




# The Risk Factors of Obesity in Children during COVID-19 Pandemic Era in Gorontalo City

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## Abstract

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**BACKGROUND:** Obesity is a condition that is often associated with an increased risk of infection for coronavirus disease 2019 or COVID-19, which can be fatal or even cause death.

**AIM:** The study aimed to analyze the risk factors of obesity incidents in children during COVID-19 pandemic era in Gorontalo City.

**MATERIALS AND METHODS:** The risk factors for obesity include physical activity, history of obesity, fast food consumption, sleep duration at night, and breakfast. It applied analytical observational research with a case-control study design, matching the gender and age. The case was students when measured with a body mass index (BMI) equal to or above 25 kg/m<sup>2</sup>, while the control was student when measured with a BMI of 18.5–22.9 kg/m<sup>2</sup>. At the same time, the numbers of samples were 150 children in which the sampling was carried out non-random by applying purposive sampling technique.

**RESULTS:** Finding denoted that all the variables examined significantly correlated with obesity incidents during COVID-19 pandemic, with odds ratio (OR) value was <1. Specifically, the physical activity variable had the highest OR value compared to other variables, namely, OR 2.939, and this meant that adolescents who do not exercise or exercise <3 times a week during the COVID-19 period were at 2.939 times risk compared to adolescents who exercise 3 times a week.

**CONCLUSION:** The finding of this study concluded that in the COVID-19 pandemic era, physical activity or exercise is the most influential risk factor for the incidence of obesity compared to other variables.

## Introduction

Nowadays, overweight and obesity are one of the global health problems for children and adults. A recent study published in the American Journal of Epidemiology revealed that obesity experienced by a person as a teenager is closely related to an increased risk of death in middle age. The study involved 227,000 Norwegian men and women, whose height and weight were measured in 1963–1975 when they were aged 14–19 years, by following their development until 2004, when they were an average of 52 years old, and it was found that 9650 of them died. From the results of the study, it is known that those who are obese or overweight during adolescence are known to be 3–4 times more at risk of experiencing heart disease which leads to death. The risk of colon cancer and respiratory diseases, asthma, and emphysema also increases 2–3 times [1], [2].

The researchers, Russell M. Viner of Middlesex Hospital in London and J Cole Team of University College London, found that every additional hour of watching TV on the weekends when a child is 5 years old increases the odds of obesity when he is 30 years old as much as 7%. In America, more than 60% of people aged 20 years and

above are overweight. A quarter of adults in the country are obese, which increases the higher risks for chronic diseases such as heart disease, type 2 diabetes, high blood pressure, stroke, and some forms of cancer [3].

Du *et al.* [2] found that overweight and obesity in children and adolescents significantly less correlated with physical activity compared to their peers with normal weight. The vigorous-intensity activity has a potential as a protector against obesity. The activities such as watching TV, in adolescents aged 10–19 years, more than or equal to 5 h/day are associated with a high risk of overweight incidents compared to those who watch TV ≤2 h/day [4].

In addition, Huang *et al.* [5] conducted a systematic review and meta-analysis examining the association between obesity and the risk of severe COVID-19. Obesity was determined based on BMI and the degree of visceral adipose tissue (VAT). Outcomes of this study include hospitalization, ICU admission, use of invasive mechanical ventilation (IMV), and mortality. The univariate and multivariate results unveiled that a higher BMI was associated with a significant risk of severe COVID-19, including for hospitalization, ICU admission, IMV requirement, and death. In addition, it was consistently found that there was a correlation between higher VAT

accumulation and the risk of severe COVID-19, either for hospitalization, ICU admission, and IMV requirement.

Another meta-analysis that had been conducted by Hussain *et al.* on 14 studies revealed that several risk factors for COVID-19 mortality in the age of 70 years or older with IMT above 25 kg/m<sup>2</sup> are chronic comorbidities, advanced respiratory support, and critical illness. Yet, it was not for the gender factor. The two meta-analyses above acknowledged that obese patients are at high risk for severe COVID-19 infection requiring hospitalization, ICU care, and even IMV assistance. In addition, COVID-19 patients with obesity are at high risk for death [6].

A study in New York, United States, also evaluated the relationship between BMI and COVID-19 severity in patients aged <60 years. When compared with patients with a BMI <30 kg/m<sup>2</sup>, the risk of need for ICU care increased 1.8 times in patients with a BMI of 30–34 kg/m<sup>2</sup> and increased 3.6 times in patients with a BMI >35 kg/m<sup>2</sup> [7] This raises the question of whether obesity is an independent risk factor for COVID-19 [8]. Moreover, a study on 375 males and 496 females conducted by Castrodis closed that the proportion of morning food intake was negatively correlated with total food intake for a day. In other words, breakfast decline the food intake and total energy. In addition, obesity can be influenced by several factors, namely, genetic, stress, and hormonal. If both parents are obese, there is a possibility, the child would be exposed to obesity. These genetic factors affect the metabolism of fats, hormones, and proteins that influencing appetite. Some of the inherited traits are fat distribution, metabolic rate, energy response to food, and food choice [8], [9], [10], [11], [12].

The result of Riskesdas (Basic Health Research) that was carried out throughout districts/city in Gorontalo Province in 2017 indicated that the prevalence of general obesity (overweight + obesity) in adult population (age of 15 years or above) were as followed; Boalemo District for 20.4%, Gorontalo District for 26.5%, Pohnuato District for 19.7%, Bone Bolango District for 24.6%, and Gorontalo City for 34.9% [13], [14].

## Research Method

This study was carried out for a month during COVID-19 pandemic in Gorontalo City. It applied an analytical observational study with a case-control study design, where the obese adolescents were the case, and non-obese adolescents (normal nutritional status) were the control by matching the gender and age. Moreover, the inclusion criteria for respondents were adolescents aged 15–17 years, body mass index for obese adolescents was more than 26.5 kg/m<sup>2</sup> and the index for non-obese adolescents was 19–22.9 kg/m<sup>2</sup>. All the respondents have signed informed

consent to participate as respondents. Besides, the research instrument used was a digital weighing scale (Model UC-322), Microtoise anthropometry, and a questionnaire [15].

Furthermore, the data analysis was done by applying odds ratio (OR) analysis with 2 × 2 contingency. To determine the strength of the correlation in each variable, the test was carried out simultaneously to find out which variables had the most influence on the incidence of obesity in adolescents. Due to the dependent variable was dichotomous, the analysis used logistic regression analysis.

## Results Findings and Discussion

The previous table unveils that the variables studied have a risk of obesity with an OR value is >1. Specifically, all variables including physical activity (exercise), history of obesity, consumption of fast food, sleep duration at night, and breakfast significantly correlated with obesity incidents where the 95% confidence interval (CI) does not include/crosses the value 1.

It is followed by multivariate analysis to identify the variables that have the most potential to have a relationship with the obesity incidents in high school students.

**Table 1: Bivariate analysis result of various risk factors for obesity incidents in adolescents during COVID-19 pandemic era in Gorontalo city**

Variable	OR	95% CI	
		Lower	Upper
Physical activity	2.939	1.492	5.790
History of obesity	2.753	1.405	5.396
Fast food consumptions	2.705	1.390	5.623
Sleep duration at night	2.020	1.024	3.987
Breakfast	2.449	1.256	4.776

Primary data, 2021.

The result of exp (B) in Table 2 shows that physical activity variable has the highest OR, namely, 3.200. In addition, it is included as a significant variable because the CI does not include the value 1. This variable has a major position in determining the obesity incidents in high school students in Gorontalo City compared to other variables. Besides, the breakfast variable is also included as a significant variable since the 95% CI value does not include the value 1, as shown in the table 1.

**Table 2: Analysis of various risk factors for obesity incidents in adolescents during COVID-19 pandemic in Gorontalo City**

Variable	B	SE	Wald	df	Sig.	Exp (B)	95.0% CI for EXP (B)	
							Lower	Upper
Physical activity	1.163	0.3814	9.301	1	0.002	3.2	1.5154	6.7581
History of obesity	0.772	0.4071	3.598	1	0.058	2.164	0.9746	4.8071
Fast food	0.762	0.3998	3.636	1	0.057	2.143	0.979	4.6921
Sleep duration	0.624	0.392	2.534	1	0.111	1.867	0.8657	4.025
Breakfast	0.787	0.3979	3.91	1	0.048	2.196	1.007	4.7905
Constant	-5.87	1.2113	23.49	1	1E-06	0.003		

Primary data, 2021.

In contrast, other variables that are not significant are history of obesity, consumption of fast food, and sleep duration at night, and this is due to the interaction among the variables so that it becomes weak, which means that the risk factors are inconsistent.

## Discussion

### **Physical activity**

The result of OR statistical test obtains that the OR value is 2.939 at 95% CI lower 1.492 and upper 5.790 and is strengthened by  $p = 0.002$  ( $0.002 < 0.005$ ). This means that respondents who do not exercise or exercise <3 times a week have a risk of 2.939 times compared to respondents who exercise more than or equal to 3 times a week. Since the CI does not include or crosses 1, it is significant (meaningful), thus the hypothesis is accepted ( $H_0$  is rejected). This finding supports the research conducted by Azhari *et al.* [16] that students who have a lower frequency of physical activity have a risk at 1.299 times to experience obesity despite the results are not significant.

This finding also in line with Azhari *et al.* [16], in which there is a relationship between physical activity and obesity (OR = 2.100, 95% CI, 1.032–4.272), which indicates that inactive students have opportunities for 2.100 times greater risk of obesity than active students. Meanwhile, the interview results reveal that most respondents, both case (obese) and control (non-obese), always do low physical activities such as watching TV, playing games, reading comics/books, and relaxing. Still, the case group did this activity much longer than the control group. Besides, with the advancement of means of transportation, such as buses, cars, people no longer need to walk, or bike to visit a place. Each building is also equipped with elevators and escalators that lower a person's physical activity. The increased busyness also causes a person not to have time to do physical activity [16], [17], [18], [19], [20].

The result of the multivariate analysis indicates that if all variables are included in the logistic regression test, the physical activity variable (frequency of exercise) obtains the exp (B) value of 3.200, and the CI does not include the value 1, which means that it is significant. This means that there is an improvement from OR 2.939 in bivariate analysis. This is influenced by the number of students who do less physical activity, and there is no burning of energy. Students do fewer physical activities such as playing games (playstation), watching TV, taking lessons, listening to music, hanging out with friends, and taking a nap much longer [21].

Even if a person does not consume fast food, does not have parents with obesity, sleeps enough, has a regular breakfast but is not balanced with good

activities that are exercised regularly, a person will still experience obesity.

This finding is different from the results obtained by George in the multivariate analysis, which states that the history of obesity is the dominant variable. This is because obesity in obese offspring manifests quickly when obese offspring does less activity. Lack of activity becomes a permanent habit pattern which is the primary factor causing obesity [22].

Obesity in patients with influenza A can increase the duration of viral shedding, thus it potentially leads to higher inter-individual transmission. This could happen in COVID-19 [23].

In spite of the above mechanisms are still the potential hypotheses linking the effect of obesity on COVID-19; overall, obesity reduces cardiorespiratory reserve, results in systemic metabolic-inflammatory dysregulation, and potentiates the risk of thrombosis. As a consequence, all of these things have the potential to worsen the outcomes of COVID-19 [24].

### **History of obesity**

The result of statistical analysis reveals that the OR value is 2.753 at 95% CI 1.405–5.396 and is strengthened by  $p = 0.003$ . This means that respondents whose parents have a history of obesity are a risk factor for obesity in high schoolchildren and gain risk of 2.753 times compared to respondents whose parents do not have a history of obesity. Because the CI does not include the value 1, so that it is significant (meaningful) or the hypothesis is accepted.

This finding is in accordance with a study conducted by Budu-Aggrey, the history of obesity factors contributed 10.866 times the odds of a person experiencing obesity. It also supports the theory which states that genetic factors play an essential role in triggering obesity. If one parent is obese, then the children have a tendency to be obese by 40%. If both parents are obese, then their tendency to be obese becomes 80% [25].

Obesity tends to be inherited, so it is thought to have a genetic cause. Family members share not only genes but also food and lifestyle habits, which can encourage the incidence of obesity. It is often difficult to separate lifestyle factors from genetic factors. A recent study discloses that, on average, genetic factors have an influence of 33% on a person's weight.

### **Fast food consumption**

The analysis result on 150 senior high school students obtains the OR value of 2.705 at 95% CI 1.390–5.623 and  $p = 0.003$ . Meaning that respondents who consume fast food more than or equal to 3 times a week have 2.705 times risk of experiencing obesity

than those who consume less fast food. Because the CI does not include the value 1, the variable consuming fast food is significant (meaningful) toward the obesity incidents in high schoolchildren in Gorontalo City.

This study supports a study conducted by Ramly which indicates that 43.4% of adolescents respondents at puberty frequently eat fast food. The finding of the study showed that there was a significant relationship between the consumption of fast food and obesity incidents. It is also reinforced by the research of Setyaningsih which showed that consumption of snacks and other small foods in excess are factors that contributes the obesity in children [26], [27].

Equally important, fast food is usually high in fat and fried at high temperatures. As a result, unsaturated cooking oil eventually becomes saturated oil. The repeated use of cooking oil also makes unsaturated cooking oil saturated. Meanwhile, the snacks or students' favorite foods are high-fat foods, fried and instant foods, such as meatballs, instant noodles, fried rice, chocolate, bread, yellow rice, and vegetable fritters/fried bananas/tofu [28].

### **Duration of sleep at night**

The results of the analysis obtain an OR value of 2.020 at 95% CI lower 1.024 and upper 3.987 and  $p = 0.041$ . Meaning that, respondents who sleep a night <8.5 h/day have a 2.020 times more risk of being obese than those who sleep more than or equal to 8.5 h/day. Because the CI does not include the value 1, the variable duration of sleep at night is significant (meaningful) toward the obesity incidents in high schoolchildren in Gorontalo City.

The researchers argue that children with adequate and quality night's sleep will be more active in carrying out activities during the day. Conversely, children who sleep less tend to be lazy to do activities but eat more. This is what makes them fat. This conclusion is in line with the result of several studies, one of which is research by experts from the University of Bristol, England. It is mentioned that people who only sleep 5 h per night have 15% more ghrelin hormone content than those who sleep 8 h. Ghrelin is a hormone that increases the sensation of hunger. Not surprisingly, those who sleep less eat more. In the end, the body becomes fat [29]. In accordance with the results of interviews that have been conducted, it is known that most students did not sleep enough 8.5 h, and most of them stated that they felt hungry at night so that some of them prefer to consume snacks before going to bed, such as bread and instant noodles, while some are hungry but prefer to hold it in.

### **Breakfast**

The analysis results obtain the OR value of 2.449 at 95% CI lower 1,256 and upper 4.776

and  $p = 0.008$ . This means that respondents who skip breakfast or breakfast <4 times a week have a 2.449 times risk of being obese than those who eat breakfast more than or equal to 4 times a week. Because the CI does not include the value 1, the breakfast variable is significant (meaningful) toward obesity incidents in senior high schoolchildren in Gorontalo City. Moreover, the multivariate analysis indicates that the breakfast variable remains significant (meaningful) with an OR of 2.196, although there is a decrease in the OR from the bivariate OR of 2.256.

The decrease in the OR value in the multivariate analysis is due to the interaction of the risk variables so that the breakfast variable is weakened, but it remains significant. It is because people who skip breakfast will decrease their work activities. Hunger due to skip breakfast will be compensated a few hours later, and they did not realize that there is a sense of hunger and looking for a snack or lunch meals that are more numerous than if they had breakfast before [30]. The result of interviews also found that students whose stomachs are empty (skip breakfast) prompt their stomachs to eat snacks that are high in sugar and fat, such as snacks (o'corn, taro, ciki, and leo), biscuits (malkis), fried bananas, vegetable fritters, brown bread and cheese bread, pop ice, mountea, Frutamine, fried noodles, and noodle soup. Students who skip breakfast eat more at lunch and dinner. Lunch commonly consists of rice, side dishes, and vegetables without consuming fruit. Yet, many also consume fewer vegetables. Similarly, at night, the case samples were added by drinking milk before going to bed [31].

Plenty of food intake at night will result in an increase of glucose that is stored as glycogen. Since the physical activity at night is very low, glycogen is then stored as fat.

The research about the correlation between obesity and breakfast in Indonesia remains limited. However, the results in this study support the findings of Castro, a psychology researcher at the University of Texas, which states that the proportion of morning food intake is negatively correlated with total food intake for a day. This means that breakfast reduces food intake and total energy. At the same time, it is also espoused the finding of research from the Division of Preventive Medicine at the University of Massachusetts Medical School, which proves that diet eating frequency  $\frac{3}{4}$  and breakfast habits  $\frac{3}{4}$  are closely related to the risk of suffering from obesity. They also found that the more often they eat the food, the less risk of suffering from obesity. This finding is somewhat contrary to the prevailing general opinion. "The more often you eat food, the more energy or fat you put into your body" [32].

Further, a study published in the American Journal of Epidemiology (2008) denotes that people who eat meals up to 3 times a day have a 45% higher risk of experiencing obesity than people who eat 4 or more meals. This is in agreement with high insulin secretion. The higher insulin secretion leads to the greater the

inhibition of lipase activity. Consequently, more and more fat is deposited in the body [33]. A study on 2,000 teens (over 5 years) conducted by Peter Richel denotes that the more often adolescents eat breakfast, the less likely they are to be obese or overweight. Accordingly, the percentages of total fat and saturated fat were found to be lower in children who ate breakfast than those who did not [34].

People who take breakfast before going to work or school usually would not eat again until lunchtime. On the other hand, those who skip breakfast will look for snacks such as cakes or biscuits that contain high sugar. In the end, this raises the problem. In spite of the fact that the analysis results support the theory that breakfast regularly reduces the risk of obesity, more in-depth research remains to be conducted [35], [36], [37].

## Conclusion

During COVID-19 pandemic era, the physical activity variable is the riskiest factor with 2.939 times risk of causing obesity in children compared to other variables. Specifically, based on the history of obesity is 2.753; meaning that, students who have parents with history of obesity are 2.753 times more likely to be obese compared to students whose parents do not have a history of obesity, the fast food is 2.705; meaning that, students who consume fast food more than or equal to 3 times a week have 2.705 times risk of being obese compared to those who consume fast food <3 times a week, the duration of sleep is 2.020; meaning that, students who sleep a night <8.5 h/day have a 2,020 times risk of being obese compared to those who sleep more than or equal to 8.5 h/day, breakfast is 2.449; meaning that students who skip breakfast or breakfast <4 times a week have a 2.449 times risk of being obese compared to those who eat breakfast more than or equal to 4 times a week.

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