

# Salivary pH, dental caries and Body Mass Index (BMI) in middle school students in Eastern Makassar



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## Abstract

**Objective:** This study aimed to assess the association of salivary pH, dental caries, and body mass index (BMI) in middle school students in Eastern Makassar.

**Material and Methods:** This study included 60 middle school students from two schools in eastern Makassar. Data were collected by filling out a questionnaire, weight and height measurement, dental examination and saliva collection. Body mass index was calculated by dividing weight and height in kg/m<sup>2</sup>, saliva was collected by draining method, and salivary pH was measured with Saliva-Check Buffer (GC Japan). Decay Missing

Filled-Teeth (DMF-T) indexes are used to assess dental caries.

**Results:** This study showed that overweight and obesity are more prevalent in female students than male students. Salivary pH in underweight students and overweight and obese students were lower compared to normal BMI students, while DMFT score in underweight, overweight and obese students was higher than the normal BMI students.

**Conclusion:** It can be concluded that body mass index (BMI) have a significant association with salivary pH and DMFT score.

**Keywords:** Body mass index (BMI), Dental caries, Salivary pH

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## Introduction

Body Mass Index (BMI) is a parameter set by WHO (World Health Organization) as a ratio of body weight to the square of height.<sup>1</sup> Body Mass Index (BMI) is determined by measuring weight and height separately, then the weight and height values are divided to get the BMI value in kg/m<sup>2</sup>. In Indonesia, the threshold of BMI scores was modified based on clinical experience and research results in several developing countries. The BMI category for underweight is 18.5-24.9 kg/m<sup>2</sup>, normal 18.5-24.9 kg/m<sup>2</sup>, overweight is 25.0-29.9 kg/m<sup>2</sup> and obese 30.0 kg/m<sup>2</sup>.<sup>2,3</sup> BMI scores are related to many things about health and disease risk and consequently related to the saliva secretion.<sup>3</sup>

Saliva is a complex oral fluid that consists of a mixture of secretions from major and minor salivary glands.<sup>4,5</sup> Saliva has many vital roles in health, including protecting the oral cavity and facilitating eating. It is also important in food perception and digestion. Saliva lubricates mucosal tissues, removes cell and food debris, protects against teeth demineralization, and has antimicrobial activity.<sup>5,6</sup> A recent study by Pannuzio et al.<sup>7</sup> showed that overweight and obese individuals are more prone to experience xerostomia dan dental caries compared to an individual with a normal BMI.<sup>7</sup>

Obesity is a significant health issue that predisposes individuals to various diseases. It is a complex, multifactorial and largely preventable disease, along with overweight affecting more than a third of the world's population.<sup>8,9</sup> If current trends continue, it is estimated that 2.7 billion adults will be overweight, over 1 billion affected by obesity, and 177 million adults severely affected by obesity by 2025.<sup>10,11</sup> It is also estimated that 41 million children under the age of 5 years were overweight or obese in 2016. The prevalence of overweight and obesity among children and adolescents aged 5-19 has risen dramatically to over 18% in 2016.<sup>9</sup>

Both obesity and dental caries are considered chronic, highly prevalent conditions with lifelong impacts on the lives of children and young people. Dental caries is the most common oral disease that is affected globally. National Basic Health Survey in 2018 showed the prevalence of dental caries had reached 88.8%. Dental caries could occur through the interaction of various factors such as cariogenic microorganisms, socioeconomic condition, eating habits, and other factors like high consumption of carbohydrates, increasing body weight, and the prevalence of dental caries.<sup>9,11</sup>

Considering this available information and evidence and a very few reports regarding the

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**Table 1** BMI category distribution based on gender

Gender	Underweight		Normal		Total		Underweight		Obesity		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Male	3	6	7	14	7	14	3	6	20	40		
Female	2	4	13	26	11	22	4	8	30	60		
Total	5	10	20	40	18	36	7	14	50	100		

**Table 2** Association of salivary pH, DMFT and BMI

Variable	Body Mass Index (BMI)				p value
	Underweight	Normal	Underweight	Obesity	
Salivary pH	6.30 ± 0.20	7.20 ± 0.30	6.00 ± 0.31	5.8 ± 0.17	0.01*
DMFT	2.98 ± 0.18	1.36 ± 0.28	3.36 ± 0.19	3.78 ± 0.22	0.02*

\*p=0.05

association of BMI with salivary pH and dental caries among adolescents; hence, this study aims to assess the correlation of salivary pH, dental caries and BMI in middle school students in eastern Makassar.

## Material and Methods

This study was an observational analytic with a cross-sectional design on 60 first-grade middle school students in eastern Makassar. Informed consent has been obtained from their parents. Data were collected by filling out a questionnaire, weight and height measurement, dental examination, and saliva collection.

Body mass index was calculated by divided weight and height in kg/m<sup>2</sup> with the formula: BMI: weight (kg) / height (m). The BMI category for underweight is 18.5-24.9 kg/m<sup>2</sup>, normal 18.5-24.9 kg/m<sup>2</sup>, overweight are 25.0-29.9 kg/m<sup>2</sup> and obese 30.0 kg/m<sup>2</sup>.

Subjects were asked not to consume anything other than water before sample taking. Stimulated saliva was collected by draining method after the subject was asked to chew paraffin gum for 5 minutes. Salivary pH was measured with GC Saliva Check Buffer; 5.0-5.8 indicate strong acid condition; 6.0-6.6 indicate the acid condition and 6.8-7.8 indicate normal condition. Salivary pH was measured by dipping the strip (GC Japan) into the sample for 10 seconds and then comparing the color change using the standard color chart provided in the saliva kit (GC Japan).

DMF-T index is the simplest and most commonly used in dental caries epidemiologic surveys. It quan-

tifies dental health status based on the number of decay, missing, and filled teeth. Statistical analysis was performed by chi-square and ANOVA with a significance of 0.05.

## Results

A total of 50 first-grade middle school students were evaluated and consisted of 30 (60%) female students and 20 (40%) male students. [Table 1](#) showed BMI distribution based on gender, where the number of overweight and obese students are half of the total sample (25 students); equal to the number of underweight and normal students. It is also shown that overweight and obesity are more prevalent in female students compared to male students.

[Table 2](#) shows the association of salivary pH and DMF-T scores toward BMI. It showed that the salivary pH in underweight students and overweight and obese students was lower than normal BMI students (p=0.01); where the obese students had the lowest salivary pH. The same thing for the DMF-T score where underweight, overweight, and obese students have a higher DMF-T score than the normal BMI students (p=0.02); the obese students have the highest DMFT score.

## Discussion

This study showed that overweight and obesity are more prevalent in female students (30%) than males (20%). Out of 50 students, 15 female students are overweight and obese, compared to

and obese category. Obesity is a growing epidemic in adolescent girls. This epidemic among teens is become a problem because adolescent girls who become obese are more likely to remain obese as adults and prone to higher level of morbidity and mortality than general population.

Salivary pH in underweight students and overweight and obese students were lower compared to normal BMI students, while DMF-T score in underweight, overweight, and obese students was higher than the normal BMI students. Changes in salivary pH are influenced by the types of food, stimulation of salivary secretion, salivary flow rate, time, and buffering capacity. Salivary pH can be decreased due to acid production from bacteria after carbohydrate consumption. On the other hand, salivary pH will increase when the acid is washed and neutralized with minerals, such as calcium, phosphate, and ions hydroxyl.<sup>13</sup> This study used stimulated saliva obtained after chewing paraffin gum. Chewing paraffin gum can increase salivary pH because stimulated saliva will stimulate the minor salivary gland to secrete more saliva.

Salivary pH in underweight students ( $6.30 \pm 0.20$ ) were lower compared to normal BMI students ( $7.20 \pm 0.30$ ). Salivary pH in overweight and obese students ( $6.00 \pm 0.31$ ;  $5.8 \pm 0.17$ , respectively) also lower compared to normal BMI students. This result is in line with the study conducted by Anamaria et al.<sup>14</sup> where the salivary pH of normal BMI children was higher than the underweight and obese children. It can be said that underweight and overweight and obese students were experiencing hyposalivation that decreased the salivary pH; as saliva have a critical role in oral cavity through its various function, thus people who have a nutritional imbalance can have delayed dental eruption, altered buffering capacity of saliva, enamel hypoplasia and higher incidence of caries. The decrease of salivary flow along with salivary pH can be associated with the initiation and progression of carious lesions.<sup>14</sup>

## Conclusion

This study showed that BMI has significant effect on the salivary pH and dental caries status in middle school students in eastern Makassar. But the relationship between saliva parameters and anthropometric measurements need further research with a larger sample size. Our recommendations are to increase awareness of dental health, dietary counselling and various preventive measures.

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## Conflict of Interest

The authors report no conflict of interest.

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