

# The Relationship between Drinking Soft Drinks with Obesity in 9-12 Years Old Children

*by Nur Nunu Prihantini Wiradi Suryanegara*

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## The Relationship between Drinking Soft Drinks with Obesity in 9-12 Years Old Children

Nur Nunu Prihantini<sup>1</sup>, Wiradi Suryanegara<sup>2</sup>

<sup>1,2</sup>Medical Faculty, Universitas Kristen Indonesia, Jakarta

Corresponding Author: Nur Nunu Prihantini

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### ABSTRACT

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Obesity is caused by an imbalance between the amount of energy intake and the energy used by the body for biological functions such as physical growth, activity, and health maintenance, which causes the build-up of fat in the body. Soft drinks have high sugar content, so our weight will quickly increase if consumed frequently. Indonesia has an increasing number in consumption of soft drinks. In 2010, Indonesia consumed 534.9 million liters, and in 2011 increased to 559 million liters. The purpose of this study is to see the relation between the frequency of soft drink drinking and obesity in "Rhema Indonesia" Elementary School in Bekasi Barat. The data is taken using a cross-sectional study with 11 elements of the questionnaire and using the height and weight of the children for counting Z-scores and eventually categorizing nutrition status. The result is that 62 out of 85 children (72.9%) often consume soft drinks. 70 out of 85 (82.4%) children is obese, and out of those 70 obese children, 57 often consume soft drink. There was a significant relationship between the frequency of drinking soft drinks and obesity in "Rhema Indonesia" Elementary School that is located in Bekasi Barat ( $p < 0.001$ )

**Keywords:** obesity, soft drink, frequency

### INTRODUCTION

Currently, obesity is an epidemic problem throughout the world, both in developed and developing countries, which is known as globesity. Obesity is caused by 12 imbalance between the amount of incoming energy required by the body for various biological functions such as physical growth, development, activity, health maintenance, and the accumulation of excess fat in the body [1; 2; 3]. The accumulation of body fat in obese people can increase body weight without increasing 16 water content in the body. As a result, obesity is one of the risk factors for the emergence of various degenerative diseases such as heart disease and stroke. These diseases are the most significant cause of death for the world's population, especially in the elderly [4; 5; 6; 7].

Obesity is not only experienced by adults but also by children. Obesity is more influenced by environmental factors than genetic factors [8]. Factors that can influence the incidence of obesity include work, age, stress, physical activity, gender, and food intake [3]. The choice of the type of consumption of fluids that contain high sugar can be a factor in obesity because high sugar drinks contribute quite a lot of energy to the body [9]. Obese or overweight children can have adverse metabolic, psychological, and economic consequences, especially if the child becomes an obese teenager [10].

Consumption of carbonated drinks has been proven as one of the factors that 10 can cause obesity in the United States. Consumption of soft drinks in the United States has increased 500% over the last 50 years and is

one of the largest sources of dietary calories in the diet of US citizens, even to the point of replacing other nutritional drinks such as milk and fruit juices [11]. Half of all Americans and most adolescents (65% girls and 74% boys) consume carbonated beverages daily [12]. School-age children's total energy intake is closely related to carbonated drinks. A study in America found that the energy intake of children who do not drink soft drinks every day is an average of 7650 kJ, and those who frequently consume soft drinks can reach 8435 kJ per day [12].

Soft drinks have high sugar content, so the weight will quickly increase if consumed in excess. Sugar, especially artificial sugar, is unsuitable for health because it can cause excess energy intake. This excess energy intake can trigger an increased risk of being overweight, obese, metabolic syndrome, insulin resistance, and reducing the desire to eat so that the body will lack vitamins, minerals, and food as a source of energy [13].

Indonesia itself has a double nutritional problem, namely the problem of undernutrition and excess nutrition. The prevalence of the Indonesian population was 15.4% obese [3; 14]. Obesity is a multifactorial problem. One of the most influential factors in obesity is eating and drinking patterns. Awareness about good eating and drinking patterns has been increasing in several countries, as seen by the limited consumption of soft drinks [15]. The consumption of carbonated drinks in 2010 was 534.9 million liters, then increased to 559 million liters in 2011 [16]. Seeing the high consumption of soft drinks accompanied by increasing rates of obesity in Indonesia, the authors would like to see the involvement of soft drinks with obesity rates, especially in children aged 9-12 years. From the background of the research above, the research problem is formulated in the form of questions as follows: "how is the frequency of drinking soft drinks in children aged 9-12 years at Rhema Indonesia Elementary School, West Bekasi?" and "is

there a relationship between frequent soft drink drinking and obesity in children aged 9-12 years at Rhema Indonesia Elementary School, West Bekasi?" with the aim of the study, namely to see the incidence of obesity in children aged 9-12 years at the Rhema Indonesia Elementary School, West Bekasi and to determine the frequency of drinking soft drinks in children aged 9-12 years at the "Rhema Indonesia" Elementary School, West Bekasi.

## LITERATURE REVIEW

Obesity is a term used to indicate being overweight. The term obesity itself, according to the Dorland medical dictionary, is an increase in body weight beyond the limits of physical and skeletal needs due to excess accumulation of body fat. Meanwhile, obesity is defined as abnormal or excessive fat accumulation that can interfere with health [17]. Obesity can also be said as a condition where fat cell mass is excessive and is not only defined by body weight because people with large muscle mass can be considered overweight without an increase in fat cells [3]. In general, obesity can be divided into two major groups, namely central obesity and gynoid obesity [14].

In short, obesity is caused by an imbalance between energy intake and expenditure. It can happen because of too much energy intake or too little energy expenditure, or both. Intake and expenditure of energy in our body can be converted and calculated roughly in units of kilo calories. In other words, obesity can occur because more kilo calories are entered than used to support the body's energy needs [1; 2]. Food and drink are the only contributors to energy intake [17]. Each food and drink have additional calories. As for energy expenditure, the contributing factors are basal metabolism, thermal effects of food, and physical activity. Basal Metabolic Rate (BMR) is a calculation of the energy released by the body to support activity. Everyone has a different BMR at different times. BMR is higher in people in their infancy, such as

young children and pregnant women, and people who often exercise. BMR can drop when fasting or malnutrition occurs. Several things must be considered to estimate the energy that enters the body, namely gender. Men usually have a higher BMR than women, but women's BMR increases during menstruation [18].

Calories expended from physical activity depend on muscle mass, total body weight, and activity. When food enters the body, sleeping cells start to work, and muscles that were previously in a relaxed state contract according to the existing rhythm. All cells that work in absorbing and processing food also require more energy and produce heat, called the thermal energy of food. The thermal energy of food is estimated to be 10% of the incoming food. Due to the insignificant number, this food's thermal energy is usually neglected [18].

The risk factors for obesity are divided into several parts, namely heredity, physical activity, mental condition, and eating and drinking patterns [19; 20]. According to the Ministry of Health, the marker for children aged 5-18 is the Body Mass Index (BMI). BMI is a calculation of weight in kilograms divided by height in meters squared. After that, it is adjusted according to age and gender and grouped. Society often confuses obesity and overweight. Obesity is a disorder or disease characterized by excessive body fat tissue accumulation. Being overweight is more than the ideal body weight, which can be caused by the accumulation of fat and non-fat tissue. For example, for an athlete, bodybuilders' overweight can be caused by the accumulation of muscle tissue [19].

Soft drinks are beverages that do not contain carbonated alcohol. Its composition consists of 90% water, and the other 10% is a combination of CO<sub>2</sub> gas, flavoring, citric acid, phosphoric acid, caffeine, and natural and artificial flavors. Natural ingredients can be nuts, fruits, and vegetables. Soft drinks include cola, beer, and wine, while coffee, tea, milk, and chocolate are not soft drinks. In the United States, the term soft

drink is used to distinguish non-alcoholic beverages from alcoholic beverages, so non-alcoholic beverages are referred to as soft drinks. The term soft drink is used for drinks with a mild nutritional status, which only have high sugar content but low levels of other nutrients. In Australia, soft drink is used for non-alcoholic beverages, whether or not CO<sub>2</sub> is added. So other ready-to-drink packaged drinks such as tea, fruit juice, and bottled water are included in the soft drink category. However, in Indonesia, the term soft drink is more famous for carbonated drinks. The composition of soft drinks generally consists of CO<sub>2</sub>, sweeteners, preservatives, artificial coloring, and flavorings [21].

Drinks sweetened with sugar contain very high levels of refined sugar, have a high glycemic load effect, and provide a satiety effect. It is believed to be one of the factors causing rapid weight gain, metabolic syndrome, and insulin resistance [22; 23]. Types of the content in soft drinks include soda water, sweeteners, flavor enhancers, acids, dyes, and some drinks also contain caffeine. Carbonation occurs when CO<sub>2</sub> gas is completely dissolved in water. It is followed by a reaction to release foam in soda which is nothing but the process of releasing dissolved CO<sub>2</sub> in the water. CO<sub>2</sub> is used to add a tingling taste in the mouth and produce a sour taste [24].

The sweet taste in soft drinks can come from sucrose or artificial sweeteners. Sucrose is a combination of fructose and glucose, which is included in carbohydrates. An artificial sweetener that is often used in soft drinks is aspartame [25]. According to the Regulation of the Minister of Health number 30 of 2013 concerning Inclusion of Information on Sugar, Salt, and Fat Content and Health Messages for Processed Foods and Fast Foods. It is stated that sugar consumption is more than 50 g (approximately equivalent to 4 tablespoons), sodium is more than 2000 milligrams, and fat/oil total of more than 67 grams (equivalent to 5 tablespoons) per person per day, will increase the risk of hypertension,

stroke, diabetes, and heart attack. Consumers must know and quickly read the information on the sugar, salt, and fat content and health messages listed on food labels and ready-to-eat foods [26]. Every can of soft drink has at least three tablespoons of sugar, even though the need for sugar in a day is no more than four tablespoons for adults. While other foods consumed in a day contain more than one tablespoon of sugar, eventually, sugar consumption becomes excessive [27]. In soft drinks, the bottle's surface often causes an explosion due to the release of CO<sub>2</sub> in giant bubbles. Carbon drinks containing sugar will cause a more regular release of gas and smaller bubbles (Honig, 1963) [28]. Glucose functions to store energy that will be used by cells.

Some sugar (carbohydrates) types include monosaccharides and disaccharides [29]. Monosaccharides are simple carbohydrates whose molecules consist of only a few carbon atoms and cannot be broken down by hydrolysis under mild conditions with other carbohydrates. Monosaccharides are simple carbohydrates with one ring group as a single molecule, and monosaccharides will also function as essential molecules for forming complex carbohydrate compounds, starch (starch), or cellulose. Examples of monosaccharides widely found in human cells are glucose, fructose, and galactose. Disaccharides are two monosaccharide molecules linked to each other, forming one disaccharide molecule, and disaccharides are sugars that have two or more molecules. Disaccharides consist of sucrose, lactose, and maltose.

## RESEARCH METHOD <sup>8</sup>

The research design used is a quantitative design using a cross-sectional approach, where the authors [36] look for the relationship between soft drinks and the incidence of obesity in children. Soft drink variables and the incidence of obesity in children will be assessed at the same time. Furthermore, the data collected through a questionnaire will be analyzed to test the

hypothesis. This research was carried out at Primary School "Rhema Indonesia" in October 2019. The population of this study was grade 4, 5, and 6 students who were obese and of average weight at SD "Rhema Indonesia" West Bekasi. The sample in this study were students in grades 4, 5, and 6 at Primary School "Rhema Indonesia" West Bekasi with a random sampling technique, namely a random sampling technique. The selected research sample is as many as 14 people. Data was collected by screening to determine the sample by measuring BMI per age in elementary school children. The authors themselves carried out the height and weight measurements. In determining BMI per age, the authors used an anthropometric calculator based on WHO 2007 for children aged 6-18. The research instrument used is a digital scale for measuring body weight and or body height. In addition, a questionnaire is used to determine the frequency of children who often drink soft drinks and the types of soft drinks that are often consumed. Data processing is carried out through several stages: editing, coding, processing, and cleaning. Data analysis was carried out in two ways: univariate and bivariate. The data that has been processed and analyzed will be presented in tabular form and accompanied by an explanation.

## RESULT AND DISCUSSION

"Rhema Indonesia" Primary School is a school that just opened in 2011. All students from "Rhema Indonesia" Primary School from grades 4 to 6 are 108 children. In random sampling using the Slovin formula, the minimum sample must be taken 85 children. SD "Rhema Indonesia" is located in a shopping area surrounded by shophouses. About 200 meters from SD Rhema, a supermarket and mini market provide soft drinks. Seeing the supportive environmental factors around the school, the authors decided to conduct research at the "Rhema Indonesia" Elementary School.

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**Table 1. Reliability Test**

Cronbach's Alpha	N of Items
.555	10

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The purpose of reliability is a tool to measure a questionnaire which is an indicator of a variable. A questionnaire can be said to be reliable or reliable if someone's answer to the statement is consistent or stable from time to time. The test is carried out in stages by comparing the value on

Cronbach's Alpha with the value on Cronbach's Alpha if several elements of the question are eliminated or replaced. The reliability test results with Cronbach's Alpha value > 0.5 indicate that the questionnaire is reliable [32]. After testing, the Cronbach Alpha value is 0.555, so it can be concluded that the questions about soft drinks are reliable.

**Table 2. Frequency of obese and obese nutritional status**

		Frequency	%	Valid Percent	Cumulative Percent
Valid	Not obese	15	17.6	17.6	17.6
	Obese	70	82.4	82.4	82.4
	Total	85	100.0	100.0	100.0

Many things can be a risk factors for obesity, including genetics, physical activity, mental conditions, and eating and

drinking patterns. In table 3 of the 85 samples, 15 children were not obese, and 70 were obese (82%). It shows the high rate of obesity in SD "Rhema Indonesia."

**Table 3. Frequency of soft drink consumption categories**

		Frequency	%	Valid Percent	Cumulative Percent
Valid	Seldom	4	4.7	4.7	4.7
	Sometimes	19	22.4	22.4	27.1
	Often	62	72.9	72.9	72.9
	Total	85	100.0	100.0	100.0

To facilitate calculations in the SPSS application, the authors categorize the frequency of drinking soft drinks into 3, namely rarely, sometimes, and often. Samples that answered "rarely" drank soft drinks will be included in the "rare" category. The "occasionally" category is for samples that answer 1-3 bottles per month. Those who answered 1-2 bottles per week to 1 bottle per day are included in the "often" category. It can be seen that of the 85

children who were in the sample, 4.7% (4 children) rarely drank soft drinks, 22.4% (19 children) occasionally, and 72.9% (62 children) were included in the frequent category.

For the obesity category, the authors first calculated the BMI of each child and matched it to age (by year and month), saw the standard deviation, looked for the Z-score for each child, then grouped the nutritional status of each child.

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**Table 4. The relationship between the frequency of nutritional status and the frequency of drinking soft drinks**

		Category			Total
		Rarely	Sometimes	Always	
Nutritional status	Not obese count	2	8	5	15
	% Within category	50.0%	42.1%	8.1%	17.6%
	Obese count	2	11	57	70
	% Within kategori	50.0%	57.9%	91.9%	82.4%
Total Count		4	19	62	85
% Within category		100.0%	100.0%	100.0%	100.0%

The table above shows that among children who are not obese, two children rarely drink soft drinks, eight children fall into the occasional category, and five children often drink soft drinks into the category of rarely

drinking soft drinks. Eleven children occasionally drink soft drinks, and 57 children are included in the often-drinking soft drinks category. The above results support the theory stated by Lancet David

[33] that drinks containing sweetened sugar are one of several risk factors for obesity in children aged 10-12 years. Luwding [34] said that this might be because the

substances obtained from this drink are no more complete than solid foods, even though they both produce energy and make you feel full.

Table 5. Frequency of types of soft drinks

		Frequency	%	Valid Percent	Cumulative Percent
Valid	Coca Cola	16	18.8	18.8	18.8
	Sprite	26	30.6	30.6	30.6
	Pepsi	9	10.6	10.6	10.6
	Fanta	34	40.0	40.0	40.0
Total		85	100.0	100.0	100.0

Judging from the conversion results in the form of percentages, the type of soft drink that was consumed the most by "Rhema Indonesia" elementary school children in grades 4-6 was Fanta (40%), Sprite (30.6%), followed by Coca-Cola (18.8%) and least is Pepsi (10.6%). In a study conducted globally in Indonesia regarding the

consumption of soft drinks, Coca-Cola is the largest in sales of soft drinks. The three companies most chosen by the sample are Coca-Cola (99.4%), Fanta (98.7%), and Sprite (97.5%). Most of the respondents drank Coca-Cola in the past month. Of the three most prominent brands, Fanta was the least drunk in the past month [35].

Table 6. Mapping of soft drink purchase

		Frequency	%	Valid Percent	Cumulative Percent
Valid	Uncertain	6	7.1	7.1	7.1
	Holiday	10	11.8	11.8	18.8
	Weekend	21	24.7	24.7	24.7
	school day	43	50.6	50.6	50.6
	Every day	5	5.9	5.9	5.9
Total		85	100.0	100.0	100.0

Judging from the results of filling out the questionnaire, 43 children (50.6%) of SD "Rhema Indonesia" buy soft drinks on school

days, 21 children (24%) buy them on weekends, while there are five people who buy soft drinks constantly (5.9%).

Table 7. Availability of soft drinks at home

		Frequency	%	Valid Percent	Cumulative Percent
Valid	Never Available	27	31.8	31.8	31.8
	Rarely Available	27	31.8	31.8	31.8
	Sometimes Available	16	18.8	18.8	18.8
	Always Available	15	17.6	17.6	17.6
Total		85	100.0	100.0	100.0

15 out of 85 children (17.6%) always have a soft drink supply in their home. Sixteen children (18.8%) admitted that they sometimes have supplies of soft drinks,

while for the "sometimes" and "never" categories, they both have a presentation of 31.8% or 27 of 85 children.

Table 8. Distance from house to the place of purchase of soft drinks

		Frequency	%	Valid Percent	Cumulative Percent
Valid	More than 500m	20	23.5	23.5	23.5
	100-500m	22	25.9	25.9	25.9
	Less than 100m	43	50.6	50.6	50.6
Total		85	100.0	100.0	100.0

The author also wants to know whether the "Rhema Indonesia" elementary school children have easy access to soft drinks.

Most of these children have close access to soft drinks because 43 children (50.6%) are less than 100 meters from the house where

they buy soft drinks. Besides that, as mentioned above, SD "Rhema Indonesia" is less than 200 meters from the supermarket and mini market.

Table 9. Types of soft drink sizes

		Frequency	%	Valid Percent	Cumulative Percent
Valid	Small	33	38.8	38.8	38.8
	Severe	30	35.3	35.3	35.3
	Big	22	25.9	25.9	25.9
Total		85	100.0	100.0	100.0

As seen in the table above, most (38.8%) of the sample bought soft drinks in small sizes, and 22 people (25.9%) bought large ones. It may be related to the data that the sample buys soft drinks more often on school days, so the sample must use their own pocket money, which is limited in number.

Table 10. Level of sample preference for soft drinks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Do not like	3	3.5	3.5	3.5
	Ordinary	28	32.9	32.9	32.9
	Like	26	30.6	30.6	30.6
	Really like	28	32.9	32.9	32.9
Total		85	100.0	100.0	100.0

From the SPSS results, it can be seen that (32.9%) are normal towards soft drinks, 26 from the 85 samples, only three children (3.5%) did not like soft drinks. 28 children (32.9%) like soft drinks, and 28 children (32.9%) like it

Table 11. Cross table of the level of preference and frequency of drinking soft drinks

		Category				Total
		Do not like	Ordinary	Like	Really Like	
Kategori	Rarely Count	1	3	0	0	4
	% Within do not like	33.3%	10.7%	0.0%	0.0%	4.7%
	Sometimes Count	2	11	5	1	19
	% Within like	66.7%	39.3%	19.2%	3.6%	22.4%
	Always count	0	14	21	27	62
% Within like	0.0%	50.0%	80.8%	96.4%	72.9%	
Total Count		3	28	26	28	85
% Within category		100.0%	100.0%	100.0%	100.0%	100.0%

Table 12. Correlation and significant relationship between liking and drinking frequency

Category	Pearson Correlation	Category	Like
			.523**
	Sig. (2-tailed)		.000
	N	85	85
Like	Pearson Correlation	.523**	.000
	Sig. (2-tailed)		.000
	N	85	85

The Pearson Correlation number, which shows 0.5-0.7, means that the two variables have a relationship, and the relationship is positive. It can be interpreted that the more a person likes soft drinks, the higher their consumption. Meanwhile, the significance number below 0.05 means that the relationship is significant. Characteristics of the frequency comparison of soft drinks with other drinks (tea, coffee, and juice).

Table 13. Comparison between drinking tea and soft drinks

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Tea	57	67.1	67.1	67.1
soft drink	28	32.9	32.9	32.9
Total	85	100.0	100.0	



Table 14. Comparison between drinking coffee and soft drinks

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Coffee	17	20.0	20.0	20.0
Soft drink	68	80.0	80.0	80.0
Total	85	100.0	100.0	

Table 15. Comparison between drinking juice and soft drinks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Valid Juice	58	68.2	68.2	68.2
	Soft drink	27	31.8	31.8	100.0
Total		85	100.0	100.0	

Apart from the frequency of drinking soft drinks themselves, the author wants to know the attitude of the sample when it is associated with other types of drinks. Compared to tea and juice drinks, "Rhema Indonesia" elementary school children primarily consume tea and juice. However, compared to coffee, Rhema Indonesia Elementary School children 80% more often consume soft drinks.

In a study by Melissa, it was seen that people who consumed sweetened drinks had a 7.8% greater energy intake than people who drank only water. If you compare water with milk and juice, the energy intake can reach 14.3%. In the end, it was concluded that plain water could reduce energy intake and prevent obesity [9].

Table 16. Correlation Test

	Value	df	Asymptotic significance (2-sided)
Pearson Chi-Square	14.619 <sup>a</sup>	2	.001
Likelihood Ratio	13.048	2	.001
Linear-by-Linear Association	13.472	1	.000
N of Valid Cases	85		

In table 16, there is a sign marked with "Asymptotic Significance (2-sided)". Significance can be used for hypothesis testing by comparing the significance level (p-value). If the significance is  $> 0.05$ , then  $H_0$  is accepted. If the significance is  $< 0.05$ , then  $H_0$  is rejected. The significance test results are 0.001, meaning  $H_0$  is rejected, and  $H_1$  is accepted. So it can be concluded that there is a relationship between drinking soft drinks and obesity. It can also be interpreted that with the increasing consumption of soft drinks, the incidence of obesity is also increasing.

It can be caused by the high sugar content in soft drinks. Soft drinks have very high sugar content, while sugar in the body will be stored in the form of energy. So if sugar intake is not balanced by energy expenditure, for example, exercising and other physical activities, the body will build up energy or sugar. Excess sugar in the body will be stored in the form of fat, which will cause obesity. Many factors can support the occurrence of obesity in children, such

as genetics, mental status, physical activity, and eating and drinking patterns. However, after the implementation of this research, we can see that drinking patterns, mainly soft drinks, are one of the supporting factors for obesity in "Rhema Indonesia" elementary school children.

## CONCLUSION

The 9-year-old class has a BMI threshold of 21.5 (female) and 20.5 (male), while in the study, it was found that the average BMI of the sample was 21.6 (female) and 22.3 (male). Age 10 years from the results of the study had a BMI of 23.12 (women) and 22 (men), which should not exceed 22.6 (women) and 21.4 (men). Children aged 11 years will be classified as overweight if their BMI exceeds 23 (girls) and 22.5 (boys). In this study, the sample had an average BMI of 23.8 (female) and 23.74 (male). Boys aged 12 years have an average BMI of 24.6, which has exceeded the standard nutritional threshold of 23.8, while girls with an average BMI of 24.4 have not

exceeded the limit of 24.9. It can be seen from the data above that almost all age classes of men and women in the sample are obese. It shows the high obesity rate in SD "Rhema Indonesia." From the study results, it was found that 62 children (from 85 samples) were included in the category of "often" drinking soft drinks, namely those who drank 1-2 bottles of soft drinks per day to those who drank soft drinks per drinks every day. After discussion, it was found that eating and drinking patterns are one of the risk factors for obesity. It supports the conclusion that there is a positive relationship between the frequency of soft drinks and obesity, which means that the more often you drink soft drinks, the more obesity tends to occur in "Rhema Indonesia" elementary school children aged 9-12 years.

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