

Adolescent Diet Induce Obesity

1st Satrianugraha, Muhammad Duddy
Medical faculty
Swadaya Gunung Jati University
Cirebon, Indonesia
biolibium@gmail.com

2nd Fatmala, Uly Tangziyah
Medical faculty
Swadaya Gunung Jati University
Cirebon, Indonesia
ullytangziyahfatmala@gmail.com

3rd Aziziyah, Qurroti A'yunina
Medical faculty
Swadaya Gunung Jati University
Cirebon, Indonesia
ninaqurroti101120@gmail.com

Abstract—BACKGROUND: Obesity results from a long-term imbalance between energy intake and energy expenditure. The 2023 Indonesian Health Survey (SKI) reported an obesity prevalence of 38% in adolescents aged >15 years and 25.7% in adolescents aged >18 years in West Java Province.

OBJECTIVE: This study aimed to investigate the relationship between dietary intake and the incidence of obesity among male and female students at SMA Negeri 4 Cirebon.

METHODS: This cross-sectional observational analytic study employed purposive sampling to select participants based on dietary intake and obesity. The sample size comprised 56 students at SMA Negeri 4 Cirebon.

RESULTS: The findings revealed that 6 (10.7%) students had a dietary intake below the Indonesian Recommended Dietary Allowance (AKG), 16 (28.6%) had a dietary intake meeting the AKG, and 34 (60.7%) had a dietary intake exceeding the AKG. Regarding obesity, 22 (39.3%) students were not obese ($BMI < 25$), while 34 (60.7%) were obese ($BMI > 25$). Statistical analysis demonstrated a significant positive correlation between dietary intake and the incidence of obesity.

CONCLUSION: The study concludes that higher dietary intake is associated with a greater risk of obesity among male and female students at SMA Negeri 4 Cirebon.

Keywords— *Diet; Obesity; Adolescent*

I. INTRODUCTION

Obesity is defined as an excessive or abnormal accumulation of fat or adipose tissue in the body, which may impair health and typically results from an imbalance between daily energy intake and energy expenditure, leading to excessive weight gain. It is considered a multifactorial disease, influenced by a combination of genetic, cultural, and social factors. Genetic studies have indicated that obesity is

highly heritable, with numerous genes identified as contributing to weight gain and increased fat accumulation. In addition to genetic predisposition, other contributing factors include reduced physical activity, insomnia, endocrine disorders, certain medications, high consumption of carbohydrates and sugar-rich foods, and a decline in energy metabolism [1].

Adolescence is a critical period of development characterized by the transition from childhood to adulthood, encompassing significant changes in attitude, behavior, and physical attributes [2]. The main focus of physical changes that occur in adolescents such as increased growth of skeletal bones, muscles and internal organs. For specific changes each gender is different such as changes in shoulder width, hips, changes in muscle distribution, fat, development of the reproductive system and secondary sex characteristics [2]. Eating habits are a way that is often done by someone as a characteristic of the individual in fulfilling physiological, social and emotional needs by repeatedly eating food to fulfill nutritional needs for the body. Eating habits in adolescents are related to consuming food which includes types of food, amount of food, frequency of food, distribution of food and how to choose food [3].

Changes in lifestyle and dietary habits among adolescents significantly influence their nutritional intake and requirements. Adequate nutrition during adolescence is essential, particularly for those who are physically active or involved in sports, as their nutritional demands are higher. However, many adolescents fail to balance energy intake with energy expenditure, which may lead to nutritional problems such as excessive weight gain or, conversely, malnutrition if too much energy is expended without sufficient intake [3]. This developmental stage is also marked by rapid increases in height and weight, further emphasizing the need for appropriate nutritional support. Among the various contributing factors to adolescent obesity, nutritional intake plays a central role. Nutritional intake refers to the daily consumption of essential nutrients required to support energy needs for physical activities [2]. A balanced diet should include carbohydrates, proteins, fats, vitamins, and minerals. Attaining this balance necessitates a varied diet that includes staple foods, plant- and animal-based proteins, vegetables, and fruits.

Nonetheless, it is critical to regulate the quantity of each nutrient consumed. Excessive intake of any nutrient can be harmful. For instance, surplus protein not utilized by the body is stored as fat, which may contribute to weight gain. Likewise, fat contains more than twice the calories of carbohydrates and protein, and excess fat is stored in subcutaneous tissue, the abdominal cavity, and intramuscular areas. An imbalance between nutrient intake and energy expenditure results in the accumulation of excess nutrients as body fat, leading to obesity. Beyond physical health concerns, adolescent obesity is also associated with social and psychological issues. Obese adolescents may experience body image dissatisfaction and are often sensitive about their weight, leading to feelings of discomfort, embarrassment, and social withdrawal [4][5].

Nutritional intake can be measured by RDA (Recommended Dietary Allowances). Food intake is all types of food and drinks consumed by the body every day. The nutritional adequacy rate is the minimum amount of nutrients needed by a person to maintain adequate nutritional status [6].

Nutritional status is commonly assessed using the Body Mass Index (BMI), which serves as a standard indicator for evaluating nutritional conditions. For adolescents, nutritional status is determined through anthropometric measurements involving body weight (BW) and height (HW), which are then used to calculate BMI. The BMI is obtained by dividing body weight in kilograms (kg) by the square of height in meters (m²), i.e., $BMI = BW (kg) / [HW (m)]^2$ [7]. This method provides a general classification of underweight, normal weight, overweight, or obesity, and is widely used due to its practicality and effectiveness in population-based assessments.

Nutritional problems in adolescents in Indonesia are still a major concern in the health sector. In addition to the problem of malnutrition, other nutritional problems have also emerged, such as overweight and micronutrient deficiencies, which have also become a focus of attention in efforts to improve adolescent health [8]. According to the General Chairperson of the Indonesian Nutritionists Association (PERSAGI), currently the number of adolescents suffering from obesity in Indonesia has reached 18% of the total population of Indonesia, where it is stated that the tendency to become fat or suffer from obesity actually starts from childhood to adolescence by experiencing an uncontrolled increase process. Based on data from the 2023 Indonesian Health Survey (SKI), in West Java Province, the prevalence of obesity at the age of >15 years was 38% and at the age of 16-18 years the results were 25.7%. Based on the data above, it is known that the incidence of obesity at that age is still quite high [7].

Based on the results of the research, it shows that there is a significant relationship between diet and the incidence of obesity in adolescents at SMA Frater Don Bosco Manado [9]. In a study at SMA Negeri 2 Tambang, it also showed a Relationship between Diet and Obesity [10].

Despite numerous studies examining the relationship between dietary patterns and the incidence of obesity in adolescents, there remains a lack of data regarding this relationship in the Cirebon area. Therefore, the researcher will investigate the relationship between dietary patterns and the incidence of obesity in the Cirebon region.

II. METHOD

The study were quantitative in nature and conducted using observational analytic method with a cross-sectional approach. The sample selection employs purposive sampling for the dietary patterns, and obesity. 56 student .were given questionnaire, weighed, and measure for hight using stadiometer. Univariate analysis were conducted using frequency distribution to identify the characteristics of each research variable, and bivariate analysis uses Spearman's were used to correlate relationship between dietary patterns and the incidence of obesity among students of SMA Negeri 4 Cirebon.

III. RESULTS AND DISCUSSION

Results show that, in terms of age, the majority of respondents are 17 years old, totaling 34 individuals (60.7%). There is 1 respondent aged 15 years (1.8%), 18 respondents aged 16 years (32.1%), and 3 respondents aged 18 years (5.4%).

TABLE I. PARTICIPAN AGE

Age	Frequency	Percentage (%)
15	1	1,8
16	18	32,1
17	34	60,7
18	3	5,4
Total	56	100,0

According to a WHO report in 2022, more than 390 million children and adolescents aged 5–19 years were classified as overweight. The prevalence of overweight and obesity in this age group has shown a significant increase, affecting both sexes relatively equally, with 19% of girls and 21% of boys recorded as overweight [11]. The same report also stated that, in 2022, approximately 2.5 billion adults aged 18 years and older were overweight, including over 890 million adults living with obesity. This figure represents 43% of the global adult population (43% of men and 44% of women) [11]. These statistics underscore the growing scale of the global obesity epidemic.

In the context of adolescents, nutritional issues warrant special attention, as they play a critical role in physical growth and development, and can lead to persistent nutritional problems into adulthood. In this study, the majority of respondents were female (n = 34; 60.7%), while male participants numbered 22 (39.3%). Obesity tends to be more prevalent among females. Several studies have reported that females are at greater risk of obesity compared to males, primarily due to slower metabolic rates in women, which may contribute to increased fat accumulation and reduced energy expenditure [12][13][14].

There are 22 students (39.3%) who are not obese with a Body Mass Index (BMI) of less than 25, and there are 34 students (60.7%) who are obese with a BMI of greater than 25.

TABLE II. OBESE CLASIFICATION

Clasification	Frequency	Percentage (%)
Not Obese (<25)	22	39,3
Obese (>25)	34	60,7
Total	56	100,0

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. According to the World Health Organization (WHO), a Body Mass Index (BMI) above 25 is categorized as overweight, while a BMI above 30 is classified as obese. In 2019, approximately 5 million deaths caused by non-communicable diseases (NCDs) were attributed to BMI levels above the optimal range [15]. The findings of this study align with WHO data, which highlight a continuing upward trend in global overweight and obesity rates. Between 1990 and 2022, the global prevalence of obesity among children and adolescents aged 5–19 years increased fourfold, from 2% to 8%, while among adults aged 18 years and over, the prevalence more than doubled, rising from 7% to 16%. Consistent with this global trend, the current study found that 60.7% of students surveyed were classified as obese [15].

The majority of respondents, totaling 34 individuals (60.7%), have dietary patterns exceeding the Recommended Dietary Allowance (RDA). There are 6 students whose dietary patterns are below the RDA (10.7%), and 16 individuals whose dietary patterns meet the RDA (28.6%).

TABLE III. CLASSIFICATION OF DIETARY PATTERNS BASED ON RDA

Clasification	Frequency	Precentage(%)
Less Than RDA	6	10,7
Meet RDA	16	28,6
Exceed RDA	34	60,7
Total	56	100,0

The dietary pattern studied was nutrient intake obtained by 1 x 24 hour recall. This study shows that the average student diet is likely to be higher than the nutritional adequacy rate according to the RDA with a percentage of 60.7%. This result indicates that energy intake in this group is likely to consume food more than the nutritional adequacy rate.

The findings of this study robustly demonstrate a strong positive association between specific dietary patterns and obesity in adolescents, as evidenced by the high Spearman correlation coefficient ($r = 0.976$, $p < 0.001$). This significant correlation underscores the substantial impact of dietary habits on weight status during this critical developmental period, highlighting the need for targeted interventions to promote

healthy eating behaviors. The strength of this association warrants a detailed examination of its implications and limitations. A significant positive relationship between energy intake and nutritional status indicates that an increase in energy intake will lead to an improvement in nutritional status, and vice versa [2] [13] [16].

TABLE IV. CORRELATION TEST BETWEEN BMI AND DIETARY PATTERNS

		BMI	Dietary Pattern
BMI	Spearman correlation coefficient	1.000	0.976
	Sig. (2-tailed)	-	0.000
Dietary pattern	Spearman correlation coefficient	0.976	1.000
	Sig. (2-tailed)	0.000	-

The analysis of the relationship between Body Mass Index (BMI) and dietary patterns reveals a correlation coefficient of 0.976, indicating a very strong relationship between the two variables. This strength level suggests that changes in dietary patterns are closely associated with changes in BMI. The direction of the relationship is also positive, as reflected in the correlation coefficient value of +0.976, which implies a unidirectional relationship—meaning that as BMI increases, dietary pattern scores also tend to increase, and vice versa. Furthermore, the significance test shows a Sig. (2-tailed) value of 0.000, which is less than the conventional thresholds of 0.05 or 0.01. This result confirms that the relationship between BMI and dietary patterns is statistically significant, indicating that the observed association is unlikely to have occurred by chance.

This study is in line with research conducted by Rivolta, et al. where the test results between energy intake and obesity showed a relationship between energy intake and obesity [9]. This shows that if there is an increase in energy intake, there will be an increase in nutritional status and vice versa. Energy consumption that exceeds sufficiency can result in weight gain. Obesity is related to diet, especially if the food is high in calories and low in fiber. Food selection affects food consumption. Consuming healthy, nutritious and sufficient food will have a good impact on the body, and vice versa. Consuming unhealthy food will affect a person's nutritional status, including obesity. Obesity occurs due to an unbalanced diet. A person's habit of consuming foods that are high in calories and fat will be a risk of obesity.

This is also in accordance with the theory of Thasim, Syam, and Najamuddin that excessive eating patterns can be a factor in obesity. Obesity occurs if someone consumes calories exceeding the number of calories burned so that obesity will occur more easily [17]. According to Guyton, poor eating patterns can cause excess nutrition which contributes to obesity, this is based on the speed of formation of new fat cells that increase and the greater the speed of fat storage, the greater the number of fat cells and obesity will occur [18].

Various factors contribute to obesity in adolescents, both direct and indirect factors, such as behavior and lifestyle, physical and non-physical environment, and also the role of genetic factors. The results of the identification of various

determinants of obesity show that the nutritional level in obese adolescents is mostly above the AKG for the adolescent group [19].

Consuming energy beyond the required amount can result in weight gain, and if this continues, it may lead to obesity and an increased risk of degenerative diseases. Therefore, it is essential to maintain nutritional status in an optimal condition. Increased risk of obesity is associated with dietary patterns, especially when consuming foods that are high in calories and low in fiber. Food choices significantly influence food consumption. Consuming healthy, nutritious, and adequate foods will have a positive impact on the body, and conversely, unhealthy food consumption will affect an individual's nutritional status, including the occurrence of overweight [5] [12] [20]. Overweight occurs due to an unbalanced diet. A person's habit of consuming high-calorie and high-fat foods poses a risk for developing excess weight. Eating habits among adolescents are excessive and irregular, with meal patterns that are inconsistent throughout the morning, afternoon, evening, and night [12] [20]. These habits, characterized by high saturated fat and sugar intake and low fiber consumption, lead to issues such as obesity, overnutrition, and an increase in free radicals, which trigger the onset of various degenerative diseases. Overweight is a significant concern among early adolescents [5] [21] [22].

This is in line with the research of Retnaningrum et al. stating that obesity is caused by an imbalance between incoming energy and expended energy, where the amount of energy entering the body is greater but the physical activity carried out for energy expenditure is very minimal. So that there is excess energy stored in the form of fat tissue [6]. Obesity, or excess weight, is a condition characterized by an excessive accumulation of fat in the body, resulting in a weight that is far from normal and potentially harmful to health [16] [21]. The adolescent age group (10-18 years) is a period of nutritional vulnerability because adolescents require higher nutrient intake due to rapid physical growth and development, lifestyle changes, and eating habits that affect their nutritional intake and needs, as well as their activity levels in sports [16] [21].

Fat serves as the body's largest energy reserve, with its storage distributed across several areas: approximately 50% is stored in the subcutaneous tissue, 45% around the organs in the abdominal cavity, and 5% within intramuscular tissue. Dietary fat is obtained from both animal and plant-based sources. Animal-derived fats can be found in foods such as milk, cheese, and eggs, while plant-based fat sources include margarine, vegetable oils, and avocados [23]. Obesity results from excessive fat accumulation in the body, primarily caused by an energy imbalance between the calories consumed and expended. One of the major contributors to this imbalance is the increased availability and consumption of highly palatable, energy-dense foods.

Research shows that adolescents with high levels of fast food consumption tend to have a higher body weight—averaging ~6 kg more—and larger waist circumferences compared to those who consume fast food less frequently. This excess energy intake contributes significantly to weight-related

health problems, which are notably more prevalent among adolescents. Furthermore, these issues may be intensified in individuals with a genetic predisposition to fat accumulation. This predisposition may be linked to complex interactions between the brain's homeostatic regulation systems and reward circuitry, which influence appetite and energy storage. In addition, the accumulation of lipid metabolites, inflammatory signals, and disruptions in hypothalamic neurons may also play a role in promoting obesity. These biological mechanisms help explain the body's defense of increased fat mass and the difficulty in reversing weight gain once obesity is established [24].

While this study presents compelling evidence regarding the association between dietary patterns and obesity in adolescents, several limitations must be acknowledged. Firstly, the use of a cross-sectional design restricts the ability to draw conclusions about causal relationships. To strengthen causal inference, future research should adopt longitudinal designs that track changes in dietary patterns and Body Mass Index (BMI) over time [12][20]. Secondly, the study relies on self-reported dietary data collected through questionnaires, which may be subject to recall bias and underreporting. Future studies are encouraged to employ more objective dietary assessment tools, such as food diaries or 24-hour dietary recalls, to improve the accuracy and reliability of dietary intake measurements.

Moreover, this study did not control for all relevant confounding variables, including socioeconomic status, access to nutritious foods, and genetic predisposition. These factors may significantly influence both dietary behavior and obesity risk. Therefore, future research should incorporate these variables to gain a more comprehensive understanding of the complex interactions between diet, genetics, and environmental factors in the development of adolescent obesity [5].

The relatively homogenous sample population may limit the generalizability of the findings to other populations with different demographic characteristics. Future studies should aim for greater diversity in the sample to enhance the external validity of the results. Finally, the study focused primarily on dietary factors. Future research should investigate the interplay between dietary patterns, physical activity levels, and other lifestyle factors to develop more holistic interventions for obesity prevention and management. Despite the limitations, the findings of this study have significant implications for public health interventions aimed at preventing and managing adolescent obesity. The strong association between specific dietary patterns and obesity underscores the critical need for targeted educational programs and public health initiatives focused on promoting healthy eating habits among adolescents and their families. These interventions should emphasize the importance of reducing saturated fat and sugar intake, increasing fiber consumption, and establishing regular meal patterns. Furthermore, strategies to improve access to healthy food options and address socioeconomic disparities in food security are crucial for achieving sustainable improvements in adolescent dietary habits and weight management. The integration of these interventions within broader community-based programs can maximize their effectiveness and reach.

IV. CONCLUSIONS

Based on the research and discussion on dietary patterns and obesity among students at SMA Negeri 4 Cirebon, with a sample size of 56 individuals, the following conclusions are drawn strong and statistically significant association between dietary habits and obesity prevalence within this population. The detailed analysis allows for a nuanced understanding of the dietary factors contributing to this observed relationship. A significant portion of the sample (60.7%, n=34) exhibited dietary patterns exceeding the recommended Adequate Intake (AI) guidelines (AKG), indicating a substantial prevalence of overconsumption. Conversely, a smaller proportion (10.7%, n=6) consumed less than the AI, while 28.6% (n=16) adhered to the recommended dietary intake. This distribution highlights a concerning trend of excessive caloric intake among a majority of the students. The relationship between dietary patterns and obesity was further investigated using statistical analysis. A strong positive correlation ($r = 0.976$, $p < 0.001$) was observed between a composite dietary pattern score (reflecting overall adherence to AI guidelines) and BMI. This exceptionally high correlation coefficient provides robust evidence of a significant association, indicating that as dietary intake exceeds the recommended AI, the likelihood of obesity increases substantially.

REFERENCES

- [1] P. K. Kiran, N. Minhthao and K. R. Kshirsagar, Obesity, StatPearls Publishing, 2023.
- [2] P. G. Pamungkas. , C. V. GP and A. Alamsyah, "Faktor Risiko Kejadian Obesitas pada Mahasiswa di STIKes Hang Tuah Pekanbaru tahun 2020," Jurnal Kesehatan Komunitas, vol. 7, no. 2, pp. 196-201, 2021.
- [3] D. Hafiza, A. Utami and S. Niriyah, "Hubungan Kebiasaan Makan dengan Status Gizi pada Remaja SMP YLPI Pekanbaru," Jurnal Medika Utama, vol. 2, no. 1, pp. 333-342, 2020.
- [4] S. Sumiyati and I. Dhian, "Obesitas terhadap Harga Diri Remaja," Jurnal Sains Kebidanan, vol. 3, no. 2, pp. 80-85, 2021.
- [5] A. M. Hanum, "Faktor-Faktor Penyebab terjadinya Obesitas pada Remaja," Jurnal Kesehatan Tadulako, vol. 9, no. 2, pp. 137-147, 2023.
- [6] Y. Listianasari and A. F. E. Putra, "Asupan Karbohidrat dan Aktivitas Fisik pada Siswa SMP dengan Status Gizi Gemuk di Kota Tasikmalaya," Jurnal Gizi dan Kesehatan, vol. 3, no. 2, pp. 73-81, 2023.
- [7] KEMENKES, Survei Kesehatan Indonesia (SKI), Jakarta: Badan Kebijakan Pembangunan Kesehatan, 2023.
- [8] A. Muhsyari, D. Yogaswara and N. N. Annashr, "Pola Konsumsi Makan dan Minuman terhadap Risiko Obesitas Remaja," Jurnal Ilmu Kesehatan Bakti Husada: Health Science Journal, vol. 15, no. 2, pp. 353-363, 2024.
- [9] R. G. M. Walangi, N. N. Legi, O. L. Paruntu, G. K. Langi, P. S. Kereh, M. Pascoal and R. Mongkau, "Hubungan Antara Asupan Nutrisi dengan Kejadian Obesitas Anak Remaja di SMA Frater Don Bosco Manado," GIZIDO, vol. 14, no. 1, pp. 25-31, 2022.
- [10] E. Dewita, "Hubungan Pola Makan dengan Kejadian Obesitas pada Remaja di SMA Negeri 2 Tambang," Jurnal Kesehatan Tambusai, vol. 2, no. 1, pp. 7-14, 2021.
- [11] WHO, "Obesity and Overweight," World Health Organization, 2024.
- [12] F. Z. Ilyas, Arneliawati. and F. Aaminatul, "Hubungan Sedentary Lifestyle dan Pola Tidur dengan Kejadian Obesitas pada Remaja Usia 14-18 Tahun," Jurnal Keperawatan Tropis Papua, vol. 6, no. 2, pp. 68-73, 2023.
- [13] A. A. Putri. and S. L. Riski, "Pengaruh Media Poster terhadap Pola Makan dan Pola Tidur dengan Kejadian Obesitas pada Remaja di SMAN 1 Pedes," Journal of Social Science Research, vol. 4, no. 4, pp. 9382-9393, 2024.
- [14] I. S. E. Nnur. , P. N. Sri. and P. Endang, "Tingkat Asupan Makronutrien dan Gaya Hidup terhadap Risiko terjadinya Obesitas di Lima Provinsi di Indonesia," Jurnal Mutu Pangan, vol. 8, no. 2, pp. 88-96, 2022.
- [15] WHO, "Obesity," World Health Organization, 2022.
- [16] K. P. I. Sari, N. K. E. Saniathi and D. A. A. A. S. Astini, "Hubungan Aktivitas Fisik dan Pola Makan dengan Status Gizi pada Anak Sekolah Dasar Usia 9-13 Tahun di Sekolah Dasar Negeri 12 Dauh Putri," Aesculapius Medical Journal, vol. 4, no. 1, pp. 69-74, 2024.
- [17] H. Retno, B. Sitti and N. Reny, "Pola Makan, Aktivitas Fisik, dan Genetik Mempengaruhi Kejadian Obesitas pada Remaja di SMK Wilayah Kerja Puskesmas Segiri," Jurnal Metro Sai Wawai, vol. 14, no. No.2, pp. 120-129, 2021.
- [18] J. E. Hall and M. E. Hall, Guyton and Hall Textbook of Medical Physiology (Guyton Physiology), Elsevier, 2025.
- [19] N. K. Wiardani and A. A. N. Kusumajaya, "Perilaku Makan, AKtivitas Fisik, dan Penggunaan Internet pada Remaja Sekolah yang Mengalami Obesitas di Provinsi Bali," Journal of The Indonesian Nutrition Association, vol. 46, no. 2, pp. 207-220, 2023.