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A Cross-Sectional Study of Obesity Determinants in Female Adolescents at the Gontor Islamic Boarding School for Girls

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Abstract

BACKGROUND: The prevalence of obesity in adolescents has increased worldwide for recent years. Body mass index (BMI)/age, waist circumference (WC), and waist-to-height Ratio (WHtR) are commonly used for assessment of nutritional status. Daily intake of fruits and vegetables and eating time of fruits inversely associated with obesity.

AIM: This study aimed to investigate the associations of daily intake of fruits and vegetables and eating time of fruits with obesity in female adolescents at the Gontor Islamic boarding school for girls.

MATERIALS AND METHODS: This cross-sectional study recruited 245 female adolescents from the Gontor Islamic Boarding School for girls, which were selected with a purposive sampling technique. They were eligible to follow this study if aged 12–16 years old and were healthy. Data of daily intake of fruits and vegetables were collected using the modified semi quantitative food frequency questionnaire. Anthropometric data consisted of body weight, height, and WC were measured using the standard measurements. Associations of individual variables with anthropometric parameters were analyzed using the Chi-square test. The multiple logistic regression tests were, then, used to analyze associations of independent variables and confounding factors together with BMI/age, WC, and WHtR with a 95% significant level.

RESULTS: The prevalence of overweight and obese was 31 and 2% among female adolescents, respectively. Intake of fruits and vegetables associated with BMI/age (p = 0.001), WC (p = 0.039), and WHtR (p = 0.024). Eating time of fruits had no associations with BMI/age (p = 0.207), WC (p = 0.551), and WHtR (p = 0.132). Inadequate intake of fruits and vegetables inversely associated with BMI/age (OR = 2.60; p = 0.002), WC (OR = 1.86; p = 0.047), and WHtR (OR = 1.92; p = 0.039).

CONCLUSION: Daily intake of fruits and vegetables inversely associates with BMI/age, WC, and WHtR but not for eating time of fruits among female adolescents in the Gontor Islamic Boarding School for girls.

Introduction

Adolescents are one of more susceptible age groups to have over nutrition around the world [1]. The global prevalence of adolescents with over nutrition (overweight and obese) reaches approximately 340 million [2]. According to data of the basic health research in Indonesia (2018), the prevalence of overweight and obese is 16% in 13–15 years and 13.5% in 16–18 years old, respectively. Moreover, the prevalence of over nutrition in female adolescents (11.4%) is higher than that of in male adolescents (7.7%) [3].

Based on the regulation of Indonesian Ministry for Education and Culture, adolescents have to get basic education, which commences from primary to secondary schools. In public or private schools, females and males study together in the same classroom[4]. However, in boarding schools, especially Islamic education, adolescent females study separately from adolescent males in different schools. Gontor boarding schools for instance are one of the biggest Islamic educations in Indonesia to provide basic education for female students, separated from male students in different buildings and locations. Interestingly, over nutrition has become a health problem for female students in the Gontor Islamic boarding schools [5], which is also found in another boarding school at Bantaeng Regency, South Sulawesi Province with 5–25% prevalence [6].

Body weight (BW), height, body mass index (BMI)/age, waist circumference (WC), and waist-to-height ratio (WHtR) parameters are commonly used to monitor the nutritional status of all people [7]. For example, the BMI/age is routinely used to measure individual nutritional status in the community setting, but this method is unable to measure body fat in all parts of the human body. Therefore, it needs another anthropometric method to evaluate body fat in cases of central or abdominal obesity [8]. WC is a sensitive

method to determine body fat distribution in the abdominal area and which can distinguish between android and gynecoid types of central obesity [9]. However, the WC measurement lacks of accuracy in determination of body fat percentage and mass [10]. In clinics of BW management, bioimpedance analysis and dual-energy X-ray absorptiometry methods are often used to measure human body fat, but these methods are expensive and impracticable in the community setting [11]. Recently, WHtR has also become an alternative parameter to determine central obesity [12].

Many factors contribute to over nutrition in Indonesian adolescents such as eating habits, daily fiber intake, and eating time of fruits. Most adolescents are more likely to consume foods with high-fat, high-energy, high sugar, and high salt but consuming foods with low-fibers and skipping breakfast [13]. A previous study reported that 62.9% adolescents with obesity in Palembang city consumed excessive amounts of fat [14]. Moreover, students with overweight often consume some snack packs with sweet, salty and savory, sweet beverages, dairy products, and other processed products [15].

In addition, Indonesian adolescents consume less than five portions of fruits and vegetables as recommended by the Indonesian Health Ministry [16]. About 95.5% of the Indonesian population also consumes inadequate amounts of fruits and vegetables [17]. In fact, vegetables and fruits are good and affordable sources of fibers and have low-calorie [18]. Another study reported that inadequate intake of fruits (84.1%) and vegetables (81.8%) were also observed in female adolescents in the Science of Al-Qur'an Islamic boarding school at Ciomas, Bogor [19]. However, daily intake of fruits and vegetables among female adolescents in the Gontor Islamic Boarding Schools has not been reported yet.

In general, most Indonesian people consume fruits in post meal times, but some people like consuming fruits during snack time. According to a previous study, the consumption of pre-breakfast banana for 3 days reduced WC in healthy adults [20] and its fiber content prolonged gastric emptying and increased food satiety [21]. Therefore, this study aimed to investigate the associations of daily intake of fruits and vegetables and eating time of fruits with BMI/age, WC, and WHtR among female adolescents in the Gontor Islamic Boarding School for girls.

Materials and Methods

Research design

This was an observational study with cross-sectional design, which was conducted from November to December 2021. Respondents were recruited from all female adolescents who lived and studied at the 2nd campus, Darussalam Gontor Boarding School, Mantingan, Ngawi, East Java. Sample size in this study was calculated using the Lemeshow formula [22]. For selecting research respondents, we established inclusion criteria as follows: aged 12–16 years old, and were healthy, while they were excluded from this study when undergoing a weight loss diet program, taking drugs or supplements, and becoming vegetarian. Therefore, we obtained 245 total respondents. Before the research began, respondents signed an informed consent.

Data collection of daily intake of fruits and vegetables

Basic characteristics of respondents such as age and educational level were collected using a short questionnaire. The modified semi-quantitative food frequency questionnaire was used to collect data of fruit and vegetable intake [23]. There were two categories of fruit and vegetable intake: less than five and more than and equal to five portions/day. According to the balanced nutrition guideline for Indonesian people, adequate consumptions of fruits and vegetables are at least five servings per day for 7 days a week. For adolescents (13–18-years-old), it was recommended to consume 400–600 g fruits and vegetables/person/day, in which two-thirds of the recommended intake come from vegetables [24]. Meanwhile, daily fruit intake was separated in two categories: snack and post meal times. Fruits were consumed twice during snack time in the morning and the afternoon [25].

Anthropometric data collection

We measured anthropometric data such as BW, height, and WC using the standard measurements [26]. The BMI/age of respondents was calculated using the z-score method, adopted from the World Health Organization. The nutrition status was classified into underweight (−3 SD to <−2 SD), normal (−2 SD to +1 SD), overweight (+1 SD to +2 SD), and obese (>+2 SD) [27]. The nutrition status was divided into two categories: normal and abnormal (underweight, overweight, and obese). The WC measurement was classified into two categories: <80 cm and ≥80 cm [28]. A WHtR was obtained by dividing the WC with the height, which was ≤0.5 and ≥0.5 [29].

Data analysis

All research data were analyzed using the Statistical Package for the Social Sciences version 18 for windows. The categorical data were presented as number and percentage, while the numerical data were presented as mean ± standard deviation. The

Table 1: General characteristics of respondents

Variable	Total (n=245)	
	Mean ± SD	Frequency (%)
Age (Years)	14 ± 1.16	
13–15		211 (86.1)
16–18		34 (13.9)
Educational level		
Junior high school		178 (72.7)
Senior high school		67 (27.3)
History of food allergies		
Yes		25 (10.2)
No		220 (89.8)
History of acute illness		
Yes		73 (29.8)
No		172 (70.2)
Intake of fruits and vegetables		
<5 Portion/day		163 (66.5)
≥5 Portion/day		82 (33.5)
Eating time of fruits		
Snack		189 (77.1)
Post meal		56 (22.9)
Nutrition status		
Underweight		11 (4.5)
Normal		153 (62.4)
Overweight		76 (31)
Obese		5 (2)
Waist circumference		
<80 cm		167 (68.2)
≥80 cm		78 (31.8)
Waist circumference-height ratio		
<0.5		168 (68.6)
≥0.5		77 (31.4)

Kolmogorov –Smirnov test was used to evaluate the data normality. Associations of daily intake of fruits and vegetables and eating time of fruits with BMI/age, WC, and WHtR were determined using the chi-square test with a 95% significance level. The multiple logistic regression tests were finally used to further analyze variable independent and confounding factors with the dependent variables.

Results

Characteristics of respondents

According to the World Health Organization (2014) and the Minister of Health of the Republic of Indonesia's Regulation Number 25 (2014), adolescent age ranges from 10 to 18 years old. From Table 1, the average of respondent's age in this study was 14 ± 1.16 years old and 86.1% among them were in 13–15 years old and mostly studied at junior high school. The majority of respondents have no allergy or acute sickness history. About 66.5% respondents consumed <5 portions/day of fruits and vegetables and most of them (77.1%) consumed fruits as a snack. We found that accidental prevalence of overweight and obese was 31% and 2%, respectively. Meanwhile, 31.8% respondents had ≥80 cm WC and 31.4% respondents had ≥0.5 WHtR.

Daily intake of fruits and vegetables inversely associated with BMI/age

From Table 2, it indicated that intake of fruits and vegetables, education level, and history of acute illness inversely associated with BMI/age. Inadequate intake of fruits and vegetables (<5 portions/day) significantly increased BMI/age (OR = 2.69; p = 0.001). Lower education level and no history of acute illness significantly increased BMI/age (OR = 0.56; p = 0.043 and OR = 1.91; p = 0.033, respectively).

Table 2: Bivariate analysis of daily intake of fruits and vegetables and eating time of fruits with BMI/age

Variable	BMI/Age		OR (95% CI)	p
	Normal n (%)	Abnormal n (%)		
Independent variables				
Intake of fruits and vegetables				
<5 Portion/day	90 (55.9)	73 (44.8)	2.69 (1.48–4.89)	0.001*
≥5 Portion/day	63 (76.8)	19 (23.2)		
Eating time of fruits				
Snack	114 (60.3)	75 (39.7)	1.51 (0.79–2.86)	0.207
Post Meal	39 (69.6)	17 (30.4)		
Confounding variables				
Educational level				
Junior high school	118 (66.3)	60 (33.7)	0.56 (0.31–0.98)	0.043*
Senior high school	35 (52.2)	32 (47.8)		
History of food allergies				
Yes	18 (72)	7 (28)	1.62 (0.65–4.04)	0.299
No	135 (61.4)	85 (38.6)		
History of acute illness				
Yes	53 (72.6)	20 (27.4)	1.91 (1.05–3.47)	0.033*
No	100 (58.1)	72 (41.9)		

*Significance with p < 0.05. BMI: Body mass index.

From further statistical analysis, only inadequate intake of fruits and vegetables had a greater risk of increased BMI/age, compared to adequate intake of fruits and vegetables (Table 3). The model 1 indicated that inadequate intake of fruits and vegetables (OR = 2.60; p = 0.002) significantly increased BMI/age, while eating more snack (OR = 1.31; p = 0.418) did not significantly increased BMI/age. When the confounding factors (education level and histories of food allergies and acute illness) were added to the independent variables, inadequate of fruits and vegetables and no history of acute illness simultaneously increased BMI/age (OR = 2.53; p = 0.003 and OR = 0.68; p = 0.045, respectively).

Daily intake of fruits and vegetables inversely associated with WC

In addition to the association of BMI/age, Table 4 indicated that only intake of fruits and vegetables significantly associated with WC (p = 0.039). Inadequate intake of fruits and vegetables (OR = 1.88; p = 0.039) significantly increased the WC, whereas no history of food allergies (OR = 1.98; p = 0.181) and no history of acute illness (OR = 1.12; p = 0.710) did not significantly increased the WC. By contrast, eating fruits at snack time (OR = 0.82; p = 0.551) and lower education level (OR = 0.60; p = 0.098) did not significantly decreased the WC.

Consistent with our previous findings, only inadequate intake of fruits and vegetables had a greater risk of increasing WC, compared to the adequate intake of fruits and vegetables (Table 5). From the model 1 and 2, inadequate intake of fruits and vegetables remained stable to significantly increase around 1.86 times of WC

Table 3: Multiple logistic regression analysis of daily intake of fruits and vegetables, eating time of fruits, and confounding factors with body mass index/age

Variable	OR (95% CI)	B	p	Nagelkerke R Square
Model 1				
Inadequate intake of fruits and vegetables	2.60 (1.42–4.76)	0.957	0.002*	0.065
Eating fruits at snack time	1.31 (0.68–2.53)	0.272	0.418	
Model 2				
Inadequate intake of fruits and vegetables	2.53 (1.37–4.68)	0.929	0.003*	0.112
Eating fruits at snack time	1.39 (0.71–2.72)	0.329	0.338	
Educational level (junior high school)	1.77 (0.98–3.21)	0.572	0.059	
No history of food allergies	0.68 (0.26–1.77)	-0.388	0.429	
No history of acute illness	0.52 (0.28–0.98)	0.640	0.045*	

*Significance with p < 0.05.

Table 4: Bivariate analysis of daily intake of fruits and vegetables and eating time of fruits with WC

Variable	WC		OR (95% CI)	p
	<80 cm n (%)	≥80 cm n (%)		
Independent variables				
Intake of fruits and vegetables				
<5 Portion/day	104 (63.8)	59 (36.2)	1.88 (1.03–3.44)	0.039*
≥5 Portion/day	63 (76.8)	19 (23.2)		
Eating time of fruits				
Snack	127 (67.2)	62 (32.8)	0.82 (0.43–1.58)	0.551
Post meal	40 (71.4)	16 (28.6)		
Confounding variables				
Educational level				
Junior high school	130 (71.0)	53 (29.0)	0.60 (0.33–1.09)	0.098
Senior high school	37 (59.7)	25 (40.3)		
History of food allergies				
Yes	20 (80)	5 (20)	1.98 (0.71–5.51)	0.181
No	147 (66.8)	73 (33.2)		
History of acute illness				
Yes	51 (69.9)	22 (30.1)	1.12 (0.62-2.03)	0.710
No	116 (67.4)	56 (32.6)		

*Significance with p< 0.05. WC: Waist circumference.

Table 5: Multiple logistic regression analysis of daily intake of fruits and vegetables, eating time of fruits, and confounding factors with waist circumference

Variable	OR (95% CI)	B	p	Nagelkerke R Square
Model 1				
Inadequate intake of fruits and vegetables	1.86 (1.01–3.42)	0.101	0.047*	0.025
Eating fruits at snack time	1.11 (0.57–2.16)	0.619	0.766	
Model 2				
Inadequate intake of fruits and vegetables	1.83 (0.99–3.40)	0.607	0.054	0.051
Eating fruits at snack time	1.10 (0.32–1.11)	0.102	0.766	
Educational level (junior high school)	0.60 (0.33–1.11)	−0.505	0.104	
No history of food allergies	2.21 (0.74–6.06)	0.752	0.160	
No history of acute illness	1.02 (0.55–1.90)	0.024	0.939	

*Significance with p < 0.05.

with p = 0.047.

Daily intake of fruits and vegetables inversely associated with WHtR

We evaluated the associations of independent and confounding variables with WHtR using the Chi-square test (Table 6). Intake of fruits and vegetables (OR = 2.02; p = 0.024) and history of food allergies (OR = 3.72; p = 0.028) inversely associated with WHtR, while eating time of fruits (OR = 0.59; p = 0.132), education level (OR = 1.20; p = 0.549), and history of acute illness (OR = 1.09; p = 0.777) did not associate with WHtR.

Table 7 confirmed that only inadequate intake of fruits and vegetables had a greater risk of increasing WHtR, compared to adequate intake of fruits and vegetables. From the model 1 and 2, the association of fruits and vegetables intake with WHtR remains

Table 6: Bivariate analysis of daily intake of fruits and vegetables and eating time of fruits with WHtR

Variable	WHtR		OR (95% CI)	p
	<0.5 n (%)	≥0.5 n (%)		
Independent variables				
Intake of fruits and vegetables				
<5 Portion/day	104 (63.8)	59 (36.3)	2.02 (1.09–3.72)	0.024*
≥5 Portion/day	64 (78)	18 (22)		
Eating time of fruits				
Snack	125 (66.1)	64 (33.9)	0.59 (0.29–1.17)	0.132
Post meal	43 (76.8)	13 (23.2)		
Confounding variables				
Educational level				
Junior high school	24 (69.7)	54 (30.3)	1.20 (0.66–2.18)	0.549
Senior high school	44 (65.7)	23 (34.3)		
History of food allergies				
Yes	22 (88)	3 (12)	3.72 (1.08–12.82)	0.028*
No	146 (66.4)	74 (33.6)		
History of acute illness				
Yes	51 (69.9)	22 (30.1)	1.09 (0.60–1.97)	0.777
No	117 (68)	77 (31.4)		

*Significance with p < 0.05. WHtR: Waist-to-height ratio.

Table 7: Logistic regression analysis of daily intake of fruits and vegetables, eating time of fruits, and confounding factors with waist-to-height ratio

Variable	OR (95% CI)	B	p	Nagelkerke R Square
Model 1				
Inadequate intake of fruits and vegetables	1.92 (1.03–3.56)	0.651	0.039*	0.039
Eating fruits at snack time	1.54 (0.76–3.09)	0.430	0.229	
Model 2				
Inadequate intake of fruits and vegetables	1.92 (1.02–3.59)	0.653	0.042*	0.074
Eating fruits at snack time	1.57 (0.77–3.20)	0.451	0.215	
Education level (junior high school)	0.86 (0.46–1.58)	−0.153	0.464	
No history of food allergies	0.25 (0.07–0.88)	−1.138	0.031*	
No history of acute illness	1.03 (0.55–1.91)	0.027	0.932	

*Significant differences with p value < 0.05

unchanged. By adding confounding factors, no history of allergies significantly decreased 0.25 times of WHtR.

Discussion

Our study found that 31% female adolescents were overweight and 2% were obese, which were followed by central obesity with increased WC and WHtR. Moreover, the majority of female adolescents consumed <5 portions of fruits and vegetables/day, which was consumed at during snack time. Therefore, inadequate intake of fruits and vegetables increased 2.53 and 1.87 greater risks of over nutrition and central obesity, respectively, compared to adequate intake of fruits and vegetables in female adolescents.

Regarding to the prevalence of over nutrition and central obesity in the Islamic boarding school, our findings are in line with a previous study conducted in the Amanatul Ummah Islamic Boarding School, Surabaya city that 31.1% (45) respondents had overweight [30]. Another study at the Al-Fattah Islamic Boarding School, Sidoarjo City showed that 32% respondents were overweight as well [31]. However, both studies did not evaluate WC and WHtR as indicators of central obesity. Altogether, it indicated that the prevalence of overweight and obesity in female adolescents is higher than that of the National Basic Health Research [3]. In contrast, 38.12% (160) adolescents in a private Senior High School Santo Ignatius at Manado City had central obesity, but the researchers did not measure their nutrition status for determination of obesity [32].

In theory, general and central obesity is dominantly influenced by external factors such as physical activity and diet. In our study, physical activity has a little contribution to obesity, because most female adolescents at the Gontor Islamic Boarding School have moderate physical activities. Our observation is in agreement with a previous study performed at the same Islamic Boarding School, which indicated that 94.2% female adolescents had moderate activities [33].

Meanwhile, the second risk factor of obesity is prominent in our study. Inadequate daily intake of fruits and vegetables increased the greater risks of general and central obesity in female adolescents, compared to the adequate daily intake of fruits and vegetables. Our result study is in accordance to a study at the Kilimanjaro Boarding School Tanzania, which found that approximately 19% all adolescents rarely consumed fruits and vegetables. In addition, it found that 22.5% students were overweight and 7.8% students were obese [34]. Another research study showed that inadequate intake of fruits and vegetables increased 1.62 times risk of overweight among adolescents in India [35].

Based on data of daily intake of fruits and vegetables, we found that 66.5% female adolescents in the Gontor Islamic Boarding School consumed <5 servings of fruits and vegetables (±100 g/day). This amount only met 26% of recommended fruits and vegetables intake for Indonesian people (at least 400 g or 5 portions/day). So far, there is no similar research study that reported the quantity of daily intake of fruits and vegetables in female adolescents at Islamic Boarding Schools. Theoretically, dietary fibers within fruits and vegetables can enhance the glucagon-like peptide-1 secretion, which regulates satiety, gastric emptying, and intestinal transit time [36]. However, we did not evaluate these parameters in the present study. By eating more fruits and vegetables, the sensation of fullness might decrease daily food intake, which is able to prevent fat accumulation in the adipose tissues [37].

Possible causes of inadequate intake of fruits and vegetables in the Gontor Islamic Boarding School are limited menu cycle and high activities of female adolescents. Only one portion of mixed vegetables was provided during the lunch time and 1–2 whole fresh fruits were given every month. Moreover, some female students often skipped their meals in the lunch time because they were very busy with academic activities. Our findings are in line with a research study conducted at the Darul Arqam Islamic Boarding School Garut City, which vegetables and fruits were not routinely consumed by female adolescents [38]. In addition, most female students at the boarding schools consumed fruits during snack time, which contributed 17–21% of the total recommended energy intake [25]. However, eating time of fruits in our study did not associate with the general and central obesity in female adolescents. Meanwhile, education level, history of food allergies, and history of acute illness as confounding factors have minor association with anthropometric parameters.

Study limitations

The limitations of our study are we did not measure the quantity of fruit servings/day, which would influence the amount of fiber daily intake. Second, we did not evaluate in details physical activities how many metabolic equivalents of tasks were conducted by female adolescents, which also affected the nutrition status of female adolescents.

Conclusion

Daily intake of fruits and vegetables inversely associates with BMI/age, WC, and WHtR but not for eating time of fruits among female adolescents in the Gontor Islamic Boarding Schools for girl. Therefore, it is not surprising that approximately 30% female adolescents have general and central obesity. Based on this research findings, the management of Gontor Islamic Boarding Schools should provide more fruits and vegetables in daily intake for female adolescents to reduce the prevalence of obesity.

Ethical Approval

The research protocol has been approved by the Research Ethics Committee, Faculty of Medicine, Universitas Sebelas Maret Surakarta No. 77/UNS.27.96.6.1/KEP/EC/2021.

Authors' Contributions

IM, DI, and BW contributed to this research's execution. DI made the basic concept of this research while IM performed the research and collected data. IM and BW conducted the statistical analysis. IM wrote the article draft, while DI and BW reviewed and revised the full-text article. All authors approved the manuscript for publication.

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