

The relationship between the salivary buffer capacity test (CAT21 Buf Test) results and caries status in Mongolian preschool children

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Abstract This study was conducted to investigate the relationship between results of a salivary buffer test (CAT21 Buf Test) and caries status in 507 preschool children, who were 4–6 years old in Ulaanbaatar City, Mongolia. The prevalence of caries in the preschool children was 96.1%, and the mean deft and d teeth were 8.1 and 7.2, respectively. The mean CAT21 Buf Test score was 53.3% for low risk (high buffer capacity) and 46.7% for high risk (low buffer capacity). When salivary buffer score was divided into two groups (high risk, low risk), mean deft differed significantly between the two groups (ANOVA $P < 0.001$). The high risk group had a mean deft higher than that of the low risk group. These results suggest that the CAT21 Buf Test is useful for clinical application in children. Furthermore, when the CAT21 Buf Test score was higher, a higher correlation was shown with caries status.

Key words

Dental caries,
Salivary buffer test
(CAT21 Buf Test)

Introduction

Saliva is one of the most important host factors, since it performs many functions that directly or indirectly affect general oral health and dental caries^{1–6}. One such function is buffering, and another is passive host defense against caries^{7–11}. These protective characteristics of saliva depend mainly on its mechanical cleansing action the dilution and neutralization of plaque acid by buffering system, particularly bicarbonates. The role of saliva in the process of dental caries is well known^{12–17}. Dreizen *et al.* have demonstrated that concentration of saliva buffers varies in relation to number of caries¹⁸. Stephan demonstrated that the teeth are decalcified in a medium with a maximum pH of 5.0¹⁹. These findings were corroborated by Muracciole *et al.*²⁰ Based on these findings, we are of the opinion that when acids are formed in the mouth, the host

organism is compelled to react against them. The most effective reaction is neutralization of the acids by saliva buffers, in much the same way that the organism protects itself against internal pH variations by blood buffering. The relationship between buffer capacity and caries activity has been of interest to many researchers^{21–23}. Our knowledge of the functions of individual bacterial and salivary constituents and their interactions has increased enormously in recent years^{24–26}. We now have a better understanding of their diagnostic importance in the determination of caries activity^{27,28}. Salivary diagnostics is now entering the realm of modern dentistry.

The aim of the present study was to investigate the relationship between the results of the CAT21 Buf Test and caries status in Mongolian preschool children.

Materials and methods

Subjects of study

Five hundred seven preschool children aged 4–6

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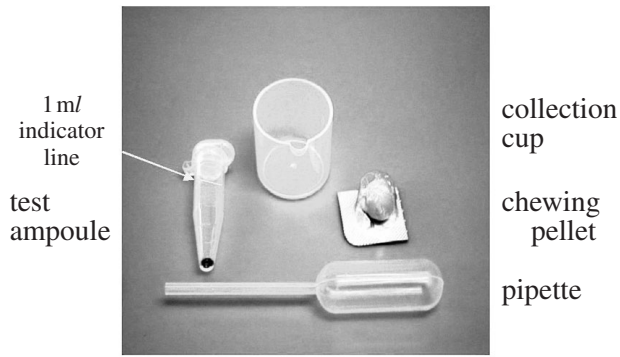


Fig. 1 CAT21 Buf Test Kit

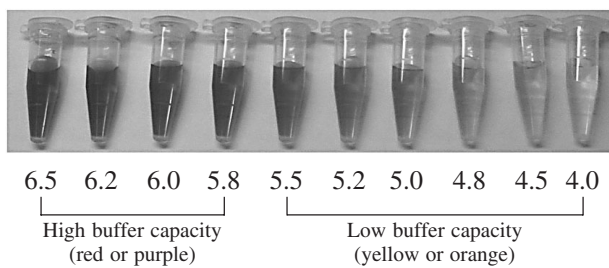


Fig. 2 CAT21 Buf Test colorimetric scale

years old, in Ulaanbaatar City, Mongolia, were randomly selected.

Methods

a. Dental examination

Dental examination was conducted by one dentist under natural light with the aid of a dental mirror and probe. The results were designated using the “def^t” system (decayed (d), extracted (e), filled (f), teeth (t)) according to WHO standard criteria.

b. Salivary buffer capacity test (CAT21 Buf Test, Morita Co., Japan)

Since sample collection could not be restricted to a specific time of day, collection was randomly performed between 9:00 a.m and 12:00 p.m (noon) at a kindergarten. There was no of any sex or group (caries and control) in any given hour within the collection period. The majority of collections were performed from two to four hours after intake of food or beverage (minimum of one hour). All procedures were completed by one investigator. The children were given a simple explanation of the nature and reasons for the test before collecting saliva samples. Each child chewed on a pellet

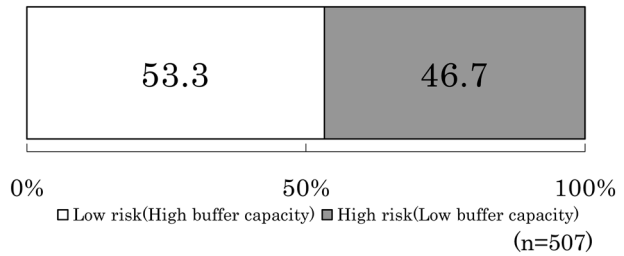


Fig. 3 Distribution of CAT21 Buf Test scores in preschool children

(unflavored gum, CAT21 Buf Test, Morita Co., Japan) for three minutes. Their stimulated whole saliva was then collected before dental examination. All samples were analyzed immediately after collection. One ml of saliva was added to the buffer test ampoule (Figure 1), covered and mixed. The resulting color was compared with the color chart and divided into two groups. The color chart has a pH scale ranging from 4.0–6.5. A yellow or orange color result signifies high risk group (low buffer capacity, pH 4.0–5.5), and red or purple, a low risk group (high buffer capacity, pH 5.8–6.5) (Figure 2).

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

Results

Prevalence of caries in the subjects was 96.1%. The mean ± SE for decayed teeth (dt) and def-teeth were 7.21 ± 0.18 and 8.13 ± 0.19, respectively. The mean value for extracted teeth (et) was 0.26 ± 0.03 and filled teeth (ft) was 0.62 ± 0.05.

Results of the CAT21 Buf Test (Figure 3) were as follows: 53.3% (n=270) of the subjects had CAT21 Buf Test scores of low risk (high buffer capacity), and 46.7% (n=237) had high risk (low buffer capacity). Figure 4 shows the correlation between CAT21 Buf Test scores and decayed teeth (dt): low risk group with mean dt 6.80 ± 0.24 and high risk group with mean dt 7.68 ± 0.26. It can, therefore be concluded that the mean dt will increase with decrease of the salivary buffer capacity. A statistically significant correlation was detected between decayed teeth and buffering capacity of saliva (ANOVA P<0.001). The high risk group

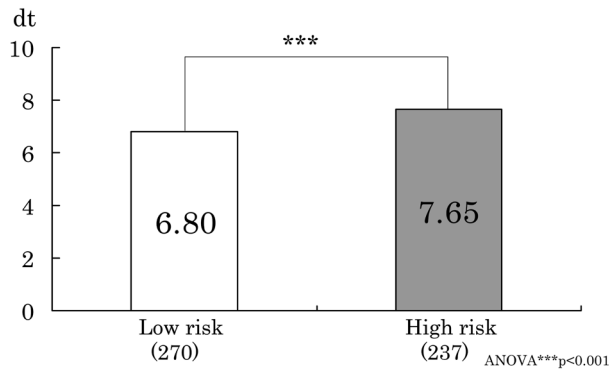


Fig. 4 Correlation between CAT21 Buf Test scores and d teeth

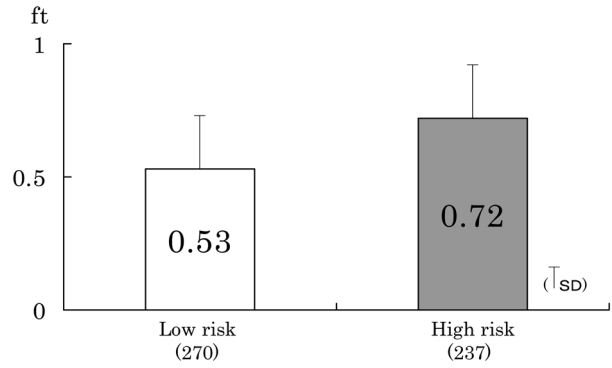


Fig. 6 Correlation between CAT21 Buf Test scores and f teeth

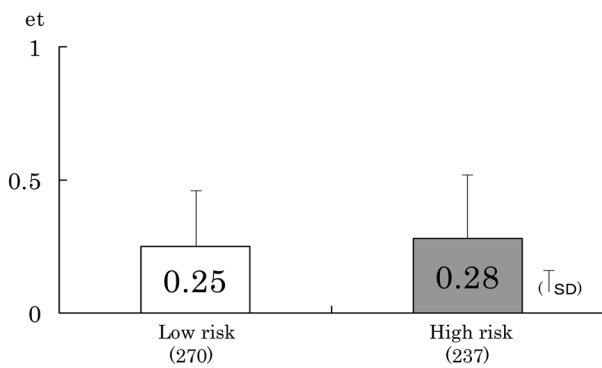


Fig. 5 Correlation between CAT21 Buf Test scores and e teeth

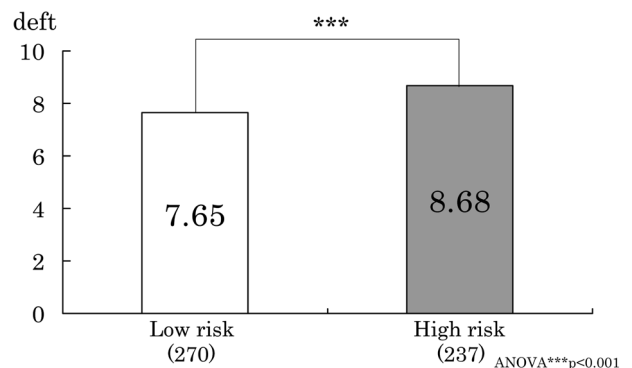


Fig. 7 Correlation between CAT21 Buf Test scores and deft

had the highest mean extracted teeth (et) (Figure 5). Figure 6 shows the correlation between CAT21 Buf Test scores and the filled teeth (ft). No significant difference was observed between “e” and “f” teeth and buffering capacity of saliva. Figure 7 shows the correlation between CAT21 Buf Test scores and deft. The mean deft was 7.65 ± 0.26 (SE) among subjects with CAT21 Buf Test scores of low risk, and 8.68 ± 0.28 (SE) for those with high risk. It can, therefore be concluded that deft will increase with increase in CAT21 Buf Test scores. Also it means that high risk group (low buffer capacity) had a high deft. A significant difference was found between deft and buffering capacity of saliva (ANOVA $P < 0.001$).

Discussion

Better understanding and analysis of caries activity in preschool children are helpful to the prevention and treatment of caries. Newbrun has stated that the only salivary factor which correlates with certainty

with the development of dental caries is buffering capacity²⁹). We compared the caries status of 507 children aged 4–6 years with CAT21 Buf Test scores. This is the first such report in Mongolia. Our results serve as reference and should be valuable for the prevention and treatment of caries in preschool children. In this study, significant differences were found between CAT21 Buf Test scores and respect to dt and deft. Based on the above results, it can be ascertained that the CAT21 Buf Test is effective in predicting caries activity. Okazaki *et al.*²⁴) investigated CAT21 Buf Test scores which showed a significant correlation with dt (ANOVA $P < 0.05$). The present results confirm this finding. In present study, the caries status was found to be higher, and 46.7% of the children were found to have low buffer capacity. Similar results have been reported for Japanese preschool children²⁷).

Many investigators have attempted to correlate dental caries activity with salivary buffer capacity^{8,15–18,22,28}). Buffer effect varies among individuals, and low or extremely low buffer capacity has been

reported to correlate with increased dental caries¹⁰. We can compare an unbuffered system to a system buffered with saliva or blood. When a very small quantity of hydrochloric acid is added drop by drop into distilled water, and the pH decreases quickly. However, when added it is saliva or blood, the pH remains stable. This demonstrating that body fluid exhibits a defense reaction and buffering action system when subjected to environmental influences. Thus, salivary buffer capacity tests are able to predict caries activity. The CAT21 Buf Test ampoule has a dry powder reagent (lactic acid + pH indicators) which is activated when 1.0 ml distilled water is added and the pH becomes 2.5. In this case study, saliva is added to the mixture. If the pH of lactic acid is 2.5, one needs to add 100 ml distilled water to raise the pH to 4.5 (yellow color, low buffer capacity). Consequently, a pH of 5.2 (orange color, medium buffer capacity), 6.0 (red color, high buffer capacity), and 6.5 (purple red color, high buffer capacity) would require the addition of 510, 3,200, and 10,000 ml of distilled water, respectively. In other words, to raise the pH back to 6.0, we need saliva in an amount equivalent tooth 3,200 times more water.

The findings of this study, indicate that low salivary buffer capacity is associated with a higher mean deft (Figure 7). There is evidence in the literature suggesting that the buffer capacity of saliva is one of the best indicators of caries susceptibility, since it reveals the degree of host response^{8,24,28}. Individuals with high buffer capacity are often quite resistant to the process of caries because high host response can compensate for active caries habits^{3,9,20}. In other studies, CAT21 Buf Test score has been found to be a good predictor of caries activity based on the high correlation between prevalence of caries and activity^{22,24,26-28}. Our finding with respect to buffer capacity also agree with those of other studies^{8,9,19}. Some investigators have reported that the buffer test is useful for clinical application among preschool and schoolchildren^{16,17,26-28}. Some investigators have suggested using an inert material such as paraffin wax or rubber bands for chewing with standard weight (1–5 g, M.P – 42°C) at a constant rate (about 70 chews/minute). A metronome is usually used for mechanical stimulation^{8,9,14,20}. In the CAT21 Buf Test, a chewing pellet is used. It is a spherical, unflavored gum 10 mm in diameter and 0.8 g in weight. This chewing method is effective in schoolchildren, and particularly suitable in preschool

children. We know for certain whether an enamel surface is carious or not, but we do not know whether the process of caries is in progress or arrested whether the lesion is merely a sign of caries in the past. The predictive value of certain salivary tests can help to reduce such uncertainties in clinical dental practice. Salivary buffer capacity is very important in the development of caries with respect to attacking and defensive factors. This study ascertained the correlation between caries status and salivary buffer capacity, and showed that a low buffer capacity is associated with a high deft. The CAT21 Buf Test appears to be a clinically useful method for improving our ability to predict the progression of caries in children at an earlier stage.

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