

## ORIGINAL ARTICLE

# Nutritional Factors Determining Body Fat Percentage of Adolescent Boys in 5 Districts of Jakarta

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## ABSTRACT

**Introduction:** Adolescence is one of the life stages that play a key role and is also affected by the epidemiology transition as the result of the development of the era. Consuming a lot of fast food and junk food nowadays causes adolescents, both girls and boys, to be subjected to nutritional problems such as the high body fat percentage. Adolescent boys even tend to be unaware of their health. This study aims to analyse nutritional factors which have an effect on body fat percentage in adolescent boys. **Methods:** This study was performed involving 1046 high school students in 5 Jakarta districts. Spearman's correlation and multiple linear regression were used for the data analysis of this study. **Results:** The result shows that there was a relationship between BMI-for-age, energy and macronutrient intakes, and body fat percentage. Adolescents with excessive intakes got affected by their body fat percentage, although their BMI-for-age is normal. The result of multivariate analysis suggests that BMI-for-age had the most effect on body fat percentage. **Conclusion:** There needs to be a regular education for adolescent boys to be aware of their body fat percentage and other factors that have an effect on it.

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## INTRODUCTION

Adolescence is a transition period from childhood to adulthood. In this stage of life, adolescents very easily get influenced by their environment and need a lot of attention (1). In this period, adolescents frequently try various behaviours considered modern or new-fashioned. Unfortunately, those kinds of behaviours not only lead to positiveness but also to negative things. Many of them bring risks to health. One of them is being unaware of intake, nutritional status, and body fat (2). Adolescent is the group that often experience overweight problem caused by food pattern and lifestyle change toward the modern ones (3).

Unlike adolescent girls, boys tend to be unmindful of their health, body perception, intake, and body fat percentage. Boy's fat accumulation is in the abdominal area, which is classified as central obesity. The visceral fat accumulation has a high risk for metabolic disorders such as increased blood pressure, blood glucose, cholesterol and triglyceride (4). It is dangerous

considering adolescent boys will be the head of the family when they grow up, so they need to be aware of their body fat percentage. Under normal conditions, the body fat percentage for adolescence is 15-20% of body weight, and the mean body fat percentage will increase as age (5). The high body fat percentage in adolescents is affected by several factors such as nutritional intake and BMI. Nowadays, there are many adolescents who often consume fast food containing high energy, fat and salt, but less vitamin, mineral, and fibre. Most fast foods contain high saturated fat, which is harmful to health (6). High calorie and fat intakes will be accumulated into body fat and will result in a high body fat percentage (7). Besides intake, another factor affecting body fat percentage that should be paid attention to is nutritional status. Total adolescents in Indonesia whose ages above 15 with over-nutrition status was 1.4% in 2010 (8) and increased in 2013 to 7.3% (9). Overnutrition may cause degenerative disease problems such as hypertension and another metabolic disease. The result (of this present study) shows that there was a positive correlation between Body Mass Index (BMI) and body fat percentage. The higher BMI of a person, the higher his body fat percentage will be (10). BMI is one of the anthropometric indexes that describes one's nutritional status and reflects body proportionality according to the Body Weight (BW) and Body Height (BH) ratio (11).

Therefore, the researcher is interested in conducting research to analyse the nutrition factors that determine the body fat percentage of adolescent boys in Jakarta districts.

**MATERIALS AND METHODS**

This study is a quantitative analysis that analysed BMI-for-age, energy intake, macronutrient intake, and body fat percentage of adolescent boys in Jakarta districts. The study design was cross-sectional, in which factors that can be operationalised as the independent variable are connected statistically to health problems/dependent variables that were collected and found simultaneously. This study was conducted in high schools in 5 Jakarta districts, namely Central Jakarta, West Jakarta, East Jakarta, and South Jakarta. The schools involved were Jakarta Public High School (PHS) of 23, 57, 113, 01, 98, 68, 3, 6, 13 and 52. The study was performed from April to June 2020. The population of the study was all students of high schools in the Great Jakarta districts, which was 221.464 students in total. The samples were taken using purposive technique sampling, so the chosen samples were those with the corresponding determined criteria. Two high schools were selected from each district of Jakarta as the representative, with the total number of samples 500 students and the total number of accessible populations in all Jakarta districts 2500 students.

The sample inclusion criteria were students of high schools in Jakarta districts aged 13-19 years old who agreed to be the study's sample. Meanwhile, the exclusion criteria were they got sick when the research was conducted and didn't join all the investigation processes. Of the 2500 students who met the inclusion criteria in this study were 1046 male students. Female students were not the focus of this study, and other research team members have published data on female students. Data from this study were collected in April 2020 by the team, assisted by several enumerators who were nutrition science program study students of Universitas Esa Unggul before data collection. The instrument used in this research is the Omron HBF 375 Body Composition Monitor type Bio Impedance Analysis (BIA) digital scale to measure body fat percentage; BMI-for-age is measured using a weight scale and microtome which then the results are converted into z-score using the WHO Anthroplus application, and a food recall form to calculate intake. A 24-hour recall was used in the nutritional intake method. The nutritional content of the food was then determined using data from the Indonesian Food Composition to determine its energy, protein, fat, and carbohydrate content. Univariate analyses were used to simplify data collection and transform it into useful information. Bivariate analyses were done to see the correlation between BMI-for-age, energy and macronutrient intakes, and body fat percentage. Statistical tests performed in this study were spearman's correlation test followed by multivariate

analysis using multiple linear regression. It is determined that the significance level ( $\alpha$ ) of this study was 5% (0.05). This study has passed ethical approval No.0319-19.198/DPKE-KEP/FINAL-EA/UEU/VII/2019 by the Research Ethics Commission of Universitas Esa Unggul, and each Respondent was asked to fill out informed consent form to participate in this study.

**RESULTS**

This study was carried out on 1046 high school students in 5 districts of Jakarta, with ages ranging from 13 to 19 years and the mean age of the respondents was 16 years (Table I). The data analysis result shows that the body fat percentage means of the Respondents was 16.6%. Though there were Respondents whose body fat percentage was 2%, the highest body fat percentage of the Respondents was 40%. This may affect health and convey drawbacks to the human body.

Another aspect affecting health and essential to be concerned about is nutritional status. In this study, Respondents' nutritional status was measured using BMI-for-age. From a geographical perspective, the highest mean BMI-for-age of the students occurred in South Jakarta with a mean value of  $0.39 \pm 1.41$ . In contrast, the lowest mean students' body fat percentage was in North Jakarta, with a mean value of  $-0.03 \pm 1.37$ . Furthermore, the weakest Respondents' BMI-for-age value appeared in the West Jakarta district among all Jakarta districts, as many as  $-4.13$ . In contrast, the highest Respondents' BMI-for-age value was shown in East Jakarta for as many as  $4.26$  (Table I).

Regarding energy intake, the mean of Respondents from all five districts of Jakarta was quite good. The highest energy intake means were shown in the East Jakarta district, with a mean value of  $1809.14 \pm 431.28$  kcal. Meanwhile, the lowest mean energy intake occurred in the North Jakarta district, with a mean value of  $1369.96 \pm 320.28$  kcal. Nevertheless, the Respondent's deficient energy intake, which was 2018 kcal, can still be found. Conversely, the Respondent also found a very high energy intake, 3619 kcal daily (Table II).

**Table I: Respondents Characteristic Distribution in 5 districts of Jakarta**

Variable	Min-Max	Mean SD
Age (year)	13-19	16.00 ± 0.017
Body Fat Percentage (%)*	2.00-40.00	16.6 ± 0.214
<b>BMI-for-age (z-score)</b>		
Central Jakarta	-3.76-3.32	0.28 ± 1.42
North Jakarta	-3.33-4.23	-0.03 ± 1.37
West Jakarta	-4.13-3.57	0.02 ± 1.61
East Jakarta	-2.28-4.26	0.26 ± 1.21
South Jakarta	-3.09-4.04	0.39 ± 1.41

\*Non normal body fat percentage distribution was shown in median ± std error value

**Table II: Energy and Macronutrient Distribution of Respondents in 5 districts of Jakarta**

Variable	Min-Max	Mean	SD
<b>Energy Intake (kcal)</b>			
Central Jakarta	804-2974	1593.65 ± 456.14	
North Jakarta	794-3208	1369.96 ± 320.28	
West Jakarta	218-3619	1705.93 ± 426.85	
East Jakarta	775-2938	1809.14 ± 431.28	
South Jakarta	954-3080	1666.34 ± 351.39	
<b>Carbohydrate Intake (g)</b>			
Central Jakarta	83.30-330.00	187.89 ± 53.10	
North Jakarta	81.60-392.00	165.00 ± 46.30	
West Jakarta	68.10-449.80	200.46 ± 60.96	
East Jakarta	78.60-353.80	214.64 ± 63.89	
South Jakarta	58.90-360.60	205.84 ± 48.35	
<b>Protein Intake (g)</b>			
Central Jakarta	16.80-187.00	59.65 ± 23.42	
North Jakarta	14.80-159.00	53.23 ± 39.15	
West Jakarta	28.00-135.10	62.55 ± 18.06	
East Jakarta	12.60-202.30	68.75 ± 25.70	
South Jakarta	24.40-156.10	63.39 ± 22.73	
<b>Fat Intake (g)</b>			
Central Jakarta	24.00-138.80	61.06 ± 22.32	
North Jakarta	24.00-138.80	57.08 ± 17.31	
West Jakarta	28.70-139.40	71.92 ± 22.69	
East Jakarta	18.70-141.90	69.18 ± 24.32	
South Jakarta	27.60-169.10	62.92 ± 22.71	

In addition to energy, another intake to be correlated to body fat percentage in this study is macronutrient intake. The first macronutrient to be discussed is carbohydrates. The analysis result shows that the lowest carbohydrate intake occurred in the South Jakarta district, with a 58.90 g intake. In contrast, the highest carbohydrate intake was demonstrated in West Jakarta, as many as 449.80 g. Unlike carbohydrate intake, the highest mean protein intake was shown in the East Jakarta district at 68.75±25.70 g. However, the East Jakarta district found the lowest level of protein intake compared to that in other districts of Jakarta, which was 12.40g. This is important to be paid attention to as adolescents are still in their growth period that need protein intake to meet their growth necessities. For fat intake, the West Jakarta district had the highest fat intake mean among other districts, about 71.92±22.69 g. However, the highest fat intake was found in the South Jakarta district, as many as 169.10 g.

Bivariate analysis suggests a correlation between BMI-for-age and body fat percentage ( $P = 0.0001$ ). However, its correlation strength was moderate, and the direction was negative (Table III). Meanwhile, the result of all intake analyses, namely energy ( $p = 0.0001$ ), carbohydrate ( $p = 0.006$ ), protein ( $p = 0.008$ ) and fat ( $p = 0.006$ ), indicates that there was a significant correlation between all the intakes and body fat percentage, with weak strength and positive direction respectively.

**Table III: Relationships between BMI-for-age, Energy Intake, Macronutrient Intake and Adolescent Boys' Body Fat Percentage in 5 Districts of Jakarta**

Variable	Body Fat Percentage (n=1046)	
	Correlation (r)	p-Value*
BMI-for-age	-0.624	0.0001
Energy Intake	0.151	0.0001
Carbohydrate Intake	0.100	0.006
Protein Intake	0.082	0.008
Fat Intake	0.086	0.006

\*there is a significant relationship ( $p \leq 0.05$ ), Spearman's Statistical Test

Multivariate analysis performed using multiple linear regression generated that protein, fat, and carbohydrate intake variables had no significant effect on body fat percentage, so they were excluded from the modelling and reanalysis was carried out. The final result of the multivariate analysis demonstrates that BMI-for-age was the variable that had the most effect on Respondents' body fat percentage, showing a regression coefficient of 2,967 ( $p = 0.0001$ ) (Table IV).

**Table IV: Multivariate Analysis of Body Fat Percentage in 5 districts of Jakarta**

Variable	Coefficient B	R Square	P Value
Constant	13.618	0.389	0.0001
Energy intake	0.002		0.0001
BMI-for-age	2.967		0.0001

## DISCUSSION

The variables for the correlation test on body fat percentage were BMI-for-age, energy and macronutrient intakes. Each variable was analysed according to the districts: Central Jakarta, North Jakarta, West Jakarta, East Jakarta and South Jakarta. In terms of BMI-for-age, the average BMI-for-age of Respondents in each district was categorised as normal. Nutritional status is normal when the BMI-for-age is within the threshold (z-score) -2SD to +1SD (12).

From the perspective of where the study took place, in the West Jakarta district, there was found a Respondent whose BMI-for-age is classified as underweight (z-score = -4.13) as his tall and weight were 170 cm and 40 kg, respectively. Conversely, in North Jakarta, a Respondent with a BMI for age belonged to the obesity category (4.26). Based on the observation, his weight was 119.80 kg. Adolescent boys who grow early, albeit at a slow speed, will become short-stature adults, while those who grow late yet with a fast speed will grow as tall-stature adults (13,14). Therefore, the category of adolescents' BMI-for-age must be concerned as it affects not only the high percentage of body fat but also the risk of body weight-related diseases such as degenerative diseases (15). It was even found in a study that men are riskier

of getting hypertension than women (16), so adolescent boys need to be mindful of their BMI for age.

The mean age of adolescent boys who became the Respondents in this study was 16, as according to The Department of Health year 2009, age 16 is classified as early adolescence (17). In the early phase of adolescence, an adolescent usually experiences emotional instability because of many rapid changes, particularly physical changes. These changes occasionally create embarrassment/self-doubt towards their body shape/low self-esteem. Additionally, adolescents easily get influenced by their peers to try new things at this age, which could lead to health problems (18). It is not uncommon for health problems, like nutritional problems, experienced by adolescents to be caused by the surrounding environment. One of the problems is the high body fat percentage of adolescents.

Compared to adolescent girls, adolescent boys are likely to have a lower body fat percentage because of their frequent physical activities. Physical activities could affect someone's body fat percentage (19), (20). The average body fat percentage of Respondents in all five districts of Jakarta was 16%. It indicates that the body fat percentage of most Respondents was still good. However, based on the data analysis result, there can still be found an adolescent boy whose body fat percentage was high, namely 40%. Based on body fat percentage classification, the good body fat percentage for adolescent boys ranged from 11 to 18%. If the body fat percentage reaches 25% or greater, it is classified as obesity (21). The increase in body fat percentage usually indicates the unbalance between the intake and energy use, so the intake is stored as body fat reserves, which eventually leads to increased BMI and degenerative disease risk and metabolic syndrome (22).

Regarding energy intake analysis results, adolescent boys in the East Jakarta district were shown to have the highest mean energy intake (1800 kcal) compared to those in other districts. Based on the observation, adolescents in East Jakarta tended to watch their daily eating behaviour, such as eating regularly and having a routine breakfast. In addition, the snacking habit was also found to be performed more by adolescents in East Jakarta. This is in line with one of the findings, showing that the highest BMI-for-age was found in East Jakarta rather than in other districts in Jakarta. Adolescents who took care of their food intake were proven to meet their daily needs of nutrients compared to those who didn't (23).

On the contrary, the former phenomenon didn't occur in North Jakarta since the lowest mean energy intake among all districts belonged to Respondents in North Jakarta (1369 kcal). The observation result showed that the adolescents in this district tended to miss their breakfast and maintain their body image, so they didn't

look fat. They thus reduced their daily food intake. It is also supported by the BMI-for-age data, indicating that the lowest mean of adolescents' BMI-for-age was found in North Jakarta. A study also discovered that negative perceptions of adolescents toward body image might affect eating disorders (24). However, the mean energy intake of Respondents in all five districts of Jakarta still did not comply with their needs. For example, adolescent boys require 2400-2650 kcal energy intake (25), but the means of Respondents' energy intake only met 67% of the adequacy level.

Like energy intake, the macronutrient intake of adolescent boys in all 5 districts of Jakarta was still lower than required. The highest mean (214 g) for carbohydrate intake was found in the East Jakarta district, whereas the lowest one (165 g) was in the North Jakarta district. Compared to the Recommended Dietary Allowance (RDA) for carbohydrate intake, the Respondents' carbohydrate intake in all five districts of Jakarta only met 49% of the requirement. Based on RDA, carbohydrate intake for adolescent boys should be within 350-400g/day (25). The kinds of carbohydrates mostly consumed by the Respondents were snacks such as chips, cilok (steamed ball made of tapioca flour), cimol (fried ball made of tapioca flour), and candies. Regarding protein intake, it was found that the protein intake of Respondents from all five districts of Jakarta was pretty good, namely 81% of the required intake, 70-75 g (25). The Respondents liked consuming animal-based side dishes such as fried chicken, meat and dairy-based food. Protein intake for adolescents is important to support body tissue growth as part of the adolescent growth spurt and help form enzymes and hormones, as well as calcium mobilisation in the body which is vital during the growth period (26).

The last macronutrient tested in this study is fat intake. Comparable to protein intake, the fat intake of Respondents in all five districts of Jakarta was quite good, with 75% of the fat intake needed. Nonetheless, in each district of the study, Respondents with excessive fat intake can still be found, even twice the required (169 g), while the fat intake needs to be between 80-85 g (25). The biggest contribution to Respondent's fat intake was high-fat snacks (fried) and fast food. Many adolescent boys didn't understand and were unaware of the fat content of snacks and fast food. A study found that many consumers misunderstood the nutrient content of fast food (27). It is crucial to be noticed, particularly by adolescents, as they are influenced easily by their peers to try many kinds of food, including fast and popular food. Therefore, they must be well educated so they won't mistakenly choose food.

The bivariate analysis demonstrates a relation between BMI-for-age and body fat percentage. This result corresponds to a study conducted on an adolescent boy in West Java, claiming that the correlation between

BMI and body fat percentage was significant (28). A person's nutritional status is strongly correlated to body fat percentage. However, in this study, it was discovered that the direction of the correlation was negative (-0.624), and the strength was moderate. In other words, the lower the BMI, the lower the body fat percentage. The body fat percentage of Asians is different to that of black people and Polynesians. Asians, those with higher body fat, tend to have lower BMI (29). Therefore, a higher BMI does not necessarily indicate a higher body fat percentage. Likewise, our field observation found that some Respondents with normal BMI for age have a high body fat percentage.

The correlation between energy and macronutrient intakes and body fat percentage in this study suggests that there was a relationship in which both energy and macronutrient intake were statistically proven to be significantly related to body fat percentage, with a positive direction. That is to say, the higher the energy or macronutrient intake is, the higher the body fat percentage will be. And the other way around, the lower the energy or macronutrient intake, the lower the body fat percentage. Intakes have a strong effect on the increase of body fat percentage. Food intake comprising total energy intake, protein, fat, and carbohydrate intake may be related to the total body fat percentage, particularly by consuming fast food such as pizza, burgers, hot dogs, french fries, and chicken nuggets. A study revealed that those who consume more unhealthy food tended to have higher BMI and body fat percentage (30). This present study found that adolescent boys in 5 districts of Jakarta who have higher energy and macronutrient intakes tended to have higher body fat percentages than those who didn't, although the BMI-for-age value was underweight or normal. Based on the findings, a deeper study of other factors that might affect BMI-for-age adolescent boys in 5 districts of Jakarta, such as physical activities, stress level, and other factors, needs to be conducted.

Multivariate analysis suggests that energy intake and BMI-for-age significantly affect body fat percentage. BMI-for-age is the variable that has the strongest effect on body fat percentage. The correlation between BMI and WHO BMI and body fat percentage was very strong, namely  $r = 0.825$  and  $r = 0.946$  for boys, respectively (31,32). Many other nutritional factors related to the body fat percentage of adolescents, such as knowledge, snacking habits, and others, were not studied in this study and became limitation in the discussion.

## CONCLUSION

BMI-for-age, energy intake and macronutrient intake are the important factors to be heeded by adolescent boys since those aspects affect body fat percentage. Adolescent boys with higher energy and macronutrient intakes have a higher body fat percentage than those

with less energy and macronutrient intakes, albeit the BMI-for-age is normal. Therefore, it is necessary to give good and regular education to adolescent boys regarding nutritional intake and body composition to become more aware and pay more attention to their nutrition and health.

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