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RESEARCH MEETS INNOVATION

THE RELATIONSHIP BETWEEN ENERGY DENSITY AND SNACKING BEHAVIOR AND NUTRITIONAL STATUS OF TEENAGERS IN MEDAN

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ABSTRACT

Objectives: Nutritional status is a state of the body that can be affected by energy density of food and snacking behavior. The purpose of this research is to determine the relationship between energy density and snacking behavior and nutritional status of an individual.
Methods: This is a cross-sectional research. The data collection technique for energy density is food-recall in 3x24 hours. The data on snacking behavior was obtained using questionnaire. Nutritional status data was obtained using anthropometric measurements of weight/height. The data was analyzed descriptively and using Spearman's rank correlation, and multiple linear regression.
Results: The results show that the energy density of teenager is 57% (high category), snacking behavior is 68% (good), and nutritional status is 43.40% (over) There is a positive and significant relationship between energy density and nutritional status with $r = 0.588$ ($p<0.05$), and a positive and significant relationship between snacking behavior and nutritional status with $r = 0.613$ ($p<0.05$). There is a negative and significant relationship between energy density, snacking behavior, and nutritional status ($0.000<0.05$)
Conclusions: There is a relationship between energy density and snacking behavior, and nutritional status of teenagers. Family, school, and education play a big role in preventing consumption of high-energy density food and snacking behavior which affect nutritional status.

Key words: energy density, snacking behavior, nutritional status.

INTRODUCTION

Nutritional status is the state of body based on the balance between nutritional intake and needs for body metabolism. Nutritional status is basically affected by two factors, nutritional intake and diseases. Meeting nutritional needs of teenagers is crucial as they have increased nutritional needs to

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support their growth and development. They also need particular nutrition related to sports activity, eating disorder, extreme diet program, drug, and change in lifestyle and eating behavior [1].

The result of Risdeknas (Basic Health Research) North Sumatera in 2014 shows that the prevalence of nutritional status based on BMI of ages 16-18 in Medan is normal category (80.45%), overweight (9.36%), obese (6.56%), and underweight (3.63%).

One of the factors related to nutritional status and intake is snacking behavior. Snacking behavior refers to the action of searching, choosing, and buying snacks sold in school environment. Snacking behavior has a significant relationship with nutritional status. A positive snacking behavior correlates to a good nutritional status. Positive snacking behavior refers to the ability of the student to choose snacks which are nutritious, clean, and healthy when consumed [2]. To choose clean and nutritious snacks, someone needs to pay attention to the place where they are sold, and tools and ingredients to make the snack.

Preliminary observation in October 2017 on 15 teenagers (grade XI students of SMA Swasta Budisatrya Medan) shows that 33.33% are overweight, 26.67% of the students are in normal category, 20% are underweight, and 13.33% are obese. Compared to the provincial prevalence of Sumatra Utara, the students in SMA Budisatrya are more likely to be overweight.

Interview with vice principal also reveals that the school management doesn't have any regulation on the school canteen and street hawkers around the school. Heavy competition due to the number of sellers cause the snack sellers to prioritize profit without thinking of the consumers' health The variety and quantity of snacks available in the school environment make it easy for students to buy snacks impulsively without paying attention to safety, hygiene, and nutrition. This is exarcebated by the lack of regulation from school. If this continues, snacking behavior of the students will worsen, leading to imbalanced nutritional intake, causing abnormal nutritional status. Based on the above, there is a need for this research titled The Relationship between Energy Density and Snacking Behavior and Nutritional Status of Teenagers in Medan."

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METHODS

This cross-sectional research aims to determine the relationship between energy density and snacking behavior, and nutritional status of teenagers. The study was conducted in October - December 2017 in SMA Swasta Budisatrya Medan. The population of this research iare all of students of grade XI, numbering 115 students. Through simple random sampling, 53 students were selected as sample. The data collection technique used was questionnaire. Respondent's characteristics were obtained using questionnaires, whereas the energy density data were collected using food-recall in 3x24 hours. The data on snacking behavior were obtained using questionnaire. Nutritional status data was obtained using anthropometric measurements of weight/height. The data was analyzed descriptively, and using Spearman's rank correlation and multiple linear regression.

RESULTS

1. Respondents' Characteristics.

The characteristics in this research consists of sex and daily allowance. The results shows that the respondents consist of 52.83% female students and 47.17 male students. The average and standard deviation of daily allowance is Rp 15 094 ± Rp 7 845. Most of the students' allowances are in Medium category (Rp 11 000 - Rp 20 000) at 75.47% and High category (> Rp 20 000) at 9.43%.

2. Energy Density

As can be seen in Table 1, 57% of teenagers have high energy density, 36% are in the medium category, and only 7% are in the low category. The lowest energy density value is 1.56 kcal/g and the highest is 2.47 kcal/g. The average energy density for teenagers is 2.03 kcal/g.

Table 1. Distribution Based on Energy Density

No.	Energy Density	n.	%
1.	Low	4	7
2.	Medium	19	36
3.	High	30	57

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Total	53	100
Min-Max	1.56-2.47	
Average ± SD	2.03 ± 0.250	

3. Snacking Behavior

Table 2 shows that 68% of teenagers have good snacking behavior while 32% have poor snacking behavior.

Table 2. Distribution Based on Snacking Behavior

No.	Snacking Behavior Category	n.	%
1.	Good	36	68
2.	Poor	17	32
	Total	53	100
	Average ± SD	69 ± 8	

4. Nutritional Status

It can be seen in Table 3 that 43.40% of teenagers are in the over-nourished category and 1.89% are in poor category. The lowest z-score is -3.05 while the highest is 3.7.

Table 3. Distribution Based on Nutritional Status

No.	Nutritional Status	n.	%
1.	Poor (≤-3 SD)	1	1.89
2.	Undernourished (-3 SD - –2 SD)	11	20,75
3.	Well-nourished (-2 SD - +1 SD)	14	26,42
4.	Over-nourished(> +1 SD - +2 SD)	23	43,40
5.	Obesity	4	7,55
Total		53	100,00
Min-Max		-3.05 - 3.7	
Average ± SD		0.33 ± 1.52	

5. The Relationship between Energy Density and Nutritional Status

Based on the result of Spearman's rank correlation, there is a positive and very significant relationship between energy density and teenagers' nutritional status with correlation coefficient of

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0.588 and p-value of 0.000 at significance of 0.05. This means that the higher energy density of the teenagers, the higher the nutritional status of the teenagers.

6. The Relationship between Snacking Behavior and Nutritional Status

Based on the result of Spearman's rank correlation, there is a positive and very significant relationship between snacking behavior and teenagers' nutritional status with correlation coefficient of 0.613 and p-value of 0.000 at significance of 0.05. This means that the better the snacking behavior of the teenagers, the higher the nutritional status of the teenagers.

7. The Relationship between Energy Density and Snacking Behavior, and Nutritional Status of teenagers

Multiple linear regression analysis shows that there is a negative and significant relationship between energy density and snacking behavior, and nutritional status (0.000 < 0.05) with $Y = -10.176 + 3.2X_1 + 6.2X_2$. The result shows negative constant of -10.176. This means that if the energy density and snacking behavior have the value of zero, there is a decrease in nutritional status. The regression coefficient of energy density variable (X_1) is 3.2 which means energy density has a positive correlation to nutritional status. The regression coefficient of snacking behavior variable (X_2) is 6.2 which means energy density has a positive correlation to nutritional status. The results show that energy density and snacking behavior correlates to nutritional status. Snacking behavior is the most dominant variable affecting nutritional status as the regression coefficient is 6.2 (bigger than energy density at 3.2). The R square value is 0.553 and p-value of 0.000. This means that the nutritional status of teenagers is affected by energy density and snacking behavior by 55.3%, while the other 44.7% is affected by other variables not included in this study.

DISCUSSION

Based on the results, energy density of teenagers are in high category at 57%. This is in line with Lestari, Ronitawati and Melani, (2016) who found that most respondents with normal nutritional

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status mostly consume food with medium energy density of 1.7 kcal/g while overnourished respondents mostly consume high energy density food of 2.0 kcal/g [3].

Energy density is related to total daily caloric intake, and positive balance (more intake than needed) can cause abdominal obesity and metabolic syndromes such as dyslipidemia, hypertension, and insulin resistance [4]. Food made from identical ingredient can have different energy density and nutrition density. Food processed by frying have increased energy density and decreased nutrition density. This is due to the oil used for frying having high energy density [5].

Based on the results, teenagers who have snacking behavior in Good category numbers 68 %. This is supported by Winarni and Mustikawati, (2017) who found that majority of teenagers have good snacking behavior [6].

Good snacking behavior means that teenagers are able to differentiate between healthy and unhealthy food. They are aware that healthy and nutritious snacks contribute to their own health [2]. The result also shows that 90% of students are able to identify healthy food based on the answer distribution on consuming uncovered snacks. They know that uncovered snacks might attract flies and causes illness.

The result shows that the students nutritional status in overnourished category numbers 43.40%. Teenagers' nutritional status are affected by several factors such as physical activity, body image, and eating pattern. Snacking behavior is one of the things contributing to eating pattern. Snack consumption which violates balanced nutrition principle affects calorie intake which in turn affects weight and nutritional status [7].

Several factors causing overnourishment in teenagers of age 16-18 are excessive calorie intake and low physical activity. Energy needs in teenagers depends on physical maturity and activity. Energy needs of male and female teenagers differ due to difference in body composition and growth rate. Physical activity affects nutritional status because physical activity increases metabolism rate, therefore burning fats which act as energy reserve [8]. Nutritional status is optimized when the body get enough nutrition and used efficiently such that physical growth, physical capability, brain development, and overall health are at the highest level possible. Meanwhile, undernourishment

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happens because the body doesn't get enough nutrition. Teenagers of age 13-18 have higher nutrition needs due to increased physical activity. If this need is not met, it causes poor nutritional status [9].

The Spearman's rank analysis result shows that there is a positive and significant relationship between energy density and nutritional status with correlation of 0.588 and p-value of 0.000 at significance=0.05. This means the better the energy density of the food they eat, the better the nutritional status of the students.

This is in line with Safitri, Fitri and Lestari, (2017) who found that 85.5% students in overweigh category eat food with high energy density. This shows that the higher the energy density of the food consumed, the higher the BMI/age value will be. Correlation test shows that there is a positive and significant relationship between these variables ($p<0.05$) [10].

High energy density food can be easily found in snacks sold at school. This is due to the fact that most school snacks are processed by frying, so the oil used contribute a lot to calorie and fat intake. This in turn affects the students' weight and nutritional status [11]. The snacks sold in SMA Swasta Budisatrya are also found to be processed by frying, such as donut, *bakwan*, *risol*, nugget, meatballs, and choco-banana.

The Spearman's rank analysis result shows that there is a positive and significant relationship between snacking behavior and nutritional status with correlation of 0.613 and *p-value* of 0.000 at significance=0.05. This means the better the snacking behavior, the better the nutritional status of the students.

This is in line with (Julinar and Lubis, 2017) who found that there is a correlation between snacking behavior and nutritional status BMI/age in SDN 55 Banda Aceh with p-value of 0.004 ($p<0.005$). This research finds that out of 29 students with good snacking behavior, 20 students are in the well-nourished nutritional status category, and out of 38 students with poor snacking behavior, 29 students are in the under-nourished category [12].

A study by (Pratiwi and Apriliawati, 2017) states that it is possible for an individual to have good snacking behavior but poor nutritional status as snacking behavior is not the sole factor affecting nutritional status. Another factor affecting nutritional status is parents education level.

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Parents with low education level tend to not have the knowledge of healthy lifestyle and balanced nutrition. This causes the children to not meet their nutrition needs, causing poor nutritional status [13].

Multiple linear regression analysis shows that there is a negative and significant relationship between energy density and snacking behavior, and nutritional status (0.000 < 0.05) with $Y = -10.176 + 3.2X_1 + 6.2X_2$. The result shows negative constant of -10.176. This means that if the energy density and snacking behavior have the value of zero, there is a decrease in nutritional status. The regression coefficient of energy density variable (X_1) is 3.2 which means energy density has a positive correlation to nutritional status. The regression coefficient of snacking behavior variable (X_2) is 6.2 which means energy density has a positive correlation to nutritional status. The results show that energy density and snacking behavior correlates to nutritional status. Snacking behavior is the most dominant variable affecting nutritional status as its regression coefficient (6.2) is higher than the regression coefficient of energy density (3.2).

This shows that energy density is interrelated with nutritional status. This supports (Safitri, Fitri and Lestari, 2015) [10] and (Davidson, Dwiriani and Khomsan, 2017) [5] findings who show that there is a significant relationship between energy density and nutritional status. In order to improve nutritional status based on energy density, SMA Swasta Budisatrya can carry out education program on how to choose low-energy density food and how to choose food based on Balanced Nutrition General Guide. The students should also be educated on consuming food according to “Isi Piringku”, which means a meal should consist of 50% fruit and vegetable while the other 50% being the combination of carbohydrate and protein.

This shows that snacking behavior is interrelated with nutritional status. This supports (Nasriyah, Kulsum and Tristanti, 2017) [2] and (Winarni and Mustikawati, 2015) [6] findings who show that there is a significant relationship between energy density and nutritional status. In order to improve nutritional status based on snacking behavior, SMA Swasta Budisatrya Medan can carry out healthy school canteen program, following the Ministry of Education's guidelines to school management. The guidelines include (1) monitoring/supervision of healthy school canteen; (2)

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skilled and knowledgeable human resource operating the canteen; (3) clean facility and infrastructure; and (4) safe, healthy and nutritious snacks. Ekaningrum et al. found that energy density and nutritional status do not have a significant relationship, but they have a positive correlation. This means that the higher the energy density consumed, the higher the z-score of BMI/age. [14]. Similarly, Fauzi finds that there is a significant relationship between protein intake and nutritional status, in which children in overweight and obese category are more likely to be children with low protein density intake rather than children with medium or high protein density [15]. Similar research also shows that there is a significant relationship between protein intake and nutritional status because most subjects consume animal protein dominantly and there is a lack of variation in consumed food.

CONCLUSION:

1. The respondents' characteristics based on sex consist of 52.8% female and 47.2% male and based on allowance the average is Rp15 000/
2. Respondents in high-energy density consumption category numbers 57%.
3. There are 68% of the respondents in the good snacking behavior category.
4. The students nutritional status in overnourished category numbers 43.40%.
5. Based on the result of Spearman's rank correlation, there is a positive and significant relationship between energy density and teenagers' nutritional status with correlation coefficient of 0.588 and *p-value* of 0.000 at significance of 0.05. This means that the higher energy density of the teenagers, the higher the nutritional status of the teenagers.
6. Based on the result of Spearman's rank correlation, there is a positive and very significant relationship between energy density and teenagers' nutritional status with correlation coefficient of 0.613 and *p-value* of 0.000 at significance of 0.05. This means that the higher energy density of the teenagers, the higher the nutritional status of the teenagers.

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