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The Relationship of Fat Intake and Body Fat Percentage in Medical Students

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ABSTRACT

Introduction. Obesity is an excessive fat accumulation in the body, now the prevalence is increasing in the group aged>18 years based on Body Mass Index (BMI). Nowadays body fat percentage has been declared to assess the risk factor of disease-related body weight better than BMI, people with proportioned weight had excessive body fat percentage evenly. Excessive fat intake is one of the important factors for obesity. The objective of this study was to analyze the association between fat intake with body fat percentage. **Methods.** This study was conducted with a cross-sectional design on 275 medical faculty students of Sriwijaya University, starting from August until December 2017 by collecting primary data through completing forms, food records, questionnaires, and physical examinations. **Results.** The results were analyzed statistically using chi-square. 67.3% of subjects had excessive body fat percentage and 50.2% with excessive fat intake. Results by the chi-square test indicate a negative association between fat intake with body fat percentage (p value=0.184). **Conclusion.** Fat intake with body fat percentage was negatively associated.

1. Introduction

Obesity is the excessive accumulation of fat in the body due to the intake of food exceeding its utilization by the body as energy.[1] Globally, 37% of men and 38% of women are overweight, with approximately 50% of these cases concentrated in 10 countries: the United States, China, India, Russia, Brazil, Mexico, Egypt, Germany, Pakistan, and Indonesia.[2] Prevalence of central obesity in Indonesia also increased by 4,4% from 2013-2018.[3] Dietary fat intake is the most dominant factor associated with adolescent obesity.[4] Similar results were also found in other studies, where adolescents with excessive intake of carbohydrates and fats were twice as likely to develop obesity compared to those with sufficient carbohydrate and fat intake.[5] According to Guyton & Hall (2006), excessive carbohydrate consumption is also a source of fat accumulation in the body. Carbohydrates consumed are primarily stored as glycogen, and when glycogen storage cells approach glycogen saturation, excess glucose is converted into fat in the liver and fat cells and stored as fat in fat cells. Regular physical activity can prevent weight gain and obesity, while a sedentary lifestyle or lack of physical activity, such as watching TV habits, has the opposite effect.[6]

In Bitung City, a study on obesity based on waist circumference was conducted in several Senior High Schools. Out of 966 adolescents aged 15-18 years, 220 adolescents were found to be obese, comprising 59 males and 161 females. Interviews were conducted with 50 obese individuals, and it was found that 49 adolescents, accounting for 98%, were obese due to their habitual consumption of high-carbohydrate and fried food.[7] Another study was conducted on obese and non-obese students at the Surabaya Nutrition Academy. The results showed that seven students with fat intake above the recommended level belong entirely to the obese group.[8]

Excessive consumption of fat causes excessive accumulation of fat in the body while too little fat consumption will also disturb the balance in the body,

both of these harm health, but currently, the health problems caused by excessive fat consumption are greater, because excessive fat consumption is one of the important factors in the incidence of obesity associated with Non-Communicable Diseases (NCDs) such as cardiovascular disease, diabetes mellitus, and cancer.[9]

Body fat percentage is a better indicator for assessing the risk of weight-related diseases compared to BMI. Some individuals may have normal BMI but excessive body fat composition, while others, particularly trained athletes, may be overweight but not have excess fat.[10,11] Similar findings were reported in another study conducted on medical students in Bharmapur. Out of 150 students, comprising 85 males and 65 females aged 17-24, it was found that their BMI fell within the normal range (23.5% in males, 23.9% in females), but their body fat percentage exceeded the normal range. Specifically, it was 22.9% in males (normal range: 8%-19%) and 31.14% in females (normal range: 21%-33%).[12]

As discussed above, several factors influence obesity, such as fat intake, carbohydrate intake, and physical activity. However, the more dominant factor is fat intake, so fat intake is very important to study body fat percentage as an indicator of obesity. So far, the relationship between body fat percentage and body fat composition in adolescents and young adults in Indonesia has not been widely studied. This study aims to analyze the relationship between fat intake and body fat percentage in medical education students of the Faculty of Medicine, Sriwijaya University, because when viewed from the environmental conditions several factors support the occurrence of excessive body fat percentage in students of the Faculty of Medicine, Sriwijaya University, such as a busy lecture schedule so that physical activity tends to be low and also reduces the opportunity for students to look for food outside the campus area, students tend to buy food in the canteen while 13 out of 15 tenants there sell high-fat and carbohydrate foods such as fried foods, fried chicken with skin, thick pan-fried bread, ice cream, fruit juice added with milk and sugar, and others, therefore based on theory, research results and existing environmental conditions, this research is important to do.

2. Methods

This study was an observational analytic study with a cross-sectional design. The sample used consists of students from the medical education program at Sriwijaya University Faculty of Medicine, from 2014-2017. Sampling was conducted using proportionate stratified random sampling. The inclusion criteria were students willing to participate in the study and sign an informed consent form. Exclusion criteria included (1) students taking medication specifically for weight loss, and (2) students with other medical conditions that could affect the results (e.g., metabolic disorders) as determined through interviews. The variables examined in the study are body fat percentage, fat and carbohydrate intake, body mass index, and physical activity. Body fat percentage is measured using bioelectrical impedance analysis (BIA) from Tanita BC-571, while fat and carbohydrate intake is assessed using food records. The assessment of physical activity level is based on the PAL (physical activity level) values established by the Food and Agriculture Organization of the United Nations (FAO).

Table 1. Physical activity ratio of various physical activities[13]

Activity	Physical Activity Ratio
Sleeping (day and night)	1
Lying down, sitting still, reading	1.2
Sitting while watching TV	1.72
Bathing and dressing	2.3
Standing still, praying, waiting (standing), grooming	1.5
Traveling by car/bus/public transport	1.2
Eating, drinking	1.6
Leisurely walking	2.5
Shopping (carrying a load)	5
Driving a vehicle	2.4
Doing household chores	2.75
Ironing clothes (sitting)	1.7
Office worker (sitting at a desk, writing, typing)	1.7
Sports (badminton)	4.85
Sports (jogging, long-distance running)	6.5
Sports (cycling)	3.6
Sports (aerobics, swimming, football, etc.)	7.5
Activities done while sitting	1.5
Light activities	1.4
Cooking	2.1

$$\textbf{Physical Activity Level } (PAL) = \frac{\textbf{PAR x time allocation for each activity}}{\textbf{24 hours}}$$

All data obtained will be processed using SPSS version 24. The data will be grouped according to the variables and subjected to univariate analysis to observe frequency distributions. This will be followed by bivariate analysis to determine the relationship between dependent and independent variables using the chi-square test.

3. Results

The successfully collected sample amounted to 275 individuals. The majority of subjects were more than 18 years old (61.1%) while those aged less than 18 years were only 38.9%. Based on gender, 199 (72.4%) females were obtained, while only 76 (27.6%) were male. Almost the majority of subjects had a normal body mass index (67.3%).

There were 261 (94.9%) research subjects who consumed an adequate amount of carbohydrates, while only 14 (5.1%) consumed excessive carbohydrates. The number of subjects consuming excess fat and those with an adequate intake was almost the same, with 138 individuals consuming excessive fat, accounting for 50.2%. The majority of research subjects fall into the category of having excessive body fat percentage (67.3%), while only 90 individuals (32.7%) fall into the category of having a sufficient body fat percentage. Most of these research subjects experienced a lack of physical activity both on weekdays and holidays.

Table 2. Distribution of subject characteristics by age, gender, body mass index (N=275)

Variable	n	%
Age		
≤ 18 y.o	107	38.9
>18 y.o	168	61.1
Sex		
Male	76	27.6
Female	199	72.4
Body mass index		
Underweight	35	12.7
Normal	185	67.3
Overweight	55	20.0

Table 3. Distribution of subjects based on carbohydrate intake, fat intake, physical activity, and body fat percentage (N=275)

Variable	n	%
Carbohydrate intake		
Adequate	261	94.9
Excessive	14	5.1
Fat intake		
Adequate	137	48.9
Excessive	138	50.2
Body fat percentage		
Adequate	90	32.7
Excessive	185	67.3
Weekdays physical activity		
Adequate	5	1.8
Excessive	270	98.2
Holidays physical activity		
Adequate	26	9.5
Excessive	249	90.5

The average carbohydrate intake for males aged 16-18 years and 19-29 years is 161.58 grams per day and 178.50 grams per day, respectively, while females consume 173.51 grams per day and 177.69 grams per day. The average fat intake of subjects indicates that the average fat intake for males aged 16-18 years and 19-29 years is 71.49 grams (643.4 kcal) per day and 58.47 grams (526.23 kcal) per day, respectively. Females aged 16-18 years and 19-29 years consume an average of 62.21 grams (558.89 kcal) per day and 60.14 grams (541.26 kcal) per day, respectively.

There is a highly significant relationship between body mass index (BMI) and body fat percentage (p=0.000). The higher a person's body mass index, the higher the percentage of body fat they have. Subjects with normal BMI tend to have higher body fat percentages, while subjects with low BMI tend to have lower body fat percentages. The analysis reveals that although there is a higher proportion of subjects with excessive fat intake who also have a high body fat percentage, and vice versa, this association is not statistically significant (p=0.184). Despite a majority of respondents with sufficient carbohydrate intake

exhibiting excessive body fat percentage, and a smaller proportion with excessive carbohydrate intake also having excessive body fat percentage, the statistical analysis indicates that this relationship is not significant (p=0.355). This research indicates that there is no significant association between regular physical activity and body fat percentage among the respondents. Despite this, it is noteworthy that a higher proportion of individuals with inadequate physical activity exhibit excessive body fat percentage compared to those with sufficient physical activity.

Table 4. Average carbohydrate and fat intake by age and gender (N=275)

	16-18 yo		19-29 yo	
	Male (g/day)	Female (g/day)	Male (g/day)	Female (g/day)
Carbohydrate intake	161.58	173.51	178.50	177.69
Fat intake	71,49	62,21	58,47	60,14

Table 5. Relationship between body mass index, fat intake, carbohydrate intake, physical activity, and body fat percentage of subjects (N=275)

	Fat Percentage			
	Adequate n (%)	Excessive n (%)	Total (%)	p
Body mass index				
Underweight	30 (10.9)	5 (1.8)	35 (12.7)	0.000
Normal	56 (20.4)	129 (46.9)	185 (67.3)	
Overweight	4 (1.4)	51 (18.6)	55 (20)	
Fat intake				
Adequate	50 (18.2)	87 (31.6)	137 (49.8)	0.184
Excessive	40 (14.5)	98 (35.6)	138 (50.1)	
Carbohydrate intake				
Adequate	87 (31.7)	174 (63.3)	261 (95)	0.355
Excessive	3 (1.0)	11 (4.0)	14 (5)	
Physical activity in weekdays				
Adequate	0 (0.0)	5 (2)	5 (2)	0.115
Inadequate	90 (32.7)	180 (65.3)	270 (98)	
Physical activity on holidays				
Adequate	8 (3)	18 (6.3)	26 (9.3)	0.823
Inadequate	82 (30)	167 (60.7)	249 (90.7)	

4. Discussion

The majority of the subjects in this study were over 18 years old and female. This aligns with a study conducted among students at Tunku Abdul Rahman University in Malaysia, where they reported that the majority of the subjects were second-, third, and fourth-year students with an age range of over 20 years, comprising 61.9% of the sample.[14] Yilmaz et al. reported a significant portion (52%) of the respondents in the study were female.[15] Based on the Body Mass Index (BMI), most of the subjects have a normal BMI. This finding is consistent with research conducted among medical students in Bharmapur, where out of 150 students aged 17-24 years, the BMI was within the normal range.[12] Another study conducted at the Faculty of Medicine, Cerrahpasa University in Istanbul also reported that 76.1% of the subjects had a normal BMI.[15]

BMI has a significant relationship with body fat percentage. This aligns with research conducted in Nigeria, where there was a statistically significant relationship (p<0.01) between BMI and body fat percentage.[16] Nutrients such as saturated fatty acids, monounsaturated fatty acids, and protein also have a significant relationship with BMI.[17]

The carbohydrate intake of the subjects from this study indicates that almost all of the subjects consume an adequate amount of carbohydrates. This finding is consistent with research conducted in Sweden, which states that the average carbohydrate consumption among subjects is 53% (in females) and 51% (in males) of total energy intake.[18] However, the relationship between carbohydrate intake and body fat percentage was not significant, as indicated by the findings of a study conducted in India, where it was found that there was no significant relationship (p=0.06) between carbohydrate intake and body fat percentage.[19]

Meanwhile for fat intake in this study, half of the sample consumed excess fat. Fat intake is considered adequate if it is <25% of the total energy requirement.[20] Based on the average fat consumption, all female subjects consume excessive fat. This finding is consistent with research conducted at the University of Michigan, which shows that, on average, females consume higher fat content than males.[21] This study indicates that there is no significant relationship between fat intake and body fat percentage. Most of the subjects in this study have excess body fat percentage. This is similar to the

findings of a study conducted on medical students in Bharmapur, where the majority of subjects, both males and females, had excess body fat percentage.[12] Looking at the distribution of variables, the majority of subjects have excess body fat, but subjects with sufficient and excess fat intake have almost the same proportion. A study conducted in South Africa stated that high body fat percentage is related to socio-demographic factors such as marital status, place of residence, occupation, education, and age, as well as psychological factors such as stress, depression, and lifestyle.[22] The same findings were shown in a study conducted in Curitiba, where there was a relationship between body fat percentage and central obesity with socio-demographic factors and habits.[23] Adequate and regular eating habits, as well as satisfaction with the food consumed, influence body fat percentage.[24] Other research findings also have a similar report which is that excessive food consumption leads to a greater proportion of food being converted into fat.[25] In theory, if energy intake from carbohydrates, protein, and fat exceeds expenditure, this will stimulate obesity.[1] Body fat percentage is not only influenced by daily fat intake but also by intrinsic factors such as genetics, age, gender, habits, and stress levels, as well as extrinsic factors such as the environment, including school or work settings, and economic factors, all of which can affect it.[26,27]

From the research results, it was found that the subjects experienced insufficient physical activity. This is consistent with a study conducted in Istanbul, where they reported that 73% of the subjects fell into the category of insufficient physical activity.[15] Other studies have indicated that reducing fat intake combined with adequate physical activity over 12 months has a significant relationship with body fat percentage.[28] However, in this study, the relationship between physical activity on weekdays or holidays and body fat percentage was not significant. This corresponds with research conducted in the Indian Migration Study, which showed no relationship between lack of physical activity and body fat percentage.[19]

5. Conclusion

Most of the students in the Medical Education Study Program of Sriwijaya University have exceeded the recommended body fat percentage. However, neither carbohydrate nor fat intake correspond to body fat percentage in this study. Meanwhile, people with normal BMI or overweight tend to have excessive body fat percentages. For further study, a better approach can be done by utilizing food records supplemented with food photographs. This can expedite data gathering while maintaining accuracy. Moreover, the study's findings may have limited generalizability beyond the specific population studied, and caution should be exercised when extrapolating the results to broader demographics.

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