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Original

Employing dmft score as a risk predictor for caries development in the permanent teeth in Japanese primary school girls

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Abstract: The aim of this study was to examine the significance of evaluating dmft for predicting the incidence of permanent teeth caries in Japanese girls. The subjects were two birth cohorts in a Primary girls' school: cohort I composed of 45 girls born in 1981 and 1982 and cohort II composed of 53 girls born in 1989 and 1990. In both cohorts, there was a significant correlation between the dmft score in the first grade and the DMFT score in the sixth grade. The validity of employing dmft score was examined by receiver operating characteristic (ROC) curve and risk ratios. The shape of the curve and areas under the curve were similar in the two cohorts. In cohort II, sensitivity and specificity for the optimal cut-off level (dmft ≧ 5) were 0.519 and 0.923, respectively. The positive and negative predictive values for that level were 0.875 and 0.649, respectively. In cohort I, sensitivity and specificity were 0.741 and 0.722 for that level and positive and negative predictive values were 0.800 and 0.650, respectively. In both cohorts, the risk ratio for permanent teeth caries was significant for many cut-off levels of dmft. The results indicated that the dmft score is a useful predictor of the permanent teeth caries in Japanese primary school girls. (J. Oral Sci. 48, 233-237, 2006)

Keywords: dmft; caries risk predictor; schoolgirls.

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Introduction

The importance of measurement of caries experience for the assessment of caries risk has been widely discussed (1-15). Hausen (13) and Powell (14) indicated that caries experience is a significant clinical variable to predict future caries development. Zero et al concluded that previous caries experience was an important predictor in most models tested for primary, permanent and root surface caries (16). The results of previous studies (3,4,6,7,10,12) seemed to support the idea of employing caries experience in the primary teeth as a predictor for caries in the permanent teeth. Helm and Helm indicated that the association between caries in the primary and permanent dentition remained fairly constant over a 20-year period, based on observation of children from the age of 8 years (7). We believe that differences in preventive measures and many other unknown factors among different countries may influence the predictability of the dmft score as an indicator of caries in the permanent teeth. However, the predictability has not been studied in Japanese children.

According to the Japanese national survey in 1999 (17), the mean number of decayed and filled permanent teeth in Japanese males and females 5 years or older were 8.6

and 10.6, respectively. As the prevalence of permanent teeth caries in females was higher than in males in Japan (17), caries prevention in female children has been considered a more significant issue. Thus, we focused on the caries risk in female children.

The main aim of the present study was to evaluate the significance of measurement of decayed (d), missing (m) and filled (f) teeth (t) (dmft) in predicting caries increment in the permanent teeth of Japanese primary school girls provided with school-based dental service in recent years. The second aim was to confirm the consistency of the predictive value between two cohorts with different caries incidence in the years exhibiting a decline of caries incidence.

Materials and Methods

Subjects

The study population included Japanese school girls who entered a private primary girls' school located in an urban district in Tokyo in April 1988 (76 girls) and in April 1996 (78 girls). From the study population, the subjects who participated in both dental health examinations, one conducted in April while the subjects were in the first grade and the other in October while they were in the sixth grade, were selected for this study. Those who had lost upper anterior primary tooth or teeth by natural exfoliation or unknown reasons at baseline examination were excluded to improve the accuracy of measurement of dmft, because caries experience in the upper primary anterior teeth was estimated to be slightly high through the observation of the study population who had their upper primary anterior tooth or teeth at the baseline. On the other hand, those who had lost lower anterior primary tooth or teeth were included in this study, because caries incidence in this segment is thought to be extremely low. Subsequently, we obtained two cohorts; Cohort I composed of 45 girls born in the year April 1981 to March 1982 and Cohort II composed of 53 girls born in the year April 1989 to March 1990.

Fluoridated water and fluoride tablets are not available in Japan. However, some Japanese children use fluoride toothpaste. In this school, semiannual dental health check-ups were conducted by dentists in April and in October and dental health education was provided by a dental hygienist for the first and sixth graders once a year. Teachers-in-charge of each class usually monitored tooth brushing after lunch during school time. These services have been carried out from 1987 regularly as part of the school dental health service. Annual dental health examination is compulsory in primary schools in Japan. But, the semiannual dental health examination in the school is not obligatory.

Data and oral examination

The caries data used in this study were from the records of the check-ups in April while subjects were in the first grade and in October while they were in the sixth grade in the school dental health service. Oral examinations were carried out based on visual observation with the aid of an artificial light and an explorer No.9, using minimal pressure when necessary. Examination of the school girls belonging to the two cohorts were carried out by a group of five dentists. We also recorded caries lesions that do not require immediate treatment and denoted them using a particular letter. With regard to detection of early caries lesion, caries were recorded as present when a lesion had an unmistakable cavity. White, chalky or discolored spots on a smooth surface with no visual cavity and stained or sticky pits and fissures that did not have visual undermined enamel were not recorded as caries. We held a meeting between each check-up to improve the intra- and inter-examiner reliability in the examination of dental caries, and a manual was placed beside each examiner to confirm definitions of the criteria and marks whenever needed during examination process.

Analysis of data

As risk predictability would be affected by the association between caries experience in the primary and permanent teeth, the correlation coefficient was calculated between them. The validation criterion was an increase in DMFT score ($\Delta DMFT > 0$) during the observation period of 5.5 years. The validity of the risk assessment by dmft score was investigated with receiver operating characteristic (ROC) curve analysis. The optimal cut-off level of dmft score for the permanent teeth caries was determined by means of the largest sum of the sensitivity and specificity values.

Furthermore, we calculated risk ratios of the positive cases (girls with a dmft score ≧ a cut-off score) to the negatives (girls with a dmft score < a cut-off score), when the subjects were classified into two groups at each cut-off level of dmft to assess the relative caries risk. Statistical analyses were conducted using the statistical package for biosciences (SPBS) and ROC curves were drew with the aid of the Excel statistical program.

Results

Table 1 presents the caries experience in the two birth cohorts at baseline and the end of the observation period. Based on the records at baseline, the rate of subjects with dmft ≧ 1 in cohort II was 10% lower, and the mean dmft was 1.3 lower compared to cohort I. At the end of the observation period, the prevalence of children with

DMFT ≧ 1 in cohort II was 9% lower, and the mean DMFT was 1.2 lower compared to cohort I. There was a statistical significant difference between cohort I and cohort II only in the DMFT index.

Table 2 presents the correlation coefficient between dmft and DMFT scores in the two birth cohorts. The correlation coefficients were 0.441 (Spearman rank P = 0.002) in cohort I and 0.597 (P = 0.001) in cohort II, respectively.

Figure 1 shows the ROC curve in cohort I based on the sensitivity and specificity calculated for each cut-off level from dmft score ≧ 1 to dmft score ≧ 12. The ROC curve analysis showed that the area under the curve was 0.717 and the optimal cut-off level in cohort I was ≧ 4, with a sensitivity of 0.741 and specificity of 0.722. In cohort II, shown in Fig. 2, the area under the curve was 0.768 and the optimal cut-off level was ≧ 5, with a sensitivity of 0.519 and specificity of 0.923. The positive and negative predictive values were 0.875 and 0.649, respectively.

Table 3 represents the risk ratios of the positives to the negatives when the subjects were classified into two groups at each cut-off level from dmft ≧ 1 to dmft ≧ 8. Risk ratios in cohort I decreased as the level of dmft increased. However, no such decrease was observed in cohort II.

Table 1 Caries experience in the two birth cohorts in the primary dentition at the start (first grade) and in the permanent dentition at the end (sixth grade) of the observation period

Time of examination	Index	Cohort I Born in 1981-1982 (N = 45)	Cohort II Born in 1989-1990 (N = 53)	Statistical test
1st grade	Rate of subjects with dmft ≧ 1	77.8 %	67.9 %	N.S[a] (chi-square)
	Mean dmft	4.4 ± 3.6	3.1 ± 3.4	N.S. (t-test)
6th grade	Rate of subjects with DMFT ≧ 1	60.0 %	50.9 %	N.S. (chi-square)
	Mean DMFT	2.5 ± 2.7	1.3 ± 1.7	0.012 (t-test)

[a] Not Significant

Table 2 The correlation coefficient between dmft and DMFT scores

Group	N	Correlation coefficient	P-value (Spearman rank)
Cohort I	45	0.441	0.002
Cohort II	53	0.597	0.001

Table3 Risk ratios for caries increase (ΔDMFT > 0) in the permanent dentition of two birth cohorts by different cut-off points in baseline dmft scores

Cut off level (dmft)	Cohort I (N = 45) Risk ratio	Cohort I 95% CI	Cohort II (N = 53) Risk ratio	Cohort II 95% CI
≧1	2.29	0.86 - 6.05	2.08	0.95 - 4.45
≧2	2.60	1.11 - 6.10	2.68	1.30 - 5.55
≧3	2.20	1.04 - 4.65	2.05	1.20 - 3.51
≧4	2.29	1.22 - 4.29	2.40	1.41 - 4.08
≧5	1.94	1.16 - 3.26	2.49	1.55 - 4.01
≧6	1.62	1.02 - 2.57	2.23	1.42 - 3.50
≧7	1.45	0.92 - 2.28	2.25	1.49 - 3.39
≧8	1.23	0.77 - 1.98	—	—

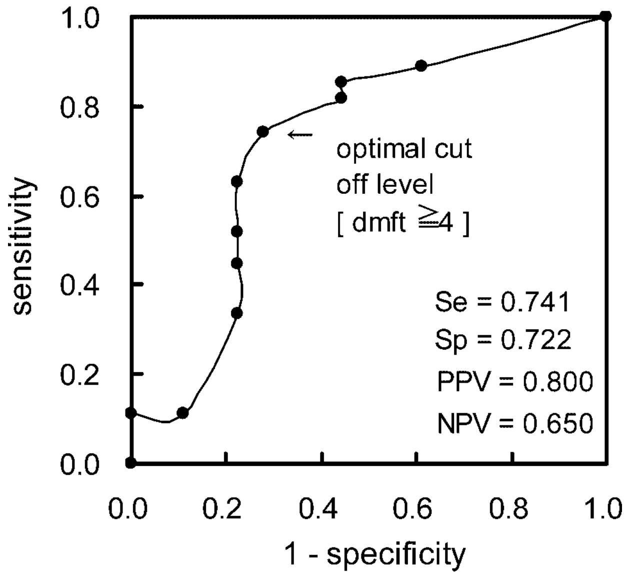

Fig. 1 ROC curve when the dmft score in first grade is a screening criterion and the caries increase (ΔDMFT > 0) during the observation period is a validation criterion (Cohort I).

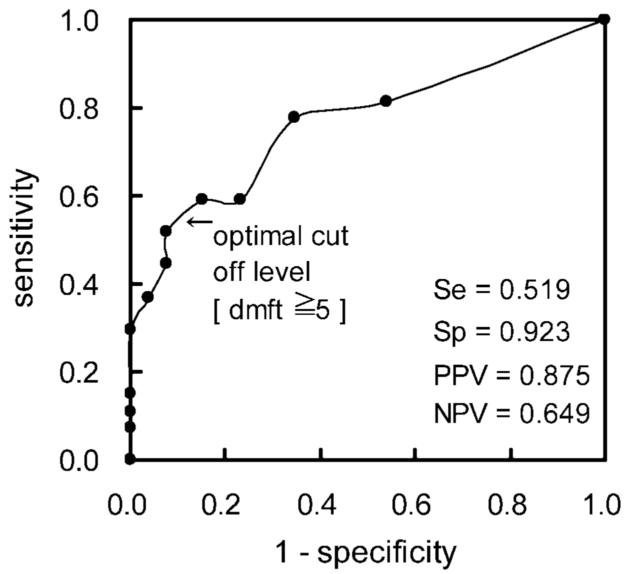

Fig. 2 ROC curve when the dmft score in first grade is a screening criterion and the caries increase (ΔDMFT > 0) during the observation period is a validation criterion (Cohort II).

The risk ratio was statistically significant at the cut-off level from ≧ 2 to ≧ 6 in cohort I and from ≧ 2 to ≧ 7 in cohort II. The maximum risk ratios were observed for the same level of ≧ 2 in both cohorts, with ratios of 2.60 (cohort I) and 2.68 (cohort II), respectively.

Discussion

Though many girls had to be excluded from the study, the exclusion was not thought to be a cause of bias in estimating the association between caries experience in the primary and permanent teeth. The mean dmft score in first grade and mean DMFT score in sixth grade in the study population of the cohort I (N: 76) were 4.4 and 2.6 (4.4 and 2.5 in the 45 study subjects as shown in Table 1 - only the scores in the study subjects are shown in Table 1). Similarly, these two scores in the study population of the cohort II (N: 74) were 3.4 and 1.4 (3.1 and 1.3 in the 53 study subjects). In both cohorts, the mean dmft score at the baseline was very similar in the study population and the study subjects. And the mean DMFT score at the end of the observation period also was similar in two groups in both cohorts. Statistically significant difference was observed between the two cohorts in mean DMFT. The general trend of a declining incidence of caries among Japanese children (2) is thought to be reflected in the difference in caries experiences in the two birth cohorts. The results of this study could be generalized to school girls in similar situations.

Behavioral factors of caries, especially related to life style like dietary habit or tooth brushing habit, may have changed more or less in each subject during the long time period of 5.5 years between measurement of dmft score and judgment of caries increment in the permanent teeth. The change in caries activity by these factors may weaken the strength of the association between past caries experience in primary teeth and the caries increment in the permanent dentition. The predictability of the dmft score also might be weakened with those changes. But there was a significant correlation between the dmft score of the first graders in April and the DMFT score of the sixth graders in October in both cohorts. This indicates that the number of girls whose caries activity changed during the observation period was not large enough to make the predictability of a dmft score alone meaningless.

According to Bayes' theorem in diagnostic test, positive and negative predictive values change with the change in disease prevalence. This theorem can also be applied to risk assessment test. Theoretically, if sensitivity and specificity are constant, positive predictive value will fall and negative predictive value will rise with a decrease in disease incidence. The specificity (0.923) for the optimal cut-off level (dmft ≧ 5) in cohort II was higher than the specificity (0.722) for the optimal cut-off level (dmft ≧ 4) in cohort I. The specificity for the optimal level in cohort II was higher than the specificity (0.62) that Pelkwijk et al (6) showed for the same screening level (dmft ≧ 5) at 7 years in a study population consisting of boys and girls. The higher specificity in cohort II may be due to lower caries incidence in the permanent teeth.

The differences in the positive and negative predictive values for the optimal cut-off level between the two cohorts were small. We observed similar ROC curves as well as areas under the curve in both cohorts. It seemed that decrease in permanent teeth caries had no significant effect on the predictive value of the dmft score for the caries risk in the permanent teeth as Helm and Helm reported (7).

The risk ratio was not statistically significant for the cut-off level of dmft ≧ 1 in both cohorts. However, the risk ratio was significant for the levels from ≧ 2 to ≧ 6 in cohort I and for the levels from ≧ 2 to ≧ 7 in cohort II. In both cohorts, assessment of the risk of caries in permanent teeth based on the dmft score is thought to be more reliable than the presence of dmf teeth. The risk ratio for the cut-off level of dmft ≧ 7 was significant in cohort I, but it was not significant in cohort II. The higher risk ratio in cohort II suggests that a tendency to maintain high caries activity in children with a high dmft score, was stronger in cohort II than in cohort I. Anyway, in both cohorts, the risk ratio for permanent teeth caries was significant for many cut-off levels of dmft.

With regard to cohort II, by the risk classification at the optimal cut-off level, most of the girls who would not develop caries were correctly classified into the believed low-risk (92.3%), but many girls who would develop caries may incorrectly be classified into the believed low-risk group (48.1%). The level of risk classification by dmft score should be smaller to secure high sensitivity when caries incidence becomes lower. Pelkwijk et al (6) showed that the sensitivity for the cut-off point between a dmft score of 0 and 1 was a maximum of 86% for risk assessment of the increase in caries in the permanent dentition of 7-year-old boys and girls. In the present study, when the cut-off level was decided at ≧ 1, the sensitivity was high (0.815). However, we should not treat the low rate of false negatives (0.185) lightly.

For caries preventive methods which are not expensive, it is not reasonable to reject the preventive intervention simply because the dmft score is small, or even zero. Therefore, we should consider acceptable preventive measures for all children as a population strategy, even with the recent low level of caries incidence in Japan. On the other hand, as dmft score may identify the high risk group, employing dmft score as an indicator in high risk strategy should also be considered.

In conclusion, the results indicated that the dmft score is a useful predictor of caries in the permanent dentition of Japanese primary school girls provided with school-based dental health service, even in recent years of declining caries incidence. In addition, it should be noted that the caries risk indicator of dmft score should be taken into careful consideration while planning oral health care programs in girls' primary schools.

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