

Caries activity test in Mongolian and Japanese children

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Abstract The main objective of this study was to investigate the relationship between a caries activity test (CAT21 Test), and caries status. The subjects of this study were 419 preschool children, of Okayama City, Japan and, of Ulaanbaatar City, Mongolia. In all, subjects were examined for dental caries using a mouth mirror and probe. Then buccal plaque samples were obtained, incubated at 37°C for 48 hours, and scored as per the manufacturer's instructions for the Cariostat method. The following results were obtained:

1. The caries prevalence and mean deft of the two subjects was 55.0% and 3.2 for Japanese, so 92.4% and 6.6 for Mongolians, respectively.
2. Results of the CAT21 Test score distribution are as follows: 14% of the Japanese, 7.6% of the Mongolians had a CAT score of 0 (very low risk), 38% of the Japanese, 12.4% of the Mongolians had a 1.0 (low risk), 16.3% of the Japanese, 17.9% of the Mongolians had a 2.0 (middle risk), 25.5% of the Japanese, 36.6% of the Mongolians had a 3.0 (high risk), and 6.2% of the Japanese, 25.5% of the Mongolians had a 4.0 (very high risk) score.
3. There was a statistically significant difference in the CAT21 Test scores and dental caries indices of Japanese and Mongolian preschool children (ANOVA $P < 0.01$, $P < 0.001$).

From these results, it was suggested that the CAT21 Test is useful in clinical application.

Key words

Caries activity test,
Cariostat method,
CAT21 Test,
Dental caries

Introduction

Dental caries is a prevalent problem, not only in Mongolia, but also worldwide. According to Mongolian research studies, the prevalence of caries and mean deft of children within the age range of 3–5 years old was 79.2% and 4.9, correspondingly¹. According to Japanese research studies, the prevalence of caries in 5-year-old children was 63.9% and 3.73, and in 6-year-old children was 78.02%, and 5.0². Several investigators have reported an increasing caries rate among Mongolian children, especially those living in cities.

In advancing the prevention of caries among

children from the dental hygiene and clinical standpoint, assessing caries activities in children at a given time is useful. The caries activity test is a means being tried out for the purpose.

Many caries activity tests are designed to measure Keyes' three caries conductive factors, namely: oral substrates largely from food residues, certain types of bacteria, and host susceptibility³. It is well known that dental caries is a multifactorial disease. The development of reliable and valid caries activity tests has also been needed.

Attempts to assess existent caries activity were first made more than 100 years ago (Miller WD, 1890) and were extended and developed in the 1960s⁴⁻⁶. Attempts to predict future caries activity have also been made during the past 30 years⁷⁻⁹. These caries activity tests utilized various biochemical

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Grade	Score
Sound	0.5
C ₁ C ₂	1
C ₃ C ₄	2

$$CSI = \frac{\text{Total grades of teeth}}{\text{Total number of teeth} \times 2} \times 100\%$$

Fig. 1 Caries Severity Index in subjects

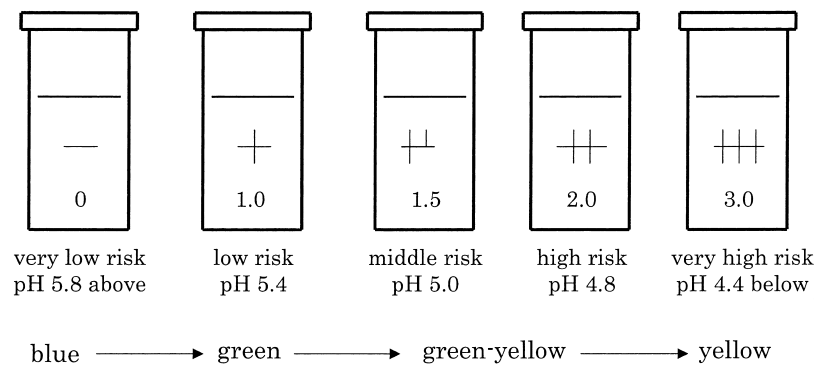


Fig. 2 CAT21 Test colorimetric scale

or bacteriological parameters of saliva and plaque. Microbiological methods have been developed for predictive testing of future caries activity. Many researchers in their epidemiological, longitudinal and clinical studies, reported that the caries activity test is a very useful diagnostic device for oral conditions and for the prediction of caries occurrence in the future^{8,10-15}. Recently, bacteriological caries activity tests are used in clinical and fieldwork. One of the caries activity tests, Cariostat was developed in Japan (by Shimono, 1974). These tests assess the acid production of microorganisms in dental plaque.

The aim of this study was to investigate the correlation between caries activity test, CAT21 Test, and caries status among Japanese and Mongolian preschool children. Japanese preschool children have lower caries prevalence than preschool children in Mongolia^{14,15}.

Materials and methods

The subjects in this investigation were 419 preschool children: 129 children were Japanese, 290 children were Mongolian. The subjects ranged in age from 5 to 6 years of age. Informed consent was obtained from the parents prior.

The following was conducted on these children:

1. Dental examination
2. Caries activity test (CAT21 Test, Morita Co., Japan)

Assessment of dental status was done using dental mirror and probe. The results were designated using the “deft” system [decayed (d), extracted (e), filled (f), teeth (t)], and Caries Severity Index (CSI) developed by Shimono *et al.*⁸⁾

Caries were scored as follows:

- S = sound
- C₁ = enamel caries
- C₂ = dentin caries
- C₃ = caries reached the pulp
- C₄ = teeth indicated for extraction

The CSI was calculated for each subject to obtain a representation of the severity of caries involvement present. Score were obtained by assigning numerical values to the various caries criteria (Figure 1).

One of the caries activity test CAT21 Test is developed by the Cariostat method. This caries activity test, Cariostat (by Shimono, 1974), is a bacteriological and colorimetric caries activity test. It is a simple test used to determine caries activity and contains 20% sucrose, NaN₃, NaCl, Tryptose, Bromocresol purple and Bromocresol green. Its original color is blue and in the presence of acidogenic

Table 1 Results of caries incidence of Japanese and Mongolians

	n	prevalence (%)	d (mean ± SD)	e (mean ± SD)	f (mean ± SD)	def (mean ± SD)	CSI (mean ± SD)
Japanese	129	55.0	1.91 ± 3.40	0	1.36 ± 2.26	3.27 ± 4.34	6.49 ± 9.33
Mongolian	290	92.4	5.91 ± 4.07	0.23 ± 0.67	0.5 ± 1.15	6.65 ± 4.45	19.42 ± 15.22

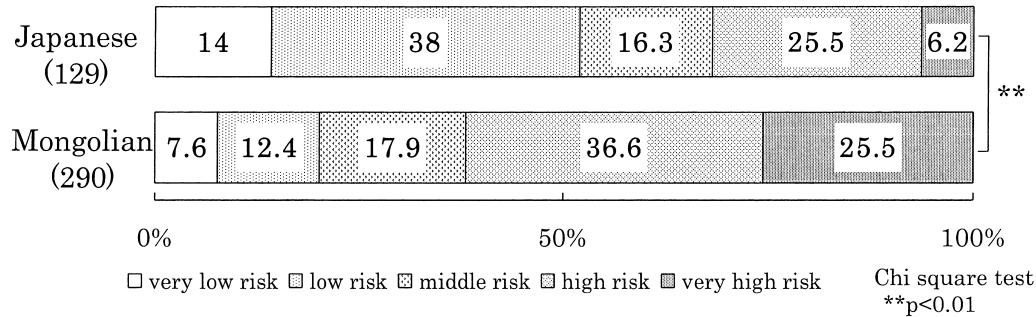


Fig. 3 Distribution of CAT21 Test score among Japanese and Mongolian preschool children

bacteria from plaque samples (e.g. *Streptococcus mutans*, *Lactobacilli*), converts the sucrose in the medium into acid, causing a decrease in the pH, and a consequent change in the color of the Cariostat medium from blue to yellow.

Plaque samples were obtained with a cotton swab from the maxillary buccal surfaces by scrubbing 2 or 3 times on the teeth surfaces with a wiping movement. This sampling technique is the usual method for the Cariostat method⁸.

Each plaque sample was placed into an ampoule of Cariostat liquid medium and incubated at 37°C for 48 hours. After incubation, five grades of colorimetric changes are assigned using a standard color chart (Figure 2). Each of these colors is evaluated as follows; blue = 0 (pH 5.8 above, very low risk), green = 1.0 (pH 5.4, low risk), green-green-yellow = 1.5 (pH 5.0, middle risk), green-yellow = 2.0 (pH 4.8, high risk), and yellow = 3.0 (pH 4.4 below, very high risk). However, the CAT21 Test is enclosed the detailed explanation.

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

Results

The prevalence of caries of the subjects was 55.0% in Japanese preschool children, 92.4% in Mongolian preschool children, the mean of the deft was 3.27 ± 4.34 in Japanese, 6.65 ± 4.45 in Mongolians and CSI was 6.49 ± 9.33 in Japanese, 19.42 ± 15.2 in Mongolian, respectively. However, the mean of the extracted teeth (et) was 0.23 ± 0.67 in Mongolians. The mean of the filled teeth (ft) was 1.36 ± 2.26 in Japanese, and was 0.5 ± 1.15 in Mongolians (Table 1). It means that dental decay is high among Mongolian preschool children. But treatment level of the primary teeth is lower than Japanese preschool children. There was a high correlation between the CAT21 Test score and deft of Japanese and Mongolians (ANOVA $P < 0.01$, $P < 0.001$).

Figure 3 shows the distribution of CAT21 Test score among Japanese and Mongolian preschool children. The CAT21 Test scores were significantly different between Japanese and Mongolian preschool children ($P < 0.01$).

Figure 4 shows the correlation between CAT21 Test score and decayed teeth (dt) scores. Mongolian preschool children had significantly higher dt scores than Japanese preschool children throughout the study. A significant correlation was seen between

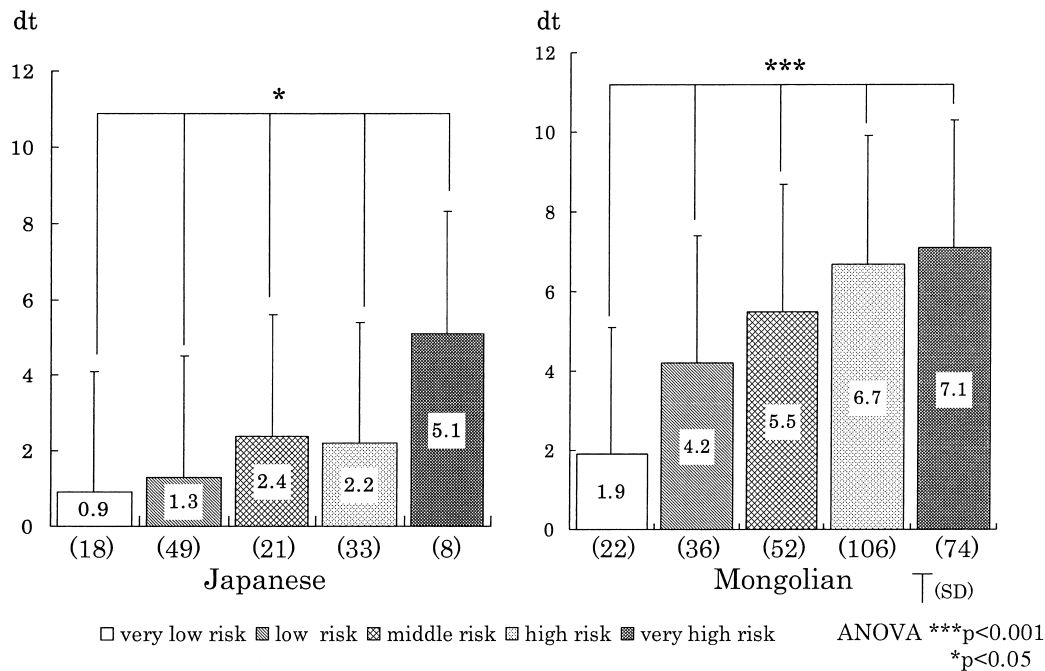


Fig. 4 Correlation between CAT21 Test score and decayed teeth (dt)

Table 2 Regression coefficient of caries indices and CAT21 Test score

	Japanese		Mongolian	
	r	p	r	p
d	0.239	<i>P</i> <0.05	0.336	<i>P</i> <0.001
def	0.255	<i>P</i> <0.01	0.340	<i>P</i> <0.001
CSI	0.857	<i>P</i> <0.01	0.340	<i>P</i> <0.001

the CAT21 Test score and the mean dt scores in Japanese and Mongolians (ANOVA *P*<0.05, *P*<0.001). However, the very high risk was highest with mean “d” teeth. Significant correlation was demonstrated between CAT21 Test scores and caries indices (Table 2).

The mean deft (Figure 5) was 1.3 ± 2.63 (SD) among Japanese in the very low risk group, 3.5 ± 4.88 (SD) for high risk group, 7.4 ± 5.85 (SD) for very high risk group. The extracted teeth have not been in Japanese preschool children. This mean deft (Figure 5) was 2.3 ± 2.83 (SD) among Mongolians with a very low risk group, 7.4 ± 4.53 (SD) for high risk group and very high risk group becomes 8.1 ± 4.26 (SD). It can therefore be concluded that the deft will increase with every increase of the CAT21 Test score. There was a statistically significant difference

in the CAT21 Test score and deft of Japanese and Mongolian preschool children (ANOVA *P*<0.01, *P*<0.001).

Figure 6 shows correlation between CAT21 Test score and Caries Severity Index (CSI) for two subjects. The results of the regression analysis show high significance (ANOVA *P*<0.01, *P*<0.001) between CAT21 Test score and the CSI. The results show that in each Japanese and Mongolian preschool children, the higher CAT21 Test score had a higher CSI. In Mongolian preschool children the CSI and CAT21 Test score was 2–3 times the difference compared with the Japanese preschool children.

Discussion

The overall caries prevalence and dt, deft in

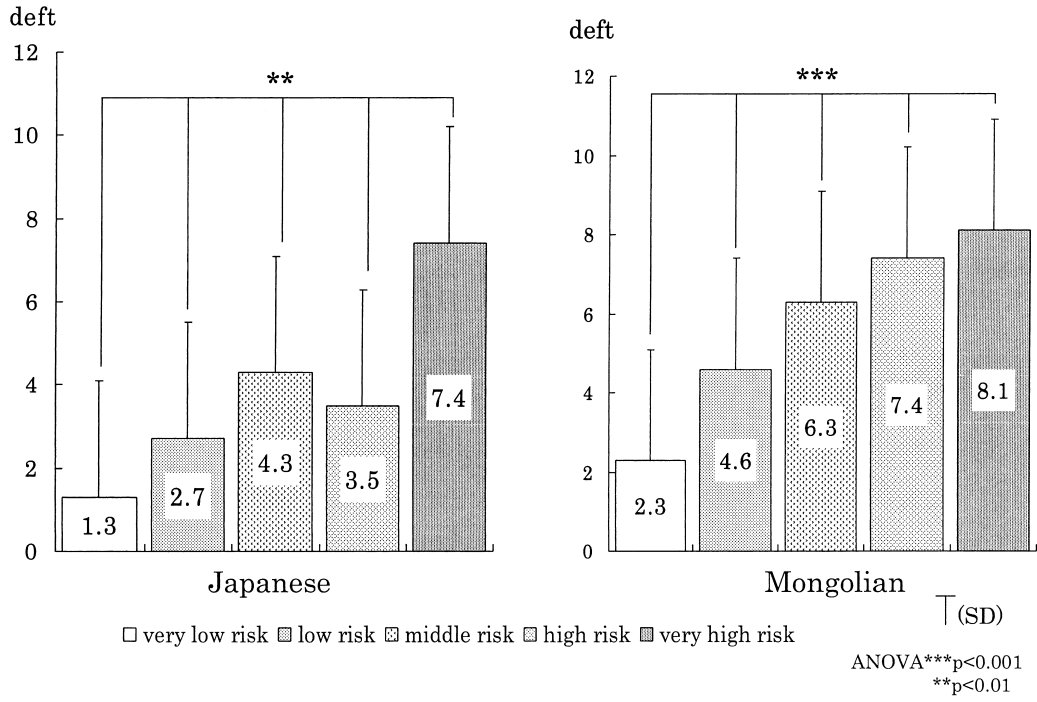


Fig. 5 Correlation between CAT21 Test score and deft

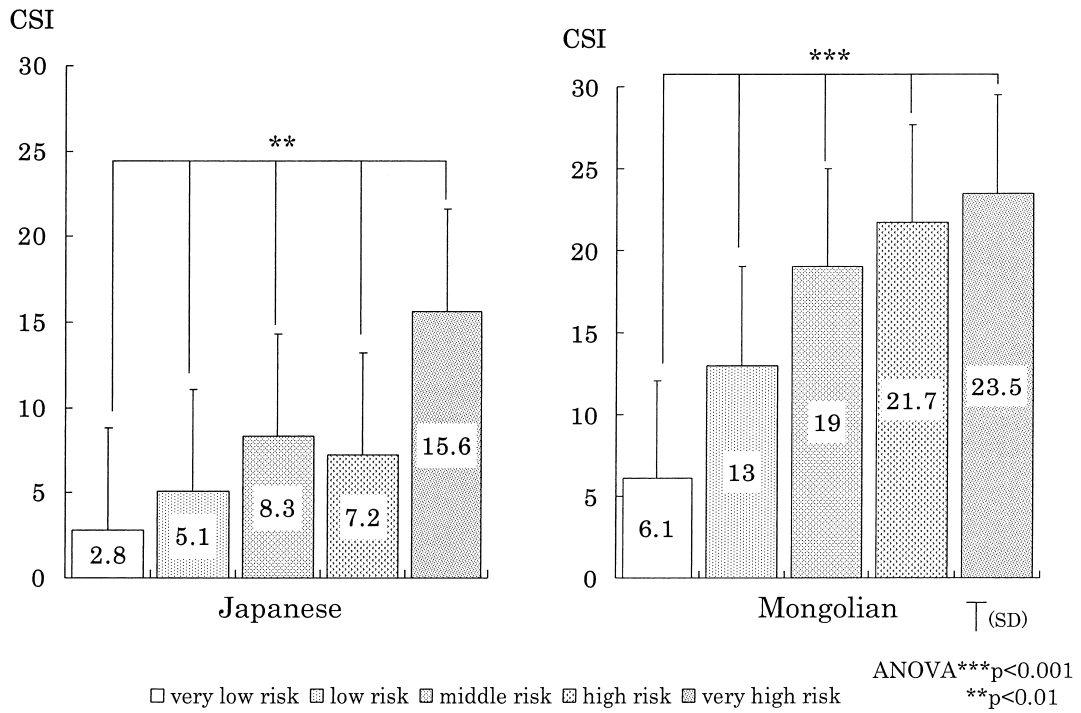


Fig. 6 Correlation between CAT21 Test score and CSI

Mongolian preschool children were higher than has been reported other studies in Japanese preschool children^{14,15,24}). In this study, significant differences were found between the CAT21 Test score with respect to dt, deft and CSI. These results may be interpreted to mean that children who score in high and very high risk have significantly higher caries rates than children who score in the very low, low and middle risk. As the color change from green-yellow to yellow occurs at a pH of 4.8–4.0 (high and very high risk), this may mean that these children harbor extremely high numbers of cariogenic bacteria.

Many investigators have considered in their epidemiological studies that caries activity test is a very useful diagnostic screen for assessing individual oral conditions and predicting caries occurrence in the future^{2,8–10,20,22–26}).

Thus, many caries activity tests are used presently: Dentocult[®] SM Strip Mutans, Dentocult[®] LB, Caries Risk Test (CRT)^{16–21}).

In this study, we found that most of the high-risk group had high caries indices. Mongolian preschool children had higher deft and CAT21 Test score than did Japanese preschool children. These differences may in part be explained by differences in the oral health systems organized for two countries. In Japan, oral examination is mandatory for all children at 18 months and 3 years. This age group is significant and critical since it has been known that if caries occur at 18 months years, there will be a higher probability for high caries distribution when the child reaches 3 years old. Thus, preventive dentistry employing caries predictability test is crucial during this stage. The test results obtained from these tests are then explained to the parents in order for them to be aware of the degree of caries susceptibility their children are likely to have. Parents can then be taught on the importance of early oral health awareness especially to children with high scores. The children with high Cariostat scores of 2.0, 3.0 had worse caries status than the children with Cariostat scores below 1.5 among children without carious teeth¹⁴). In Mongolia, there is no similar prevention orientated program for children, and care of the primary dentition is not considered a priority in comprehensive care.

The CAT21 Test has many favorable characteristics, being highly valid, feasible, having a good predictive value, safe, simple and inexpensive. A good caries predictive test should possess at least three characteristics: validity, reliability and feasibility¹³). The usefulness of CAT21 Test as a caries

activity test was investigated based on these criteria. Personnel at various levels of training and experience can be taught to use this method quickly and reliably. It requires only minimal time in plaque sampling and does not require any special equipment.

In other studies by Shimono, *et al.*, the Cariostat method has shown strong validity and predictive value⁸). Heriandi, *et al.*, also reported that the Cariostat method had been effectively used as an effective screening method in children and strong correlation between this test score and deft in 1,385 children, from 1 to 4 years of age, in Indonesia¹¹).

Our results correspond with these previous investigations. We conclude from this study's results that the CAT21 Test appears to be a very clinically useful method in enhancing our ability to present the progress of caries in children. Additional longitudinal investigations are however needed to confirm further the predictive value of the CAT21 Test.

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