



THE DIFFERENCES OF DIETARY INFLAMMATORY INDEX (DII) BETWEEN OVERWEIGHT-OBESE AND NORMAL ADOLESCENCE

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Background: The state of obesity in the body lead to have chronic low-grade inflammation in the long term condition. Diet has been known as an important regulatory factor on inflammatory condition. Characteristic of individual diet according to its inflammatory properties in order to investigate the inflammatory links between obesity and diet can be assessed by dietary inflammatory index (DII). **Objective:** The study aimed to assess the differences of dietary inflammatory index between overweight-obese and normal adolescence. **Methods:** A comparative cross sectional study with 152 overweight-obese and 151 normal adolescence in Trenggalek District was involved. Inflammation contained on foods measured by dietary inflammatory index. Nutritional status of adolescence was categorized using CDC (BMI-for-Age-percentils). **Result:** Overweight-obese adolescence have higher median intake of several food inflammatory parameter compare with normal adolescence. There was no differences between dietary inflammatory index and nutritional status ($p>0.05$). **Conclusion:** However, a pro inflammatory diet (the higher dietary inflammatory index score) was found among overweight and obese adolescence. Inversely, anti inflammatory diet (the lower dietary inflammatory index score) was associated with normal adolescence.

Keywords: Nutritional Status, Adolescence, Foods, Inflammation, Dietary Inflammatory Index

INTRODUCTION

In Indonesia, prevalence of overweight and obese among adolescence aged 16-18 years increase from 1,4 percent (2010) to 7.3 percent in 2013. Among 7.3 percent adolescence aged 16-18 years who categorized as ornutrition 5.7 percent are overweight and 1.6 percent are obese¹. However, several studies found that the prevalence of overweight and obese among adolescence was higher compare with national prevalence. The prevalence of overweight and obese among anemic and non anemic adolescence in Malang District is 19.1 and 17.4 percent respectively².

Obesity in adolescence substantially increases the risk of health problems in adulthood³. Being overweight and obese increases the risk of developing diabetes, heart disease, high blood pressure, cancer and other adverse health outcomes⁴. Obesity is a state in which there is an overaccumulation of subcutaneous or abdominal adipose tissue⁵. Obesity is associated with alterations in immunity, a chronic low-grade inflammation in which there are elevated circulating pro-inflammatory cytokines⁵. The increase size of adipocytes plays a decisive role because, in the long term condition, it will increases adipose tissue. The effect of increasing adipose tissue was rising production of adipocytokines and it triggers a series of inflammation⁵. Overall, obesity is thus an underlying condition for inflammatory and metabolic diseases⁵.

On the other hand, diet has been known to be an important regulatory factor on immune response⁶. The study showed that there was association between different dietary pattern and chronic low grade inflammation⁷. Additionally, another study conducted by Steck et al (2014) explain that there is positive association between western type diets and pro-inflammatory biomarkers⁸. A



considerable effort has been forwarded to link the dietary pattern and some low grade inflammatory markers⁹.

To assess the diet quality in relation to inflammation it may cause in the body, Dietary Inflammatory Index (DII) was developed. The dietary inflammatory index is a tool for assessing diet quality and has the potential to be used for evaluating and guiding individuals in setting dietary goals to help decrease levels of inflammation. Thereby, DII can be used potentially to reduce the risk of obesity and certain chronic health conditions⁸. Dietary inflammatory index (DII) can be useful to characterise an individual's diet according to its inflammatory properties in order to investigate the inflammatory links between obesity and diet.

In the light of these development, it is very important to understand the type of adolescence diet which contained pro- or anti-inflammatory and thus contributes to obesity. The reason for conducting study among overweight, obese and normal adolescence was able to capture variation in the type of diet of adolescence based on their nutritional status. Meanwhile, there is no such studies about level of pro- and anti-inflammatory markers which contain on foods that consumed by adolescence especially in Indonesia.

METHODS

Study Design and Sampling Procedure

This study was designed as a comparative cross sectional study to investigate the differences between dietary inflammatory index among overweight, obese and normal adolescence. Multistage random sampling design was used to select 16-18 years school adolescence in Trenggalek district. Firstly, researcher determine location of the place where the data will be collected. Trenggalek District are chosen for the setting research area selected purposively. Researcher look for the data of total senior high school which located in Trenggalek district from Depdikbud at the venue. Randomly selected 6 out of 48 senior high schools. The researcher do the screening both inclusion and exclusion criteria in the senior high school to determine the samples which use for the present study.

Instrument Development and Data Collection Procedure

Instrument of the study, we used structured questionnaires, SQ FFQ and food photograph. For screening, we used SECA weighting scale, SECA measuring length boards for anthropometry measurement. We conducted pre tested before data collection.

Ethical Considerations

This present study received ethical approval from the Faculty of Medicine University of Indonesia with ethical approval number 381/UN2.F1/ETIK/2017. This study also had permission letter from Ministry of Internal Affairs (11 38/16.1/31/1.86/2017). There is no problem of ethics in this present study, before this research conducted the researcher explained in advance what will be done and subject asked to sign the informed consent if agreed to follow this research.

Data Processing and Analysis

Data Processing

Nutritional Status

Adolescence nutritional status was described using CDC chart 2000. BMI was calculated as weight in kg divided by stature in cm twice and multiply by 10,000. After that look in CDC chart (this chart is different between boys and girls age 2-20 years old) and categorized BMI for-age-percentiles into non obese (5th - < 85th percentiles), overweight (85th – 95th percentiles) and obese (\geq 95th percentiles).

Calculation dietary intake

Intakes of all food items had been converted into intakes of energy and nutrients by using Nutri-survey for window version 2007.

Calculation of adapted dietary inflammatory index

According to Shivappa's reference, 45 food nutrients parameters specific overall inflammatory score was available for DII index. Calculation of this DII was linked to standard global daily mean intake and standard deviation from the world composite database for all food nutrients



parameters. Z score was calculated by subtracting this global mean from individual dietary data from individual dietary intake and dividing by standard deviation¹⁰.

Calculation of centered percentile value for each food nutrient parameters

Z score was converted to percentile values (0-100) by using percentiles rank in SPSS and these values were divided by 100 to get (0-1). To minimize the effect of “right skewing” (a common occurrence with dietary data), this value was squared and subtracting 1 to convert as a centered percentile score which ranged from -1 to +1 for each food nutrient parameter.

Food nutrient parameter specific dietary inflammatory index (DII) score

Food nutrient parameter specific dietary inflammatory index (DII) score was calculated by multiplying centered percentile value for each food nutrient parameters with respective overall food nutrient parameter specific inflammatory effect score.

Overall dietary inflammatory index (DII) scores

Overall dietary inflammatory index (DII) had been obtained from the sum of all food nutrient parameter specific dietary inflammatory index (DII) score and was converted as DII quintiles. The greater the DII score, the more pro-inflammatory the diet, and more negative values represent more anti-inflammatory diets.

Data Analysis

The data had been analyzed by SPSS version 20.0. Normality check was performed using Kolmogorov Smirnov. Categorical data of socio economic demographic was analyzed using chi square. Furthermore, differences of dietary intake among overweight, obese and normal adolescence analyzed by independent t- test if it was distributed normally. To assess association between dietary inflammatory index (DII) and nutritional status, chi square was performed.

RESULT

Socio economic demographic

For socio economic demographic, there was significant association between sex, age and nutritional status. Prevalence of female suffered overweight and obesity was higher (69.7%) compare with male (30.3%). Furthermore, the most prevalence of overweight and obesity happened in adolescence who had age 16 years old (63.2%).

Dietary intake of overweight/obese and normal adolescence

Overweight and obese adolescence had significantly higher intake of energy, protein, total fat, fiber, Fe, niacin, thiamin, vit B6, vit B12, PUFA, saturated fat, MUFA, trans fat, omega 6, omega 3, folic acid, magnesium compare with normal adolescence. Additionally, normal weight adolescence had higher intake of selenium and beta carotene compare with overweight and obese adolescence.

Association between dietary inflammatory index (DII) and nutritional status.

There was no association between dietary inflammatory index and nutritional status ($p > 0.05$). The median of DII among overweight/obese adolescence was -0.0665 following by first and thirds percentiles around -0.1512 and 0.0108 respectively. Meanwhile the median of dietary inflammatory index of normal adolescence was -0.3318 following by first and third percentiles around -3.7380 and 0.8457 respectively. The result described that median of dietary inflammatory index among overweight and obese adolescence was higher compare to normal adolescence.

Adolescence who belonged to pro inflammatory scores of dietary inflammatory index had risk of suffering overweight and obese 1.16 times than adolescence who belonged to anti inflammatory scores of dietary inflammatory index.

DISCUSSION

Prevalence of overweight and obesity among female adolescence were higher compare with male adolescence. The findings of higher nutritional status among female adolescence was conform to those of a previous study by World Health Organization¹⁰. According to Rosenfeld (2004), both male and female humans experience pubertal growth spurts and are not sexually dimorphic in adult



stature. This pubertal growth spurt occurs during adolescence and serves to prepare the child for adulthood. This means that the organs and characteristics required for certain roles in adulthood are developed during this period and the relatively larger female size might have evolved to support the birth of offspring in adulthood¹¹. Besides that during this period, boys gain proportionately more muscle mass than fat as compared to girls. They experience increased linear growth to produce a heavier skeleton and develop greater red blood cell mass than girls. Girls on the other hand have more fat than muscle tissues. Therefore, more females adolescence are at risk of obesity than male¹⁰. This may explain the reason why females were found in this study have overweight and obese during adolescence compare than male.

Adolescence who were in age 16 years old suffered more overweight and obesity compare with those who were in 17 years old. The same findings from previous study explained that over 80% of adolescence growth (attained weight and height) is completed in early adolescence (10-16 years), with a marked deceleration in weight and height velocity in the post-pubertal phase¹⁰. During that periods, when the adolescence had high attained of height and weight, it was possible to become overweight and obesity, if they did not consider their nutritional balance requirement and had enough physical activity.

High consumed of macronutrient intake was caused obesity was in line with previous study. But, for micronutrient consumption such as vit B complex, fiber, omega 3 and 6, PUFA and MUFA, magnesium was not in line with previous study. Furthermore, there was no difference in the result of FFQ source of micronutrient foods between overweight/obese and normal adolescence. Additionally, it might be happened because of overestimation sq ffq result.

The median of dietary inflammatory index of overweight and obese adolescence was -0.0665. It was in line with previous study that the highest value of dietary inflammatory index which contain pro inflammatory was closed to '+1'⁹. Meanwhile the median of dietary inflammatory index of normal adolescence was -0.3318. It was similiar with previous study that showed the highest value of dietary inflammatory index which contain anti inflammatory was related to '-1'⁹.

Present findings suggested that diet induced inflammation might be contributed to increasing or maintaining obesity⁷¹. The origin of inflammation during overweight and obesity is not yet fully understood. It is acknowledged that inflammation is induced by adiposity, but this relationship can be directional (i.e pro inflammatory diet can increase or maintain adiposity), thus creating a vicious cycle, because nutrient excess and some spesific foods or nutrients also have been asociated with inflammation. The potential mechanism underlying this association is the activation of pathogen-associated molecular pattern, such as Toll-like receptor and Nod-like receptor, which induced the activation of inflammatory markers in several tissues including the adipose tissue¹². Moreover, dietary patterns (e.g high fat /low fibre or low fat/high fiber diet) and single spesific nutrient (e.g dietary fiber) appear to have important consequences in the gut microbiota, which is also involved in low grade inflammation associated with obesity¹².

Several studies show that pro-inflammatory diet have positive association with abdominal obesity¹³, risk of chronic disease¹⁴. Otherwise, anti-inflammatory diet was associated with decrease of weight¹⁵. Moreover, proinflammatory cytokines, including IL-6, IL-1, and TNF-a, could stimulate appetite, thereby increasing energy intake and fat deposition¹⁶. Weight gain also could be promoted by b-adrenergic desensitization due to chronic stimulation of the peripheral sympathetic nervous system caused by adiposity signals, such as leptin and insulin, which are related to the inflammatory process¹⁷. Excess of certain nutrients can also triggers hypothalamic inflammation, which has the potential to cause of the obesity¹⁸.

CONCLUSION

However, a pro inflammatory diet (the higher dietary inflammatory index score) was found among overweight and obese adolescence. Inversely, anti-inflammatory diet (the lower dietary inflammatory index score) was associated with normal adolescence.



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