

## Associations between caries activity, salivary buffer tests and caries increment in Mongolian children

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**Abstract** The aim of the study was to evaluate caries increment in combination with a caries activity test (CAT21 Test) and a salivary buffer test (CAT21 Buf Test)—to predict future caries activity in Mongolian preschool children living in Ulaanbaatar City. The effectiveness of combining both tests and deft (decayed, extracted, filled teeth) means was also investigated. The caries prevalence in subjects was 94%, and deft mean value was 6.8. The caries increment after one year was 2.3 teeth. From the distribution of CAT21 Test scores a low risk was found in 38.6% and high risk in 61.4% of the examined children. From the CAT21 Buf Test scores, the high risk (lower buffer capacity) was found in 79.8% of the examined children. When the combination CAT21 Test and CAT21 Buf Test scores were divided into four groups (low-low/low-high/high-low/high-high), the mean deft-teeth showed a significant difference among the four groups (ANOVA  $P < 0.001$ ). One year after the caries increment was evaluated in combination with the CAT21 Test scores and CAT21 Buf Test scores, the low-low risk group showed the lowest mean deft-teeth. On the other hand, the high-high risk group showed the highest mean deft-tooth (ANOVA  $P < 0.05$ ). Based on these results, the CAT21 Test and CAT21 Buf Test are useful for clinical application of preschool children in predicting future caries activity. Furthermore, when the CAT21 Test and the CAT21 Buf Test were combined, a higher correlation was shown with the caries status.

### Key words

Caries activity test (CAT21 Test),  
Cariostat method,  
Dental caries,  
Salivary buffer test (CAT21 Buf Test)

### Introduction

Caries status of deciduous teeth in Mongolian children is still serious, as manpower and material resources for the prevention and treatment of dental caries are limited<sup>1,2</sup>. Some groups demonstrate active caries, and most of them are at a high risk for developing caries in the future. It is useful, therefore, to identify the high risk group and to formulate effective preventive methods for these groups. Research and application of caries predictive tests become significant in accomplishing this difficult task. However, reliable predictions about future caries risk in individuals cannot be made by using

only using deft scores. Among groups of children, past caries experience is known to be related to subsequent caries increment<sup>3</sup>. In the study of Klock and Krasse<sup>4</sup> the number of incipient caries lesions on smooth surfaces showed the best correlation with caries increment among several factors including salivary parameters in children. The development of reliable and valid caries activity tests has also been needed. It is well known that dental caries is a disease with multifactorial etiology. Microbiological and salivary methods have been developed for predictive testing for future caries activity<sup>5-9</sup>. Many studies with these bacteriological and salivary tests, which count the number of mutans streptococci and lactobacilli in saliva or plaque, have reported significant relationships between these results and the occurrence of caries<sup>4,10-16</sup>. It was shown that

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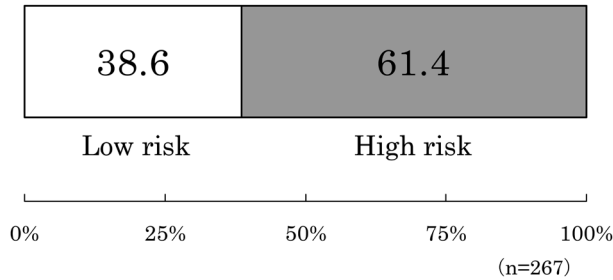


Fig. 1 Distribution of CAT21 Test scores in preschool children

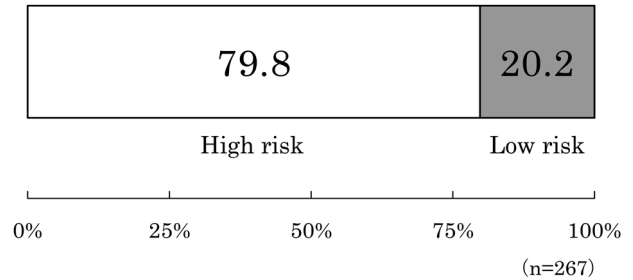


Fig. 2 Distribution of CAT21 Buf Test scores in preschool children

these methods were effective for predicting the development of caries. One of these caries activity tests (CAT21 Test) and one of the salivary buffer capacity tests (CAT21 Buf Test) were developed in Japan<sup>1,13–16,20,22,30</sup>. The purpose of this study was to investigate the dental caries status and caries increment and to compare the data with the caries activity test (CAT21 Test) and salivary buffer test (CAT21 Buf Test) of the same group of children.

## Materials and methods

The study subject consisted of 267 preschool children with ages from five to six years old of Ulaanbaatar City, Mongolia.

**Clinical examinations:** Clinical examination was performed by one examiner. Each child was examined under natural light with the aid of a dental mirror and probe, according to WHO standard methods and criteria. The results were designated using the “deft” system (decayed (d), extracted (e), filled (f), teeth (t)). Only deciduous teeth were examined.

**Caries activity test (CAT21 Test Morita Co., Japan):** This test uses a high concentration of sucrose solution to evaluate the acidogenic ability of the overall plaque bacteria<sup>1,13–15</sup> from exposure to sucrose. Plaque samples were obtained with a cotton swab from the maxillary buccal surfaces by scrubbing two or three times on the teeth surfaces with a wiping movement of standard sampling technique for the Cariostat method<sup>13,15</sup>. Each plaque sample was placed into an ampoule of Cariostat liquid medium and incubated at 37°C for 48 hours. After incubation, two grades of colorimetric changes were assigned using a standard color chart<sup>13–15</sup>. Each of these colors was evaluated as follows; blue and green-yellow = 0–1.5 (pH 7.2–5.0 low risk) or yellow-green and yellow = 2.0–3.0 (pH 4.9–3.8 high risk).

**Salivary buffer capacity test (CAT21 Buf Test, Morita Co., Japan):** The children were given a simple explanation as to the nature and reasons for the test before collecting saliva samples. Stimulated whole saliva was collected by chewing on a pellet (unflavored gum, CAT21 Buf Test, Morita Co., Japan), before the clinical examinations. The collection period was 3 min. All samples were analyzed immediately after collection. One ml of saliva was added to the buffer test ampoule and the lid was replaced tightly. The resulting color of the mixed solution was compared with the color chart and divided into two groups. The color chart has a pH scale ranging from 4.0–6.5<sup>16</sup>. A yellow or orange color result signifies a high risk (low buffer capacity, pH 4.0–5.5) and red or purple as low risk (high buffer capacity, pH 5.8–6.5). After one year, clinical examination and the two tests were performed again on the same groups of children, and the results were compared with the previous results. All examinations were carried out by one of the authors (B.O.).

All data were analyzed using the SPSS (Statistical Package for the Social Sciences) software. Statistical significance was determined using non-parametric partial correlation analysis and ANOVA.

## Results

Caries prevalence of the subjects was 94%. The mean value for def-teeth was  $6.81 \pm 4.43$  (SD). The caries increment after one year was  $2.33 \pm 3.65$  (SD) teeth. The distribution of CAT21 Test scores showed that 38.6% of the children belonged to the low risk group and 61.4% of the children belonged to the high risk group (Figure 1). Results of the CAT21 Buf Test (Figure 2) are as follows: 79.8% of the subjects had a CAT21 Buf Test score of high risk (low buffer capacity) and 20.2% had low risk (high

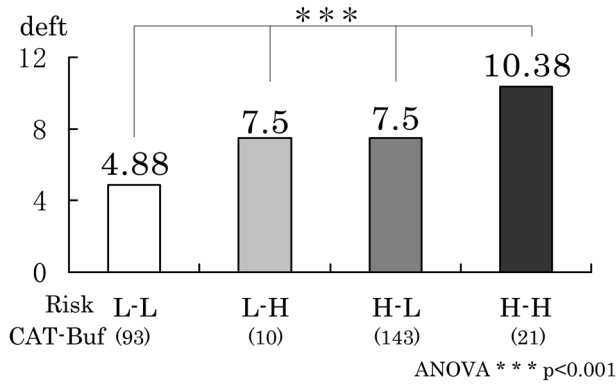


Fig. 3 Correlation between test scores and deft

buffer capacity). Figure 3 shows the correlation between deft scores and combination risk groups of CAT21 Test and CAT21 Buf Test scores. When the combined CAT21 Test and CAT21 Buf Test scores were divided into four groups (low-low/low-high/high-low/high-high), the mean def-teeth showed a significant difference among the four groups (ANOVA  $P<0.001$ ). The high-high risk group had the highest mean def-teeth. When the caries increment after one year and the when the CAT21 Test score and CAT21 Buf Test score were combined (Figure 4), deft was  $1.66 \pm 2.96$  (SD) for the low-low risk group,  $3.76 \pm 5.18$  (SD) for the low-high risk group,  $2.11 \pm 2.84$  (SD) for the high-low risk group and  $4.14 \pm 3.43$  (SD) for the high-high risk group. For caries increment after one year, the low-low risk group showed the lowest mean def-teeth. On the other hand, the high-high risk group showed the highest mean def-teeth (ANOVA  $P<0.05$ ). It can, therefore, be concluded that the deft will increase with increase of the CAT21 Test score. Also it means that low buffer capacity had a high deft. A significant difference was found among deft and risk groups (ANOVA  $P<0.05$ ).

### Discussion

The current study reports the correlation between caries status and CAT21 Test and CAT21 Buf Test results among Mongolian preschool children. There was a slight correlation between the CAT21 Test score and caries status (ANOVA  $P<0.05$ ,  $P<0.001$ ). These results may be interpreted to mean that children who scored as high risk have significantly higher caries rates than children who scored as low risk. The color change to green-yellow and

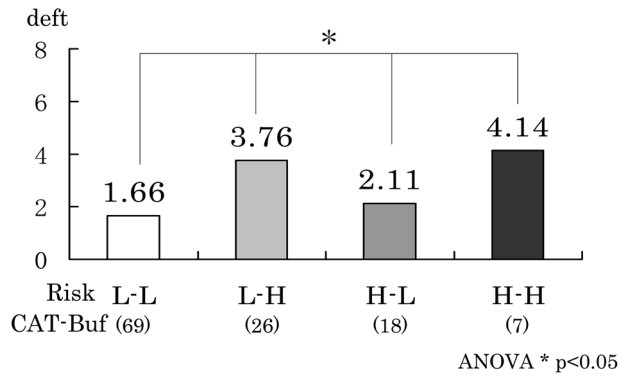


Fig. 4 Caries increment after one year and two test results

yellow occurs at pH4.9–3.8 (high risk), meaning that these children harbor extremely high numbers of cariogenic bacteria. In their epidemiological studies, many investigators have considered a caries activity test as a very useful diagnostic device for assessing individual oral conditions and predicting caries occurrence in the future<sup>8,13–15,18–22</sup>. In addition, the CAT21 Test is used to determine caries risk status. The best results obtained from these tests are then explained to the parents to make them aware of the degree to which their children are susceptible to caries. Parents, especially those with high risk score children, can then be taught the importance of early oral health awareness. Several studies have reported that when CAT21 Test scores of 1.5 years, 2, 3, and 6 year-old were combined, a higher correlation was shown with caries status<sup>14,19,21</sup>.

Although it appears that a low buffering capacity of saliva is correlated with caries experience, there is no clear consensus from stimulation studies indicating that the buffering capacity in saliva is important in caries risk. Many investigators have attempted to correlate dental caries activity with salivary buffer capacity<sup>16,23–31</sup>. Dreizen and Mann have noted a definite relationship between the ability of saliva to neutralize acid and caries in a given mouth<sup>25</sup>. There is evidence in the literature suggesting that the buffer capacity of saliva is one of the best indicators of caries susceptibility because it reveals the host response. Individuals with a high buffer capacity are often quite resistant to the caries process because a high host response can compensate for active caries habit<sup>26,32,33</sup>. In other studies, the CAT21 Buf Test has been found to be a good predictor of caries activity based on the high correlation between caries prevalence and activity<sup>28–31</sup>. Our findings, with

respect to the buffer capacity, also agree with other studies<sup>23,24,26</sup>. Some investigators have reported that the buffer test is useful for clinical application among preschool and schoolchildren<sup>25,27-31,33</sup>. This investigation ascertained the correlation between caries status and salivary buffer capacity. Salivary buffering capacity decreased in relation to the increasing mean deft in contrast to the results obtained in other studies. The reasons for this high caries status and the prevalence of caries amongst the preschool children in general maybe due to poor oral hygiene, lack of dental awareness and education, and inadequate quality of the dental treatment provided. In summary, the results of the present study show that dental caries experience amongst the examined preschool children is high and that it affects a large proportion of the children. We conclude from this study's results that the CAT21 Test and CAT21 Buf Test appear to be clinically very useful methods to enhance our ability to predict progress of caries in children at an early stage. Further prospective studies using the CAT21 Test and CAT21 Buf Test should be done to investigate their ability to screen populations of children for caries susceptibility and observe the identified high risk individuals for the subsequent development of dental caries.

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