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Factors Affecting Abdominal Circumference in Adolescent Girls

Faktor-Faktor yang Berpengaruh terhadap Lingkar Perut pada Remaja Putri

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ABSTRACT

Background: Central obesity was a health problem in Indonesia. One of indicator to find out central obesity was abdominal circumference. According to preliminary research, 28.4% of students had abdominal circumference >80 cm. Central obesity cause is multifactorial.

Objectives: To identify factors related to abdominal circumference in adolescent girls.

Methods: The design research was a cross-sectional. The total sample was 89 respondents, using the Lemeshow formula. The Sampling was taken by purposive sampling. The abdominal circumference data was measured by a metline. The percentage of body fat was analyzed with the Omron body fat analyzer. Food consumption patterns used Semi Quantitative Food Frequency (SQ-FFQ). Emotional overeating used the Adult Eating Behaviour Questionnaire (AEBQ), diet attitude, and oral control with the Eating Attitude Test (EAT)-26. The Data was analyzed by STATA 13 with the spearman test.

Results: Relationship of BMI (p=0.000; r=0.677), percentage of body fat (p=0.000; r=0.56), kind of junk food (p=0.02; r=0.23). frequency of junk food (p=0.04; r=0.21), energy intake from junk food (p=0.0061, r=0.28), fat intake from junk food (p=0.018, r=0.24), total enery intake (p=0.036; r=0.222), total fat intake (p=0.01; r=0.24); total fiber (p=0.17; r=0.14); overeating (p=0.018, r=0.25); diet attitude (p=0.000; r=-0.52), and oral control (p=0.0001; r=0.39) with abdominal circumference.

Conclusions: There was a relationship between BMI, body fat percentage, junk food consumption pattern (type, frequency, amount of intake and fat), energy intake, fat intake, emotional overeating, diet attitude, and oral control of the abdominal circumference. There was no significant relationship between fiber intake and abdominal circumference.

INTRODUCTION

Central obesity has emerged as a prominent health concern in Indonesia. One of the indicators used to determine central obesity is abdominal circumference measurement. Individuals with an abdominal circumference >90 cm for men and >80 cm for women are classified as central obesity[1]. Based on Harbuwono's research, the prevalence of central obesity in Indonesia was high, especially in adults. According to Basic Health Research (Riskesdas) 2018, the prevalence of central obesity at the age of >15 years stood at 31%, while in East Java, the prevalence of central obesity reached 30.4%[2]. Adolescents have a higher risk of obesity[3], and the risk of central obesity was observed to be higher in women compared to men[4], then fat storage in women bodies higher than in men. In young women entering puberty, there is a change in the hormone GnRH (gonadotropin-releasing hormone) produced by the brain. The GnRH hormone increases the function of the body's organs during puberty, causing the body to produce more fat in the abdomen[5]. Based on preliminary research on young women at Islamic boarding schools, 28.4% of female

students have an abdominal circumference >80 cm[6]. Hence, further research is imperative to investigate the contributing factors to central obesity within Islamic boarding schools, to provide a more comprehensive understanding of this phenomenon. Islamic boarding schools, as a vital educational institution, hold a significant role in the health of their students. However, there is a notable scarcity of research related to central obesity in those area.

Factors related to abdominal circumference are food intake, including fat and fiber intake, and dietary intake[7]. Abdominal circumference is related to the incidence of central obesity. Factors of central obesity in adolescents are multifactorial, including energy, fat, and excess carbohydrate intake, fast food consumption frequency, low physical activity, genetics, and habit of not eating breakfast, which are more at risk for obesity[8]. Nugraha said that fast food and sleep quality affect central obesity[9]. Eating behavior along with environmental and genetic factors influence the incidence of central obesity. O'Neil's research showed that body fat levels and eating behavior (i.e., overeating)

are associated with the incidence of obesity[10]. Similar to Jaakkola's study, several types of eating behavior with energy-dense diets were associated with body weight and central adiposity[11].

Abdominal circumference associated with degenerative diseases. Darsini's research showed the risk of health problems associated with high abdominal circumference, such as diabetes mellitus, hypertension, hypercholesterolemia, low back pain, Obstructive Sleep Apnea Syndrome (OSAS) and hyperuricemia[12]. In addition, high abdominal circumference as a marker of central obesity has a risk for health problems, especially those related to cardiovascular disease and also related to degenerative diseases such as diabetes and hypertension[1]. The impact of central obesity on various chronic degenerative diseases such as hypertension, coronary heart disease, stroke, cancer, type 2 diabetes, and bone disease is very broad. In addition, the death rate for obese people was quite high[13]. Large abdominal circumference causes the release of leptin, angiotensinogen, necrosis tumor factor-α (TNF-α), plasminogen activator inhibitor-1 (PAI-1), and reject from stomach adipocytes, and reduces the release of adiponectin, thereby inducing diseases such as diabetes mellitus, periodontitis, and cardiovascular[14].

The purpose of this study was to determine the factors associated with abdominal circumference in adolescents girls, where the risk of central obesity was observed to be higher in women compared to men[4]. Apart from that, these factors include body mass index, body fat percentage, food consumption patterns including type, frequency and amount of energy intake, fat and sugar, as well as eating behavior, including overeating and dieting behavior. Statistical analysis of the causes of abdominal circumference is necessary to prevent central obesity.

METHODS

This research was an observational analytic study with a cross-sectional research design. It was conducted at one *Pesantren*-Based University in East Java,namely Universitas Darussalam Gontor. The population in the study were young women aged 18 - 24 years, with a sample of 89 respondents calculated using the lameshow formula. Sampling was taken by purposive sampling, namely the sampling method by adjusting predetermined criteria[15]. The inclusion criteria in the study were young women aged 18-24 years and were not on a diet. Exclusion criteria in the study were taking weight loss supplements.

The dependent variable in this study was abdominal circumference and the independent variables in this study were body mass index, body fat percentage, junk food consumption patterns including type, frequency and amount of energy and fat from junk food, energy, fat and sugar intake, and eating behavior, including overeating behavior and dieting behavior.

Abdominal circumference data was taken by using metline with the brand name was one med medline. Measurements were taken at the midpoint between the supra iliac border and the ribs[16].

Body Mass Index (BMI) was obtained by measuring body weight using a digital scale with the brand GEA and height using a microtoise with the brand One Med. It was calculated using the formula [weight (kg)/height² (m²)]. BMI was categorised into two categories; normal and abnormal. If the score is 18.5 - 22.9 then it is categorized as normal BMI meanwhile, if the score is less than 18.5 and more than 22.9, then it is abnormal BMI[17]. Body weight, height and abdominal circumference measurements were carried out by personnel who have been previously trained. Body fat percentage was obtained throughthe Bioelectrical Impedance Analysis (BIA) method, using an Omron body fat analyzer. Food consumption patterns including quantity and frequency were obtained using the SQ-FFQ. The food ingredients in the questionnaire list were created based on a preliminary survey using recall as well as conducting a Focus Group Discussion (FGD)[18]. Junk food variables including, type, frequency and amount of energy and fat from junk food were obtained using the SQ-FFQ with junk food ingredients in the questionnaire list were created based on FGD.

Eating behavior to see overeating used a questionnaire that adopts the Adult Eating Behavior Questionnaire (AEBQ). AEBQ consists of several questions that lead to eating behavior[19]. Diet and oral control data were obtained by the Eating Attitude Test (EAT) questionnaire[20]. EAT-26 is a questionnaire to see the risk of eating disorders which includes three factors; diet, bulimia and oral control. The diet factor consists of 13 items and was characterized by reducing foods containing calories, carbohydrates and sugar motivated by the desire to lose weight. The second factor was bulimia and/or food preoccupation with 6 items, characterized by the desire to expel food that has been consumed due to thoughts related to excessive food. The remaining seven items were included in the "oral control" factor which reflects self-control tendencies towards eating[21]. The last was pocket moneyin which the data was taken using questionnaire. Pocket money also have relationship with nutritional status[22]. There are 4 categories that adopted from previous research[6]. Data analysis used the STATA 13 application using the Spearman test due to not normally distributed data.

RESULTS AND DISCUSSION

Respondent characteristics including age, pocket money, central obesity category and BMI presented in Table 1. The subjects in the research were female teenagers aged 18–24. According to the World Health Organization (WHO) and the United Nation Population Fund (UNFPA), adolescents are young people aged 10-24 years[23]. In reality, Central obesity increases with age[4]. The prevalence of central obesity in adolescents continues to increase, especially in adolescent girls, which tends to be higher than to adolescent boy[5]. The data showed that The average pocket money for female students was around Rp 500,000 – Rp 1,000,000. The results of research by Rahman stated that there was a relationship between pocket money and food consumption patterns and nutritional status[24]. Furthermore, Miao Li also stated that pocket money was related to consuming unhealthy food and being overweight[25]. Another research stated that Pocket money was a risk factor for unhealthy eating and obesity[22]. The results of this study indicate that 48.3% of

respondents had an abnormal BMI.

Table 1. Respondent characteristic

Characteristic	n	%
Aged		
18-20 years old	44	49.44
21-24 years old	45	50.56
Pocket Money		
<Rp 500,000	28	31.5
Rp 500,000 – Rp 1,000,000	47	52.8
Rp 1,000,000 – Rp 2,000,000	12	13.5
>Rp 2,000,000	2	2.2
BMI	43	51.7
Normal		
Abnormal	46	48.3

The Factor of central obesity in adolescents are multifactorial, which means it is caused by many factors[5]. Table 2 showed the relationship between the factors causing central obesity. Factors causing obesity were BMI, percentage of body fat, type of junk food, frequency of junk food, energi intake from junk food, fat intake from junk food, total energy intake, total fat intake, fiber intake, overeating behavior, diet attitudes dan oral contral.

Table 2. Factor of central obesity

Variabel	Mean ± SD	(min – max)	p-value*	r
BMI	23.53 ± 4.08	16.11 – 37.16	0.00	0.677
Percentage of body fat (%)	30.48 ± 6.15	15.30 – 54.30	0.00	0.5635
Type of junk food	19.66 ± 12.57	3 – 52	0.03	0.2349
Frequency of junk food (times)	2.71 ± 2.27	0.41 – 11.10	0.04	0.2121
Energy intake from junk food	563 ± 413	655 - 1936	0.01	0.2886
Fat intake from junk food	22.95 ± 21.4	1.74 – 135.43	0.02	0.2487
Total energy Intake (kcal)	1438 ± 571	653 – 2973	0.04	0.2224
Total fat intake (gram)	39,35 ± 25.04	10.07 – 148.82	0.02	0.2475
Fiber intake (mg)	5.48 ± 3.45	2.23 – 17.87	0.18	0.1454
Overeating behavior (score)	10.24 ± 4.80	5 – 25	0.02	0.2501
Diet attitude (score)	21.03 ± 7.95	3 – 36	0.00	-0.5279
Oral control (score)	10.70 ± 3.44	3 – 18	0.00	0.3926

*Spearman test

Based on the relationship test of several variables, it is said that there was a significant relationship between BMI, body fat percentage, food consumption patterns including the type and frequency of junk food consumption, food intake including energy, fat and sugar, as well as intake from consuming junk food including energy and fat from junk food, overeating eating behavior, diet and oral control with abdominal circumference.

Relationship between BMI with Abdominal Circumference

Based on statistical results, BMI has a significant correlation/relation with abdominal circumference (p<0.001) with a value of r=0.67 which showed a strong relationship and positive correlation. The higher body mass index, the higher the abdominal circumference. Evidence in previous studies, showed that abdominal circumference increases with increasing body mass index[26]. In the study group, abdominal circumference was found to be significantly correlated with BMI (r=0.78, p<0.01). Based on Gierach's research, it showed that overweight was associated with an increase in the volume of visceral tissue in the stomach[27]. Sudibjo in his research also said that BMI was related to abdominal circumference. In men, excess body fat is stored in the stomach and in women, apart from the stomach, it is also stored in the buttocks and gluteofemoral[28]. Fat storage will cause variations in body fat distribution. An increase in total body fat will cause the mass of subcutaneous and visceral adipose tissue to also increase[7].

Relationship between Body Fat Percentage and Abdominal Circumference

Body fat percentage has a relationship with abdominal circumference (p<0.001) with a value of r=0.56, indicating that the higher the percentage of body fat, the higher the abdominal circumference value. Furthermore, Body fat was significantly higher in women than in men[29]. Research conducted by Arif stated a positive correlation between abdominal circumference and body fat percentage. Individuals with a high percentage of body fat tend to have a higher distribution of fat in the abdominal area[30]. Similar to Mighra, it showed a positive relationship between fat percentage and abdominal circumference. Excessive abdominal circumference was associated with excess body fat and obesity[31]. In addition, Freur also said that measuring

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abdominal circumference was a measurement that was generally used to estimate excess body fat[32].

Relationship between the Type of Junk Food Consumption and Abdominal Circumference

Based on the research, it was found that the type of junk food consumption was significantly related to abdominal circumference (p<0.05) with a value of r=0.23. This means that the type of junk food consumed has a positive correlation with abdominal circumference, where the more types of junk food consumed, the greater the the abdominal circumference, but with low link strength. However, Factors that influence the prevalence of obesity are lifestyle and dietary changes. Eating habits have changed from a traditional to a western diet, in which people tend to consume foods in high calories, fat, carbohydrates, cholesterol, and sodium, but low in fiber, such as junk food and soft drinks, which will lead to an imbalance in food intake and as a risk factor for obesity in teenagers[33]. Similar to the research conducted by Cuncha who said that the western diet including junk food, had a significant effect on abdominal circumference[34]. Junk food is food and drink that has less of nutritional value[35]. Consuming junk food is one of the causes that contributes to the increase in obesity because junk food has a less nutritional content, high fat and low fiber, which also contains a lot of salt, sugar, and additives, high in calories, low in vitamins and minerals[36]. Based on research conducted by Septiana, it showed that young women like to consume various types of junk food. The types of junk food often consumed by young women were instant noodles, fried food, cilok, and fried chicken. Junk food has become a popular food because has a good taste, practical, and economical. Fried food was a type of junk food that contributes more energy compared to Western food[37]. Singh in his research said that adolescent girls who consumed junk food were found to have a greater risk of developing central obesity[38].

Relationship between Frequency of Consumption of Junk Food and Stomach Circumference

Frequency of junk food consumption was related to abdominal circumference (p<0.005) with a strength of relationship r=0.21 which means weak. The higher the frequency of junk food, the larger a person's abdominal circumference. The frequency of food consumption was related to abdominal circumference[39]. Cuncha result said that there was a relationship between the pattern of consumption of junk food, including the frequency of junk food consumption with the abdominal circumference[34]. Boylan, in his research, said that teenagers like to eat junk food more than 3 times per week[40]. Adolescent girls who are obese, on average, consume junk food more than once a week and even every day. The cause of the high consumption of junk food was if their desire and habit of snacking and the availability of junk food around them. The habit of consuming junk food was caused by doing assignments and chatting with peers, one of the factors that also influences the high consumption of junk food in young women[37]. Based on literature review research conducted by Pebriani, concluded that the frequency of consumption of junk food affects obesity[36]. The

frequency of consumption of junk food influences the incidence of central obesity. Singh in his research found that the percentage of respondents who frequently consumed junk food was very high, by 77.60% among the population studied[38].

Relationship between Energy Intake from Junk Food and Abdominal Circumference

Junk food has a correlation with central obesity. Energy intake from junk food contributed 40% odaily energy intake[41]. The results of the data analysis showed a significant relationship between energy intake from junk food and abdominal circumference (p<0.005) with positive strength (r=0.28) Thehigher the energy intake from junk food, the larger a person's abdominal circumference. The Result from Cuncha research indicated that there was a relationship between the pattern of junk food consumption, including the amount of energy from consuming junk food to the abdominal circumference[34]. The average energy intake from junk food contributed 23.20% of the Recommended Dietary Allowance (RDA) or ¼ of the adequate RDA of[37]. Hartanti's research on the relationship between energy intake and waist to hip rasio circumference stated that the high energy intake was mostly caused by consuming a lot of junk Food purchased at local stalls Office for lunch which is a high-calorie meal[42].

Relationship of Fat Intake from Junk Food Against Abdominal Circumference

Women who consume junk food have a higher risk of developing central obesity[38]. Junk food is a food that high in fat, high in sugar, and salt[43]. Research showed that fat intake from consuming junk food was related to abdominal circumference (p<0.05). The higher the fat intake from junk food, the larger the abdominal circumference (r=0.24). Junk food had a high-fat content and low nutrients such as vitamins and minerals[44]. Result from Cuncha said that there was a relationship between the pattern of consumption of junk food, including the amount of fat from consumption of junk food to the abdominal circumference circumference[34].

Relationship between Total Energy Intake and Abdominal Circumference

Energy intake had a significant relationship to abdominal circumference and body mass index, in other words, energy intake was correlated with obesity, including central obesity[45]. This study showed that energy intake was correlated with abdominal circumference (p<0.005) with a value of r=0.222. The higher the energy intake consumed in one day, the higher the stomach circumference. In contrast to Fransisca's research, energy intake had no relationship with abdominal circumference, but as many as 20 subjects with central obesity were known to have an average energy intake that exceeded the nutritional adequacy rate[46]. This research was in line with Hartanti's research, that energy intake had a relationship with waist circumference. Energy intake was the number of calories consumed in one day. Excess energy occurs when energy intake through food exceeds the energy expended

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through physical activity, so this excess energy will be stored as body fat[42].

Relationship between Fat Intake and Abdominal Circumference

Patterns of macronutrient intake, especially fat intake, had a significant relationship with abdominal circumference[47]. This Research showed that fat intake had a significant relationship with abdominal circumference ($p<0.05$). The higher the fat intake, the greater the abdominal circumference with a value of $r=0.24$. Previous research also showed the same thing, namely high fat intake was associated with high abdominal circumference[32]. In contrast to the Kooshki study which said that fat intake was not associated with central obesity, however, the study found that as many as 43.9% of women had central obesity with an average percentage of fat intake was 67.13 grams[48]. High intake of foods contributes high fat and sugar content 78ndi f not excreted there will be accumulation in the body[49].

Relationship between Fiber Intake and Abdominal Circumference

Fiber plays an important role in obesity control. Fiber intake was related to abdominal circumference. Du's study concluded that fiber intake from fruits and vegetables did not have a significant relationship with body weight but was associated with abdominal circumference[50]. In contrast to this study, which said that fiber consumption had no relationship with abdominal circumference ($p>0.05$). However, fiber was not the only factor that affected abdominal circumference[50].

Relationship of Emotional Overeating to Abdominal Circumference

Emotional overeating is one of the assessments of eating behavior in terms of the behavior of the desire to eat or what is called the food approach[51]. Emotional over eating behavior had a strong relationship with the incidence of obesity[19]. In line with this research, there was a significant relationship between emotional overeating and abdominal circumference ($p=0.01$ with $r=0.25$). There was a positive relationship indicating that the higher the eating behavior was related to emotional overeating or the desire to overeat which leads to the higher of abdominal circumference. In contrast to this study, which used measurements of abdominal circumference, Kowalkowska's study showed that eating behavior in the form of emotional eating affected BMI in women with a value of $r=0.184$. On the other hand, BMI also had a significant relationship with abdominal circumference[52]. Herle in his research showed that emotional eating affected obesity as was measured using a body mass index of[53].

Relationship of Diet Attitude to Abdominal Circumference

Eating behavior had a significant relationship with body mass index[54]. It is stated that the relationship between BMI and abdominal circumference in this study indicated that body mass index also had a positive correlation with abdominal circumference. Eating behavior using the EAT questionnaire is one way to see whether someone has an eating disorder. This eating behavior can reflect strict weight management or a diagnosis of incorrect eating behavior. One of the points in the EAT is diet attitude[54,20]. Based on the research, it was concluded that diet-eating behavior had a negative effect on waist circumference ($p<0.001$; $r=-0.52$). Thus, the higher the eating behavior score on the dietary behavior factor, the lower a person's abdominal circumference, and vice versa, the lower a person's desire or dietary attitude score, the smaller the abdominal circumference. The EAT questionnaire is a questionnaire to identify the possibility or risk of eating disorders. At the point of dieting the questions asked were "fear of getting fat", "paying attention to the calories of food consumed", avoiding foods with high calories", "feeling guilty after eating", "thinking about wasting calories", "likes to think about body fat", "avoid consuming sugar", "eat diet food", "feel uncomfortable after eating sweet". Based on the existing questions, it can be explained that someone who had a behavior related to EAT questionnaire, they will have a smaller abdominal circumference compared to people who do not have this behavior. However, in contrast with Rukavishnikov, in his research, he stated that a higher EAT score on a diet is associated with a higher risk of obesity[55].

Relationship between Oral Control Behavior and Abdominal Circumference

Oral control is self-control over food. Based on the results of the study it was said that there was a significant relationship between oral control and abdominal circumference ($p=0.0001$) with a value of $r=0.39$. It indicated that the higher the EAT score on oral control, the higher the abdominal circumference. This is not in line with a study conducted by Rukavishnikov which said that a high EAT score on oral control was associated with a reduced risk of obesity[55]. On the EAT questionnaire, questions related to oral control were related to food self-control. The question points were "avoiding eating when hungry", "reducing food portions", "other people think that they are too thin", consuming food longer", "controlling themselves when there is food", and "other people's feelings pressure to eat".

CONCLUSIONS

Based on the analysis, There was a significant relationship between BMI, body fat percentage, junk food consumption patterns (type, frequency, amount of intake, and fat), energy intake, fat, emotional overeating, diet attitudes and oral control with abdominal circumference. However, There was no significant relationship between fiber intake and abdominal circumference.

The implication of policy from this reseach was to provide policies regarding food labels, especially for junk food. This policy should include the number of calories in each food sold so as to prevent an increase in the prevalence of obesity. The limitation of the research is that it was only carried out in Islamic boarding school areas and did not pay attention to confounding variables that could influence the research results.

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