

# Time of eliminating Foods with Different Degrees of Adhesion by Preschool Children

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## ABSTRACT

**Aim:** Dental caries is a biofilm-dependent disease resulting from the interaction between microorganisms, a susceptible host, and a cariogenic diet. The risk of developing caries lesions varies according to the individual characteristics and socioeconomic and cultural factors. The aim of this study was to evaluate the length of time of oral clearance of food from the occlusal surfaces of molars in preschool children.

**Materials and methods:** Chocolate cookies or pieces of apple were distributed to 188 children aged 3 to 6 years, and the food retention was observed every 10 minutes for 1 hour. The degree of retention was ranked by scores: (0) total elimination, (1) partial retention, and (2) total retention.

**Results:** Children 3 to 4 years of age took 30 minutes to eliminate the cookies from the surfaces of the teeth examined, while the children who were 5 to 6 years of age took 20 minutes. The lower molars needed more time to eliminate the cookies. All children eliminated apple in <10 minutes.

**Conclusion:** The results suggest that in younger children, the food may remain in the oral cavity for a significant period of time.

**Clinical significance:** As eating habits influence significantly the development of caries lesions, and cariogenic food directly changes the demineralization–remineralization process, the results of this study show the importance of counseling the families regarding the frequency, time, and type of food to be offered to preschoolers as a preventive measure to early childhood caries.

**Keywords:** Cariogenic, Child, Dental caries, Diet, Longitudinal study, Observational study, Preschool.

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## INTRODUCTION

Dental caries is a chronic disease, biofilm-dependent, resulting from the interaction between microorganisms,

susceptible host, and cariogenic diet. Although there is a change in the epidemiological profile of dental caries, in Brazil, greater access to dental services, improvement in living conditions, and expansion of health promotion and education in oral health, in particular, the use of fluorides,<sup>1,2</sup> caries is still considered a major public health problem<sup>3</sup> that is responsible for pain, anxiety, and functional limitation.<sup>4</sup>

The relationship between the cariogenic diet, represented by high consumption of foods rich in monosaccharides and disaccharides,<sup>2</sup> and tooth decay requires consideration of cariogenic critical determinants, such as amount and frequency of intake of sugars, exposure of dental surfaces to sugars, food bioavailability, nature of the bacterial biofilm, and buffering capacity and salivary flow rate.<sup>5,6</sup>

A major concern about the intake of free sugars in drinks and food for children and adults has been discussed by the World Health Organization,<sup>6</sup> indicating a possible reduction in food intake with nutritionally adequate calories, leading to improper diet, weight gain, and increased risk for the development of dental caries.<sup>2,7-9</sup>

The cariogenic diet is also associated with the type of sugar and adhesiveness or adhesion to dental enamel, that is, the greater the adhesiveness of the food, the greater the time to be eliminated from the oral cavity.<sup>2,6,10</sup> As saliva is secreted into the oral cavity, the sugar present in the food is diluted and becomes available to microorganisms for their fermentation; however, this availability of sugar is reduced at the same time by swallowing.<sup>5</sup> Therefore, it is believed that the food adhesiveness can influence the ability of salivary oral clearance.<sup>6,10</sup> High retention rates were found in sweet and salty snacks and potato chips, which are frequent in children's diets.<sup>11</sup> The ingestion of hard and fibrous foods has been recommended as a way to promote natural teeth cleaning to stimulate saliva and thus collaborates with the elimination of cariogenic sugars.<sup>6</sup>

Based on the relationship between food consistency and tooth decay, as well as evidence that the ability of the mouthwash is affected by the age of the child,<sup>12</sup> the aim of this study was to evaluate the time of eliminating foods with different degrees of adhesion on the occlusal surface of primary molars, upper, and lower, by preschool children.

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**MATERIALS AND METHODS**

Total 188 boys and girls of 3 to 6 years of age from a municipal school system in Cuiabá-MT, Brazil, participated in the study. Their legal guardians signed the informed consent, authorizing their participation in the study, which was approved by the research ethics committee of the University of Cuiabá-UNIC (2012-028 CEP/UNIC).

For assessing the food elimination time, three unstuffed chocolate biscuits (buttered chocolate flavor, Marilan, composition: Carbohydrate, 20 gm; protein, 3 gm; total fat, 4.8 gm; saturated fat, 2.2 gm; trans-fat, 0 gm; dietary fiber, 1.1 gm; and sodium, 94 mg) or three pieces of apple were randomly assigned to the preschool children, creating two groups.

Following the intake of investigated food, an examiner previously calibrated and evaluated the retention of food in the upper and lower primary molars in each child every 10 minutes for 1 hour.

The degree of elimination of the cookies and apples was ranked by the following scores: (0) total elimination (lack of coverage of the occlusal surface); (1) partial retention (occlusal surface with up to 70% coverage); and (2) total retention (occlusal surface with the top sheet 70%).

The data were statistically analyzed using the non-parametric Friedman test at a significance level of 5%.

**RESULTS**

To evaluate the time to eliminate the different kinds of foods investigated from the oral cavity of preschool children, the nonparametric Friedman test was selected. The results of the Friedman test and multiple comparisons of average posts of evaluation periods at the 5% level of significance are presented in Table 1.

To optimize the analysis, the scores relating to children aged 3 and 4 years were grouped, as well as the

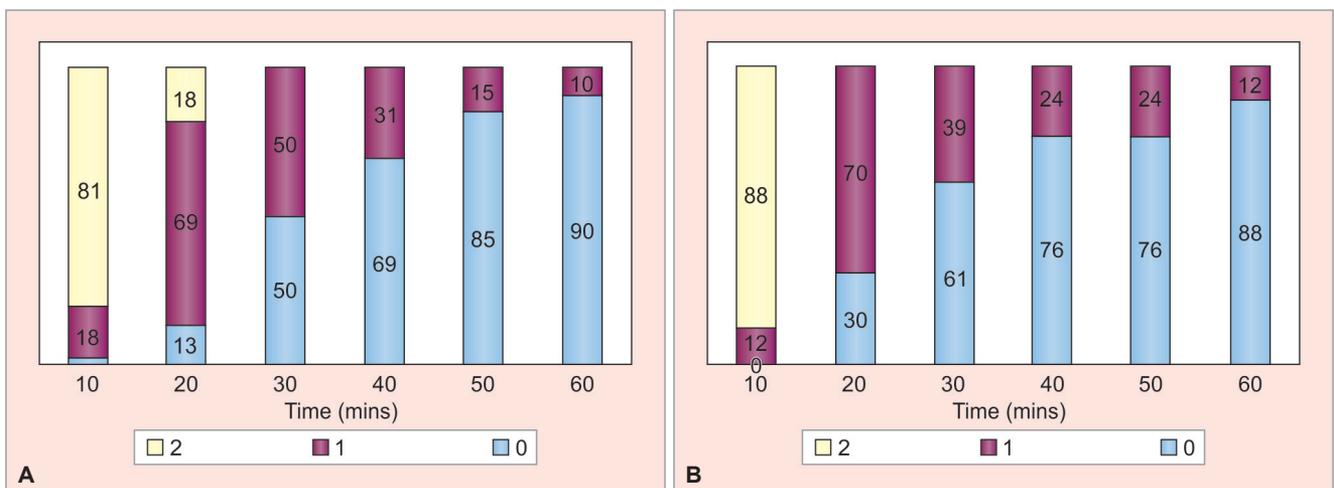
**Table 1:** Friedman test for analyzing the elimination of chocolate biscuits in primary molars of preschool children according to age

Friedman test	Age (years)			
	3	4	5	6
Friedman (%)	87.1	89.1	37.4	43.8
p-value	<0.0001	<0.0001	<0.0001	<0.0001
Multiple comparisons between periods of times of investigation (seconds)				
10 and 20	>0.05	>0.05	<0.05	<0.05
10 and 30	<0.05	<0.05	<0.05	<0.05
10 and 40	<0.05	<0.05	<0.05	<0.05
10 and 50	<0.05	<0.05	<0.05	<0.05
10 and 60	<0.05	<0.05	<0.05	<0.05
20 and 30	>0.05	<0.05	>0.05	>0.05
20 and 40	<0.05	<0.05	>0.05	>0.05
20 and 50	<0.05	<0.05	>0.05	>0.05
20 and 60	<0.05	<0.05	>0.05	>0.05
30 and 40	>0.05	>0.05	>0.05	>0.05
30 and 50	>0.05	>0.05	>0.05	>0.05
30 and 60	>0.05	>0.05	>0.05	>0.05
40 and 50	>0.05	>0.05	>0.05	>0.05
40 and 60	>0.05	>0.05	>0.05	>0.05
50 and 60	>0.05	>0.05	>0.05	>0.05

scores of children aged 5 and 6 years. Percentage frequency distributions of scores were arranged according to the evaluation period. These distributions are represented in Graph 1.

After 20 minutes, retention of chocolate cookies was higher in lower primary molars in both age groups ( $p < 0.05$ ), while in other periods of observation, there was no statistically significant difference between the degree of elimination of cookies on the surfaces of the upper and lower teeth. However, there was a trend toward greater food elimination of surfaces of upper molars after 30 and 40 minutes.

All children eliminated apple pieces in <10 minutes.



**Graphs 1A and B:** Representation of the oral clearance time of chocolate cookies in each evaluation period for preschool children in the different age groups investigated: (A) 3 to 4 years of age and (B) 5 to 6 years of age

## DISCUSSION

In the present study, we observed a greater retention of chocolate-flavored biscuits than the apple pieces, which could be explained by the difference in bioavailability of the investigated food, taking into consideration the type of food and its adhesiveness.<sup>2,5,10</sup> In chocolate cookies, there is a great amount of fermentable carbohydrates, such as wheat flour, sugar, invert sugar, cocoa powder, whole milk powder, and malt extract. In the first instance, salivary levels of carbohydrates from the cookies are degraded in the buccal cavity by salivary amylase,<sup>13</sup> making faster oral salivary clearance.<sup>11</sup>

However, most of the cookies present on their composition fermentable carbohydrates that slow the rate of oral salivary clearance, directly affecting their retention on the tooth surfaces.<sup>11,13</sup>

Differentiating the properties of stickiness and viscosity of food is extremely important to evaluating cariogenicity.<sup>13</sup> A more viscous food, such as caramel has low retention to the tooth surface, whereas the cookies with low viscosity and high stickiness are eliminated more slowly than the caramel.<sup>13</sup> Furthermore, fibrous foods are less retentive and stimulate salivation, thus influencing the ability of natural teeth cleaning, and as a result, causing a greater elimination of cariogenic sugars.<sup>6,10</sup>

In this study, the elimination of cookies in primary molars of children between 3 and 4 years old was slower than in children aged 5 and 6 years. The motor development and feeding skills are achieved along with central nervous system development, being associated with a learning experience.<sup>14,15</sup> The development of the child's motor skills takes place in an organized manner—within a continuous process that has several steps and is time-consuming—because of the marked changes that occur early in life.<sup>14</sup>

During the first 2 years, progressive standards of overall and fine motor and oral motor development are preconditions for self-feeding skills, favoring the nutritional status and growth of infants.<sup>16</sup> This evidence may suggest that the younger the child, the lower the oral motor development, and therefore, the less control of the tongue and cheek, which are important auxiliaries for digestion and elimination of food in the oral cavity.<sup>15,16</sup> This explains the results of this study, in which we observed a greater retention of chocolate biscuits on the occlusal surfaces of the molars of children of 3 to 4 years of age than in children 5 to 6 years of age.

The manual skills for the practice of toothbrushing are also dependent on the motor development stage of children,<sup>12,14</sup> which reinforces the importance of toothbrushing supervision by parents or responsible adults in preschool children, as well as the importance of establishing oral health habits and promoting toothbrushing

training and learning.<sup>12,15</sup> Thus, the acquisition of healthy oral habits must take place with the help of family, minimizing the difficulty of incorporating such habits in the daily lives of children.

The elimination of the chocolate cookies was similar in the upper and lower teeth with only a difference after 20 minutes of observation, when the retention was higher on the surface of lower teeth. This difference could be explained by the degree of individual variation in the location of the orifices of the parotid glands and their ducts, which are larger and dependent on their locations, significantly affecting the mouthwash at different exposures to tooth surfaces<sup>17</sup> and favoring greater retention in the lower molars as observed in this study.

This study suggests that most adhesive food determines greater permanence in the oral cavity, expanding their cariogenic effect, especially in younger children who, due to higher motor immaturity, are more susceptible to dental caries. In this way, instructions to parents to monitor their children's oral hygiene, as well as guidance on the diet, such as the type of food, period of time, and frequency of intake are key to preventing tooth decay.

## CONCLUSION

Based on this study, we can conclude that the adhesive foods, such as chocolate-flavored cookies, remain longer in the oral cavity. On the contrary, the fibrous foods, such as apple pieces are eliminated quickly in the oral cavity. Furthermore, younger children are more susceptible to tooth decay due to higher motor immaturity, thus retaining the food longer.

## CLINICAL SIGNIFICANCE

As eating habits influence significantly the development of caries lesions, and cariogenic food directly changes the demineralization–remineralization process. The results of this study showed the importance of counseling the families regarding the frequency, time, and type of food to be offered to preschoolers as a preventive measure to early childhood caries.

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