SPECIAL SECTION
Clinical

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An Oral Health Survey in Southern China, 1997: Background and Methodology

ABSTRACT

Relatively limited information is available about the oral health in the Guangdong Province of Southern China, the closest neighbor to Hong Kong. The study intended to explore the oral health status, knowledge, attitudes, and dental care utilization in the Guangdong population as a basis for formulating strategies for oral health prevention and treatment. Through multi-stage stratified and quota-sampling, individuals from urban as well as rural communities were selected (5- to 6-; 12-; 35- to 44-; and 65- to 74-year-olds; total N = 6251). Structured interviews and clinical examinations were performed. Inter-examiner reliability was high (κ = 0.60-0.96). Samples of community water were taken for fluoride assessment. Overall, the sample surveyed was acceptably representative of the population, with some under-representation of rural residents and agricultural workers. Re-weighting was performed in appropriate analyses. The data analysis model used in the Second International Collaborative Study was used as a guide for the present data analysis. This approach has not previously been used on a Mainland Chinese population.

KEY WORDS: dental health survey, Chinese, epidemiology, research design.

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INTRODUCTION

There is a general agreement in the dental professional community that the two most prevalent oral diseases, dental caries and periodontal diseases, are largely preventable through a combination of professional and self-care activities, and that people's attitudes and behavior play an important role in the development and prevention of oral diseases (Gjermo, 1986; Schou and Blinkhorn, 1993; Cohen and Gift, 1995). Concern has been expressed that improvements in oral health conditions were taking place in many Western countries, whereas a deterioration in oral health has been taking place in many developing countries (Barmes, 1989; World Health Organization, 1989). For assessment of the global generalizability of such statements for a country such as China, appropriate data from representative population studies are needed that can be of use for the planning of preventive and curative oral care programs and developing training programs for dental personnel. However, only a few studies, mostly from Northern China, have been carried out in Mainland China with collaborating investigators from abroad using internationally recognized methods (Powell *et al.*, 1986; Baelum *et al.*, 1988; Luan *et al.*, 1989; Wright *et al.*, 1989; Shi *et al.*, 1992; Douglass *et al.*, 1994; Petersen *et al.*, 1997; Petersen and Esheng, 1998). Lin (1999) used information available in both the Medline database and the major Chinese journals, which are not indexed internationally (Schwarz and Lin, 1997), to review thoroughly the socio-epidemiologic studies in China published in either English or Chinese. This review revealed that most oral health surveys among adults in Mainland China were conducted after the 1970s. Study subjects of regional and local surveys were mainly urban residents living in big cities. Surveys conducted among farmers were uncommon, although the farmers comprised around three-quarters of China's population. Most surveys were in or around Beijing, Shanghai, Chengdu (in Western China), and Wuhan (in Central China), which are the locations of major medical universities with dental schools. Surveys among adults in Southern China were uncommon. Dental caries and periodontal disease were the major dental diseases studied. Only a few surveys on people's oral health knowledge, attitudes, and behavior were conducted in recent years. Published papers concerning dental treatment needs and utilization of dental services among adults in Mainland China were scarce. Further, the review showed that sample size was usually not a major problem in these surveys, but that many surveys used convenience samples or did not describe the sampling methods. In some surveys, the diagnostic criteria used were poorly defined and thus caused difficulty when the results were interpreted. Recent surveys usually claimed to use internationally accepted criteria, such as those described by the World Health Organization (WHO). Reported mean DMFT scores were low in adults in Mainland China. Most studies reported a mean DMFT score of between 2 and 6 in the 35- to 44-year-olds and between 9 and 16 in the elderly younger than 75 years. Calculus and gingivitis were reported to be

common in adult Chinese, but the reported proportion of subjects with shallow and deep periodontal pockets was not high. Complete edentulousness in the 60- to 69-year-olds was usually reported to be less than 10%. About 14% of the 35- to 44-year-olds and 19% of the 65- to 74-year-olds did not brush their teeth daily.

In Hong Kong, both descriptive and analytic epidemiological oral surveys have added considerably to the knowledge concerning oral health of the population and provided a basis for oral health policy there (Schwarz *et al.*, 1994). Thus, the overall purpose of this project was to conduct a survey in Guangdong Province in Southern China that would provide comparable basic data related to the oral health status, knowledge, and attitudes of the people in Southern China for the formulation of strategies for oral health prevention and treatment. It could also help to fill the gaps in the understanding of certain oral health developments in Hong Kong, whose population is culturally closely related to that of Guangdong Province, with most of Hong Kong's people being descendants of the province. The overall objectives of the study were:

(1) to describe the socio-demographic characteristics, the oral health status, and the treatment needs of internationally comparative age groups of children and adults in Guangdong Province, *i.e.*, 5- to 6-year-olds, 12-year-olds, 35- to 44-year-olds, and 65- to 74-year-olds;
(2) to explore the oral health knowledge, attitudes, and behaviors in these age groups; and
(3) to analyze the interrelationships among socio-demographic characteristics, oral health behavior, and the oral health status of these population groups.

Additionally, the subsequent reports detailing the findings of various aspects of the survey may contain more specific objectives in relation to the individual sections of the study.

STUDY POPULATION & METHODS

Guangdong Province

In the Chinese Mainland, there are 22 provinces, 5 autonomous regions, and 4 metropolises directly under the central government in Beijing (not counting Hong Kong Special Administrative Region [SAR], Macau SAR, and Taiwan). Guangdong Province, located in the south, is one of the large provinces in terms of population and an important one in economic terms in China. It has a land area of 178,100 square kilometers and a 3368-kilometer-long coastline. Annual average temperature is 21.7°C. Administratively, it is divided into 21 cities (administrative regions) and further subdivided into 42 urban districts and 78 rural counties. In this study, these 42 urban districts were defined as urban areas, and the 78 counties were defined as rural areas. Results of the 1% population census of Guangdong Province conducted in 1995 showed that the resident population then was 68 million, with 75% living in rural areas, and the male-to-female ratio was 1.03:1 (Population Census Office of Guangdong Province, 1996). In 1995, only 2% of the population had attended tertiary or post-secondary education. About 31% of the population was from 0 to 14 years old, and 11% was aged 60 or more. Around 50% of the working population was agricultural. Another 23% of the work force were manual workers. The annual gross national product in Guangdong Province was RMB¥ 1403 billion (about US$2480 *per capita*) in 1995 (Guangdong Statistical Bureau, 1996).

There are 16 dental hospitals in the major cities in Guangdong Province (Guangdong Statistical Bureau, 1996), and there are dental clinics in most of the county-level and city-level general hospitals. However, about half of the 1500 township hospitals do not provide dental services (Zhang *et al.*, 1993). There are approximately 1.5 university-trained dentists *per* 100,000 people. In addition, there are about 1000 middle-level dentists who have received 3 years of basic dental training in a health worker training school. Thus, the overall dentist-to-population ratio is about 1:33,000. It should be pointed out that the geographic distribution of dentists is very uneven. There are many more dentists in the major cities and urban areas than in the towns, and hardly any in the rural areas.

In the rural areas of Guangdong Province, there are some dental care providers who have been trained in traditional apprenticeships rather than in dental schools. They mainly provide relief of dental pain, tooth extraction, and prosthetic treatment. However, no information is available regarding their number and distribution.

Private dental clinics are not as common in Mainland China as in many industrialized countries, but their number is increasing. Almost all of the dental hospitals and dental clinics in general hospitals belong to and get support from the government. Public health bureaus in the cities or counties supervise the clinics. Medical insurance usually covers basic dental health care in Mainland China, such as fillings and tooth extractions, but not orthodontics and dental prostheses. Government employees and people who work in state-owned institutions and companies usually can get partial or total reimbursement of expenditures on basic dental health care in appointed hospitals. The proportion of this reimbursement varies from one institution to another. People who are not working in state-owned institutions and companies, like farmers, usually have no or little medical insurance, and they can go to any dental clinic for treatment. Private dental clinics are more common in towns and small cities than in big cities, because the hospital coverage is better in big cities, and people working in the cities usually have medical insurance, which requires them to visit a dentist in a state-owned dental clinic for oral health care when needed.

Selection of Study Population

Four age groups—5 to 6, 12, 35 to 44, and 65 to 74 years—were selected in this study. These age groups are standard target groups for oral health surveys recommended by the World Health Organization (1997) to facilitate cross-cultural comparisons. Based on the situation in the province, a combination of multi-stage stratified sampling and quota sampling was used in this study. There are 21 administrative regions (called cities) in the province: 4 in the northern, 5 in the western, 6 in the eastern, and 6 in the central parts of the province. In the first stage, the largest administrative region in each of the 4 parts was selected as the survey area: Guangzhou (Central, capital city of the province), Shantou (East), Zhanjiang (West), and Qingyuan (North). For each selected administrative region, lists of urban districts and rural counties were obtained. Second, 2 urban districts and 1 rural county were then selected by simple random sampling through the drawing of lots. Third, within each selected urban district, 1 sub-district was selected by simple random sampling from the list of all sub-districts. As for the selected rural counties, 2

townships in each county were selected by simple random sampling from the list of all townships in that county. Thus, altogether there were 16 randomly selected survey sites, 4 in each of the 4 administrative regions.

The population of a typical urban sub-district or rural township was between 15,000 and 50,000. In each sub-district or township, around 100 subjects (male-to-female ratio was around 1:1) were recruited in each age group. Thus, around 400 subjects were recruited in each survey location, making up a total sample size of around 1600 examinees in each age group, as described in the following.

Recruitment of Subjects

With assistance from the Department of Public Health of Guangdong Province and the Sun Yat-Sen University of Medical Sciences, relevant authorities in the survey sites were contacted before the fieldwork started. Meetings were held to explain the aims of the study and the detailed plans to the persons in charge. Staff of the local government offices were usually very helpful in the recruitment of study subjects and the arrangement of logistics in the study.

In China, children usually go to school at the age of seven and study for 6 years in primary schools. Thus, the 5- to 6-year-olds in this survey were recruited from kindergartens or primary schools (pre-school class), and the 12-year-olds were recruited from primary schools. A list of children in the selected age groups was prepared by the selected kindergartens or schools from their student records, which had the birth dates of the students. One or more kindergartens or schools, usually the largest ones, in each survey site were visited until the required sample size was reached. The survey was conducted in the kindergartens and schools.

The 35- to 44-year-olds in urban areas were mainly recruited from factories, because manual workers constitute over 20% of the working population in the province, and other occupation groups, like professionals, technicians, clerical workers, and administrators, can also be found in the factories. If the number of 35- to 44-year-olds found in a factory was not sufficient in the urban survey site under study, other places of work, *e.g.*, commercial companies, schools, and government offices, were contacted to recruit more subjects.

The 65- to 74-year-olds in the urban areas were recruited from their homes with the aid of neighborhood committees in the selected sub-districts. Administrators of the committee informed the resident elderly in the sub-district of the survey and invited them to go to the examination venue, which was usually set up at the neighborhood committee office or a social center for the elderly.

Almost all of the study subjects in the rural areas were farmers or retired farmers. With the aid of the local government, they were recruited from the villages where they lived. If an audio amplifier system was available, it was used to broadcast information concerning the survey and to invite the villagers in the selected age groups to attend an examination. Despite this, the most effective way to recruit subjects was when the leaders in the villages contacted the villagers personally and encouraged them to participate in the survey. The examination site was set up in a convenient place in the village.

Interview and Clinical Examination

The main fieldwork procedures included registration of the examinees, confirmation of correct age range, interview, and clinical examination. One member in the survey team completed the registration procedures. Questionnaires were filled out by interviewers during the face-to-face interviews. The completed questionnaires were checked by the examiners before the clinical examination. After the examination, an oral health care product such as a toothbrush was given to each surveyed subject as a token of thanks.

Two structured questionnaires were developed especially for the interview in this study, one for the 12-year-olds and the other one for the two adult age groups. The questionnaires included 6 sections: demographic background, perceived oral health conditions, oral health knowledge, oral health attitudes, oral hygiene habits (and eating habits for the 12-year-olds), and use of dental services. The questionnaires were pilot-tested before adoption.

Questionnaires were completed by trained interviewers during the interviews. Because some of the subjects could speak only local dialects, interviewers were recruited (from staff of the local hospitals or government offices) who had at least a secondary school education and who spoke these dialects. Three interviewers were employed in each survey site, and they attended a three-hour training session before they started work.

The clinical examination recorded tooth status, tooth-based treatment needs, dental fluorosis (for the 12-year-olds), tetracycline stain (for the 5- to 6-year-olds and the 12-year-olds), prosthetic status and treatment needs (for adults), oral mucosal lesions (for adults), Community Periodontal Index (CPI) and loss of attachment (by index teeth for the middle-aged and by tooth for the elderly), and occluding tooth pairs (for the elderly). The instruments, examination procedures, and diagnostic criteria recommended by the WHO (1997) were adopted. An overhead light, a mouth mirror, and a CPI probe were used during the clinical examination. All the instruments used were sterilized by means of a portable autoclave. Even though some of the examination venues were indoors and some were outdoors, an artificial light was always used during clinical examinations. Portable chairs were carried to the survey sites, and the subjects were examined in a supine position.

All the clinical examinations were completed by one of three examiners. There were two training and calibration exercises for the examiners, one prior to the fieldwork in late 1996 and another prior to the fieldwork in early 1997. Two epidemiologists and one periodontist were responsible for training the examiners. For increased examination reliability, thorough discussions and clarifications took place at each of the training sessions. In addition, throughout the survey, duplicate examinations were carried out on one in ten subjects. The results of these duplicate examinations were used for monitoring and assessment of the inter-examiner reliability, as documented in Table 1. The Kappa statistics (weighted kappa for the periodontal parameters) among the three examiners were over 0.6 for all variables in the clinical examination. The mean overall Kappa statistics indicated that agreement between examiners was substantial to good, according to the WHO (1997) criteria. (Further details concerning reliability are given in the subsequent articles.)

Water Fluoride Level in Survey Sites

Two or three samples of community water were taken from each survey site so that the fluoride concentration could be assessed. Water samples were taken from tap water in urban areas. In the rural areas, both tap water and well water samples were taken. The test was performed at The University of Hong

Table 1. Overall Kappa Statistics for Internal Reliability of Selected Clinical Parameters

Group	Examiners: 1 & 2	1 & 3	2 & 3	All
5- to 6-yr-olds				
Tooth status	0.95	0.90	0.93	0.93
12-yr-olds				
Tooth status	0.93	0.89	0.94	0.93
CPI[a]	0.64	0.53	0.64	0.60
35- to 44-yr-olds				
Tooth status	0.82	0.95	0.87	0.89
Root caries	0.57	0.64	0.55	0.60
CPI[a]	0.67	0.60	0.70	0.67
LOA[b]	0.75	0.74	0.67	0.72
Oral mucosal lesions	1.00	0.50	0.86	0.72
Prosthesis status	1.00	0.95	0.96	0.96
65- to 74-yr-olds				
Tooth status	0.83	0.94	0.90	0.89
Root caries	0.83	0.85	0.87	0.85
CPI[a]	0.88	0.89	0.91	0.90
LOA[b]	0.91	0.88	0.90	0.90
Oral mucosal lesions	0.88	0.68	0.85	0.83
Prosthesis status	0.95	0.88	0.95	0.94

[a] Weighted kappa for Community Periodontal Index (CPI).
[b] Weighted kappa for Loss of Attachment (LOA).

Kong by means of a Benchtop ISE/PH Meter (Model 920A, Orion Research Inc., Boston, MA, USA) and fluoride/combination fluoride electrode (Orion Research Inc., Model 96-09). Most of the samples taken contained less than 0.4 ppm of fluoride. Three samples of well water from villages of two townships contained more than 1 ppm of fluoride. However, we were informed by the local Public Health Bureau that the people in these villages had stopped using the well water and had changed to tap water several years previously. Thus, all the survey sites can be regarded as non-fluoridated.

Background of Subjects

The numbers of survey subjects according to age group, gender, and location of residency are shown in Table 2. A total of 6251 subjects in 4 age groups were surveyed in this study. Selected demographic characteristics of the adult subjects are shown in Table 3 along with those of the general population in Guangdong Province. A direct comparison was not possible, because age-group-specific data about the population were not available. The male-to-female ratio in the survey sample was around 1:1, which was similar to that in the province. The urban-to-rural-resident ratio in the province in 1995 was 1:3 (Population Census Office of Guangdong Province, 1996), but the ratio in this study sample was around 1:1. The urban residents were over-sampled in this study so that there would be an adequate sample size for comparison with the rural residents.

Around half of the 65- to 74-year-old subjects in this study had not attended school. The finding that the 35- to 44-year-olds had higher education levels than the 65- to 74-year-olds was in accordance with the data from the Population Census Office of Guangdong Province (1996), which showed that 4% of the 35- to 44-year-olds and 59% of the 65+-year-olds had no formal schooling. The occupations recorded for the retired 65- to 74-year-olds were their reported former occupations before they retired. Close to half of the urban subjects were manual workers, while the vast majority of the rural subjects were agricultural workers. This resembles the situation in the province (Population Census Office of Guangdong Province, 1996).

Table 2. Number of Survey Subjects According to Age Group, Gender, and Location of Residence

Location	Gender	Age Group (yrs) 5-6	12	35-44	65-74
Urban	Male	406	406	393	391
	Female	396	388	405	383
Rural	Male	405	396	370	368
	Female	380	386	405	373
Total		1587	1576	1573	1515

Re-weighting

Overall, the sample surveyed was acceptably representative of the population studied, although there was an under-representation of rural residents and agricultural workers. To counter the bias in the sample toward urban areas indicated by the approximately equal numbers of urban and rural residents in the survey sample, re-weighting was performed in the key analyses. The actual ratio of the urban to rural residents in the province is about 1:3. Thus, in an estimation of the overall provincial population disease prevalence or mean score of some key measures, *e.g.*, DMFT, a weighted prevalence or mean is computed by assigning weights according to the actual urban to rural population ratio to the data obtained from the rural and urban samples. In all subsequent papers, the data from the urban and rural samples will always be presented separately and not pooled, unless otherwise stated.

DATA ANALYSIS

Data collected were input into computers equipped with Access 2.0 software and proofread. A logic check was also performed before data analyses by means of a specially written computer program. When errors were found, original forms were inspected to correct the errors. Data analyses were performed by means of SPSS for Windows and SAS for Windows.

The data analysis model used in the Second International Collaborative Study (Chen *et al.*, 1997), which is conceptually close to the model for individual determinants of health care utilization suggested by Andersen and Newman (1973), was used as a framework for the present data analysis. This approach has not previously been used on a Mainland Chinese population. The model postulates that system-level variables, socio-environmental characteristics, and the oral health care system, together with personal predisposing and enabling characteristics, will affect an individual's oral health behaviors and consequently his/her oral health status. Predisposing variables, such as gender, education level, and oral health knowledge, predispose an individual to engage or not to engage in certain oral health behavior, while enabling variables, such as income, might facilitate or impede the individual's practice of such behavior. Since dental care delivery systems and dental care providers were not surveyed in this study, however, these components of the model were disregarded, but selected outcome measures were

incorporated. In this simplified model, an individual's oral health behaviors are influenced by his or her predisposing and enabling characteristics. This, in turn, together with the predisposing and enabling factors, will affect the oral health status of the individual. The variables and their classification used in this study are illustrated in Table 4, the ordering adapted from Kiyak's modified model (1986).

The main demographic variables measured included gender, age, location of residence, education, and economic status, and their operational definitions are given here. Age was the age (in years) of the subjects at their last birthday. Education was measured as the level at which the subject left the education system, *e.g.*, no schooling, primary school, etc. Because reliable information about income was difficult to obtain, a proxy socio-economic indicator, the "Family Material Possession Index" (FMPI), which had been previously used in Hong Kong (Ng, 1987; Schwarz *et al.*, 1994), was used to indicate the economic status of the subjects surveyed. Ng (1987) stated that, first, material possessions obviously reflect the availability and disposability of economic resources. Second, material possessions indicate a style of life that is not only dependent on economic resources but also s consequence of a person's values and preferences, which, in turn, are shaped by one's educational attainment, occupational subculture, and social network. The question asking about material possessions was as follows: "Are the following objects or facilities present in your home?" The question was accompanied by a list of 18 objects or facilities (*e.g.*, air-conditioner, hi-fi sound system, oven, television, etc.) on which the respondent indicated possession or not. Further, when the FMPI was calculated, two dimensions were considered important in addition to possession: value and rarity. Value refers to the relative monetary value of the object, and rarity refers to the extent to which an object is possessed by the group of people in question, and the standards for these concepts were defined through special studies comprised of representative panels of people. Finally, a weight was applied to televisions, air-conditioners, and cameras for "extra quantity", *e.g.*, 3 or more cameras. If all items on the list were selected, and if televisions, cameras, and air-conditioners were present in the maximum quantity, the total index score would reach 100; the minimum score was 0. The total FMPI is the summation of the item scores. A higher score is taken as an expression of more material wealth of the subject.

Table 3. Selected Demographic Characteristics of the Adult Survey Subjects and the General Population in Guangdong Province (percentages)

	Guangdong Province		35- to 44-year-olds		65- to 74-year-olds	
	Urban	Rural	Urban (n = 798)	Rural (n = 775)	Urban (n = 774)	Rural (n = 741)
Gender						
Male	50	51	49	48	50	50
Female	50	49	51	52	50	50
Education level[a]						
No schooling	8	12	1	14	39	57
Primary	35	49	8	36	34	37
Lower secondary	32	29	28	31	15	4
Upper secondary	19	8	44	17	9	2
Post-secondary	6	1	19	1	3	0
Occupation						
Administrator	5	2	22	2	14	3
Professional & technician	12	5	20	5	8	1
Sales & commercial sector	13	7	5	4	4	2
Office worker	7	2	9	1	2	1
Manual worker	35	19	37	3	49	1
Service worker	9	4	3	1	3	0
Agricultural worker	19	61	0	82	11	90
No job	-	-	4	1	9	2

[a] This included all persons aged 6 years and above for the Guangdong population.

Other variables obtained from questionnaires and the clinical examinations will be described in the following papers, as are the specific statistical analysis methods used.

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Table 4. Data Analysis Model for the Study Indicating the Incorporated Variables (adapted from Chen *et al.*, 1997, and Kiyak, 1986)

Predisposing Factors	Enabling Factors	Behavior Factors	Oral Health Status (outcome factors)
Gender	Family possessions	Oral hygiene practices	DMFT
Education	Location of residence	Smoking habits	Missing teeth
Dental knowledge		Drinking habits	CPI
Dental attitudes		Use of dental service	Loss of attachment
Dental fear			Prosthetic status
			Oral mucosal lesions
			Normative need for treatment
			Perceived need for treatment
			Perceived conditions of teeth
			Dental pain experience

subjects as souvenirs after the interview and clinical examination. We acknowledge with gratitude the contributions to the success of the fieldwork of the other survey team members, Dr. X.H. Liao, Dr. J.W. Liu, Dr. B.C. Liang, Ms. W.Z. Gu, Ms. Y.Z. Zhou, and Ms. G.P. Liufu.

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