The 4th National Oral Health Survey in the Mainland of China: Background and Methodology

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Oral disease patterns change over time and it is important to conduct epidemiological surveillance population surveys regularly to monitor the situation. The overall objectives of the present survey were: (1) to describe the oral health status of Chinese children and adults in the 2015–2016 4th National Oral Health Survey; (2) to investigate the oral health knowledge, attitudes, and behaviours among children and adults; (3) to explore the association among sociodemographic characteristics, oral health behaviours, and the oral health status of Chinese children and adults. A national oral health survey was conducted among a representative sample of Chinese children and adults. Local residents from the five age groups – 3 to 5 years, 12 to 15 years, 35 to 44 years, 55 to 64 years, and 65 to 74 years – were selected. A multi-stage cluster sampling method was adopted for the identification of participants. All 31 provinces, autonomous regions and municipalities of the mainland of China were included. All participants were clinically examined and information on their oral health status, including oral mucosal lesions, dental caries experience, periodontal health status, dental fluorosis, and dental prosthesis status, was collected according to the procedures and criteria recommended by the World Health Organization (WHO). A calibration training programme and quality control procedures were conducted to ensure the reliability of the findings. Information on sociodemographic background, oral health behaviours, knowledge and attitude was also collected from all five age groups through a questionnaire survey.

Key words: *China, epidemiology, methodology, the 4th National Oral Health Survey*
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Oral diseases such as dental caries and periodontal diseases are major public health problems worldwide. Poor oral health may have a profound impact on general health. Severe periodontal disease is strongly associated with diabetes mellitus and is considered the sixth most prevalent complication of diabetes[1].

Pain, as well as problems with eating, chewing, smiling and communication due to missing, discoloured or damaged teeth, can have a major impact on people's daily lives and wellbeing[2].

According to the WHO, although great improvements have been achieved in the field of oral health throughout the world, the global burden of oral disease remains high[3]. Dental caries of permanent teeth is the greatest prevalent disease and, according to the

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Global Burden of Disease Study 2016, is the second highest incidence disease. The incidence rate is just followed by the upper respiratory infections[4]. It affects 60% to 90% of school-age children and almost 100% of the adult population in most countries[5,6]. Additionally, most children and adolescents, worldwide, have signs of gingivitis (gingival bleeding) and about 5% to 20% of adults have severe periodontitis, which can lead to tooth loss[5]. Even in industrialised countries the public generally considers that losing teeth is a natural consequence of ageing. In the United States of America and the United Kingdom, 26% and 46% of the population, respectively, are edentulous[3].

Conducting regular oral health surveys has become increasingly important as a public health surveillance measure. National and regional data from regular oral health surveys are used to assess oral health needs, monitor oral health status – including disparities between different populations – plan intervention programmes at national and local levels, establish sound health policies, and evaluate progress towards national health objectives[7].

Over the past few decades, three national oral health surveys have been conducted in China. According to WHO criteria, the level of dental caries among school children and adults in China is considered to be at a very low level on the world map, based on the findings of the 2005 national oral health survey[8]. Despite this, the last national survey showed the d/D (decay)-component contributed the most to the dental caries index among children, whereas in adults the M (missing)-component was the most prominent. As for periodontal health, gingival bleeding and calculus were prevalent in both adolescents and adults.

The population of China – a newly industrialised lower-middle-income country – is steadily ageing (from an aged population proportion of 7.7% in 2005 to 10.5% in 2015), along with a decrease in the size of the rural population (from 57.0% in 2005 to 43.9% in 2015)[9], as well as economic development and dramatic changes in lifestyle[10]. Therefore, people's oral disease patterns are expected to alter over time. It is important to regularly conduct epidemiological surveys to monitor the oral disease patterns of children and adults in China.

The overall objectives of the present survey were: (1) to describe the oral health status of Chinese children and adults in the 2015–2016 4th National Oral Health Survey; (2) to investigate the oral health knowledge, attitudes, and behaviours among children and adults; (3) to explore the association among sociodemographic characteristics, oral health behaviours, and oral health status of Chinese children and adults.

Furthermore, the subsequent papers in this and the following issues, separately, and as a whole of results of the 4th National Oral Health Survey, reported detailed findings of various aspects of the national survey and may contain more specific objectives pertaining to the individual aspects of the study.

Materials and methods

Participants

The total population of China was 1.37 billion in 2015, and the country's mainland comprises 31 provinces, autonomous regions and municipalities[9]. The present study included children and adults. Ethical approval was obtained from the Ethics Committee of the Chinese Stomatological Association (Approval no. 2014-003) prior to the implementation of the study. Written informed consent was obtained from the participants or children's guardians, as appropriate. The survey was conducted from October 2015 to September 2016.

The sample size for the five age groups was estimated. With reference to the findings of the 3rd National Oral Health Survey in 2005, the prevalence of dental caries experience among children aged 5 and 12 years were 66% and 28.9%, respectively; the detection rate of periodontal disease among adults was 86%. The 95% confidence interval (CI) was set at 10% with two sides (95% CI was 15% for the 12-year-old group) and a design effect was set at 4.5. To account for the stratification factor and an anticipated response rate of 80%, the sample size for the five age groups was 166,245 participants: 13,365 each for the 3, 4 and 5 years age groups, 28,365 each for the 12, 13, 14 and 15 years age groups, and 4,230 each for the 35 to 44, 55 to 64 and 65 to 74 years age groups. The minimum sample sizes for each province were 432 each for the 3, 4 and 5 years age groups; 915 each for the 12, 13, 14 and 15 years groups; and 136 each for the 35 to 44, 55 to 64 and 65 to 74 years groups.

In order to observe developmental trends of oral disease, the present national survey included additional age groups besides the WHO recommendation – that is ages 3 to 5, 12 to 15, 35 to 44, 55 to 64, and 65 to 74 years. Residents (who had lived in the area for over 6 months) from the five age groups – 3 to 5, 12 to 15, 35 to 44, 55 to 64, and 65 to 74 years – were selected. A multistage cluster sampling method was adopted for this survey. All 31 provinces, autonomous regions and municipalities (including Tibet) in the mainland of China were included. Two urban and two rural districts

(defined according to the National Bureau of Statistics of China) were selected in each province using probability proportional to size (PPS) sampling. The local Centre for Disease Control and Prevention of each province was responsible for the identification of the districts. In total, 62 urban and 62 rural districts were selected. Three sub-districts (referred to as streets in urban districts, and as townships in rural districts) were then selected using the PPS sampling method in each district. A total of 186 streets and 186 townships were selected. One neighbourhood community from an urban district or one village community from a rural district, one junior high school, and one kindergarten were also selected using a simple random sampling method in each sub-district.

In total, 186 neighbourhood communities, 186 village communities, 372 primary high schools and 372 kindergartens were selected. Adults (age groups 35 to 44, 55 to 64, and 65 to 74 years) were recruited from neighbourhood or village communities. In each neighbourhood or village community, 36 local residents with a male to female ratio of 1:1 (12 each for the age groups 35 to 44, 55 to 64, and 65 to 74 years) were consecutively recruited. Children aged 3 to 5 years and 12 to 15 years were selected from kindergartens and schools, respectively. In total, 320 students from each school (80 for each age group: 12, 13, 14 and 15 years) and 108 preschool children from each kindergarten (36 for each age group: 3, 4 and 5 years), with an equal number of boys and girls, were invited to participate in the survey using the cluster sampling method. If the selected school or kindergarten did not have a sufficient number of students or preschool children, additional children were selected from schools or kindergartens located closest to the selected school/kindergarten.

Clinical examination

All participants were clinically examined and information on their oral health status, including oral mucosal lesions, dental caries experience, periodontal health status, dental fluorosis, and dental prosthesis status was collected. The diagnostic criteria were adopted according to the WHO recommendation[11], except for the root caries. A disposable dental mirror, an intraoral light-emitting diode light and a ball-ended WHO Community Periodontal Index (CPI) probe were used in the examination. Portable dental chairs were carried to the survey sites, and the participants were examined in a supine position.

Oral mucosal lesions

All adults (35 to 44, 55 to 64, 65 to 74 years) were examined for oral mucosa. Oral cancer, leukoplakia, lichen planus, ulceration, candidiasis, abscess and other conditions were recorded if they were found.

Dental caries experience

Dental caries experience was measured by the decayed, missing, and filled teeth (DMFT/dmft) index according to WHO criteria[11]. The root caries was measured by counting the number of roots that were decayed or filled (DF-Root). Dental caries was recorded as present when there was an unmistakable cavity, undermined enamel, or a detectably softened floor or wall. Dental caries was primarily assessed by visual inspection and then confirmed by tactile inspection using a WHO CPI probe. Where any doubt exists, caries should not be recorded as being present. For children (3 to 5 years old and 12 to 15 years old), only the coronal part of the teeth was examined, while for adults the status of the root was also recorded. The diagnostic criteria of root caries are a little different from criteria recommended by the WHO. Root caries was recorded as being present when a lesion feels soft or leathery on probing with the CPI probe. If a single caries lesion affects both crown and root, no matter from where the caries originally was, coronal and root caries were both recorded as being present. A residual root was recorded both as coronal and root caries. All teeth (including third molars) were examined.

Periodontal status

The modified CPI (data on gingival bleeding, calculus, pocket depth and clinical attachment loss were collected separately) recommended by WHO were used to examine the periodontal health status[11]. For children aged 12 to 14 years, only gingival bleeding and calculus were recorded. For the 15 years and adult groups, all four aspects were examined. For each tooth, the presence of gingival bleeding and calculus was evaluated using a dichotomous index, scored as 0 or 1 corresponding to absence or presence, respectively. Probing pocket depth (PPD) was assessed using the following scores: 0 = no probing pocket; 1 = probing pocket depth of 4 mm to 5 mm; and 2 = probing pocket depth of 6 mm or greater. Clinical attachment loss (CAL) was scored using four categories: 0 = 0 mm to 3 mm; 1 = 4 mm to 5 mm, 2 = 6 mm to 8 mm; 3 = 9 mm to 11 mm; and 4 = 12 mm or more. All teeth present (including third molars) were subjected to a periodontal examination.

Dental fluorosis

Dental fluorosis was only recorded for the 12-year-old age group. Dean's index was applied to evaluate dental fluorosis recommended by the WHO[11]. The assessment was made on the base of the two teeth that were most severely affected. If the two teeth were not affected equally, the score for the less severe teeth was recorded.

Dental prosthesis status

The presence of dentures was recorded for the adult groups. This included implant supported dentures, fixed prostheses, removable partial dentures, complete dentures and unqualified dentures.

Calibration

Prior to the field survey, calibration training programmes were launched to ensure reliability of the results. Two or three examiners selected from each province attended the training programmes and then conducted all the clinical examinations in their own province. Each examiner was calibrated with a standard examiner in the same setting. Examiners with kappa values higher than 0.8 for the DMFT index and 0.6 for periodontal pocket depths were qualified. In the field survey, 5% of the participants were randomly selected for a duplicate examination on each examination day to monitor inter-examiner reproducibility. As measured using Kappa statistics, the inter-examiner reliabilities of the DMFT index and periodontal pocket depth were > 0.8 and > 0.6, respectively. A calibration training programme and quality control procedures were conducted to ensure the reliability of the findings.

Questionnaire survey

Three structured questionnaires in the survey were applied to 3 to 5-year-old children, 12 to 15-year-old adolescents, and adults, respectively. Two or three trained investigators acted as interviewers. Furthermore, in districts where dialect was difficult to understand, a local person acted as an assistant.

For the 3 to 5-year-age group, the child's parents or grandparents were interviewed face-to-face. The questionnaire included the respondent's relationship to the child, his/her birth weight, feeding approaches within the first half year of life, toothbrushing behaviour, sugar intake behaviour, dental attendance experience and household income, parents' or grandparents' education levels, and parents' or grandparents knowledge of and attitude to oral health knowledge.

For the 12 to 15-year-old age group, a self-completed questionnaire was designed to collect the data of the participants' sociodemographic background, attitude to oral health, knowledge and behaviours. Teachers and interviewers co-organised and illustrated the content of the questionnaire, before the participants completed all questions by themselves in the classroom.

In the adult age groups, a structured questionnaire including participants' age, gender, education level, per capita household income, occupation, oral health knowledge, and attitude were recorded in face-to-face interviews by trained interviewers. Moreover, the questionnaire aimed to collect information on oral health-related quality of life, including physical functioning, pain and discomfort, and psychosocial functioning.

Data analysis

Collected data were fed into computers using a data input platform designed for the national survey. A proofread and logic check was also performed and if errors were found, original forms were inspected to correct the mistakes. Data were analysed using SPSS, version 22.0 (IBM Corp, Armonk, NY, USA). Statistical significance level was set at 0.05 for all tests.

The descriptive statistics (means, standard deviation and percentage) of clinical data, by age group, were presented. Bivariate analyses were performed to investigate the relationships among sociodemographic characteristics, oral health behaviours, and the oral health status of Chinese children and adults.

Other specific statistical analysis methods will be described in the following papers according to the different objectives.

Conflict of interest

The authors reported no conflicts of interest related to this study.

Author contribution

Drs Hai Xia LU, Dan Ying TAO contributed to the literature review, study conception and design, data analysis, and drafted the manuscript; Drs Edward. Chin. Man. LO and Rui LI contributed to the study conception and design, data analysis, data interpretation and critically revised the manuscript, Drs Xing WANG, Bao Jun TAI, De Yu HU, Huan Cai LIN, Bo WANG, Yan SI, Chun Xiao WANG, Shu Guo ZHENG, Xue Nan LIU, Wen Sheng RONG, Wei Jian WANG, and Xi Ping FENG, trained the investigators, designed and supervised the

survey; Dr Xi Ping FENG contributed to the study conception and design, data acquisition, organisation and supervision of the study, and critically revised the manuscript. All the authors have read and approved the final manuscript.

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