No Relationship of Salivary Flow Rate or Secretory Immunoglobulin A to Dental Caries in Children

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Abstract

To investigate the relationship between dental caries and the salivary flow rate, secretory immunoglobulin A (sIgA) or other components in children, nonstimulated whole saliva was collected and teeth status was examined in 138 boys and 134 girls aged 11-12 years. The subjects were apparently healthy. The mean salivary flow rate was faster in boys than in girls (0.29 vs 0.18 ml/min, p<0.001). In both sexes, secretion of salivary sIgA and three other components (total protein, calcium and amylase activity) was markedly dependent on salivary flow rates. These results suggest that basal components of resting saliva are secondarily secreted with the flow of saliva fluid. The mean erupted permanent teeth was 21.0 teeth (range: 10-28 teeth) in boys, and 23.0 teeth (13-28 teeth) in girls (sex-difference: p<0.001). The means of DMFT, the DMFT ratio (% of DMFT to erupted permanent teeth) and DT+dt (sum of decayed permanent and milk teeth, an index for active caries) were 3.4 DMFT (range: 0-11 DMFT), 16.0% (0-40.0%) and 0.5 DT+dt (0-7 DT+dt) in boys, and 3.8 DMFT (0-12 DMFT), 16.2% (0-44.4%) and 0.8 DT+dt (0-5 DT+dt) in girls, respectively (sex-differences: p>0.05 in all). The salivary flow rate or the four salivary components (either concentration or secretion rate) used here had no relationship to the DMFT ratio or to DT+dt in either sex. Variation in the flow rate or in the basal components of resting saliva may not influence caries development in healthy children.

Key words: Saliva, Flow rate, Secretory IgA, Dental caries, Children

Introduction

Dental caries of permanent teeth is very common even in children in Japan. In the Survey of Dental Disease, 1993 in Japan conducted by the Ministry of Health and Welfare11, the mean number of decayed, missing and filled permanent teeth (DMFT) was 2.8 DMFT in children aged 10 years, and 6.6 DMFT in those aged 15 years. These findings indicate that dental caries of permanent teeth steadily increase and accumulate during these periods of growth in the Japanese population. Therefore, factors influencing caries development in children should be clarified, also, to improve the dental health of adults. On the other hand, it is generally agreed by dental professionals that saliva and its components influence teeth status. The salivary flow rate, rather than salivary components, is thought to be a main protective factor for dental caries because of its function of dilution and clearance of cariogenic bacteria and substrates in the oral cavity2. Secretory immunoglobulin A (sIgA) in saliva may also be related to the prevention of dental caries’ development6, since sIgA is one of the humoral immune factors effective in mucosa against pathologic agents. However, the results from previous human studies on the relationship between dental caries and the salivary flow rate8,9 or IgA12 are conflicting. The effects of other components of saliva on teeth are more obscure. Thus, to investigate the rela-
tionship between dental caries and salivary flow rate, slgA or the levels of other components (total protein, calcium, amylase) in healthy children, resting whole saliva was collected and teeth status was determined in Japanese children aged 11-12 years.

Subjects and Methods

The subjects were 138 boys and 134 girls aged 11-12 years in the 6th grade, the last grade of a Japanese primary school. All the subjects were apparently healthy. The subjects brushed their teeth and washed their oral cavities at home just before going to school on the mornings of the sampling days, and were not allowed to eat until saliva was collected in the school. Nonstimulated whole saliva was collected by the drain method at 11 a.m. on weekdays of February 1994 in the school. The method is an easy and safety method without specific procedures to collect nonstimulating saliva. Briefly, after swallowing saliva in the mouth, the subjects were seated, head slightly down, and were asked to spit the saliva spontaneously secreted into graduated plastic tubes. The collection time varied from 7 to 30 min (mean: 19.6 min) to collect an adequate sample volume for saliva analysis. The saliva was placed at 4 °C during the following treatment and analysis. The salivary flow rate (ml/min) was calculated from the volume of saliva collected and the collection time. After centrifugation of the saliva at 3000 rpm for 10 min, a supernatant was used as saliva samples for the analysis of its components. Within 48 hours of the sampling, salivary total protein (TP, mg/l) was determined by the Coomassie blue dye binding method using a Bio-Rad Protein Assay (Bio-Rad, California), and salivary calcium (Ca, mg/l) by the OCPC method using a Calcium C-test kit (Wako-Jyunyaku, Osaka), and salivary amylase activity (Amy, IU/ml) by the Carboxy-methyl-amylose/DEX method using an Amylase B-test kit (Wako-Jyunyaku, Osaka). Residual saliva samples were stored at -80°C until slgA analysis. Salivary slgA (mg/l) was determined by the ELISA method with a Purified Human Secretory IgA (Cappel, Pennsylvania) as a standard of slgA. The interassay coefficients of variation for 10 measurements of the same sample were less than 2.0% for TP, 5.1% for Ca, 6.6% for Amy, and 7.0% for slgA. The four salivary components were expressed also by secretion rate per minute (μg/min in TP, Ca and slgA, IU/min in Amy).

Teeth of the subjects were examined by a school dentist (K. M.) as an annual oral health check for school children. X-rays were not used in the checkup. A DMFT ratio (% of DMFT to erupted permanent teeth) was calculated as an index for caries experience of permanent teeth, since the number of erupted permanent teeth widely varied among the subjects (12 to 28 teeth), and since DMFT was positively correlated with erupted permanent teeth in the subjects (r=0.419 in boys, r=0.314 in girls, p<0.001 in both). Missing permanent teeth were not found in any subjects. Children aged 11-12 years naturally have remaining milk teeth, so, the sum of decayed permanent and milk teeth (DT+dt) was used as an index for active dental caries.

Sex-differences of salivary components and teeth status were tested by the Student’s t-test with or without Cochran’s correction, and the Pearson’s correlation coefficient test was used to test the relationship between the two variables. Spearman’s correlation coefficients also calculated were not apparently different from the Pearson’s, so, the Pearson’s correlation coefficients are used here. In the tests, the salivary flow rate and components (both concentration and secretion rate) were used after logarithmic transformation. A commercial software for personal computers (PC-SAS, SAS Institute Inc., North Carolina) was used in the statistical analysis, and statistical significance was denoted by p<0.05 for all tests.

Results

Salivary components and teeth status of the subjects by sex are summarized in Table 1. Pearson’s correlation coefficients among salivary flow rate and components, and the DMFT ratio or DT+dt are presented in Table 2.

The mean salivary flow rate was faster in boys than in girls (0.29 vs 0.18 ml/min p<0.001). The mean concentrations of salivary slgA, TP or Amy were not different between sexes (p>0.05), but that of Ca was slightly lower in boys than in girls (35 vs 37 mg/l, p<0.05). There were inverse correlations between the salivary flow rate and the concentrations of the components in both sexes (r=-0.010 to -0.463, not significant in slgA or Amy in girls, significant in the others). The mean secretion rates of salivary slgA (20 vs 13 μg/min, p<0.01), TP (156 vs 103 μg/min, p<0.001), Ca (10.0 vs 6.8 μg/min, p<0.001) and Amy (126 vs 89 IU/min, p<0.01) were higher in boys than in girls. The secretion rates of the four components were markedly and positively dependent on the salivary flow rate in both sexes (r=0.575 to 0.959, p<0.001 for all four components).

Erupted permanent teeth ranged from 10 to 28 teeth in boys, and from 13 to 28 teeth in girls, and the mean was smaller in boys than in girls (21.0 vs 23.0 teeth, p<0.001). On the contrary, the mean remaining milk teeth were more in boys than in girls (3.0 vs 2.0, p<0.01). DMFT, DMFT ratio and DT+dt ranged from 0 to 11 DMFT, from 0 to 40.0% and 0 to 7 DT+dt in boys, and from 0 to 12 DMFT, from 0 to 44.4% and from 0 to 5 DT+dt in girls, respectively. The mean DMFT (3.4 vs 3.8 DMFT), DMFT ratio (16.0 vs 16.2%) and DT+dt (0.5 vs 0.8 DT+dt) were slightly smaller in boys than in girls, but the sex-differences were not significant.

No significant relationships between the DMFT ratio or DT+dt and the salivary flow rate or salivary components (either concentration or secretion rate) used here were found in either sex (r=-0.159 to 0.135, p>0.05 in all).

Discussion

The mean salivary flow rate found in children was less than that (0.3 to 0.4 ml/min) in adults previously reported. The salivary gland and its secretory function may have not yet matured in the subjects aged 11-12 years. A faster flow rate in men than in women has, also, been found in adults. Concentrations of the four salivary components analyzed here were slightly inversely correlated with the salivary flow rate (r=-0.010 to -0.463). Faster flow rates of saliva with lower concentrations of IgA and other components have been reported in previous studies. Secretion rates of the four salivary components determined here were markedly dependent on the salivary flow rate (r=0.575 to 0.959). A positive correlation