship between dietary diversity and obesity outcomes has shown inconsistent results. In a cross-sectional study using several food groups, 7 of 16 studies reported a nonsignificant relationship; five studies reported a positive association. Four other studies reported an inverse relationship between dietary diversity scores and the prevalence of overweight and obesity. Effective treatment and prevention of obesity can be achieved if the pathogenesis is known comprehensively[11,12]. Other studies have also found the limited ability of diet diversity scores to measure dietary quality and micronutrient adequacy. That diet diversity score is not directly related to health outcomes. In developing countries, most the diet diversity score is often used to assess dietary patterns and overall diet quality[13]. Based on the reasons above, it is necessary to investigate the comparison of dietary diversity scores between obese and normal and the relationship between dietary diversity scores and obesity in adolescent girls in the Minangkabau ethnicity.

METHODS

Study design and partisipants: This comparative cross-sectional study was carried out in four districts of West Sumatera Province in Indonesia, between 2016 and 2017. West Sumatra is dominated by the Minangkabau ethnic group. This ethnic group, also known as Minang, is an Austronesian ethnic group native to West Sumatra's Minangkabau Highlands. The Lamesow formula is used to determine the number of samples; the minimum sample in each group is n=110. We had a total of 272 adolescent females participate in this study (110 obese and 162 normal). The age group comprises pre-teenagers (10-12 years) and adolescents (12-17 years). The region settlement is split depending on the origin of residency, rural citizens live in a district, whilst urban residents live in the municipality's city/capital. The level of education of fathers and mothers is divided into two categories: low if the education level is less than senior high school and high if the education level is at universities.

Ethical consideration: This research has been accepted by the ethical committee of the Faculty of Medicine, Andalas University No. 096/KEP/FK/2015, and the informed consent has been approved by the subject and parents.

Research variables: Body Mass Index (BMI) is calculated according to the BMI Z-score based on gender and age. Subjects were classified as overweight/obese if BMI Z score > +1 SD, and group BMI > -2 SD - < +1 SD grouped as normal/non-obese[14]. Blood pressure was measured twice after participants rested for about 15 minutes. Food intake data is carried out face to face by trained nutritionists. Food intake was measured using 143 semi-quantitative FFQ items validated for the Minangkabau[6]. FFQ provides a list of foods that the Minangkabau people commonly consume. The Diet Diversity Score was assessed using a semi-quantitative Food Frequency Questionnaire (FFQ) with 143 food items. This DDS was calculated based on Kant[15] and is now the method used by Farhangi[16]. Dietary Diversity Score [DDS] is a qualitative measurement of 5 (five) food groups consumed by subjects in 7 days, namely group (1) carbohydrate sources; (2) proteins; (3) vegetables; (4) fruits dan (5) milk and dairy products. According to the Food and Agriculture Organization (FAO), this prominent group is divided into ten subgroups. The subgroups consist of (1)Rice; (2) Sweet potato (cassava); (3) Meat (beef, chicken, etc.); (4) eggs; (5) fish; (6) vegetable sources of vitamin A (carrots); (7) green vegetables; (8) fruits rich in vitamin A (mango, papaya etc.); and (9) other fruits (bananas); (10) dairy products (various types of milk, yoghurt and cheese). Consumption of each subgroup was given one if at least one consumption in 7 days and a value of 0 if no consumption at all. Subjects must consume at least half of the recommended daily intake. For example, if Indonesia's daily allowance recommendation recommends that one protein item should be consumed three servings a week, then participants must consume 1.5/7 servings a day. Each subgroup has a maximum of 2 DDS points. To calculate the score for each subgroup, by dividing the number of subgroups consumed by the total subgroup and then multiplied by 2. For example, suppose a person consumes at least half the recommended portion of the four types of protein categories. In that case, the DDS protein value will be (1/4) x 2 = 0.5. If someone consumes at least half of the serving, it is recommended that 2 of the four subgroups of vegetables, then the DDS of vegetables is (2/4) x 2 = 1. In one food group, the maximum DDS score is 2. Total DVDs score by adding up the five food groups with the top score is 10. DDS is divided into three categories, namely low (≤3), medium (>3 – 6) and high (≥6)[17].

Statistical Methods: The statistical analysis performed using SPSS software ver.22. Data were described in frequency distribution, mean ± standard deviation or median and 25-75th percentile. An independent t test was used to compare mean DDS between obese and normal groups; an ANOVA test was used to analyze anthropometry based on DDS tertile (low, medium, and high); and a chi-square test was used for

categorical data on the link between DDS and obesity.. Statistical significance was indicated by $p < 0.05$

RESULTS

Based on the characteristics of the place of residence, there was a significant relationship between the place of residence and the incidence of obesity. The percentage of obesity is higher in the city than in the village. There is a significant relationship between maternal employment status and obesity, where mothers who do not work have a higher percentage of normal children who are obese. (Table 1).

In table 2, it can be seen that there is a significant relationship between a mother's education and diet diversity

Table 1. The relationship of characteristics participants with obesity

Characteristic	Total		Normal		Obese		p-value
	n	%	n	%	n	%	
Age							
<12 years	23	8.5%	13	56.5%	10	43.5%	0.751
>12 years	249	91.5%	149	59.8%	100	40.2%	
Settlement Region							
Urban	159	58.5%	82	51.6%	77	48.4%	**0.012***
Rural	113	41.5%	80	70.8%	33	29.2%	
Father's Education							
Low	230	84.6%	134	58.3%	96	41.7%	0.570
Higher	42	15.4%	28	67.7%	14	32.3%	
Father's Occupation							
Unemployee	16	5.9%	9	56.2%	7	43.8%	0.780
Employee	256	94.1%	153	59.8%	103	40.2%	
Mother's Education							
Low	236	86.8%	136	57.6%	100	42.4%	0.09
Higher	36	13.2%	26	72.2%	10	27.8%	
Mother's Occupation							
Unemployee	161	59.2%	105	65.2%	56	34.8%	**0.020***
Employee	111	40.8%	57	51.4%	54	48.6%	
Number of Siblings							
< 3	19	7.0%	9	47.4%	10	52.6%	0.521
3-5	159	58.5%	97	61.0%	62	39.0%	
> 5	94	34.6%	56	59.6%	38	40.4%	
Family History Of Obesity							
Yes	147	54.0%	80	54.4%	67	45.6%	0.082
No	125	46.0%	82	65.6%	43	34.4%	

Table 2. The relationship of characteristics with a dietary diversity score

	Dietary Diversity Score			p-value
	Low	Medium	High	
Range of DDS	1–3	3-6	6-10	
Number of participants	62	171	39	
Age				
<12 years	4 [17.4%]	17 [73.9%]	2 [8.7%]	0.500
>12 years	58 [23.3%]	154 [61.8%]	37 [14.9%]	
Settlement Region				
Urban	36 [22.6%]	95 [59.7%]	28 [17.6%]	0.172
Rural	26 [23.0%]	76 [67.3%]	11 [9.7%]	
Father's Education				
Low	56 [23.7%]	148 [62.7%]	32 [13.6%]	0.486
Higher	6 [16.7%]	23 [63.9%]	7 [19.4%]	
Father's Occupation				
Unemployee	3 [18.8%]	11 [68.8%]	2 [12.5%]	0.88
Employee	59 [23.0%]	160 [62.5%]	37 [14.5%]	
Mother's Education				
Low	55 [24.0%]	148 [64.3%]	27 [11.7%]	**0.020***
Higher	7 [16.0%]	23 [55.0%]	12 [29.0%]	
Mother's Occupation				
Unemployee	40 [24.8%]	95 [59.0%]	26 [16.1%]	0.270
Employee	22 [19.8%]	76 [68.5%]	13 [11.7%]	
Number of Siblings				
< 3	46 [25.8%]	111 [62.4%]	21 [11.8%]	0.144
3-5	16 [17.0%]	60 [63.8%]	18 [19.1%]	
> 5	62 [22.8%]	171 [62.9%]	39 [14.3%]	
Family history of obesity				
Yes	39 [26.5%]	88 [59.9%]	20 [13.6%]	0.286
No	23 [18.4%]	83 [66.4%]	19 [15.2%]	
BMI				
Normal	29 [17.9%]	104 [64.2%]	29 [17.9%]	**0.020***
Obese	33 [30.0%]	67 [60.9%]	10 [9.1%]	

score. A low level of parental education was associated with low DDS. In contrast, a high level of parental education was associated with high diet diversit

The mean and standard deviation of age and anthropometric measures and per cent body fat and blood pressure based on DDS tertile categories are shown in Table 3. There were no significant differences between DDS groups based on age, BMI, waist circumference, and blood pressure. There was a significant difference in per cent body fat between the DDS groups.

Based on the DDS subgroup, it can be seen that the most consumed food groups are carbohydrate sources (rice), protein sources (primarily eggs, fish and chicken, beef), fruits (bananas, etc.), vegetables (vegetable sources of vitamin A and vitamin C). green vegetables) and the minor consumption of food is dairy milk [milk, cheese, yoghurt, etc.). There was a significant difference between DDS dairy milk between normal adolescents and obese adolescents with p = 0.011. The mean DDS of normal adolescents was significantly higher than that of obese adolescents (4.46 ± 1.52 vs 4.10 ± 1.52). p = 0.042. (Table 4). There was a significant relationship between low DDS and obesity risk.

DISCUSSION

Obesity rates in cities are significantly higher than in rural areas. Obesity is also strongly linked to maternal employment status. In families whose mothers work, the role of mothers will experience a shift where mothers cannot pay attention and teach healthy eating habits to prevent obesity. Mother also can not prepare healthy food at home[17]. Gwozdz et al. found that mothers who worked full-time were more likely to have higher BMI, WC, and fat than children of mothers who did not work[19]. Likewise, the Korea National Health and Nutrition Examination Survey (KNHANES) study found that obesity in girls was associated with longer working hours than their mothers[20]. However, maternal dietary behaviour was associated with children's eating habits and changes in body mass[20]. Long parental working hours are consistently associated with obesity in children in several developed countries[22,23]. The influence of parents on children's food choices and intake affect individual and family practices and plays a role in food availability and accessibility or parents' eating behaviour as food models[23]. Mothers play a crucial role in shaping their children's food intake through their food intake and the food they provide at home. Studies show that a high level of education in mothers can reduce their children's vulnerability to obesogenic factors. Maternal education revealed that children of mothers with an undergraduate or postgraduate education showed significant reductions in food responses, desire to drink, and emotional overeating compared to mothers with lower levels of education[25]. The nutritional status of children is influenced by a number of female characteristics, including women's empowerment and health[26].

Meanwhile, there is a significant relationship between DDS and obesity based on DDS. Adolescents with low DDS have a higher percentage of obesity than those with high DD. Low DDS has a higher % body fat than high DDS. This is in line with a study that reported that body mass index, waist circumference, and waist-to-hip ratio were slightly more significant in individuals with high DDS, but they were not significant except for the waist-to-hip ratio[27]. The low economic status significantly causes a low DDS risk[27,28]. Higher DDS is not always associated with increased body weight, as it may be due to increased consumption of low-calorie foods such as vegetables, whole grains and fruits. DDS is an appropriate method to measure the adequacy of food intake in adolescents[29]. The results of this study are consistent with several other studies where high DDS is associated with a low prevalence of obesity[30]. A study in Sri Lanka on diabetic adults with a sample of 600 people found a positive relationship between DDS and obesity using BMI and waist circumference measurements[31]. In developing countries, diet diversity in adolescents is minimal, mainly consisting of plant-sourced foods but with a high level of dietary diversity. Low consumption of fruits and vegetables[3]. This study follows a study on adolescents in West Java who found low levels of fruit and vegetable

Table 3. Comparison of diet diversity score based on anthropometry

	Low [*n* = 62]	Medium [*n* = 171]	High [*n* = 39]	p-value
Age (years)	13.93 ± 0.91	13.83 ± 1.01	13.64 ± 0.77	0.322
Body Mass Index (kg/m2)	25.58 ± 4.01	25.15 ± 2.89	23.44 ± 4.57	0.582
Waist Circumference (cm)	78.46 ± 8.667	76.47 ± 10.44	74.85 ± 9.52	0.184
% Body fat	28.48 ± 3.39	27.00 ± 4.28	26.54 ± 3.90	**0.021***
Sistole (mmHg)	123.34 ± 11.3	122.65 ± 13.4	122.23 ± 12.5	0.972
Diastole (mmHg)	74.73 ± 9.86	75.17 ± 12.46	74.28 ± 10.68	0.904

Table 4. Comparison of dietary diversity scores in normal and obese groups

	Normal	Obese	p-value
Sub groups of DDS			
Rice	1.0 ±0.00	1.0 ±0.00	-
Cassava	0.07 ± 0.25	0.07 ± 0.26	0.891
Meat [beef/chicken]	0.08± 0.27	0.06 ± 0.14	0.602
Eggs	0.73 ± 0.24	0.65 ± 0.28	0.176
Fish	0.68 ± 0.26	0.65 ± 0.27	0.677
Dairy product	0.4 ± 0.29	0.23 ± 0.12	**0.010***
Vit A rich vegetables	0.39 ± 0.18	0.35 ± 0.18	0.566
Green leafy vegetables	0.31± 0.16	0.36 ± 0.18	0.342
Vit A rich fruits	0.44 ± 0.29	0.39 ± 0.29	0.433
Other fruit	0.69± 0.20	0.62 ± 0.25	0.172
Major groups of DDS			
Grain diversity score	1.07 ± 0.25	1.07 ± 0.26	0.877
Meat diversity score	1.05 ± 0.52	0.97 ± 0.52	0.192
Vegetable diversity score	0.70± 0.22	0.72 ± 0.21	0.811
Fruits diversity score	1.03 ± 0.69	1.01 ± 0.70	0.175
Dairy diversity score	0.41± 0.19	0.23 ± 0.12	**0.011***
Dietary Diversity Score [DDS]	**4.46± 1.52**	**4.10 ± 1.52**	**0.042***

consumption as much as 92.1% and 77.1% of adolescents, respectively. Where the influencing factors are the consumption habits of parents and the availability of fruits and vegetables at home[32].

Higher DDS was associated with a healthier diet, whole grains and more protein, fruit, vegetables, and milk. Higher DDS is negatively associated with obesity. There was a significant negative relationship between DDS and obesity $p < 0.05$. This study follows studies that found an inverse relationship between DDS, obesity and abdominal adiposity[33-35]. Another study found that DDS was not associated with obesity[35]. Another study reported that adults who ate a more diverse diet had a higher BMI than adults who ate a less varied diet[37,38]. The underlying mechanism explaining the positive association between DDS and weight gain is unclear. It is known that consumption of a diverse and varied diet is a predictor of dietary adequacy and energy intake, which increases body weight and ultimately leads to obesity[39].

A cross-sectional study of Iranian adolescent girls aged 18–28 years (n = 289) found that higher diversity scores were associated with lower odds of measuring BMI 30 kg/m2 and central obesity (waist circumference 88 cm)[40]. Research on medical students in Iran also found that DDS negatively correlated with the waist-hip ratio. Still, there was no significant relationship between BMI and waist circumference. This study concludes that DDS influences body fat distribution[8]. The inconsistent results of this study may be due to the different methods of measuring DDS. There has been no consensus on the best approach to measure DDS. Therefore, promoting dietary diversity as part of a healthy diet requires careful consideration. Dietary diversity is a protective factor against metabolic syndrome. High food diversity is associated with healthy food groups such as vegetables, fruit and fibre.

Children and teenagers' eating habits have changed since the Covid 19 era. Changes are both positive and negative, both changes have significant short- and long-term conse-

quences for public health. Most studies show a significant increase in the number of meals, snacks, fruits, vegetables, nuts, bread, and bakery products consumed. On the other hand, studies show that people consume significantly less fast food and soft drinks[41]. However, the COVID-19 pandemic in Indonesia has an indirect impact on household food insecurity, which can worsen food consumption conditions, particularly in terms of food diversity[42-44].

CONCLUSION

Some adolescent girls on West Sumatera had low and medium dietary diversity score (22.8% low DDS and 62.7% medium DDS), and only 14.3% had high dietary diversity score. The DDS of normal adolescents was significantly higher than obese 4.46 ± 1.52 vs 4.10 ± 1.5 with $p < 0.05$, and there was a significant relationship between low DDS and the risk of obesity $p<0.05$.

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