

# Dietary Trends Among Adolescents in Surakarta City During the COVID-19 Pandemic

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## ABSTRACT

**Introduction:** Restrictions on activities outside the home due to the COVID-19 pandemic, including schools, can influence dietary profiles, especially those of adolescents. The effort to suppress COVID-19 transmission changes Adolescents' lifestyles, physical activity, and eating behavior towards deterioration endangers their health, and increases the risk of degenerative diseases such as obesity, diabetes, and other NCDs that can exacerbate COVID-19 disease. This study aims to explore nutritional modifications during the COVID-19 pandemic in adolescents aged 15 to 19 years, compared with their usual diets before the pandemic, and identify variables that may correlate with the changes.

**Methods:** This study used a cross-sectional design. Data were collected by online questionnaire and interviews on food intake, body mass index (BMI), and physical activity among 96 adolescents from Surakarta City. We used the Wilcoxon test and the Kruskal-Wallis test for comparative analysis.

**Results:** The results showed that the COVID-19 pandemic modified insignificantly the dietary intake, BMI, and physical activity. In particular, we recorded and analyzed the modified consumption of main dishes ( $p=0,745$ ), side dishes ( $p=0,082$ ), vegetables ( $p=0,000$ ), fruits ( $p=0,528$ ), snacks ( $p=0,128$ ), and beverages ( $p=0,046$ ) using Wilcoxon's analysis ( $p<0,005$ ). In addition, the Kruskal-Wallis analysis showed that gender, BMI, and physical activity had varied comparisons with dietary intake during COVID-19.

**Conclusion:** The COVID-19 pandemic had an insignificant impact on changes in dietary intake which were not significantly affected by gender, BMI, and physical activity in adolescents in Surakarta City.

**Keywords:** adolescents; BMI; COVID-19; diet; questionnaire

## INTRODUCTION

Adolescents infected with COVID-19 are more asymptomatic than adults or children. Adolescents' social contact patterns are also very risky compared to adults so adolescents play a major role in the transmission of COVID-19 in society. So adolescents need to carry out activities at home and reduce social contact outside the home (PSBB)<sup>1,2</sup>.

To implement the PSBB, many adaptations have been made from workplaces that apply for a "work from home" system to educational institutions that carry out remote or online learning<sup>3</sup>. Limited family activities for both parents and children, especially adolescents outside the home, create lifestyle changes that support sedentary behavior<sup>4,5</sup>.

For adolescents, health care during a pandemic is very much needed. Apart from increasing physical activity at home, adequate nutrition is a potential factor for health and reducing predisposition to diseases such as obesity, diabetes, and cardiovascular disorders in adulthood<sup>6</sup>.

For adolescents to be protected from viral infections, including COVID-19, the key lies in diet and immunity. Healthy nutritional intake is a crucial determinant of the microbial composition of the intestinal system, such as vegetables, healthy fats, high-protein, low-fat foods, especially intake of micronutrients such as iron, zinc, vitamin A, E, B6, and B12 along with the adequate physical activity. adolescents need to support the immune system<sup>7-9</sup>. However, as felt by people throughout the country, activities that are centered at home and the burden of the COVID-19 pandemic, especially in terms of health, economy, and education, cause adolescents to tend to behave sedentarily, suffer from anxiety, stress, emotional disturbances, and boredom<sup>8</sup>. These things can have a direct impact on motivation to eat, lifestyle changes, decreased diet quality, and promotion of excessive food consumption in adolescents<sup>10</sup>. Thus, it is important to evaluate changes in food intake patterns based on age caused by quarantine during the COVID-19 pandemic to identify adolescents who are at risk of inadequate nutrition and the development of eating disorders<sup>6</sup>.

This study aimed to study nutritional modifications during the COVID-19 pandemic in adolescents aged 15 to 19 years, compare them to their usual diet before the pandemic, and identify variables that might correlate with these changes.

## METHOD

This research is an observational study with cross-sectional because the observations were made without providing any intervention to the respondents. Data collection was carried out by filling out online questionnaires and interviews regarding food intake, body mass index (BMI), and physical activity in adolescents in Surakarta City.

The inclusion criteria, namely the age range of 15-19 years, originating from the City of Surakarta, living in the City of Surakarta from before the time of the COVID-19 pandemic. Exclusion criteria; adolescents who are not willing and not allowed parents. Dropout criteria; incomplete questionnaire. Questionnaires were distributed via social media such as *WhatsApp*, *Line*, or others, and interviews via *Zoom*.

The research sample was taken from a population of 41,716 adolescents aged 15-19 years<sup>11</sup> with a purposive sampling technique. The sample size was determined using a cross-sectional research formula where the total population (N) of the study was known. The samples/respondents needed were 96 adolescents from Surakarta City. The independent variables of this study were gender, age (15-19 years), level of physical activity which was categorized into low, medium, and high, then nutritional status which was categorized as Underweight (BMI < 18.5), Normal (18.5 ≤ BMI ≤ 22.9), Overweight (23.0 ≤ BMI ≤ 24.9) and Obesity (BMI ≥ 25.0). The dependent variable of this study is food intake based on the frequency of eating in food categories based on a previous study in a modified version, namely Staple Foods, Side Dishes, Vegetables, Fruits, Snacks, and Drinks<sup>6</sup>. Food intake frequency categories are divided into Always (1-3 times a day), Often (2-4 times per week), Rarely (1-2 times per month), and Never (0)<sup>12</sup>. Then based on nutritional values, namely energy, protein, fat, carbohydrates, vitamins, and minerals which were analyzed by NutriSurvey2007. Recommended Dietary Allowance (RDA) of energy and protein are categorized as severe deficit (<70% RDA), moderate deficit (70-79% AKG), mild deficit (80-89% RDA), normal (90-119% RDA), excess (≥120% RDA)<sup>12,13</sup>. RDA of vitamins and minerals is categorized as deficiency (<77% RDA) and adequate (≥77% RDA)<sup>12,13</sup>. RDA of fat and carbohydrates are categorized as deficiency (<20% energy requirement), normal (≥20-≤30% energy requirement), and excess (>30% energy requirement)<sup>12,14</sup>.

Data analysis using univariate analysis to determine the frequency distribution of the percentage or proportion of the independent variable and the dependent variable. The data obtained were analyzed using the Kolmogorov-Smirnov test (p>0.05) to determine whether the data were normally distributed. A comparative test of food intake before the pandemic against during the COVID-19 pandemic using a

paired T-test ( $p < 0.05$ ,  $H_0$  is accepted) if the data is normally distributed, with the Wilcoxon test ( $p < 0.05$ ,  $H_0$  is accepted) if the data is not normally distributed. A comparative test of food intake by sex, age, level of physical activity, and nutritional status using the unpaired T-test ( $p < 0.05$ ,  $H_0$  accepted) if the data is normally distributed, with the Kruskal-Wallis test ( $p < 0.05$ ,  $H_0$  accepted) if the data is not normally distributed. This research has passed the ethical feasibility of the health research ethics committee of RSUD Dr. Moewardi Number: 688/VI/HREC/2021.

## RESULT

### Subjects Characteristics

Table 1. Distribution of Subject Characteristics

| Variable     | Percentage (%) |
|--------------|----------------|
| Sex (N = 96) |                |
| Male         | 16,7           |
| Female       | 83,3           |
| Age (N = 96) |                |
| 15 years old | 2,1            |
| 16 years old | 5,2            |
| 17 years old | 13,5           |
| 18 years old | 38,5           |
| 19 years old | 40,6           |

Table 2. Distribution of Nutritional Status and Physical Activity Levels Before and During the Pandemic

| Variable                          | Before Pandemic | During Pandemic |
|-----------------------------------|-----------------|-----------------|
|                                   | Percentage (%)  |                 |
| Nutritional Status (N = 96)       |                 |                 |
| Underweight (<18,5)               | 27,08           | 26,04           |
| Normal (18,5 - 22,9)              | 42,71           | 43,75           |
| Overweight (23,0 - 24,9)          | 17,71           | 10,42           |
| Obesity ( $\geq 25,0$ )           | 12,5            | 19,79           |
| Physical Activity Levels (N = 96) |                 |                 |
| Low                               | 52,1            | 65,6            |
| Medium                            | 32,3            | 22,9            |
| High                              | 15,6            | 11,5            |

### Distribution of Adequacy Rates of Nutrients During the COVID-19 Pandemic

Interview data (24H food recall) are listed in Table 3. Then based on nutritional value, namely energy, protein, fat, carbohydrates, vitamins, and minerals which were analyzed by NutriSurvey2007. Recommended Dietary Allowance (RDA) of energy and protein are categorized as severe deficit (<70% RDA), moderate deficit (70-79% AKG), mild deficit (80-89% RDA), normal (90-119% RDA), excess ( $\geq 120\%$  RDA)<sup>12,13</sup>. RDA of vitamins and minerals is categorized as deficiency (<77% RDA) and adequate ( $\geq 77\%$  RDA)<sup>12,13</sup>. RDA of fat and carbohydrates are categorized as deficiency (<20% energy requirement), normal ( $\geq 20\%$ - $\leq 30\%$  energy requirement), and excess (>30% energy requirement)<sup>12,14</sup>.

### Food Intake Before and During the COVID-19 Pandemic Based on Meal Frequency

Food intake is based on the frequency of eating in food categories based on a previous study in a modified version, namely Staple Foods, Side Dishes, Vegetables, Fruits, Snacks, and Drinks<sup>6</sup>. Food

intake frequency categories are divided into Always (1-3 times a day), Often (2-4 times per week), Rarely (1-2 times per month), and Never (0)<sup>12</sup>.

Questionnaire results by respondents showed that the average frequency of eating per week for the staple food category was 4.85 times (Always) per week before the pandemic and decreased to 4.75 times (Always) per week during the COVID-19 pandemic. In the side dishes categories, there were 3.59 times (often) per week before the pandemic and decreased to 3.18 times (often) per week during the COVID-19 pandemic. In the vegetable category, it was 2.84 times (often) per week before the pandemic and decreased to 2.01 times (often) per week during the COVID-19 pandemic. In the fruit category 2.68 times (Frequently) per week before the pandemic and increased to 2.69 times (Frequently) per week during the COVID-19 pandemic. In the snack category, it was 2.36 times (often) per week before the pandemic and increased to 2.56 times (often) per week during the COVID-19 pandemic. In the beverage category, it was 4.09 times (Always) per week before the pandemic and decreased to 3.35 times (Often) per week during the COVID-19 pandemic.

Table 3. Distribution of Adequacy Rates of Nutrients During the COVID-19 Pandemic

| Nutrients        | (%)  | Nutrients  | (%)  |
|------------------|------|------------|------|
| Energy           |      | Vitamin B6 |      |
| Severe Deficit   | 61,5 | Deficiency | 59,4 |
| Moderate Deficit | 11,5 | Adequate   | 40,6 |
| Mild Deficit     | 8,3  | Folic Acid |      |
| Normal           | 16,7 | Deficiency | 99,0 |
| Excess           | 2,1  | Adequate   | 1,0  |
| Protein          |      | Vitamin C  |      |
| Severe Deficit   | 34,4 | Deficiency | 72,9 |
| Moderate Deficit | 8,3  | Adequate   | 27,1 |
| Mild Deficit     | 6,3  | Calcium    |      |
| Normal           | 28,1 | Deficiency | 87,5 |
| Excess           | 22,9 | Adequate   | 12,5 |
| Lemak            |      | Phosphor   |      |
| Deficiency       | 46,9 | Deficiency | 53,1 |
| Normal           | 34,4 | Adequate   | 46,9 |
| Excess           | 18,8 | Magnesium  |      |
| Carbohydrate     |      | Deficiency | 53,1 |
| Deficiency       | 18,8 | Adequate   | 46,9 |
| Normal           | 27,1 | Sodium     |      |
| Excess           | 54,2 | Deficiency | 80,2 |
| Vitamin A        |      | Adequate   | 19,8 |
| Deficiency       | 37,5 | Potassium  |      |
| Adequate         | 62,5 | Deficiency | 83,3 |
| Vitamin E        |      | Adequate   | 16,7 |
| Deficiency       | 95,8 | Iron       |      |
| Adequate         | 4,2  | Deficiency | 85,4 |
| Vitamin B1       |      | Adequate   | 14,6 |
| Deficiency       | 91,7 | Zinc       |      |
| Adequate         | 8,3  | Deficiency | 80,2 |
| Vitamin B2       |      | Adequate   | 19,8 |
| Deficiency       | 82,3 |            |      |
| Adequate         | 17,7 |            |      |

### The COVID-19 Pandemic Changes Adolescent Food Intake Trends

The results of statistical analysis using the Wilcoxon test showed that during the pandemic there was no change in the average frequency of consumption of staple foods, side dishes, fruit, and market snacks with a p-value of 0.745 respectively; 0.082; 0.528, and 0.128. On the other hand, there were significant changes in consumption patterns of vegetables and beverages with p-values of 0.000 and 0.046, respectively.

Table 4. Changes in Food Intake Before the Pandemic to During the COVID-19 Pandemic

|              | Food Category | p-Value |
|--------------|---------------|---------|
| Uji Wilcoxon | Staple food   | 0,745   |
|              | Side dishes   | 0,082   |
|              | Vegetables    | 0,000*  |
|              | Fruits        | 0,528   |
|              | Snacks        | 0,128   |
|              | Drink         | 0,046*  |

\*Significant

### Adolescent Diet During the COVID-19 Pandemic According to Characteristics, Nutritional Status, and Physical Activity Levels Compared to Before the COVID-19 Pandemic

Analysis results using the Kruskal-Wallis test showed that there was no significant difference from the average frequency of meals per week before the pandemic to during the COVID-19 pandemic based on independent variables (age, sex, nutritional status, and level of physical activity) except for staple food intake before the pandemic to age ( $p = 0.045$ ).

## DISCUSSION

Adolescent lifestyle behaviors changed dramatically during the COVID-19 pandemic period<sup>4</sup>. Sedentary behavior is a risk factor for death, metabolic disorders, and an increased risk of obesity. Decreased physical activity causes a reduction in muscle mass which is then the metabolic consequence of a sedentary and prolonged sedentary lifestyle that will increase body weight, including fat mass, and impaired glycemic control<sup>5</sup>. In addition, this pandemic situation might contribute to laziness and increase the need for distraction which leads individuals (adolescents) to over-consumption of food while using electronic devices as a source of entertainment. Although weeks or months of low physical activity will not result in the sudden onset of metabolic disease, interruption of physical activity can impair insulin sensitivity, cause muscle and bone atrophy, and reduce the psychological benefits of exercise<sup>15</sup>. Whereas in particular, physical activity makes an important contribution to daily energy expenditure, thus increasing lean body mass, increasing energy intake, metabolic profile, and psychological status of adolescents<sup>16</sup>.

Negative eating habits especially when physical activity is low, such as low consumption of nuts and water, high consumption of low-quality foods, high energy density foods, low micronutrient foods, foods high in sugar, saturated fat, sodium, and food Fried foods can cause excess weight. Thus, adolescents' consumption of legumes, high-fiber foods, foods with low energy density, high protein intake, and low glycemic index foods with high nutritional quality will enable weight control and prevention of metabolic diseases<sup>5,15</sup>.

Previous studies stated that low levels of physical activity can interact with body fat and appetite dysregulation<sup>17</sup>. During the COVID-19 quarantine, feelings of hunger and satiety fluctuated<sup>18</sup>. Another study in the Australian population showed that 43.4% of the population ( $n = 5469$ ) exercised less during the COVID-19 pandemic and found a link between binge eating and exercise<sup>5</sup>. The results of other studies also show that watching television (sedentary behavior) increases the simultaneous intake of

solid, tasty, and familiar foods. This increase in intake is carried out in hungry conditions or not<sup>10,15</sup>. The pandemic also supports unhealthy dietary behaviors from weight gain, decreased physical activity, increased sitting time, and decreased consumption of fresh fruits and vegetables and other foods<sup>19</sup>.

Previous research data shows that the majority of respondents (53%) did not change their dietary habits during the COVID-19 pandemic<sup>9</sup>. There was no significant change in food intake in terms of weekly frequency of consumption of red meat, chicken, processed meat, fruits, vegetables, bread, dairy, cooked fat, and most snacks, both before and during the pandemic<sup>20-22</sup>.

Other survey data shows that almost half of the participants surveyed do not eat fruit every day and a third do not eat vegetables every day<sup>19</sup>. The results of another study also found that most of the research subjects (adolescents) did not meet the recommended minimum daily intake of fruits and vegetables. As many as 76.9% and 73.8% of participants did not meet the recommendations for fruit consumption either before or during the COVID-19 pandemic. Moreover, around 86% of the participants did not fulfill the recommendations for consuming vegetables either before or during the pandemic<sup>20</sup>. Other research also states that there has been a change in vegetable consumption habits and 9.8% of adolescents experienced a worsening during the COVID-19 pandemic<sup>23</sup>. On the other hand, WHO strongly recommends consuming nuts, fruits, and vegetables as the best foods during self-quarantine or staying at home longer<sup>6</sup>.

Then, in line with previous research, the average intake of fried foods and snacks has increased during the COVID-19 quarantine<sup>6</sup>. In addition, other studies state that adolescent consumption of processed meats, soda, and sugary drinks has decreased in frequency during the COVID-19 pandemic<sup>21</sup>.

These results confirm previous research which stated that quarantine or in this case PSBB can lead to unhealthy, disordered eating patterns and increase the desire to eat fun foods in adolescents caused by changes in daily routines that tend to stagnate, thus increasing feelings of boredom and stress. These dietary habits, as adaptations for coping with boredom and stress, are strongly associated with higher caloric intake and an increased risk of obesity. Meanwhile, it is highly recommended for adolescents avoid fried foods, foods with saturated fat, and consuming sugar sporadically and in small amounts during the COVID-19 pandemic<sup>5,19</sup>.

Data on the nutritional value of respondents' daily food intake during the COVID-19 pandemic in this study are in line with the results of research by Di Renzo et al. which shows that during the pandemic there was a reduction in the consumption of fresh food, accompanied by deficiencies of vitamins and minerals, including vitamin C and vitamin E and beta-carotene which have antioxidant and anti-inflammatory properties. Deficiencies in these micronutrients are associated with obesity and impaired immune response, making them more susceptible to viral infections<sup>7</sup>.

In controlling cardiovascular disease and obesity, MDA (malondialdehyde) which has a high concentration of antioxidants, can be obtained from nuts and vegetables. In addition, nuts and fish make a significant contribution through essential fatty acids which have a good effect on body weight. In previous research, it was stated that consuming fruits and vegetables had a non-unidirectional relationship with metabolic syndrome and its risk factors<sup>5,19</sup>. In addition, the consumption of a diet rich in vegetables and fruits is especially important during the COVID-19 pandemic due to its high content of antioxidants, phytonutrients, and anti-inflammatory substances. Apart from being a rich source of fiber, as well as various micronutrients and antioxidants, sufficient fruit and vegetable intake can optimize immunocompetence, which is a very potential benefit in the prevention and treatment of COVID-19<sup>19</sup>.

## CONCLUSION

Based on the results of research on 96 adolescents in Surakarta City, the following conclusions can be drawn. During the COVID-19 pandemic, there was no trend of significant changes in the average

frequency of consumption of staple foods, side dishes, fruits, and market snacks in adolescents in Surakarta City. The trend of changes in food intake for adolescents in Surakarta City during the COVID-19 pandemic was not affected by gender, nutritional status, and level of physical activity.

## CONFLICT OF INTEREST

The authors reported no potential competing interests.

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