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Coronal and Root Caries in Southern Chinese Adults

ABSTRACT

Southern China is the most prosperous part of China, but information useful for oral care planning is very limited. A large-scale epidemiological survey was conducted in 1996-97. The objectives of this report were to describe the coronal and root caries of the adult Southern Chinese and to analyze the influence of selected demographic and socio-economic factors on the disease pattern. A total sample of 1573 35- to 44-year-olds and 1515 65- to 74-year-olds from 8 urban and 8 rural survey sites in Guangdong Province participated in an oral health interview and underwent clinical examination. World Health Organization examination procedures and diagnostic criteria were used. The weighted mean DMFT scores of the middle-aged and the elderly subjects were 4.8 and 16.1, respectively. People living in rural areas had a higher DMFT score than those living in urban areas (4.9 *vs.* 4.3 in the 35- to 44-year-olds and 16.5 *vs.* 14.7 in the 65- to 74-year-olds). In both age groups, MT was the major component of the DMFT score. Analysis of covariance showed that women and those who were economically less well off had higher DMFT scores in both age groups. The weighted prevalence rates of decayed/filled roots were 12% and 37%, with a mean of 0.2 and 0.7 teeth affected, in the middle-aged and the elderly, respectively. In conclusion, socio-economic factors had a considerable effect on the dental caries status of adults in Southern China.

KEY WORDS: dental caries, tooth decay, elderly, oral health surveys, Chinese.

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INTRODUCTION

The target groups in most oral health surveys conducted in Mainland China have been children and adolescents. Reported surveys on dental caries in adults, especially rural residents, were much less common. A survey in Beijing (in the northern part of China) on dental caries status in adult Chinese reported DMFT scores ranging from 3.9 in the 20- to 29-year-olds to 21.4 in the elderly aged 70 years and above (Luan *et al.*, 1989). The average DMFT score of the 35- to 44-year-olds in the above survey, estimated to be around 5.5, was somewhat higher than that observed in the same age group surveyed in Chengdu, Western China (Liu *et al.*, 1984), which was 1.6. DMFT scores of 35- to 44-year-olds and 65- to 74-year-olds surveyed in Hubei Province in the central part of China were found to be 1.8 and 8.9, respectively, but these were based on examination of only 28 teeth (Petersen *et al.*, 1997). The dental caries status and the factors affecting caries among adults in Hong Kong, which adjoins Guangdong Province in Southern China, have been reported (Lo and Schwarz, 1994). However, information concerning the current dental caries status of adults in Guangdong Province was lacking. Thus, a socio-epidemiological study on oral health conditions among selected age groups in Guangdong Province was conducted in 1996-97.

The objectives of the present analyses were to describe the coronal and root caries of 35- to 44-year-old and 65- to 74-year-old Chinese from both urban and rural areas of Guangdong Province in Southern China, and to determine the influence of various demographic and socio-economic factors on dental caries in these populations.

MATERIALS & METHODS

The study sample consisted of 1573 35- to 44-year-old and 1515 65- to 74-year-old Chinese living in both urban and rural areas in Guangdong Province, Southern China. Details of the sampling methods and recruitment of subjects have been described in a preceding paper (Schwarz *et al.*, 2001). In brief, 16 sampling sites (8 urban and 8 rural sites) were selected through a combination of multi-stage stratified sampling and quota sampling. First, 4 representative major administrative regions of the Province were chosen for the survey, mainly based on their geographic location. Then, by two-stage stratified simple random sampling, 2 urban sub-districts and 2 rural townships in each region were selected to be the survey sites. With assistance from the local government and health authority, about 100 subjects in each age group were recruited in each survey site. In urban areas, the 35- to 44-year-olds were recruited from factories and other work places, to include different occupation groups, and the 65- to 74-year-olds were recruited from their homes. In rural areas, subjects were recruited from their homes in the villages.

All of the subjects were interviewed by trained interviewers using a structured questionnaire which collected information about the subject's demographic background, perceived oral health conditions, oral health knowledge, attitudes and practices, and use of dental services. Clinical examinations were conducted by one of three calibrated examiners. Procedures

Table 1. Caries Status of Adults in Southern China According to Age Group, Gender, and Location of Residence

Age Group	Location	n	% with DMFT > 0	DT	MT	FT	DMFT (SE)	% with DF-Root > 0	D-Root	F-Root	DF-Root (SE)
35- to 44-yr-olds											
Men	Urban	393	87	0.9[a]	2.1	0.4[a]	3.5 (0.2)	9	0.1	< 0.1	0.1(< 0.1)
	Rural	370	83	1.5	2.1	0.1	3.7 (0.2)	11	0.2	< 0.1	0.2(< 0.1)
Women	Urban	405	91	1.4[a]	2.7	1.0[a]	5.1[b] (0.2)	11	0.1	< 0.1	0.2(< 0.1)
	Rural	405	94	2.9	2.9	0.2	6.0 (0.2)	15	0.2	< 0.1	0.2(< 0.1)
Total	Urban	798	89	1.2[a]	2.4	0.7[a]	4.3[b] (0.1)	10	0.1	< 0.1	0.1(< 0.1)
	Rural	775	89	2.2	2.5	0.1	4.9 (0.2)	13	0.2	< 0.1	0.2(< 0.1)
65- to 74-yr-olds											
Men	Urban	391	99	2.5[a]	10.9	0.3[a]	13.7 (0.4)	35	0.6	< 0.1	0.6 (0.1)
	Rural	368	99	3.8	10.5	< 0.1	14.3 (0.5)	37	0.6	< 0.1	0.6 (0.1)
Women	Urban	383	99	2.9[a]	12.4[b]	0.4[a]	15.7 (0.5)	41	0.7	0.1	0.8 (0.1)
	Rural	373	99	4.6	13.9	< 0.1	18.6 (0.5)	38	0.8	< 0.1	0.8 (0.1)
Total	Urban	774	99	2.7[a]	11.6	0.3[a]	14.7[a] (0.3)	38	0.7	< 0.1	0.7(< 0.1)
	Rural	741	99	4.2	12.2	< 0.1	16.5 (0.3)	37	0.7	< 0.1	0.7(< 0.1)

[a] Significant between urban and rural residents (*t* test, $p < 0.001$).
[b] Significant between urban and rural residents (*t* test, $p < 0.01$).

and diagnostic criteria recommended by the World Health Organization (1997) were followed. Examiner calibration was done before fieldwork. Duplicate examinations were conducted on 10% of the subjects throughout the study, and the results were used to assess inter-examiner reliability by means of Cohen's kappa statistic (Fleiss *et al.*, 1979).

The examination for dental caries was conducted with plane mouth mirrors, WHO CPI probes, and a portable light. Portable chairs were carried to the survey sites so that the subjects could be examined in a supine position. Tooth status, both crown and root, was primarily assessed by visual inspection and secondarily confirmed by tactile inspection by means of a WHO CPI probe. The teeth were neither cleaned nor dried before the assessment, but food debris obscuring visual inspection was removed. No radiographs were taken. Coronal caries was recorded as present when there was a cavity, undermined enamel, or a detectable softened floor or wall. A residual root left behind as a result of gross caries was scored as coronal caries only. Where any doubt existed, caries was not recorded as present. Root caries was recorded as present when a lesion located on a root surface or presumed to have commenced on the root surface was felt to be soft with the probe. If it was not possible to judge the original site of a single caries lesion affecting both crown and root, both were recorded as present. When DMFT or DF-Root scores were calculated, only permanent restorations that were judged to be placed for caries treatment and with no decay were included in the F-component. Teeth not present for any reason were included in the M-component. We counted the DF-Root score by totaling the numbers of decayed roots (D-Root) and filled roots (F-Root).

Analysis performed on the duplicate examination recordings gave a kappa statistic of 0.89 for coronal caries in both age groups, and the respective figures for root caries in the middle-aged and the elderly were 0.60 and 0.85. These figures indicated that the inter-examiner reliability in assessing coronal caries was good in both age groups, and for root caries, it was good in the elderly and substantial in the middle-aged (WHO, 1997).

Table 2. The Relationship between Selected Individual Factors and DMFT Scores in the 35- to 44-year-old Subjects

Factor	Group	n	DMFT (SE)	p-value
Location of residence[a]	Urban	798	4.3 (0.1)	
	Rural	775	4.9 (0.2)	< 0.01
Gender[a]	Men	763	3.6 (0.1)	
	Women	810	5.6 (0.2)	< 0.01
Education level[b]	No schooling/primary	461	5.4 (0.2)	
	Secondary	958	4.3 (0.1)	
	Post-secondary	154	4.0 (0.3)	< 0.01
Toothbrushing frequency[a]	Once or less a day	816	4.8 (0.1)	
	Twice or more a day	757	4.5 (0.1)	0.18
Dental fear[a]	No	1073	4.3 (0.1)	
	Yes	500	5.3 (0.2)	< 0.01
Time lapsed since last dental visit[b]	< 2 years	532	5.6 (0.2)	
	2-5 years	265	5.4 (0.3)	
	>5 years/non-user	776	3.7 (0.1)	< 0.01

[a] *t* test.
[b] One-way analysis of variance (ANOVA).

Data Analysis

We performed a *t* test and analysis of variance (ANOVA) to find out whether the differences in DMFT scores between groups were statistically significant. Pearson's correlation coefficients were used in assessing the relationship between selected continuous variables and DMFT score. Based on the analytical model adopted in this study (Schwarz *et al.*, 2001), 9 predisposing, enabling, and oral health behavior factors—location of residence, gender, education level, dental knowledge score, dental attitude score, dental fear, family material possession index (FMPI), toothbrushing frequency, and time lapsed since last dental visit—were chosen as independent variables in the analysis of covariance (ANCOVA) on mean DMFT score for both age groups. The calculation of FMPI and the calculation of dental knowledge and dental attitude scores have been described in preceding papers (Lin *et al.*, 2001; Schwarz *et al.*, 2001). In this study, ANCOVA was performed by means of the computer software SAS for Windows, and other analyses were performed with SPSS for Windows. The level of statistical significance was set at 0.05.

RESULTS

The coronal and root caries situation of the survey subjects according to age group, gender, and location of residence is shown in Table 1. The vast majority of subjects in all sub-groups had a DMFT score greater than zero. The mean DFMT scores of the 35- to 44-year-olds in urban and rural areas were 4.3 and 4.9, respectively. The overall weighted mean DMFT score for the Guangdong Province (urban:rural = 1:3) was 4.8. The mean DFMT scores of the 65- to 74-year-olds in urban and rural areas were 14.7 and 16.5, respectively (overall weighted mean DMFT score, 15.6). Missing teeth (MT) was the major component of the DMFT score in both age groups.

The prevalence rates of decayed/filled roots of the urban and rural middle-aged were 10% and 13%, with a mean of 0.1 and 0.2 teeth affected, respectively. The prevalence rates of decayed/filled roots of the elderly in both urban and rural areas were similar, about 37%, and the mean number of teeth affected was 0.7. DF-Root scores consisted almost entirely of D-Root.

The proportion of FT in DFT was very low in the populations surveyed, being 38% in the urban middle-aged, 6% in the rural middle-aged, 11% in the urban elderly, and 0.4% in the rural elderly. Men and women had similar percentages, while the urban residents had a significantly ($p < 0.01$) higher proportion of filled teeth than did the rural residents in both age groups.

Statistically significant differences ($p < 0.05$) in DMFT scores between sub-groups of subjects were found (Tables 2 and 3). In both age groups, rural residents, women, and subjects with a lower education level had mean DMFT scores higher than those recorded in other groups of subjects. In the 35- to 44-year-olds, subjects who were afraid of visiting a dentist also had a higher mean DMFT score than those who were not. In relation to time lapsed since the last dental visit, different patterns were found in the 2 age groups. While the 35- to 44-year-old subjects who had visited a dentist within 2 years had higher DMFT scores, an opposite association with DMFT in the 65- to 74-year-olds was found.

Dental knowledge score, dental attitude score, and FMPI score of the 65- to 74-year-olds were found to have negative relationships with the DMFT score (r = -0.09, -0.12, -0.13, respectively, all $p < 0.01$), *i.e.*, those with better dental knowledge, those with more positive dental attitude, and those who were wealthier had lower DMFT scores. Among the 35- to 44-year-olds, only the FMPI score had a statistically significant ($p < 0.01$) negative relationship with the DMFT score (r = -0.08). Although these correlations were statistically significant, they were all rather weak.

The results of ANCOVA analysis on mean DMFT scores

Table 3. The Relationship between Selected Individual Factors and DMFT Scores in the 65- to 74-year-old Subjects

Factor	Group	n	DMFT (SE)	p-value
Location of residence[a]	Urban	774	14.7 (0.3)	
	Rural	741	16.5 (0.3)	< 0.01
Gender[a]	Men	759	14.0 (0.3)	
	Women	756	17.1 (0.3)	< 0.01
Education level[b]	No schooling	722	17.3 (0.3)	
	Primary	540	14.5 (0.4)	
	Secondary and above	253	12.9 (0.5)	< 0.01
Toothbrushing frequency[a]	Once or less daily	1030	15.8 (0.3)	
	Twice or more daily	485	15.1 (0.4)	0.19
Dental fear[a]	No	1138	15.7 (0.3)	
	Yes	377	15.2 (0.4)	0.34
Time lapsed since last dental visit[b]	< 2 years	541	14.6 (0.4)	
	2-5 years	301	16.4 (0.5)	
	> 5 years	673	16.0 (0.4)	< 0.01

[a] *t* test.
[b] One-way analysis of variance (ANOVA).

Table 4. Relationship between DMFT Scores and Selected Independent Variables among the 35- to 44-year-old Subjects (result of ANCOVA analysis)

Independent Variable	Estimate	SE (Estimate)	p-value	Bonferroni's Multiple Comparison
Gender			< 0.01	
Men[a]				
Women	1.77	0.20		
Last dental visit			< 0.01	
> 5 yrs (1)[a]				
2-5 yrs (2)	1.67	0.27		(2) > (1)
< 2 yrs (3)	1.82	0.22		(3) > (1)
FMPI		-0.02	0.01	< 0.01
(Intercept)	3.34	0.19	< 0.01	

F-value = 48.1; df = 4, 1568; p < 0.01.
[a] Reference category.

Table 5. Relationship between DMFT Scores and Selected Independent Variables among the 65- to 74-year-old Chinese (result of ANCOVA analysis)

Independent Variable	Estimate	SE (Estimate)	p-value	Bonferroni's Multiple Comparison
Gender			< 0.01	
Men[a]				
Women	1.89	0.55		
Education level			< 0.05	
(1) No schooling[a]				
(2) Primary	-1.27	0.60		(1) > (3)
(3) Secondary and above	-2.07	0.79		
FMPI	-0.05	0.02	< 0.01	
Dental attitude score	-0.35	0.16	< 0.05	
(Intercept)	18.18	1.01	< 0.01	

F-value = 16.9; df = 5, 1509; p < 0.01.
[a] Reference category.

for the 35- to 44-year-olds and the 65- to 74-year-olds are shown in Tables 4 and 5, respectively. It was found that, among the 35- to 44-year-olds, women, those who were less wealthy, and those who had a more recent dental visit had higher DMFT scores. In the elderly subjects, higher DMFT scores were found among women, those who had a lower education level, those who were less wealthy, and those who held less positive attitudes toward dental health.

DISCUSSION

The mean DMFT scores of the subjects found in the present study were similar to the results obtained in a survey conducted in Beijing (Luan *et al.*, 1989). A mean DMFT score of 4.3 in the urban 35- to 44-year-olds in the present study was somewhat higher than the mean DFT score of 1.6 observed in 35- to 44-year-olds in Chengdu, Western China (Liu *et al.*, 1984), and 1.8 detected in a recent pathfinder survey in Hubei Province, Central China (Petersen *et al.*, 1997). Beijing and Guangdong Province are relatively affluent areas in Mainland China, compared with Western and Central China. The above differences in DMFT scores may be due to possible differences in sugar consumption and dental visit behaviors, but more studies are required to confirm or refute this proposition.

The Hong Kong Adult Oral Health Survey in 1991 reported mean DMFT scores of 8.7 and 18.9 in the 35- to 44-year-olds and 65- to 74-year-olds, respectively (Lo and Schwarz, 1994), which were higher than the present results from Guangdong Province. In fact, the mean DT scores of Hong Kong adults were lower than those of Guangdong urban adults in the same age groups (1.0 *vs.* 1.2 in the 35- to 44-year-olds and 1.4 *vs.* 2.7 in the 65- to 74-year-olds). The higher DMFT scores in Hong Kong adults were contributed by the larger MT and FT components. Although the community drinking water in Hong Kong has been fluoridated since 1961, DMFT scores among Hong Kong adults were still higher than those among Guangdong adults. Possible reasons included differences in diet and use of dental services between Hong Kong residents and Guangdong residents. One can observe that Hong Kong adults have a more Westernized life-style. Furthermore, Hong Kong residents have better access to dental care services than Guangdong residents, which can increase the FT and MT scores. The caries-diagnostic criteria adopted in an epidemiological study are probably different from those used clinically by dentists. Incipient caries and some non-caries lesions, which do not contribute to DMFT scores originally, can contribute to FT after restoration. Teeth extracted due to reasons other than caries can also contribute to the MT component of the DMFT score in these age groups (WHO, 1997).

The finding that women had higher DMFT scores than men is in agreement with findings from many other surveys in both industrialized and developing countries (Luan *et al.*, 1989; Lo and Schwarz, 1994; Schier and Cleaton-Jones, 1995; Petersen and Razanamihaja, 1996; Winn *et al.*, 1996; Petersen and Kaka, 1999). A proposed explanation for this tendency in Chinese people was that women had easier access to cariogenic foods during the day than men (Luan *et al.*, 1989), but further investigation would be necessary to confirm this. For a long time, it was considered that urban populations had more caries than rural populations in Mainland China (Sichuan Medical College, 1980). However, a study of Beijing adults in 1989 yielded a reverse result (Luan *et al.*, 1989), and this was also found in Guangdong Province in the present study. The change might be related to the economic development in coastal provinces and metropolises of China in the recent 2 decades. In these areas, rural and urban residents now have similar access to sweet foods, but the rural residents still have less access to fluoridated toothpaste and preventive dental care. This may partly explain why the rural residents in Guangdong Province and in Beijing had experienced more dental caries than their urban counterparts.

In the present study, subject's education level and FMPI score were found to be associated with DMFT scores in both age groups. The results were consistent with findings from other studies outside China which showed that people in lower social classes had a higher risk of developing dental caries (Petersen, 1990; Alvarez-Arenal *et al.*, 1996). In Mainland China, location of residence, education level, and material wealth are related. People living in urban areas usually have a higher education level and a better economic status compared with people living in rural areas (Guangdong Statistical Bureau, 1996). In a comparison of the results of bivariate and multivariate analyses on DMFT, some independent variables which were statistically significant in the bivariate analyses were not found to be significant in the multivariate analyses. The reason for that is the existence of confounding variables that are associated with both DMFT and the independent variables. To adjust for the effects of the confounding variables on DMFT and other independent variables, a multivariate analysis should be performed. In the process, some variables which have been shown to have a statistically significant association with the dependent variable in the bivariate analysis may be removed from the final model, when these have associations with other independent variables which remain in the final model. This may explain why location of residence and education level in the middle-aged and location of residence in the elderly were not statistically significant in the ANCOVA analyses, although they were statistically significant in the bivariate analyses.

Different patterns of association between DMFT and time lapsed since last dental visit were observed in the 35- to 44-year-olds and the 65- to 74-year-olds. It was found that the use of dental services by the middle-aged subjects of this study was largely problem-driven, and these subjects seldom received preventive treatment (Lo *et al.*, 2001). Thus, it can be envisaged that the frequent dental service users were the people with more dental diseases. Moreover, the curative treatment approach adopted by the dentists would also inflate the FT and MT scores of these subjects and lead to a higher DMFT score. This relationship between dental service utilization and DMFT score was also found in a recent survey of 35- to 44-year-olds in Central China (Petersen *et al.*, 1997). As for the elderly subjects, they had much higher DMFT scores than the middle-aged, and MT was the predominant component. Thus, the elderly subjects who had high DMFT scores also had many missing teeth, *i.e.*, few natural teeth left. These subjects probably had fewer recent dental problems than the elderly who had more teeth, *i.e.*, those with lower DMFT scores, and therefore they had less-frequent visits to the dentists.

The low proportion of FT in DFT scores showed that most of the caries lesions were not restored in the populations surveyed. The much lower proportions in the rural residents and in the elderly may be due to their difficulty in accessing dental services, lower affordability of dental services, and less positive attitudes toward dental health.

Reported surveys on root caries were rare in Mainland China. The present finding that 38% of the 65- to 74-year-olds had 1 or more DF-Root(s) was similar to that found by Zhang and Li (1995) in Jiangxi Province, Southeastern China. Besides the DF-Root index, the Root Caries Index (RCI) developed by Katz (1980) is also a popular index used to measure root caries status. Since WHO (1997) recommends reporting the root caries status of a population in terms of percentage of subjects with root caries and the mean number of teeth with root caries per person, RCI was not used for comparative purposes in this study. It has been reported that RCI increased with age in the 50- to 70-year-olds in Shanghai (Liu *et al.*, 1992), but this result was not directly comparable with the findings of the present study, since different measurements were used. While DMFT scores of the subjects in the present study were lower than those of Hong Kong adults (Lo and Schwarz, 1994), DF-Root scores were similar.

In conclusion, the results of this large-scale oral epidemiological survey provided a good basis for the future planning of dental prevention and treatment programs for adults in Southern China. Although the dental caries situation among the Southern Chinese adults, as measured by the DMFT and DF-Root indices, was not particularly serious when compared with that in other population groups, the present findings show that socio-economic factors had an effect on dental caries in the adults in Southern China. Since the rural residents, women, and those who were less wealthy were found to have higher DMFT scores, more attention should be paid to these population groups.

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