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OVERWEIGHT IN SCHOOL-AGE CHILDREN AND ITS RISK FACTORS

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ABSTRACT

Introduction: According to data from the Basic Health Research in 2018, the prevalence of overweight and obesity among children in East Java Province was 24.27%. This prevalence is still higher than the national average. **Aims:** This study aims to analyze the risk factors for overweight in school-age children in Tawangsari Village, Sidoarjo Regency, East Java Province. **Methods:** This study used a case-control design and involved 132 school-age children at 1 and 3 Tawangsari State Elementary Schools, Sidoarjo Regency. The respondents were divided into two groups, namely case and control. The data were analyzed using multiple logistic regression with a significance level at 0.05. **Result:** The results of the multivariate analysis suggested that sedentary behavior ($p = 0.002$; Exp(B) = 8.340), sugar intake ($p = 0.000$; Exp(B) = 9.125) and vegetable and fruit intake ($p = 0.007$; Exp(B) = 20.643) were significant variables ($p < 0.05$). **Conclusion:** School-age children with low levels of physical activity were found to be 8.34 times more likely to be overweight compared to those with high levels of physical activity. In addition, excessive sugar intake and inadequate consumption of vegetable and fruit were associated with a higher likelihood of being overweight in school-age children. However, dietary diversity is not a risk factor for overweight in school-aged children.

Keywords: vegetables, fruits, sugar, overweight, risk factors

INTRODUCTION

Overweight in children has become a worldwide issue that leads to higher morbidity and premature mortality rates. According to data from the Basic Health Research in 2018, the prevalence of overweight children aged between 5 and 12 years in Indonesia was 20%, with 10.8% being overweight and 9.2% being obese. The prevalence of overweight was higher in urban areas (22.4%) than in rural areas (17.4%). In East Java Province, the prevalence of overweight and obesity in children was 24.27%, which is still higher than the national average. Sidoarjo Regency is one of the regions in East Java with a relatively high prevalence of overweight in children at 29.88% (Ministry of Health of the Republic of Indonesia, 2018). Overweight is caused by the accumulation of fat mass in the body (Hastuti, 2019). Factors that contribute to the development of overweight in children include genetics, eating habits, lack of physical activity, the influence of food intake, dietary diversity, consumption of vegetables and fruits, lack of knowledge, and socioeconomic status (Spinelli et al., 2019). Obesity in children has serious consequences as it persists into adulthood and increases the risk of degenerative diseases, such as diabetes

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mellitus, cardiovascular disease, chronic kidney disease, cancer, and sleep apnea or temporary cessation of breathing, which is associated with premature death (Lee and Yoon, 2018).

According to Magriplis et al. (2021), obesity may be associated with increased sugar consumption as a source of energy. Children worldwide consume between 17% and 34.8% of total sugar intake. Overweight and obesity were 2.33 times higher in children and adolescents who consumed sugar (95% CI: 1.298, 4.183.000) and 2.57 times higher in those who consumed added sugar with more than 10% increase in energy intake (95% CI: 1.398, 4.717.100, p = 0.002) (Magriplis et al., 2021). In addition to sugar consumption, overweight in children is associated with their diet. Dietary patterns related to vegetable and fruit consumption and dietary diversity contribute to the incidence of overweight in school-age children. According to Gebrie et al. (2018), inadequate consumption of vegetables and fruits is a risk factor for overweight and obesity in childrenClick or tap here to enter text.. According to Mohajeri et al. (2020), individuals with a higher dietary diversity score (DDS) meet their nutritional needs. Environmental factors, such as imbalances in consumption, eating behavior, and physical activity, also contribute to overweight. In addition, sedentary behavior as a result of lifestyle changes is a major contributing factor. The World Health Organization (WHO) estimated that sedentary behavior is responsible for approximately two million deaths every year (Guan et al., 2020). Sedentary behavior refers to prolonged physical inactivity outside of sleeping hours. According to data from the Ministry of Health in 2018, the percentage of Indonesians who lacked physical activity increased from 26% in 2013 to 33% in 2018 (Ministry of Health of the Republic of Indonesia, 2018).

1 and 3 Tawangsari State Elementary Schools are located in Tawangsari Village, Sidoarjo Regency, East Java Province. A preliminary study on students aged between 9 and 12 years at these schools revealed that 44.8% of the 96 students at 1 Tawangsari State Elementary School and 55.1% of the 118 students at 3 Tawangsari State Elementary Schools were overweight, resulting in a total prevalence of 51.8%. The prevalence of overweight in school-ae children in Tawangsari Village is higher than the national average. Therefore, this study aims to analyze the risk factors associated with overweight in this population.

METHODS

This study used an analytical observational design with a case-control approach. This study used pa urposive sampling technique with a population of 569 students aged between 9 and 12 years from 1 and 3 Tawangsari State Elementary Schools. The inclusion criteria were overweight or obese students who were physically and mentally healthy and able to communicate effectively. Meanwhile, the exclusion criteria were students who were ill or had allergies to certain foods. Based on these inclusion and exclusion criteria, 132 school-age children at 1 and 3 Tawangsari Elementary Schools were included in this study and divided into two groups: the case group consisting of 66 children with overweight or obesity and the control group which consisted of 66 children with normal nutritional status. The nutritional status was assessed using the body mass index (BMI) indicators according to age (BMI-for-age) using the WHO AnthroPlus application. Children were categorized as overweight if their z-score was between +2 and +3, obese if it was greater than +3, and normal if it is between -2 and +1.

Data collection was conducted through direct interviews with the respondents about their physical activity, consumption of vegetables and fruits, sugar intake, and dietary diversity. The Physical Activity Questionnaire for Children (PAQ-

C) was used to record the physical activity of the respondents for the previous seven days. The questionnaire, which had been adapted to the conditions and habits in Indonesia contains eight questions with five points on a Likert scale (Kowalski, Crocker and Donen, 2004).

Data on consumption of vegetables and fruits and sugar intake were examined using the Semiquantitative Food Frequency Questionnaire (SQ-FFQ) (FAO, 2018), which includes all types of vegetables and fruits available in the environment surrounding the residence of the respondents. In addition, it also includes types of foods and beverages that have a high content of sugar in them. This study also used a tool in the form of food pictures to illustrate the portion of foods consumed by the respondents. Dietary diversity was measured using the 2 x 24-hour food recall method and scored using the Dietary Diversity Score (DDS) (FAO, 2018).

Data analysis was performed using multivariate analysis with multiple logistic regression with a significance level at 0.05. The odds ratio determined the risk factors for overweight in school-age children. This study received ethical approval from the Health Research Ethics Commission of Universitas Nahdlatul Ulama Surabaya with a certificate number 0046/EC/KEPK/UNUSA/2023.

RESULTS

Characteristics of Respondents

The characteristics of the respondents which include gender, age and nutritional status of school-age children in this study are presented in Table 1. The 132 respondents were divided into control and case groups. The majority of the children were males (59%).

Table 1. Characteristics of the Respondents

Category	Case (overweight and obese)	Control (normal)	Total
	n (%)	n (%)	n (%)
Sex			
Male	40 (60.6)	38 (57.6)	78 (59)
Female	26 (39.4)	28 (42.4)	54 (41)
Age (years)			
9	7 (10.6)	13 (19.7)	20 (15.3)
10	19 (28.8)	15 (22.7)	34 (25.7)
11	20 (30.3)	17 (25.8)	37 (28)
12	20 (30.3)	21 (31.8)	41 (31)
Nutritional status			
Overweight	30 (45.4)	-	30 (22.7)
Obese	36 (54.4)	-	36 (27.2)
Normal	-	66 (100)	66 (50)
Total	**66 (100)**	**66 (100)**	**132 (100)**

In terms of age, the majority of the children were 12 years old (31%). The school-age children who were overweight or obese were mostly between 11 and 12 years old. In terms of nutritional status, the majority of the case group were obese (54.4%), while the rest were overweight (45.4%).

Physical Activity of School-Age Children

The PAQ-C questionnaire was used to assess physical activity during the previous seven days in the school-aged children. The results were categorized into two groups, namely high physical activity (score ≥ 5) and low physical activity (score between 1 and 4) (Kowalski, Crocker and Donen, 2004).

Table 2. Physical Activity of the School-Age Children

Physical Activity	Case (overweight and obese)	Control (normal)	Total
	n (%)	n (%)	n (%)
High	7 (10.6)	35 (53)	42 (31.8)
Low	59 (89.4)	31 (47)	90 (68.2)
Total	**66 (100)**	**66 (100)**	**132 (100)**

Out of the 132 respondents, the majority fell into the category of low physical (68.2%), while the remaining respondents fell into the category of high physical activity (31.8%). In the case group, 59 children (89.4%) exhibited low levels of physical activity, while only seven (10.6%) exhibited high levels of physical activity. Meanwhile, in the control group, most of the children exhibited high levels of physical activity.

Sugar Intake of School-Age Children

The SQ-FFQ was used to measure the sugar intake of school-age children in this study. The data were processed using the NutriSurvey software to determine the amount of daily sugar intake. The results were categorized into excessive (>50 gr/day) and sufficient (≤ 50 gr/day).

Table 3. Sugar Intake of the School-Age Children

Sugar Intake	Case (overweight and obese)	Control (normal)	Total
	n (%)	n (%)	n (%)
Excessive	58 (87.9)	24 (36.4)	82 (62.1)
Sufficient	8 (12.1)	42 (63.6)	50 (37.9)
Total	**66 (100)**	**66 (100)**	**132 (100)**

In the case group, the majority of the children consumed excessive amounts of sugar (87.9%). In comparison, in the control group, the majority of the children consumed sufficient amounts of sugar (63.6%) children. Excessive sugar intake among school-age children was associated with the consumption of sweet snacks and packaged beverages.

Consumption of Vegetables and Fruits of School-Age Children

The SQ-FFQ was used to measure the consumption of vegetables and fruits among the children. The results were categorized into inadequate (<400 grams/day) and adequate (≥400 grams/day) (WHO, 2019).

Table 4. Consumption of Vegetables and Fruits of the School-Age Children

Consumption of Vegetables and Fruits	Case (overweight and obese)	Control (normal)	Total
	n (%)	n (%)	n (%)
Inadequate	62 (93.9)	24 (36.4)	86 (65.2)
Adequate	4 (6.1)	42 (63.6)	46 (34.8)
Total	**66 (100)**	**66 (100)**	**132 (100)**

According to Table 4, the majority of the school-age children had an inadequate consumption of vegetables and fruits. In the case group, 93.3% of the respondents had an inadequate consumption of vegetables and fruits, while in the control group, 63.6% of the respondents had an adequate consumption of vegetables and fruits.

Dietary Diversity of School-Age Children

Dietary diversity was assessed using the 2 x 24-hour food recall, including both weekdays and weekends. The data were used to calculate the Dietary Diversity Score (DDS), which was categorized into low (≤3 food groups), medium (4-5 food groups), and high (≥6 food groups) (FAO, 2011). The dietary diversity of the two groups are presented in Table 5.

Table 5. Dietary Diversity of the School-Age Children

Dietary Diversity	Case (overweight and obese)	Control (normal)	Total
	n (%)	n (%)	n (%)
Low	36 (54.5)	9 (13.6)	45 (34.1)
Moderate	26 (39.4)	31 (47)	57 (43.2)
High	4 (6.1)	26 (39.4)	30 (22.7)
Total	**66 (100)**	**66 (100)**	**132 (100)**

In the case group, 54.5% of the school-age children had low dietary diversity. In contrast, in the control group, 47% of the children had moderate dietary diversity. Table 6 presents the data on food groups consumed by the school-age children in this study.

Table 6. Food Groups Consumption of the School-Age Children

Food Groups	Case (overweight and obese)	Control (normal)
	n	n
Starchy foods	66	66
Green vegetables	13	12
Vitamin A fruits and vegetables	3	10
Other fruits and vegetables	4	8
Innards	4	2
Meat and fish	41	54
Eggs	31	30
Pods, nuts, and seeds	19	18

Food Groups	Case (overweight and obese)	Control (normal)
	n	n
Milk and its processed products	4	10

According to Table 6, only a small percentage of school-age children with overweight or obesity in the case group consumed fruits and vegetables. The majority of the children consumed staple foods such as starch and eggs.

Analysis of Risk Factors for Overweight in School-Age Children

A multiple logistic regression test was used to analyze the risk factors for overweight in school-age. The analysis was conducted using the backward stepwise method with a significance level at 0.05 on four independent variables, namely physical activity, sugar intake, consumption of vegetables and fruits, and dietary diversity. According to the results of the multiple logistic regression analysis, the variables that have a p-value of less than 0.005 are sedentary behavior, sugar intake, and consumption of vegetables and fruits. Therefore, it can be concluded that the risk factors for overweight in school-age children at 1 and 3 Tawangsari State Elementary Schools were sedentary behavior, sugar intake, and consumption of vegetables and fruits. The results of the multiple logistic regression test analysis are presented in Table 7.

Table 7. Results of Multiple Logistic Regression Analysis

Variables	B	Sig	Exp(B)
Physical activity	2.121	0.002*	8.340
Sugar intake	2.211	0.000*	9.125
Consumption of vegetables and fruits	3.027	0.007*	20.643
Dietary diversity	-1.088	0.415	0.337

The Exp(B) values obtained from the multiple logistic regression test show the probability of the independent variables affecting the dependent variables. It can be concluded that school-age children with low physical activity were 8.34 times more likely to be overweight than those with high physical activity. In addition, school-age children with excessive sugar intake were 9.12 times more likely to be overweight than those with sufficient sugar intake. Furthermore, school-age children with inadequate consumption of vegetables and fruits were 20.64 times more likely to be overweight than those with adequate consumption of vegetables and fruits. On the other hand, dietary diversity was not a risk factor for overweight in school-age children ($p > 0.005$).

DISCUSSION

Overweight is a condition caused by consuming and absorbing nutrients over time without sufficient energy expenditure. The nutritional status of school-age children was determined using the body mass index according to age (BMI-for-age) indicators. In this study, overweight was more prevalent in male children (60.6%). Differences in the prevalence of obesity between males and females may be influenced by sociocultural factors (Shah et al., 2020). Research suggests that females generally prefer low-energy foods, while

males prefer meat and calorie-dense foods (Wang et al., 2018). Another study found that females tend to have a lower prevalence of obesity compared to males (Shah et al., 2020).

Risk Factors for Overweight in School-Age Children

Physical Activity

This study found that a large majority of school-age children (89.4%) had low levels of physical activity compared to those with normal nutritional status. The statistical analysis revealed that school-age children with low levels of physical activity were 8.34 times more likely to be overweight than those with high levels of physical activity. In addition, the majority of the case group reported engaging in the skipping and jogging activities only once to twice per week. The preferred physical activities of the children included skipping, soccer (for males), and cycling, with dancing being less common, for twice or three times per week. The maximum frequency of exercise for the children was typically between once to three times per week, with the majority taking place during sports class hours. The results of this study also suggested that the children spent a significant amount of their free time engaging in sedentary behavior, such as chatting with friends or playing with their gadgets, both during and after school. Excessive screen time, including the use of video games, television, computers, or laptops is a risk factor associated with overweight and obesity in children (Paduano et al., 2021). This behavior can lead to shorter sleep duration and negatively affects eating habits. A study conducted in Canada suggested that the consumption of sugary drinks while playing games for hours before bed can lead to overweight and negatively affects sleep quality at night (Turel, Romashkin and Morrison, 2017).

In the control group with normal nutritional status, male children engaged in soccer between four to five times, basketball between once or twice, roller skating between once to twice, and martial arts once during weekly extracurricular activities. In comparison, female children engaged in skipping between once or twice and roller skating between once or twice. According to the WHO (2020), screen time should be limited to less than two hours per day and physical activity should be at least 60 minutes per dayClick or tap here to enter text.. A study suggested that an imbalance of energy intake and expenditure is a risk factor for overweight and obesity in children (Paduano et al., 2021). In addition, another study found that sedentary behavior is positively associated with the incidence of obesity in children aged 12 years (Mitchell et al., 2009).

Sugar Intake

Excessive sugar intake is a risk factor for overweight in school-age children. The results of this study suggested that school-age children who were overweight had excessive sugar intake, while those with normal nutritional status had sufficient sugar intake. The results of the multivariate analysis suggested that school-age children with excessive sugar intake were 9.12 times more likely to be overweight than those with sufficient sugar intake.

The results of the SQ-FFQ showed that in the case group, the most commonly consumed snacks were candy twice per day, biscuits once per day, and sachet drinks with an average consumption of twice to three times per day, with some consuming more than three times per day. In addition, they frequently consumed packaged drinks such as tea and soft drinks with sugar content ranging from 11 to 46 grams per package, consumed between three to five times per week. Children who were overweight also consumed instant food between three to four times per week and snacks between once or twice per week. Instant foods and drinks often contain artificial sweeteners, which, if consumed excessively, can increase the risk of overweight in children. The consumption of sugary drinks in children and adolescents is

associated with an increased risk of obesity and metabolic diseases, including diabetes mellitus, hypertension, and metabolic syndrome. (Calcaterra et al., 2023).

Research shows that exceeding recommended sugar and added sugar intake significantly increases the risk of becoming overweight or obese (Magriplis et al., 2021). Monosaccharides have a higher glycemic index, which leads to faster and stronger insulin secretion and anabolic effects on the hormone. This is one of the causes of overweight and obesity in children, where sugar intake accounts for more than 10% of total energy (Magriplis et al., 2021).

Consumption of Vegetables and Fruits

The results of this study showed that school-age children who were overweight had inadequate consumption of vegetables and fruits. The multivariate analysis revealed that school-age children with inadequate consumption of vegetables and fruits were 20.64 times more likely to be overweight than those with adequate consumption of vegetables and fruits.

According to the results of the SQ-FFQ, school-age children who were overweight mostly consumed vegetables twice to four times per week and fruits twice to three times per week. It is recommended that vegetables and fruit be consumed with every meal as they are sources of many important nutrients, including vitamins, minerals, and fiber, sterols, flavonoids, and antioxidants. In addition, consuming vegetables and fruits can help prevent noncommunicable diseases. The WHO (2019) recommends a daily intake of 400 grams of vegetables and fruits.

Inadequate consumption of vegetables and fruits is a contributing factor to obesity (Ledoux, Hingle and Baranowski, 2011). Vegetables and fruits are low-energy foods that contain fiber, which can delay gastric emptying, thereby keeping the stomach full for longer and preventing overeating (Champagne et al., 2011). Children who consume the recommended amount of vegetables and fruits have a lower risk of obesity and are more likely to maintain a healthy diet throughout their lives compared to those who consume less (Gerritsen et al., 2019). The MyPlate guide can be used to determine the recommended consumption of vegetables and fruits, which is half a plate for each meal

Dietary Diversity

The results of this study showed that school-age children who were overweight had low dietary diversity (≤ 3 food groups). Meanwhile, those with normal nutritional status had high dietary diversity (≥6 food groups). In other words, dietary diversity and nutritional adequacy in children are positively correlated.

A study suggested a correlation between dietary diversity and the incidence of obesity (Salehi-Abargouei et al., 2016). Tao et al. (2020) conducted a study on school-age children and found a negative correlation between dietary diversity and the incidence of obesity. In contrast to previous studies, this study found that dietary diversity was not a risk factor for overweight in school-age children. This is consistent with the findings of Salehi-Arbagouei (2016) and Fernandez (2016) that found no correlation between dietary diversity and overweight or obesity.

Although dietary diversity was not found to be a risk factor for the incidence of overweight in school-age children, cross-tabulated data showed that that school-age children who were overweight tended to consume less diverse foods than those with normal nutritional status. A previous study suggested that children who consume more diverse foods may reduce their risk of overweight and obesity (Spiegel and Foulk, 2006). This is because a varied diet includes a great variety of vegetables and fruits, which are high in fiber and can help prevent overweight and obesity. Furthermore, this study found that school-age children who

were overweight tended to consume more processed flour-based foods and fewer vegetables and fruits. A diverse diet is one that contains all food groups, including grains, meats, vegetables, fruits and dairy products. In children, the consumption of a variety of foods is essential for optimal growth and development (Zhao et al., 2017).

CONCLUSION

Based on the results of this study, it can be concluded that the risk factors for overweight in school-age children include sedentary behavior, sugar intake, consumption of vegetables and fruits. In addition, children with low levels of physical activity were more likely to be overweight than those with high levels of physical activity. Furthermore, school-age children with excessive sugar intake were more likely to be overweight than those with sufficient sugar intake. Moreover, school-age children with inadequate consumption of vegetables and fruits were more likely to be overweight than those with adequate consumption of vegetables and fruits. However, dietary diversity was not found to be a risk factor for overweight in school-age children.

The limitation of this study includes the reliance on self-reported physical activity and dietary habits of school-age children during the previous seven days. However, the use of in-depth interviews and tools such as food pictures can help obtain relatively accurate data.

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