

H.C. Lin², E.F. Corbet¹, and E.C.M. Lo^{1*}

¹Faculty of Dentistry, The University of Hong Kong, 3/F, Prince Philip Dental Hospital, 34 Hospital Road, Hong Kong; and ²Department of Preventive Dentistry, Sun Yat-sen University of Medical Sciences; *corresponding author, hrdplcm@hkucc.hku.hk

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ABSTRACT

The objectives of this analysis were to determine the prevalence of oral mucosal lesions (OML) among adults in Southern China and to determine possible associations between OML and reported tobacco-smoking and alcohol-drinking habits. The sample consisted of 1573 35- to 44-year-old and 1515 65- to 74-year-old Chinese from both urban and rural areas of Guangdong Province. The subjects were interviewed by trained interviewers and underwent a clinical examination of the oral mucosa performed according to WHO guidelines. A specially prepared color atlas of OML was used for lesion recognition and confirmation during the survey. Among the 35- to 44-year-old subjects, the overall prevalence of OML was found to be 13% in urban men, 6% in urban women, 15% in rural men, and 4% in rural women. The corresponding figures for the 65- to 74-year-olds were 22%, 12%, 26%, and 19%. Tongue lesions and white lesions were relatively common, but denture-related lesions were not. No malignancies or erythroplakia was observed. Age and gender were found to relate to the occurrence of OML. In elderly men, smoking was significantly ($p < 0.05$) associated with some white lesions and tongue lesions, and alcohol drinking was also associated with some white lesions. In conclusion, tongue lesions and white lesions were relatively common in men, but pre-cancerous lesions were not prevalent.

KEY WORDS: oral mucosal lesion, adults, oral health survey, smoking, Chinese.

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Oral Mucosal Lesions in Adult Chinese

INTRODUCTION

A few investigators have attempted to document the full spectrum of oral mucosal lesions (OML) in Chinese populations (Xu *et al.*, 1981; Fang *et al.*, 1983; Cao *et al.*, 1988; Lin *et al.*, 1989; Corbet *et al.*, 1994). Four of these studies have been published in Chinese and were performed in Beijing or Shanghai, whereas the one published in English was conducted in Hong Kong. In these studies, the populations examined were mainly elderly living in urban areas, except for a survey in Shanghai (Xu *et al.*, 1981) which also included some rural residents. The studies in Mainland China found the common OML in elderly Chinese to be leukoplakia and other white lesions, fissured tongue, and atrophic tongue. In Asia, the association of oral pre-cancerous lesions and oral carcinomas with tobacco and betel-chewing habits, particularly in India and Southeast Asia, has been well-documented (Gupta *et al.*, 1980; Lay *et al.*, 1982; Reichart *et al.*, 1987). Recent surveys have reported the epidemiology of OML in selected Cambodian and Vietnamese populations (Ikeda *et al.*, 1995; Nair *et al.*, 1996). The present analysis aimed to determine the prevalence of OML among adults in Southern China and to determine if any association existed between OML and reported tobacco-smoking and alcohol-drinking habits.

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) were selected through a combination of multi-stage stratified 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 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 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.

In the survey, all subjects were interviewed by trained interviewers using a structured questionnaire. Since some of the subjects, especially the elderly, could communicate only in their own dialect, the interviewers were recruited from staff of the local government or hospital who were fluent in the appropriate dialect. In the interview, questions on the subject's tobacco-smoking and alcohol-drinking habits were asked, and responses were recorded. Because residents of Guangdong Province do not practice betel chewing, no question on this habit was asked. Subjects were classified into 3 categories according to their reported smoking habit, namely, "smoker" (smokes every day), "former smoker", and "never been smoker". "Former smoker" and "never been smoker" were defined as "non-smokers" in data analyses. Alcohol-drinking habits were divided into 4 categories based on the frequency of the habits—every day, several times a

Table 1. Prevalence of Common Oral Mucosal Lesions in 35- to 44-year-old Chinese (%)

Lesion	Urban		Rural	
	Men (n = 393)	Women (n = 405)	Men (n = 370)	Women (n = 405)
Pre-cancerous lesion and condition				
Leukoplakia	1.5	-	0.5	-
Lichen planus	0.8	1.0	0.8	0.3
Other white lesions				
Smoker's palate	3.6	-	6.8	0.3
Cheek and lip biting	2.3	0.7	2.2	0.3
Ulcers				
Recurrent aphthous ulcers (RAU)	1.3	2.7	0.5	0.8
Lesions related to infection				
Angular cheilitis	0.5	0.7	0.8	0.8
Denture-related lesions ^a	0.3	-	0.3	-
Herpes	0.3	-	0.3	-
Tongue lesions				
Fissured tongue	0.3	-	0.8	1.1
Hairy tongue	2.8	-	1.6	0.3
Atrophic tongue	-	0.5	0.3	-
Lingual varicosities	-	-	-	-
Tumor				
Hemangioma	-	-	-	-
Excessive melanin pigmentation	1.0	-	1.9	-
Others	0.5	0.3	1.1	0.3
All lesions ^b	13	6	15	4

^a Including ulcer, hyperplasia, and stomatitis.

^b Differences between men and women in both urban and rural areas were statistically significant (Chi-square test, $p < 0.01$).

week, seldom, and never. Those who reported drinking seldom or never were classified as "non-drinkers" in the analyses.

After the interview, the subjects were clinically examined by one of three calibrated examiners. Training sessions for examiners were conducted prior to the survey in a dental teaching hospital. Systematic procedures for examination of oral mucosa were performed according to WHO (1997) guidelines. Clinical diagnoses were based on pertinent criteria used by Axéll (1976). However, the criteria of leukoplakia followed the definition presented in an international seminar (Axéll *et al.*, 1984), stating that "Leukoplakia is a whitish patch or plaque that cannot be characterized clinically or pathologically as any other disease and it is not associated with any physical or chemical causative agent except the use of tobacco". A color atlas of oral mucosal lesions prepared for use in epidemiological surveys of OML, with photographed examples of each condition incorporating as many examples as possible from Chinese subjects, was used to aid in the positive identification of lesions. This atlas was consulted for the positive identification of any lesion not readily diagnosed and for the confirmation of already established diagnoses of rarer lesions. A portable overhead light, a mouth mirror, and a periodontal probe were used for examination of the oral mucosa. The mucosa was not specifically dried prior to examination. Sometimes a cotton swab was used to remove evident debris; a swab was always used to test whether a white lesion could be wiped off. Lesions were recorded

Table 2. Prevalence of Common Oral Mucosal Lesions in 65- to 74-year-old Chinese (%)

Lesion	Urban		Rural	
	Men (n = 391)	Women (n = 383)	Men (n = 368)	Women (n = 373)
Pre-cancerous lesion and condition				
Leukoplakia	2.6	-	1.9	-
Lichen planus	2.6	1.0	1.4	0.5
Other white lesions				
Smoker's palate	0.8	-	1.6	-
Cheek- and lip-biting	1.0	-	1.6	-
Ulcers				
Recurrent aphthous ulcers (RAU)	0.3	0.8	-	-
Lesions related to infection				
Angular cheilitis	0.3	0.3	0.3	0.5
Denture-related lesions ^a	0.3	0.3	0.8	0.3
Herpes	-	-	0.3	0.3
Tongue lesions				
Fissured tongue	6.9	6.8	12.5	12.6
Hairy tongue	2.3	0.3	4.1	1.1
Atrophic tongue	0.8	1.3	0.5	1.6
Lingual varicosities	0.8	0.5	1.1	0.3
Tumor				
Hemangioma	1.8	0.8	1.1	1.1
Excessive melanin pigmentation	3.8	0.5	2.2	1.3
Others	1.8	0.8	-	1.1
All lesions ^b	22	12	26	19

^a Including ulcer, hyperplasia, and stomatitis.

^b Differences between men and women in both urban and rural areas were statistically significant (Chi-square test, $p < 0.01$).

by means of a simplified digital classification system (Corbet *et al.*, 1994), and the location of each lesion intra-orally was recorded by the digital system recommended by the WHO (1997).

Duplicate examinations were conducted on 10% of the subjects throughout the study, and the results generated kappa statistics of 0.72 and 0.83 for the OML of the 35- to 44-year-olds and the 65- to 74-year-olds, respectively. These figures indicated that inter-examiner reliability in assessing OML was substantial in the middle-aged and good in the elderly (WHO, 1997).

Differences in the overall prevalence of OML between men and women in urban and in rural area were assessed by Chi-square tests. Differences in the smoking and the drinking habits of men and women in urban and in rural area were also assessed by Chi-square tests. To investigate the effects of smoking and drinking on the prevalence of selected OML, we performed Chi-square tests and calculated odds ratios for the different age and gender subgroups. The statistical significance level was set at 0.05.

RESULTS

Tables 1 and 2 show the prevalence of the more common OML in the subjects according to their location of residence (urban or rural), gender, and age. The OML which were found in only one or two subjects, *e.g.*, leukoedema and geographic tongue, are grouped in Tables 1 and 2 under "others". As shown in Table 1, 13% of the urban men, 6% of the urban women, 15% of the rural men, and 4% of the rural women in

Table 3. Percentage Distribution of Adult Chinese by Age Group, and by Smoking and Drinking Habits

		Smoker	p-value ^a	Drinker	p-value
35- to 44-year-olds					
Urban	Men (n = 393)	69.0	< 0.01	16.5	< 0.01
	Women (n = 405)	0.2		0.7	
Rural	Men (n = 370)	83.5	< 0.01	27.8	< 0.01
	Women (n = 405)	7.4		1.7	
65- to 74-year-olds					
Urban	Men (n = 391)	50.9	< 0.01	22.5	< 0.01
	Women (n = 383)	17.2		3.1	
Rural	Men (n = 368)	69.0	< 0.01	25.0	< 0.01
	Women (n = 373)	17.7		3.5	

^a Chi-square test.

the 35- to 44-year-old age group had some form of OML. The most prevalent lesion in the 35- to 44-year-olds was smoker's palate, followed by hairy tongue. Fissured tongue was the most common OML encountered in the elderly. The overall prevalence of OML among the urban elderly was 22% in men and 12% in women, and the prevalence among the rural elderly was 26% in men and 19% in women (Table 2). The prevalence of OML was significantly higher in the 65- to 74-year-old subjects than in the 35- to 44-year-olds ($p < 0.01$). In both age groups, the difference in prevalence of OML between men and women in both urban and rural areas was statistically significant ($p < 0.01$). No statistically significant difference was found in the prevalence of OML between urban and rural dwellers in both age groups ($p > 0.05$).

Reported tobacco-smoking and alcohol-drinking habits in 35- to 44-year-old and 65- to 74-year-old subjects are shown in Table 3. It is evident that tobacco smoking was very common in men—from 69 to 84% in the 35- to 44-year-olds and from 51 to 69% in the 65- to 74-year-olds ($p < 0.01$). The prevalence of tobacco smoking was much lower among the women, less than 10% among the middle-aged and about 17% among the elderly ($p < 0.01$). While only a few percent of the women in both age

groups had a habit of alcohol drinking, from 17 to 28% of the men had such a habit ($p < 0.01$). It was found that the majority of the alcohol drinkers (79%) were also tobacco smokers.

To test, within each age and gender sub-group, the possible effects of smoking and drinking on selected OML, which theoretically could be causally related to or influenced by smoking or drinking, we calculated odds ratios (Table 4). In the 35- to 44-year-old men, smoking was not found to increase the likelihood of any selected OML significantly, while drinking increased their likelihood of having white lesions other than leukoplakia and lichen planus. In the 65- to 74-year-old men, smoking was found to increase significantly their likelihood of having white lesions other than leukoplakia and lichen planus, and tongue lesions. Drinking was also found to increase the likelihood of having white lesions other than leukoplakia and lichen planus in the elderly.

No oral cancer or oral erythroplakia was found in any of the subjects surveyed. All of the 24 subjects with leukoplakia were men. Among them, 22 were smokers, and the remaining two were former smokers.

DISCUSSION

This component of the study dealt with the full spectrum of OML in both urban and rural residents aged 35-44 and 65-74 years in Southern China. The overall prevalence of OML in the urban dwellers in the two age groups was in line with that found in Shanghai adults (Xu *et al.*, 1981) and in Beijing elderly (Fang *et al.*, 1983), which were 15% and 20%, respectively. In a selected Vietnamese population of 550 2- to 60-year-olds, the prevalence of OML was found to be 14% (Nair *et al.*, 1996). A high prevalence, more than 50%, has been reported in the institutionalized elderly in various countries (Fleishman *et al.*, 1985; Vigild, 1987; Jorge *et al.*, 1991). However, such comparisons should be made with caution, because not all investigators specified the range of lesions of interest, and different criteria were used to define the lesions. In the study of 65- to 74-year-old Hong Kong adults (Corbet *et al.*, 1994), the prevalence of OML was found to be 36%, which was higher than the prevalence of 18% found in the urban dwellers of the present study. Both studies used the same range of lesions of interest and the same diagnostic criteria and the same atlas of OML. The examiners in the present study were trained by one of the examiners from the Hong Kong study (EFC). The best possible explanation for the difference in overall prevalence of OML is the difference in denture wearing between the survey subjects in Hong Kong and those in urban Guangdong. It is known that denture wearing is associated with a higher prevalence of OML (Budtz-Jørgensen, 1981). Therefore, the relatively lower prevalence of OML in the 65- to 74-year-olds in the present survey may be related to the lower proportions of subjects who were denture wearers. The proportion of the elderly with 1 or more dentures was 18% in the present study (Lin *et al.*, 2001) but was 52% in the Hong Kong study (Corbet and Lo, 1994). Furthermore, denture-related lesions were the common lesions detected in the Hong Kong elderly (Corbet *et al.*, 1994). The finding that men exhibited a higher prevalence of OML than women is consistent with the results of other studies in China (Xu *et al.*, 1981;

Table 4. Odds Ratios (OR) for Presence of Selected Oral Mucosal Lesions in Subjects With or Without a Habit of Smoking or Drinking by Their Age and Gender

		Pre-cancerous Lesions ^a	Other White Lesions ^b	Tongue Lesions ^c	Aphthous Ulcer
35- to 44-year-olds					
Men	Smoking	1.6	-	3.4	0.2
	Drinking	1.8	1.9 ^d	0.5	1.0
Women	Smoking	-	6.5	-	-
	Drinking	-	-	-	-
65- to 74-year-olds					
Men	Smoking	1.7	7.0 ^d	2.1 ^d	-
	Drinking	1.3	4.9 ^d	0.7	-
Women	Smoking	-	4.8	1.6	-
	Drinking	-	-	1.0	-

^a Includes leukoplakia, lichen planus, discoid lupus erythematosus.

^b Includes smoker's palate, cheek- & lip-biting, frictional keratosis, leukoplakia, galvanic lesion.

^c Includes fissured tongue, hairy tongue, atrophic tongue, geographic tongue, lingual varicosities.

^d OR significantly different from 1 (Chi-square test, $p < 0.05$).

Fang *et al.*, 1983; Cao *et al.*, 1988; Lin *et al.*, 1989).

The reported prevalence of leukoplakia in most studies outside China ranges from about 1% to 5% (Kleinman *et al.*, 1991). There were also studies which have reported a prevalence lower than 1% (Gangdharan and Paymaster, 1971; Mehta *et al.*, 1972). The prevalence found in surveys conducted in China ranges from 0.4 to 10.1%. These large variations may be related to differences in the diagnostic criteria used to classify cases and the different demographic composition of the study populations. Many Chinese studies used criteria which included leukokeratosis caused by physical factors (Xu *et al.*, 1981; Zhang *et al.*, 1981; Chen *et al.*, 1983; Fang *et al.*, 1983; Mu *et al.*, 1984) and reported prevalence of leukoplakia from 2.7% (Mu *et al.*, 1984) to 10.1% (Fang *et al.*, 1983). A survey of Beijing elderly (Lin *et al.*, 1989) and a survey of Guangdong adults aged 15 to 65 years (Lin *et al.*, 1992a) reported prevalences of 0.6% and 0.4%, respectively. The prevalence of leukoplakia in Hong Kong elderly was found to be 0.8% (Corbet *et al.*, 1994), which is similar to the present finding of 1.3% in the 65- to 74-year-old urban dwellers. Tobacco smoking is widely known as the most important factor causing leukoplakia, and all of the subjects with leukoplakia in the present study were smokers or former smokers. Alcohol drinking has been considered as a "weak" etiologic risk factor for oral leukoplakia by some investigators (Gupta, 1984). However, the odds ratio analysis did not show either reported smoking or drinking as significantly increasing the likelihood of leukoplakia being detected in the Guangdong adults or elderly.

Prevalence of lichen planus in countries other than China has usually been reported to be less than 1% (Pindborg *et al.*, 1965; Lay *et al.*, 1982; Bouquot and Gorlin, 1986), and a study reported a prevalence approaching 2% (Axéll and Rundquist, 1987). Most surveys in China also reported a prevalence of less than 1% (Xu *et al.*, 1981; Xu and Li, 1981; Fang *et al.*, 1983; Lin *et al.*, 1991). A high prevalence, 3.4%, was found in the survey of Hong Kong elderly (Corbet *et al.*, 1994). The present survey detected a prevalence of 1.3% in the urban elderly.

Cigarette smoking is the predominant type of smoking habit among the Southern Chinese and is very popular among men. Many of the locally made cigarettes produce smoke which is high in tar—hence the occurrence of smoker's palate in some subjects. Smoking increased the likelihood of a group of white lesions generally not thought to be pre-cancerous, which included smoker's palate, in the men of both age groups, as did alcohol drinking in the elderly. Smoking also increased the likelihood of tongue lesions, which included fissured tongue and hairy tongue, in the elderly.

The short duration of recurrent aphthous ulcers (RAU) leads to a remarkable difference between the reported prevalence of a positive history of RAU found when people were questioned and that detected in clinical examinations. The prevalence of clinically detected RAU among an adult Swedish population was 2.0% (Axéll, 1976), whereas the prevalence increased to 17.7% when positive histories were included. The prevalence of clinically detected RAU in the present study was 1.3% in urban men and 2.7% in urban women aged 35 to 44 years. This finding is similar to that found in another group of urban Southern Chinese with an average age of 35 years (Lin *et al.*, 1992b), which gave a prevalence of 1.7% in men and 3.4% in women. The findings of the present study also concur with the general belief that RAU is more likely to be found in

younger than in older adults (Ship, 1987; Axéll, 1976).

Epidemiological surveys have shown that tongue lesions constitute a considerable proportion of OML, and their prevalence rates vary in different parts of the world (Aboyans and Ghaemmaghami, 1973; Axéll, 1976; Bouquot, 1986; Lin *et al.*, 1989; Darwazeh and Pillai, 1993). Among the tongue lesions, fissured tongue and atrophic tongue have been reported to be common in elderly Chinese, with prevalences ranging from 2% to 24% for fissured tongue and from 3% to 6% for atrophic tongue (Fang *et al.*, 1983; Cao *et al.*, 1988; Lin *et al.*, 1989). The prevalence of fissured tongue in the present study population, 9.6% in the elderly, is at the middle range of the above-reported prevalences in Chinese. The prevalence of fissure tongue in other populations was 3.2% in US adults (Bouquot, 1986), 11.4% in Jordanian dental outpatients (Darwazeh and Pillai, 1993), 2.6% in Iranian dental outpatients (Aboyans and Ghaemmaghami, 1973), and 8.8% in a Hungarian population (Bánóczy *et al.*, 1993).

It was found in this study that the middle-aged had fewer tongue lesions than the elderly, except for geographic tongue. Other studies in China also found that geographic tongue was not common in elderly Chinese (Xu *et al.*, 1981; Fang *et al.*, 1983; Cao *et al.*, 1988; Lin *et al.*, 1989; Corbet *et al.*, 1994). This has also been found in studies outside China (Bánóczy *et al.*, 1993). Hairy tongue was detected in 1.1% of 35- to 44-year-olds and 1.9% of 65- to 74-year-olds in the present study, which is similar to the findings in white Americans (Bouquot, 1986) and Jordanian dental outpatients (Darwazeh and Pillai, 1993). The study in Jordan described a strong correlation between hairy tongue and tobacco smoking. A positive correlation between smoking and tongue lesions was found only in the elderly male subjects of this study.

In conclusion, the overall prevalence of OML was found to be higher in men than in women of both age groups, and the elderly had a higher prevalence than the 35- to 44-year-old subjects. Tongue lesions and white lesions were relatively common, but denture-related lesions were not. Tobacco-smoking habits were related to the occurrence of some OML in this population. The prevalence of tobacco smoking in the men in both age groups, especially the rural 35- to 44-year-old men, was found to be very high. This finding is of major public health significance, and smoking cessation programs should target these population groups.

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REFERENCES

- Aboyans V, Ghaemmaghami A (1973). The incidence of fissured tongue among 4,009 Iranian dental outpatients. *Oral Surg Oral Med Oral Pathol* 36:34-38.
- Axéll T (1976). A prevalence study of oral mucosal lesions in an adult Swedish population. *Odontol Revy* 27(Suppl 36):1-103.
- Axéll T, Rundquist L (1987). Oral lichen planus—a demographic study. *Community Dent Oral Epidemiol* 15:52-56.
- Axéll T, Holmstrup P, Kramer IRH, Pindborg JJ, Shear M (1984). International seminar on leukoplakia and associated lesions related to tobacco habits. *Community Dent Oral Epidemiol* 12:145-154.
- Bánóczy J, Rigó O, Albrecht M (1993). Prevalence study of tongue lesions in a Hungarian population. *Community Dent Oral Epidemiol* 21:224-226.

- Bouquot JE (1986). Common oral lesions found during a mass screening examination. *J Am Dent Assoc* 112:50-57.
- Bouquot JE, Gorlin RJ (1986). Leukoplakia, lichen planus, and other oral keratoses in 23,616 white Americans over the age of 35 years. *Oral Surg Oral Med Oral Pathol* 61:373-381.
- Budtz-Jørgensen E (1981). Oral mucosal lesions associated with the wearing of removable dentures. *J Oral Pathol* 10:65-80.
- Cao HK, Yue FY, Cheng JH, Lu H, Shi HB, Shen ZY, *et al.* (1988). Epidemiological study of oral mucosal diseases in 3,091 Shanghai elderly. *Stomatology* 8:169-171 (in Chinese).
- Chen Z, Chen XW, Ma QY, Chen HZ, Wang ZH, Jiang YC (1983). Oral leukoplakia in 58,850 residents in Tianjing. *Chin J Stomatol* 18:170-172 (in Chinese).
- Corbet EF, Lo ECM (1994). Tooth spaces in and prosthetic treatment received by the middle-aged and the elderly in Hong Kong. *Community Dent Oral Epidemiol* 22:386-391.
- Corbet EF, Holmgren CJ, Philipsen HP (1994). Oral mucosal lesions in 65-74-year-old Hong Kong Chinese. *Community Dent Oral Epidemiol* 22:392-395.
- Darwazeh AMG, Pillai K (1993). Prevalence of tongue lesions in 1013 Jordanian dental outpatients. *Community Dent Oral Epidemiol* 21:323-324.
- Fang XZ, Liu JY, Xue YQ, Zhou Y (1983). Oral mucosal diseases in 1,048 Beijing residents aged 60 years and above. *Chin J Geriatrics* 2:176 (in Chinese).
- Fleishman R, Peles DB, Pisanti S (1985). Oral mucosal lesions among elderly in Israel. *J Dent Res* 64:831-836.
- Gangdharan P, Paymaster JC (1971). Leukoplakia—an epidemiologic study of 1,504 cases observed at the Tata Memorial Hospital, Bombay, India. *Br J Cancer* 25:657-668.
- Gupta PC (1984). Epidemiologic study of the association between alcohol habits and oral leukoplakia. *Community Dent Oral Epidemiol* 12:47-50.
- Gupta PC, Mehta FS, Daftary DK, Pindborg JJ, Bhonsle RB, Jainawalla PN, *et al.* (1980). Incidence rates of oral cancer and natural history of oral precancerous lesions in a 10-year follow-up study of Indian villagers. *Community Dent Oral Epidemiol* 8:283-333.
- Ikeda N, Handa Y, Khim SP, Durward C, Axéll T, Mizuno T, *et al.* (1995). Prevalence study of oral mucosal lesions in a selected Cambodian population. *Community Dent Oral Epidemiol* 23:49-54.
- Jorge J Jr, deAlmeida OP, Bozzo L, Scully C, Graner E (1991). Oral mucosal health and disease in institutionalized elderly in Brazil. *Community Dent Oral Epidemiol* 19:173-175.
- Kleinman DV, Swango PA, Niessen LC (1991). Epidemiologic studies of oral mucosal conditions—methodologic issues. *Community Dent Oral Epidemiol* 19:129-140.
- Lay KM, Sein K, Myint A, Ko SK, Pindborg JJ (1982). Epidemiologic study of 6,000 villagers of oral precancerous lesions in Bilygyun: preliminary report. *Community Dent Oral Epidemiol* 10:152-155.
- Lin BC, Dai YY, Zhu YX, Zhang RD (1989). A survey of oral mucosal diseases in 2,191 elderly inhabitants in Beijing. *Chin J Stomatol* 24:175-177 (in Chinese).
- Lin HC, Yu QX, Guo YZ, Chen XH (1991). A survey on oral lichen planus. *Chin J Stomatol* 26:124 (in Chinese).
- Lin HC, Yu QX, Guo YZ, Chen XH (1992a). An epidemiological study of oral leukoplakia. *J Clin Stomatol* 8:8-10 (in Chinese).
- Lin HC, Yu QX, Guo YZ, Chen XH (1992b). Tobacco and recurrent oral ulcerations. *J Comprehen Stomatol* 8:75-77 (in Chinese).
- Lin HC, Corbet EF, Lo ECM, Zhang HG (2001). Tooth loss, occluding pairs and prosthetic status of adults in Southern China. *J Dent Res* 80:1491-1495.
- Mehta FS, Gupta PC, Daftary DK, Pindborg JJ, Choksi SK (1972). An epidemiologic study of oral cancer and precancerous conditions among 101,761 villagers in Maharashtra, India. *Int J Cancer* 10:134-141.
- Mu J, Zhang XW, Zheng XL, Zhang YM, Xu ZR (1984). A survey on oral leukoplakia among the Wei, Han and Hasake ethnic groups in Xinjiang. *Chin J Stomatol* 19:114-116 (in Chinese).
- Nair RG, Samaranyake LP, Philipsen HP, Grahann RGB, Itthagarun A (1996). Prevalence of oral lesions in a selected Vietnamese population. *Int Dent J* 46:48-51.
- Pindborg JJ, Chawla TN, Misra RK, Nagpaul RK, Gupta VK (1965). Frequency of oral carcinoma, leukoplakia, leukokeratosis, leukoedema, submucous fibrosis and lichen planus in 10,000 Indians in Lucknow, Uttar Pradesh, India. *J Dent Res* 44:615.
- Reichart PA, Mohr U, Srisuwan S, Geerlings H, Theetranont C, Kangwanpong T (1987). Precancerous and other oral mucosal lesions related to chewing, smoking and drinking habits in Thailand. *Community Dent Oral Epidemiol* 15:152-160.
- Schwarz E, Zhang HG, Wang ZJ, Lo ECM, Corbet EF, Wong MCM (2001). An oral health survey in Southern China 1997: background and methodology. *J Dent Res* 80:1453-1458.
- Ship II (1987). Epidemiologic aspects of recurrent aphthous ulcerations. *Oral Surg Oral Med Oral Pathol* 33:400-406.
- Vigild M (1987). Oral mucosal lesions among institutionalized elderly in Denmark. *Community Dent Oral Epidemiol* 15:309-313.
- WHO (1997). Oral health surveys: basic methods. 4th ed. Geneva: WHO.
- Xu GQ, Shi HB, Qiu XY, Tang H (1981). A report on oral mucosal diseases in 18,769 Shanghai residents. *Stomatology* 1:26-29 (in Chinese).
- Xu XY, Li HF (1981). Prevalence of oral lichen planus. *Chin J Dermatol* 14:153-154 (in Chinese).
- Zhang RP, Zhong ZM, Zhao RL (1981). Report of a survey on oral leukoplakia in 5400 people. *Chin J Stomatol* 16:167-168 (in Chinese).