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The Effect of Food Diversity, Junk Food, and High Sugar Products on The Incidence of Overnutrition in Adolescent of SMAN 6 Depok

Pengaruh Keragaman Pangan, Junk Food, dan Produk Tinggi Gula Terhadap Kejadian Gizi Lebih Remaja SMAN 6 Depok

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ABSTRACT

Background: The problem of overnutrition in adolescents (10-18 years) is currently quite high, >15%. Food intake is known to affect nutritional status. Consumption of diverse foods reduces the risk of overnutrition in adolescents. However, adolescents today more often consume poor food intake, such as foods high in sugar, fat, and sodium and low in fiber. It is common knowledge that they increase the risk of overnutrition.

Objectives: To determine the relationship between the habit of dietary diversity, sugary food and beverages, and junk food consumption with overnutrition in adolescents.

Methods: This study employed an observational analytic design with a cross-sectional approach, conducted at SMAN 6 Depok. Data analysis included univariate and bivariate analyses using the chi-square test with a 95% confidence level. The sample consisted of 112 respondents, calculated using Lemeshow's formula for the difference between two proportions and selected using stratified random sampling. Validity and reliability tests with a significance level of 0.05 have been carried out on the questionnaire before being distributed.

Results: The validity test showed validity, and the reliability test showed a Cronbach Alpha value > r table (0.314). Bivariate analysis showed the adolescents did not experience overnutrition (80.4%), adolescents consumed a variety of foods (86.6%), rarely consumed sugary foods (80.4%) and sugary beverages (69.6%), and junk foods (70.5%)

Conclusions: There is no significant relationship between dietary diversity, sugary food and beverages, junk food consumption, and overnutrition in adolescents.

INTRODUCTION

Overnutrition and obesity are health problems occurring in many countries. Currently, the prevalence of overnutrition continues to increase and claims the lives of approximately 2.8 million people each year[1]. According to the FAO (Food and Agriculture Organization), the prevalence of obesity has increased by 2% since 2012, with more than 672 million people in the world who are obese[2].

In Southeast Asian countries, adolescents are currently facing the triple burden of malnutrition – a condition that refers to nutritional deficiencies (stunting and wasting), excess nutrition (obesity), and micronutrient deficiencies with anemia[3]. In 2023, the problem of over-nutrition status in Indonesia has increased compared to the prevalence of stunting, which has decreased by 2.8%[4]. Based on the results of the 2018 Basic Health Research data, the prevalence of overnutrition and obesity in adolescents in the West Java region can be said to be high – in adolescents aged 13–15

years, there were 16.9% who were overweight and obese, while in adolescents aged 16-18 years, there were 15.4% who were overweight and obese[5]. This percentage suggests much larger than the percentage of overnutrition experienced by toddlers aged 0-59 months (2%) in the West Java region[5].

Adolescents are an age group that still depends on their parents to meet their daily nutritional needs, whether by food, pocket money, or snacks provided[6]. Nevertheless, providing pocket money gives adolescents the right to choose what food or beverage to consume. The results of previous studies stated that the use of food delivery applications in the Jabodetabek (Jakarta, Bogor, Depok, Tangerang, Bekasi) area was quite high, at 77%[7]. These applications are generally used to purchase high-calorie and high-sodium food and sugary beverages[8].

The prevalence of overnutrition and obesity in adolescence is quite high, as can be seen from the high number of risky food purchases. One of the efforts that can be made to reduce overnutrition, obesity prevalence, and the consumption of dangerous foods is to implement

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and get used to consuming dietary diversity[9]. Consuming a diverse range of foods in adolescence can increase the opportunity to get optimal daily nutritional adequacy[10].

Dietary diversity is one of the efforts to reduce the number of nutritional problems because it meets both the macronutrients and the micronutrients needed by the body[11]. However, based on data from the 2018 Basic Health Research, 98.1% of the community does not consume sufficient vegetables and fruits[5]. In adolescence, vegetable and fruit intake is also minuscule when compared to the intake of risky foods[5]. Vegetables and fruits are needed to support the body's necessity for micronutrient intake. In adolescence, based on the results of a study by Amelia & Fayasari (2020) in Jakarta, it is known that the average daily fiber consumption was around 2.6–2.79 grams/day[12]. Adolescents who consumed vegetables <5 times a week had a 1.82 times greater chance of obesity, while adolescents who consumed fruit <3 Serving a day had a 2.25 times greater chance of obesity[13]. These findings indicate that many adolescents fail to achieve the recommended levels of fruit and vegetable intake, which contributes to poor diet quality and an increase in obesity risk. It suggests the need for targeted interventions to promote a balanced and diverse diet in the schools.

According to the 2018 Basic Health Research data, adolescents often consumed risky foods, such as sugary food at 41% and sugary beverages at 56.43%[5]. Currently, many types of sugary foods and beverages, and junk food are easily found in the school and an adolescent play environment. This is reinforced by the research in the Jember Regency area, which shows that adolescents often choose sugary beverages when playing outside the house[14]. Sugary foods and beverages are recognized as food containing quite high added sugar[15]. Sugary foods and beverages include contemporary tea, contemporary coffee, donuts, mochi, and others that are quite widely consumed by adolescents Currently, such risky foods are quite popular with adolescents, with easy access and prices that are affordable for adolescents[16].

As to junk food intake, according to Basic Health Research in 2018, the consumption rate of fatty and high-cholesterol foods with frequent frequency (> 1 time a day) in adolescence reached 43.8% to 44.2%[5]. This figure is the highest compared to other age groups. In addition, the prevalence of high-fat and high-cholesterol foods consumption in West Java is also quite high, with a frequency of > 1 time a day of 52.5%, the second most frequent after Central Java[5]. Junk food itself is a term that refers to foods with high flour content, high saturated fat, high trans-fat, high sodium, and low fiber[17]. Examples of junk food adolescents mainly consume are french fries, fried chicken, fried tempeh, fried chicken skin, burgers, instant noodles, and many others.

The high prevalence of sugary food and beverage intake and junk food in adolescence is inseparable from the availability of these foods around adolescents[18]. The influence of social media, exposure to advertising, and peers play a significant role in influencing the intake of risky foods. It is well noted that as many as 20.3% of adolescents with higher nutritional status have a high appetite for unhealthy foods dominated by fast food restaurants, processed or high-fat products, packaged food and beverage products, and sugared drinks[19]. Consumption of high-risk foods and not accompanied by sufficient physical activity will increase the chances of energy accumulation in the body and allow for weight gain[6]. Therefore, regulating marketing for adolescents and introducing nutritional labels must be done to help reduce the prevalence of risky food consumption in adolescents[20].

The results of the researcher's observations showed that 20% of adolescents were malnourished and 6.8% of adolescents were overweight at SMAN 6 Depok. In addition, the result showed that adolescents often consumed sugary food and beverages and junk food daily. Based on this description, this study aims to determine the relationship between the consumption of dietary diversity, sugary food and beverages, and junk food and overnutrition among adolescents at SMAN 6 Depok. Regarding the high prevalence of junk food and sugary drinks in adolescent diets, this study suggests stronger regulatory policies related to the marketing and availability of food in schools. These findings can applicably encourage a healthier food environment in educational institutions that restrictions on junk food and the campaign of nutritious alternative foods can significantly impact adolescent health.

METHODS

This study was an analytical observational study using a cross-sectional design. The study population involved 689 students in grades X and XI at SMAN 6 Depok. The number of samples used in the study was 112 students. This figure was obtained from calculations using the Lemeshow two-proportion difference hypothesis test formula, then added 10% to avoid dropouts. The sample selection procedure was carried out using the stratified random sampling technique.

The inclusion criteria used were 1) students aged ≤18 years, 2) students in grades X and XI of SMA Negeri 6 Depok, 3) willing to be sampled in this study without any pressure, and 4) healthy, and not diagnosed with illness in the last 1 week. The exclusion criteria in this study were 1) students who have been diagnosed with illness in the last 1 week and 2) students who were absent from data collection due to illness or permission.

Primary data collection for dependent and independent variables was conducted simultaneously. The dependent variable studied was the overnutrition status in adolescence. The independent variables studied were the consumption of dietary diversity, sugary food and beverages, and junk food. Primary data were obtained using an anthropometric questionnaire and Semi Quantitative–Food Frequency Questionnaire (SQ-FFQ) to see the consumption of dietary diversity, sugary food and beverages, and junk food. In addition, there is an Individual Dietary Diversity Score (IDDS) questionnaire to review the consumption of diverse foods.

Validity and reliability tests were done on the questionnaire before being used in this study. The validity test was done with a significance level of 0.05 and obtained valid results, namely the Corrected Item-Total Correlation value > r Table. Furthermore, a reliability test was done to get reliable results, namely the Cronbach Alpha value > r Table (0.314).

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Data was collected by distributing questionnaires to respondents, including an explanation of filling out the questionnaire. Furthermore, measuring body weight and height, filling out the respondent's characteristics questionnaires, and interviewing the SQ-FFQ and IDDS questionnaires were performed. The indicators used to measure BMI/U (body mass index according to age) are overnutrition (> +1 SD) and good nutrition (≤ +1 SD). The indicators used for dietary diversity are less (<3 types of food in a week) and good (≥3 types of food in a week)[21]. The indicators used for sugary foods and beverages are frequent (≥50 grams/day) and rare (<50 grams/day)[22]. The indicators for junk food are frequent (≥3x/week) and rare (<3x/week)[23].

Data was processed using univariate and bivariate analysis of the questionnaire results. Univariate analysis was carried out to see the distribution of each variable used. In contrast, using the chi-square test, bivariate analysis was used to test the relationship between independent and dependent variables. A variable can be said to be significant if the p-value is <0.05. This study obtained research ethics approval from Universitas Prima Indonesia on April 1, 2024, with the assigned ethics approval number 090/KEPK/UNPRI/III/2024.

RESULTS AND DISCUSSIONS

Overnutrition Among Adolescents Due to Lack of Food Variety, Sweet Foods and Drinks, and Junk Food Consumptions

A total of 112 respondents have participated in this study. The group consisted of students from both the Science (IPA) and Social Studies (IPS) divisions. There are a total of 58 students from 10th grade (IPA and IPS), and 54 students from 11th grade (IPA and IPS). The following is a description of the respondents' characteristics from this study:

Tabel 1. Characteristics of respondents

Variable	n	%	Mean
Age (years)			
15	17	15.2	
16	51	45.5	
17	40	35.7	16
18	4	3.6	
Gender			
Male	54	48.2	
Female	58	51.8	
Parents' Education			
Low (No schooling, did not finish elementary school, junior high school, senior high school)	7	6.3	
High (Graduated from senior high school/equivalent and higher education)	105	93.8	
Parents' Income			
Low (< IDR 4,972,996.00)	33	29.5	
High (≥ IDR 4,972,996.00)	79	70.5	
Pocket Money (Per Day)			
Low (<mean)	71	63.4	IDR 24,232
High (≥mean)	41	36.6	

In Table 1, it is shown that 15.2% of respondents are 15 years old, 45% of respondents are 16 years old, 35.7% of respondents are 17 years old, and 3.6% of respondents are 18 years old. This is since the respondents of this study consisted of 58 adolescents from 10th grade and 54 adolescents in 11th grade. There was a total of 58 female students and 54 male students that had participated in this study.

Table 1 shows that a total of 93.8% of the respondents' parents had pursued a higher education, while a total of 6.3% of the respondents' parents did not finish either elementary, middle, high school or an equivalent tier of education. Most respondents' parents had income that was considered above average in their region (DKI Jakarta and Depok) or IDR 4,972,996.00 (70,5%), while a total of 29.5% had under the average income in their region (DKI Jakarta and Depok) or IDR 4,972,996.00. Although, those figures are inverse compared to the student's lunch/pocket money, where 63.4% of students had a lower amount of lunch/pocket money while 36.6% of students had a higher amount of

lunch/pocket money. As such, a conclusion could be made based on the data that the parent's income does not contribute towards a student's purchasing power at school.

According to Duesenberry's theory as found in Hanun's research, there are 2 possible factors on why students from higher-income households received lower amounts of lunch/pocket money, which are (a) Their environment had influenced the household's spending habits, (b) A fluctuating source of income (highs and lows) had affected the household's spending habits[24]. From this study, it was found that the adolescents' lunch/pocket money was used for several needs, such as buying lunch or snacks, transportation, and miscellaneous goods (such as photocopying or stationery). A common denominator as for why some adolescents had received lower amounts of lunch/pocket money was their distance/proximity to the school. Some students lived within walking or biking distance. Meanwhile, some students were still picked up and dropped off by their parents, and others rely on public transportation such as "*angkutan kota*" mini bus

for city transport or online ridesharing apps *(ojek* online*)*, where prices are still relatively affordable.

Nutritional status was assessed from direct anthropometric measurements such as body weight and height. The results of which were used to calculate the Z-Score of the body mass index for age (BMI/Age). The following scores were then put into two categories, which are excess/over nutrition (>+1 SD) and good nutrition (≤ +1 SD)[25].

Anthropometric measurements had found that the minimum body weight in this study was 37 kg, with the minimum body height being 144 cm. The maximum body weight recorded from the group was 116 kg, while the largest body height measured at 180 cm. Based on minimum–maximum values found from the anthropometric measurements, the average body weight from the group of teens in this study was 56.2 kg. The average recorded body height in this study was 162.2 cm.

Based on Z–Score of the body mass index for age testing (BMI/Age) results, it's found that a total of 80.4% of adolescents had good nutrition, while 19.6% of respondents were considered over-nourished. The same results were also found in a study done by Rachmayanti (2023), where the number of adolescents with good nutrition (82.7%) outweighed the number of those who were over–nourished (17.8%)[26]. Another study had shown that a total of 85.2% of adolescents had good nutrition and 14.8% of adolescents were considered overnourished[27].

Over nutrition typically occurs when the amount of energy used by an individual is lower than their level of intake[28]. Physical activity is an important factor in managing the balance of energy, by expending calorie intake from the body. A lower level of physical activity increases the risk of over nutrition or even obesity by 9.5 times[29]. Other than lifestyle, over nutrition could also be hereditary or affected by genetics[30]. Several studies have found that, in general, children with parents who are overnourished or obese were 40–50% more likely to develop obesity[29].

Nutritional status could also be affected by the use of energy and maintaining the balance of nourishment into the body, which are regulated by neural and hormonal mechanisms. During energy homeostasis, two mediators are at play, which are: (1) neuropeptides which are produced in the brain as one of the components from the nervous circuit/system, and (2) peripheral mediators that circulate through the bloodstream and carry inputs to the brain. Inputs/signals from peripheral mediators are then transferred to the brain, where it connects to receptors in order for the peripheral molecules to contribute towards energy homeostasis. Hormones that are considered as peripheral molecules include leptin, cholecystokinin (CCK), ghrelin and insulin. Leptin is a hormone produced within adipose tissue that's known as to reduce the risk of obesity/the anti-obesity hormone. Leptine reduces the secretion of Y neuropeptides. Due to this, leptin can help in reducing appetite through inhibiting Y neuropeptides, while also stimulating pro-opiomelanocortin (POMC) as well as cocaine and amphetamine regulated transcript (CART) in the arcuate nucleus of the hypothalamus. An abnormal level of leptin could cause someone to gain excess weight and/or obesity. Kolesistokinin (CCK) transmits the signals needed to the nucleus tractus solitarus to show that the body is full, through the release and transduction of the nesovagus load. Kolesistokinin also causes an increased release of serotonin (5-HT) in the hypothalamus that could inhibit food intake. Meanwhile, ghrelin hormones during energy homeostasis activate Y neuropeptides and agouti related peptides (AgRP) which stimulates appetite. Insulin also plays a role in regulating glucose levels by stimulating glucose consumption, absorption and other core energy storage pathways in the peripheral tissue.

Consumption and distribution of various foods such as sweet foods, sweet drinks and junk food among adolescents.

Food consumption in this study was determined through interviews using SQ-FFQ and Individual Dietary Diversity Score (IDDS) questionnaires. The SQ-FFQ questionnaire was used in order to determine which types of high-risk foods were being consumed among adolescents throughout the course of a week. The purpose of the IDDS questionnaire was to see which food groups were frequently consumed among adolescents throughout the week[21].

Tabel 2. Distribution of food variety, sweet foods, sweet drinks, and junk food consumption among adolescents

Distribution of Consumption	n	%	Mean	Min	Max
Food Variety					
Varied	97	86.6			
Less Varied	15	13.4	3.90	1	5
Sweet Foods					
Frequent	22	19.5			
Infrequent	90	80.4	34.35	0	440
Sweet Drinks					
Frequent	34	30.4			
Infrequent	78	69.6	51.62	1	666
Junk Food					
Frequent	33	29.5			
Infrequent	79	70.5	18.57	1.50	18.57

Variety of Food Consumed/Diet Balance

Table 2 shows that 86.6% of adolescents had a balanced diet, while 13.4% of teens were lacking in terms of variety in their diet. A balanced diet is determined by the consumption of at least 3 types of food groups, which are staple foods (such as carbohydrates), meat or plant-

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based protein, fruits and vegetables, in a day[21]. The same results were found in a study done by Ariesta et al., in 2021, which showed that 96.9% of adolescents had a balanced diet while 3% lacked in terms of diet variety[31].

A balanced diet consists of staple foods (such as carbohydrates), meat or plant-based protein, vegetables and fruits[31]. Although, there is no strict guideline on the amount of each component to be consumed, as each component can compensate for one another to fulfill nutritional needs. Not one component can fulfill said needs on their own. As a result, a collaboration among all food groups is needed to meet nutritional requirements[11]. Meeting the nutritional requirements could help reduce the risk of nutrition-related complications such as stunting, over nutrition, dyslipidemia, and metabolic syndrome[32].

A balanced diet could ensure that adolescents received adequate amounts of micro and macro nutrients[32]. Although, in a developing country, maintaining a varied/balanced diet remains a challenge, due to the fact that most sources of food contain significant amount of calories, while lacking in terms of meat, nuts/beans, vegetables and fruits[32]. Among adolescents, the lack of a balanced diet could be caused by their parents' level of education, or a lower level of income that causes a lack of variety in terms of food groups available at home[33]. It could also be caused by a lack of purchasing power or poverty[34]. A lower level of education could affect how well someone react and their awareness on the downsides of an unbalanced diet or nutrition-related negative consequences[34]. Earlier studies have shown a correlation between purchasing power and knowledge of a balanced diet[33].

Percentages for frequently consumed food groups throughout the week in this study are as follows: Staple foods (such as carbohydrates) at 100%, meat/animal-based protein at 98.2%, plant-based protein dishes at 57.1%, vegetables at 71.4% and fruits at 63.4%. Based on SQ-FFQ data, the most consumed foods within the three major food groups include rice, noodles, bread, potatoes, and porridge for carbohydrates; chicken, eggs, beef, shrimp and squid for meat-based protein; and carrots, spinach, lettuce and cabbage for vegetables.

Consumption of Sweet Foods/Sweets

The respondents' intake of sweet foods was divided into two categories, which were frequent and infrequent. The infrequent category consists of respondents who consumed <50 grams of sugar in a day, while the frequent category consists of respondents who consumed ≥50 grams of sugar in a day[35]. This study used the SQ-FFQ questionnaire to determine the frequency and quantity of sweet foods consumed by respondents in a day.

Table 2 shows the percentage of the respondents' intake of sweet foods, in which the majority were considered infrequent (80.4%), while 19.4% of respondents were considered frequent in terms of sweet/sugary food intake. This shows that most respondents did not consume ≥50 grams of sugar in a day. Said results were in-line with a study done by Juliantina (2022) in Depok, which found that 52.6% of adolescents infrequently had sweet foods while 47.4% had sweet/sugary foods frequently[27]. Sweet/sugary foods are often had in-between meals as snacks among adolescents[36]. In this study, the most frequently consumed sweet foods among adolescents were ice cream, *martabak manis* (a sweet, pancake-like dish), donuts, chocolate, and pudding. Adolescents frequently consumed sweet/sugary foods due to their delicious taste and mood-boosting effects[37].

Sweet foods are defined as dishes with added sugar such as glucose and fructose. An excess in fructose intake could cause the failure of leptin hormone production. Higher levels of leptin could cause the amount of insulin hormones to decrease and reduce one's appetite[38]. Although, lower levels of leptin cause the opposite effect, where the amount of insulin increases alongside appetite. Resistance to leptin is often due to a higher fructose intake, which could cause a lack of control over appetite (especially on knowing when the body feels full or satiated), an imbalance in energy and could lead to over nutrition[39].

Over consumption of sweet foods could pose a nutritional risk among adolescents. This can happen if not accompanied by an equal amount of physical exercise/activity. It's also found that a higher intake of sweet foods could increase the risk of complications such as diabetes, hypertension, cancer or even premature death[35].

Consumption of Sweet/Soft Drinks

Consumption/intake of sweet drinks was divided into two categories, which were frequent and infrequent. Those considered infrequent consumed <50 grams of sugar in a day, while those considered frequent consumed ≥50 grams of sugar in a day[35]. Using data from the SQ-FFQ questionnaire helped in determining the frequency and quantity of sweet/soft drinks consumed by respondents in a day.

In table 2, habits of sweet/soft drink consumption in this study are as follows: 69.6% of adolescents had infrequently consumed sweet/soft drinks (<50 grams in a day) while 30.4% of adolescents frequently consumed sweet/soft drinks (≥50 grams of sugar in a day.) This is in-line with a study conducted by Asriati & Juniasty (2023) which found that 63% of adolescents consumed <50 grams of sugar from sweet/soft drinks in a day, while 37% of adolescents consumed ≥50 grams of sugar from sweet drinks in a day[40]. The results of said study were similar with another done by Hardiansyah et al., (2017) where a significant number of adolescents (77.4%) had consumed <50 grams of sugar from sweet drinks in a day, compared to adolescents who had consumed ≥50 grams of sugar in a day from sweet drinks (22.6%)[41].

The increase in sugar intake from sweet drinks could pose a bigger risk than sweet foods[42]. Although sweet drinks contain a significant amount of sugar, they do not have the same filling effect as sweet foods after consumption[37]. Sugar found in sweet drinks such as fructose and glucose could increase the risk of obesity by 5.7 times[15]. 37-54 grams of sugar can be found in a single 300-500ml package of soft/sweet drinks[18]. Like sweet foods, an increase in fructose intake due to excess sweet/soft drinks could cause a resistance to leptin,

which raises insulin levels and increases appetite[38]. Based on SQ-FFQ data, the most frequently consumed types of sweet/soft drinks are packaged tea, trendy tea-based drinks, isotonic beverages, and trendy coffee-based drinks.

Consumption of Junk Food

The study on junk food consumption was conducted in order to analyze the intake of junk food among adolescents. Interviews were done using SQ-FFQ questionnaires. In this study, junk food consumption was split into two categories, which were frequent and infrequent. Respondents were placed into the infrequent category if they had not consumed junk food often (<3 times in a week), while respondents who often had junk food (≥3 times throughout the week) were placed in the frequent category[23].

Habits on junk food consumption, as found in this study, are as follows: 70.5% of adolescents infrequently consumed junk food (<3 times in a week) and 29.5% had frequently consumed junk food (≥3 in a week). Prima et al. (2018) had similar findings, in which the percentage of adolescents who infrequently (<3 times in a week) consumed junk food was higher (89.1%) than the percentage of adolescents who had frequently (≥3 in a week) consumed junk food (10.9%)[43]. Other studies have found that 58% of adolescents infrequently consumed junk food, while 42% of adolescents had frequently consumed junk food[44].

The majority of adolescents had chosen to eat junk food due to it being easily accessible, affordable, and favorable taste[45]. Junk food was not only consumed as a main course but also as a snack[46]. Frequently consumed types of junk food found in this study included instant noodles, fried chicken, meatball soup, chicken noodles, and chicken nuggets. Meatball soup and chicken noodles were categorized as junk food due to their high contents of natrium, fat and lack of fiber[47]. In addition, street vendors selling said dishes near school grounds often used mass-produced pre-packaged options which had higher amounts of flour and other additives compared to meat. This caused an overall reduction to the amount of protein in the dish itself[48].

The biggest factor contributing towards a lower consumption of junk food was economic status and awareness on nutrition. A fluctuating income (and lower economic status) causes a lack in purchasing power, which reduces the access to junk food[20]. There are several factors as to why junk food consumption among adolescents is low, such as bans from parents on junk food, caused by worries on ingredients used to make said junk food, and concerns from adolescents themselves on side-effects caused by junk food on their body, such as over nutrition or obesity[49].

Bivariate Analysis

A bivariate analysis was done to determine any correlation between independent and dependent variables using the chi-square method. Independent variables used include diet balance/variety, sweet foods, sweet/soft drinks, and junk food. Dependent variables used include over nutrition. The chi-square method was used with a 95% level of confidence, so if p-value<0,05 was found then a correlation could be made between independent and dependent variables used.

Tabel 3. Correlation of diet balance/variety, sweet foods, sweet drinks, and junk food with overnutrition

Consumption	Nutritional Status						p-value
	Over Nutrition		Normal Nutrition		Total		
	n	%	n	%	n	%	
Food Variety							
Varied	18	16.1	79	70.5	97	86.6	
Less Varied	4	3.6	11	9.8	15	13.4	0.489
Sweet Foods							
Frequent	5	4.5	17	15.2	22	19.6	
Infrequent	17	15,2	73	65.2	90	80.4	0.766
Sweet Drinks							
Frequent	6	5.4	28	25	34	30.4	
Infrequent	16	14.3	62	55.4	78	69.6	0.926
Junk Food							
Frequent	6	5.4	27	24.1	33	29.5	
Infrequent	17	15.2	62	55.4	79	70.5	0.608

Correlation Between Diet Balance/Variety and Over Nutrition

In table 3, it is found that a majority of adolescents had a balanced/varied diet. It is also found that 70.5% of adolescents who had a varied/balanced diet also had good nutrition. On the other hand, 16.2% of adolescents who had a varied/balanced diet were found to be overnourished. 3.6% of adolescents lacked in terms of diet variety/balance while also being overnourished, and 9.8% of adolescents had lacked in terms of diet variety/balance, but had good nutrition.

Based on analysis of the relationship between a varied/balanced diet and overnutrition, this study had found a p-value of 0.489 (p-value>0.05). Due to this, it can be said that no correlation was found between diet variety/balance and overnutrition. These findings were in line with a study done by Susmiati et al, (2024) which found that a majority of adolescents who were considered obese had a balanced/varied diet (82.2%)[50]. Similarly, a study done by Olatona et al., (2023) in Nigeria had found that 79.6% of adolescents who had normal/good nutrition also had a varied/balanced diet (82.2%), while 20.4% of adolescents who were

overnourished and obese lacked in terms of diet variety/balance (17.2%)[51].

Earlier studies had shown that a varied/balanced diet may help in achieving a normal nutritional status[11]. A varied/balanced diet could also help in reducing the risk of undernutrition among adolescents[52]. Additionally, consumption of fruits and vegetables as a source of fiber could help in reducing or even preventing several complications such as obesity, cancer, type 2 diabetes, and cardiovascular disease among adolescents.

On the other hand, a adolescents' nutritional status can be affected by several factors, such as a lack of physical activity, eating habits, their family's economic status, awareness/knowledge on nutrition, parental factors, and history of obesity within the family[19]. Food consumption patterns are commonly associated with the availability and variety of dishes at home[53]. In this study, a majority of adolescents often consumed 3 main groups of food, which are staple foods (100%), meat-based protein (98.2%) and vegetables (71.4%).

Correlation Between Consumption of Sweet Foods and Overnutrition

In table 3, it's shown that a majority of adolescents had rarely/infrequently consumed sweet foods. There was a smaller percentage of adolescents who frequently consumed sweet foods in this study at 19.6%, when compared to the total amount of students who infrequently consumed sweet foods (80.4%). Additionally, it's found that a total of 4.5% of adolescents who frequently consumed sweet foods were considered overnourished, while 15.2% of adolescents frequently consumed sweet foods but had good/normal levels of nutrition. Out of the 15.2% of adolescents who frequently consumed sweet foods, 65.2% of which had good nutrition.

An analysis on the correlation between sweet foods and over nutrition in this study had found a p-value score of 0.766 (p-value>0.05). It could be said that no correlation could be found between consumption/intake of sweet foods and over nutrition. These findings are in line with a study conducted by Asriati & Juniasty (2023) that found no correlation between consumption of sweet foods and overnutrition among adolescents in Jayapura[40]. Said findings were supported in a study done by Juliantina (2022) in Depok, which found no correlation between the frequency in which adolescents consumed sweet foods and overnutrition[27]. Although, in a study done by Hanita (2022), the opposite was found, in which there was a correlation between consumption of sweet foods and obesity among adolescents[54].

A nutritional incident could occur if fat reserves in the body are not being utilized, which causes fat buildup in the body[37]. High glycemic index content found in sweet foods could increase blood glucose levels as well as increase insulin excretion. Those factors may cause an imbalance of insulin concentration in the glucagon which causes an increase of one's appetite[54].

Other factors that could explain why sweet foods did not affect nutritional status in this study is the presence of physical activities, and a level of glucose intake that did not exceed daily limits[54]. A lower, sedentary lifestyle that lacks physical activity could increase the risk of over-nutrition or obesity by 1.937 times, due to the higher amount of energy intake compared to utilization of said calories by the body[55]. Additionally, consuming sweet foods in moderation ensures that the total calorie intake does not exceed the body's daily limits[54]. If this intake is not accompanied by sufficient physical activity, fat buildup in the body could increase the risk of overnutrition and obesity[56].

Correlation between Soft/Sweet Drink Consumption and Overnutrition

Table 3 shows that a higher percentage of adolescents had infrequently consumed sweet drinks compared to adolescents who frequently consumed sweet/soft drinks. 5.4% of adolescents were considered as frequent consumers of soft/sweet drinks, with 25% of adolescents that frequently consumed soft/sweet drinks having nutrition levels that were considered good. Among adolescents who rarely/infrequently consumed sweet drinks, 14.3% were considered overnourished, while 55.4% of adolescents who infrequently consumed sweet drinks had good nutrition.

An analysis on the correlation between consumption of sweet drinks and over nutrition found a p-value of 0.926 (p-value>0.05). As such it can be concluded that no correlation was found between the consumption of sweet drinks and over nutrition. These findings are in-line with a study done by Ramadhany et al. (2023), in which there was no correlation between intake of sweet drinks and overnutrition among adolescents[56]. Laulaulinnuha et al. (2024) found similar findings, in which no correlation was found between consumption of sweet drinks and overconsumption among adolescents in Serang[57]. Badriyah & Pijaryani (2022) had found a correlation between consumption of sweet drinks and nutrition among adolescents in their study[16].

These findings had revealed that the average sugar intake from sweet drinks was 51,.2 grams. However, based on analysis no correlation was found between consumption of sweet drinks and overnourishment among teens. Said results could be due to the frequency of consumption, which only fulfilled or increased the respondents' caloric intake, while not surpassing their daily limit (≥50 grams).

Intake of simple carbohydrates from sweet drinks could cause a decrease in appetite. This is due to the fact that sugar content from these sweet drinks are considered as simple carbohydrates, which are easily digestible by the intestine[54]. In addition, the glucostatic theory states that within the human body there are feeding and satiety centers which function based on glucose levels in the blood. The satiety center is located in the ventromedial nucleus of the hypothalamus. The center is activated when glucose levels in the blood rises, which triggers the appetite and will to eat. Meanwhile, the feeding center is located in the lateral nucleus of the hypothalamus. The feeding center activates when there's a decrease of glucose levels in the blood, which causes satiety and reduces one's appetite[58]. Due to this, the increase in sugar intake from sweet drinks does not affect the feeding center, which is caused due to an increase in blood glucose levels. As such, it does not cause an excess of energy in the body[57].

Correlation between Junk Food Consumption and Overnutrition

Table 3 shows that a majority of adolescents had rarely/infrequently consumed junk food. 15.2% of adolescents who rarely consumed junk food was considered overnourished while 55.4% of adolescents who rarely consumed junk food had good/normal nutrition. Among adolescents who frequently consumed junk food, 5.4% were considered overnourished, while 24.1% had good/normal nutrition.

An analysis on correlation between junk food consumption and overnourishment showed a p-value score of 0.608 (p-value>0.05). It can be concluded that no correlation was found between junk food consumption and overnourishment. Similar results had been found by Mustofa & Nugroho (2021), in which their study found no correlation between junk food consumption and overnutrition among adolescents[59]. Said findings were supported in a study conducted by Suryani et al., (2020) that found no correlation between the consumption of junk food and overnutrition in adolescents. Although, in their research, Patarru et al., (2022) found a correlation between junk food consumption and nutritional status among adolescents[60].

These results could be attributed to the frequency in which adolescents consumed junk food, where the majority fell into the "infrequent" category, which was defined as consuming junk food less than 3 times throughout the week, or in moderation. Intake frequency is known to be a factor in determining an individual's nutritional status, where adolescents who consumed junk food as much as 6 times in a day had increased their risk of overnourishment by 20.3%[45]. There are cases where a high caloric intake and overconsumption (>3 times throughout the week) did not affect an individual's nutritional status, due to a high enough level of physical activity, which balanced out the level of intake. The amount of energy burnt through physical activity was equal to that or even higher than the intake[17].

Most adolescents had consumed junk food due to its accessibility, taste and affordability. Popular types of junk food include western-style dishes such as fried chicken, chicken fillet, chicken nuggets, pizza, and burgers, among others[26]. The amount of calories found in a single serving of fried chicken, chicken nuggets or chicken fillet was around 332-385 calories per 100 grams[47]. Consuming these western-styled junk foods >2 times in a week was found to increase the risk of overnutrition by 8.7%[47]. The natrium contents found in junk food was found to fulfill ≤50% of the daily recommended intake (2000 mg)[61]. While the content of saturated fat in a single serving of junk food could fulfill ≤46% of the daily recommended intake[61]. Due to this, the consumption of junk food needs to be limited to prevent harm towards the body/any long-term effects on the body. Overconsumption of junk food may cause overnutrition and obesity, kidney disease, cancer, and diabetes[62].

In this study, the researcher has clearly laid out the types of food frequently consumed among teens. These food groups were chosen based on food diversity, or because they were well-known as a high-risk food. The researcher hopes that this data could be used to further study why these foods are desirable, or undesirable, among adolescents. In addition, the quantity of these food types was calculated based on interviews, which utilized probing questions, which dug through the respondents' personal experiences, to ensure accurate responses.

The family's economic status could play a role in a teenager's nutritional status. A higher-income background could be considered as a factor in a teenager's choice of food, while the same could be said for those from lower-income families. This study had only mentioned factors such as parents' income and pocket/lunch money in passing, which could play a role in overnutrition among adolescents.

The researcher has realized the lack of variety in terms of variables in this study. There are several more factors that could cause overnutrition among teens, such as physical activity, awareness and knowledge on nutrition, social environment, or even genetics. The researcher hopes that future studies could delve into more of these variables in order to prevent the rise of overnutrition in the following years.

CONCLUSIONS

There was no relationship between the habit of consuming food diversity, sweet foods, sweet drinks, and junk food with overnutrition in adolescents at SMAN 6 Depok. Therefore, it is recommended that further research examine other factors that may influence overnutrition such as physical activity, sleep quality, peer influence, and knowledge related to nutrition.

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CONFLICT OF INTEREST AND FUNDING DISCLOSURE

AUTHOR CONTRIBUTIONS

SAK: conceptualization, data curation, formal analysis, investigation, methodology, resources, software, visualization, roles/writing-original draft, writing-review & editing; IMBI: funding acquisition, project administration, supervision, validation, writing-review; SFS: supervision, validation, writing-review.

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