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ORIGINAL ARTICLE

Prevalence and risk indicators of oral mucosal lesions in an urban population from South Brazil

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OBJECTIVE: The objective of the study was to assess the prevalence of oral mucosal lesions (OML) and to perform a multivariable risk assessment of demographic, socioeconomic, behavioral, and oral risk indicators for its occurrence in an urban population in South Brazil.

METHODS: This cross-sectional study selected 1586 subjects (719M/867F, age: 14–104 years) using a multistage probability sampling strategy (65.1% response rate). Prevalence, odds ratios (OR), and confidence intervals (95% CI) were calculated accounting for the survey design.

RESULTS: Leukoplakia and lichen planus were observed in 1.01% and 1.02% of subjects, respectively. In the multivariable analysis, these lesions were significantly associated with moderate/heavy smoking (OR = 9.0, 95% CI = 2.1–39.1) and heavy drinking (OR = 2.0, 95% CI = 1.1–3.7). Candidiasis and proliferative lesions were observed in 14.09% and 3.80% of the subjects, respectively. These lesions were significantly associated with female gender (OR = 2.2, 95% CI = 1.5–3.2 and OR = 1.7, 95% CI = 1.0–2.8), older age (OR = 22, 95% CI = 8.0–60.8 and OR = 8.9, 95% CI = 3.4–23.7), and low socioeconomic status (OR = 1.9, 95% CI = 1.0–3.5 and OR = 3.0, 95% CI = 1.2–7.2).

CONCLUSIONS: This population is in need of OML prevention and treatment. Future studies should validate the findings that premalignant lesions are causally related to smoking and alcohol consumption, and that other OML are associated with socioeconomic-demographic disparities in this and similar populations.

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Keywords: oral mucosa; oral lesions; oral leukoplakia; oral lichen planus; cross-sectional study; epidemiology

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Introduction

Oral mucosal lesions are common in many populations (Salonen *et al*, 1990; Kovac-Kovacic and Skaleric, 2000; Espinoza *et al*, 2003; Shulman *et al*, 2004; Mumcu *et al*, 2005; Triantos, 2005; Pentenero *et al*, 2008). The epidemiology of oral lesions in the adult population of developing countries is mostly unknown due to the lack of large population-based oral surveys. Nevertheless, findings of age-restricted studies suggest that a significant proportion of Latin American populations may have oral lesions (Bezerra and Costa, 2000; Espinoza *et al*, 2003; Bessa *et al*, 2004; dos Santos *et al*, 2004; Castellanos and Diaz-Guzman, 2008).

Case–control (Fioretti *et al*, 1999; Jaber *et al*, 1999; Morse *et al*, 2007) and cross-sectional (Salonen *et al*, 1990; Shulman *et al*, 2004) studies have shown an increased likelihood of oral cancer and premalignant lesions in heavy smokers and individuals with alcohol misuse. Recent epidemiological studies showed a positive relationship between occurrence of these lesions and poor oral hygiene and periodontal disease (Tezal *et al*, 2005; Guha *et al*, 2007), whereas non-malignant oral lesions have been associated with multiple factors, including denture use (Espinoza *et al*, 2003; dos Santos *et al*, 2004; Shulman *et al*, 2004; Mumcu *et al*, 2005), poor oral hygiene (Freitas *et al*, 2008), low socioeconomic status (Hashibe *et al*, 2003), and low education (Hand and Whitehill, 1986; Hashibe *et al*, 2003).

Accurate estimates of the epidemiology of oral lesions and a better understanding of the factors associated with their occurrence are essential for the establishment of adequate preventive and health promotion measures. Most of the epidemiology of oral lesions is based on studies that have used convenience samples (Fleishman *et al*, 1985; Hand and Whitehill, 1986; Martinez Diaz-Canel and Garcia-Pola Vallejo, 2002; dos Santos *et al*, 2004; Triantos, 2005; Castellanos and Diaz-Guzman, 2008), samples with specific demographic characteristics (Fleishman *et al*, 1985; Hand and Whitehill, 1986; Bezerra and Costa, 2000; Martinez Diaz-Canel and

Garcia-Pola Vallejo, 2002; Espinoza *et al*, 2003; Bessa *et al*, 2004; dos Santos *et al*, 2004; Triantos, 2005), and estimates of association not adjusted for important co-factors (Fleishman *et al*, 1985; Hand and Whitehill, 1986; Salonen *et al*, 1990; Shulman *et al*, 2004; Mumcu *et al*, 2005). The primary aim of this study was to assess the prevalence of oral mucosal lesions in a representative sample of an urban population in South Brazil. The secondary aim was to assess the association among oral mucosal lesions and demographic, socioeconomic, behavioral, and oral health exposures.

Subjects and methods

Study design and sample

A multistage probability sampling method was used to derive a sample representative of the 14 major municipalities in the metropolitan area of Porto Alegre, Brazil. Detailed information of the study design and sampling procedures is described elsewhere (Susin *et al*, 2004, 2005a,b). In short, geographic areas of 10 km^2 each were stratified into high-income and low-income status using census data and other relevant official information. Within each of these two income strata, 11 primary sampling units were randomly selected. The second stage consisted of 29 sectors that were randomly selected within each geographic area. The third stage included selecting households within each sector.

The number of individuals of 14 years and older eligible for the survey was 2435. A total of 1646 (67.6%) subjects were interviewed, of whom 1586 (65.1%) subjects were clinically examined. The age of the study subjects ranged from 14 to 103 years (mean: 37.9, s.d.: 13.3 years), and comprised 719 (45.3%) males and 867 (54.7%) females and 1309 (82.5%) whites and 277 (17.5%) non-whites. The study group comprised 1465 dentate and 121 edentulous subjects. In this study, we report oral mucosal and dental findings of 1586 and 1460 subjects, respectively.

Interview and clinical examinations

Interviews and clinical examinations were performed in a mobile examination unit consisting of a trailer equipped with a complete dental unit, comprising a dental chair, light, compressor, and other basic amenities. Four dentists and two dental assistants conducted the fieldwork between June and December, 2001. Eligible subjects who consented to participate were interviewed to gather demographic, socioeconomic, oral health, and other health-related data using a structured written questionnaire.

Clinical examination included oral mucosal manifestations, dental prosthesis use, and periodontal disease. Criteria for the diagnosis of oral mucosal lesions were adapted from the WHO guide for oral surveys (Kramer *et al*, 1980; WHO, 1997). Oral mucosal conditions were scored as cancer, leukoplakia, lichen planus, ulceration, necrotizing gingivitis/periodontitis, oral candidiasis, abscess, and other manifestation. Diagnosis of oral mucosal conditions was performed using the following stepwise protocol:

(1) Participants' oral mucosa was clinically examined by trained field examiners following a standard clinical protocol. If oral lesions were observed during the clinical examination, the clinical characteristics of the lesions were recorded, and lesions were photographed using an intra-oral camera. An initial diagnosis was provided by consensus by the field examiner and the reference examiner (CS).
(2) After initial diagnosis, two experienced oral pathologists (PVR and MSF) confirmed the diagnosis by reviewing participants' medical/dental history and clinical pictures. Cases with unconfirmed diagnosis were refereed to the Oral Pathology Service at the Federal University of Rio Grande do Sul for further examination.
(3) Patients referred to the Oral Pathology Service were clinically examined by the two oral pathologists, and biopsies were taken whenever deemed necessary to confirm the diagnosis. Cases were reviewed and received a final diagnosis based on clinical and laboratory information (VCC).

Removable prostheses use was assessed, and presence of complete and/or removable partial dentures was recorded for the upper and lower arches. All permanent fully erupted teeth, excluding third molars, were periodontally examined at six sites per tooth (mesiobuccal, midbuccal, distobuccal, distolingual, midlingual, and mesiolingual). Teeth of each quadrant were dried with a blast of air, and presence of visible dental plaque and supragingival calculus was recorded. Thereafter, gingival bleeding was assessed. The periodontal probe was inserted 1–2 mm into the gingival sulcus starting at one interproximal area and moving to the other. Presence of gingival bleeding was scored after sites of a single quadrant were probed. Periodontal probing depth (PPD) was defined as the distance from the free gingival margin to the bottom of the pocket/sulcus. Periodontal attachment loss (PAL) was defined as the distance from the CEJ to the bottom of the pocket/sulcus.

Ethical considerations

The study protocol was reviewed and approved by the following committees: Research Ethics Committee, Federal University of Rio Grande do Sul, Porto Alegre, Brazil; the National Commission on Ethics in Research, Ministry of Health, Brasilia, Brazil; Ethics in Medical Research Committee, University of Bergen, Bergen, Norway. Subjects who agreed to participate signed an informed consent form. At the conclusion of the study, the participants were provided with a written report detailing their oral status and any diagnosed mucosal lesion. Treatment and follow-up were offered for all cases.

Non-response analysis

At least three attempts on different days were made to examine the eligible household members while the examination team was in the same residential area. Among the 849 subjects who did not participate in the survey, 636 were not at home, 127 refused to participate,

26 were unable to attend the examination site due to an impairing medical condition, and 60 subjects were interviewed, but refused to be part in the clinical examination. Subsequent to the completion of the survey, a random sample of 339 (39.9%) subjects was selected out of 849 eligible subjects who either refused to participate or were not available during the normal survey schedule. Non-response data were obtained for 271 (79.9%) subjects. Compared to participants, non-respondents had similar mean age, but somewhat higher percentages of males and whites and had higher education than the study participants. Any bias in the population parameter estimates (Korn and Graubard, 1999), which could arise due to the non-response was reduced by using a weight variable. The calculation of the weight variable was based on Census information.

Measurements reproducibility

At two time points, before and 3 months after the start of the study, the examiners were trained and calibrated in performing the clinical measurements. Assessment of measurement reproducibility used replicate measurements performed during the fieldwork. One examiner with the most clinical experience served as the 'reference' examiner (CS). A total of 57 subjects, divided into four groups ranging from 8 to 20 subjects, were used for the reproducibility assessment. The percentages of agreement and the unweighted kappa coefficients for oral mucosal diagnosis ranged between 71.4% and 91.7% and between 0.36 and 0.67, respectively. The intraclass correlation coefficients for mean attachment loss at subject level ranged between 0.95 and 0.99, and between 0.92 and 0.99 for mean probing depth. The weighted kappa (± 1 mm) for attachment loss and probing depth at site level ranged between 0.65 and 0.87 and between 0.85 and 0.92, respectively. The intraclass correlation coefficients for percentage of sites with visible plaque ranged between 0.64 and 0.82, and between 0.73 and 0.98 for supragingival calculus.

Data analysis

Prevalence of an oral mucosal lesion was defined as the percentage of individuals having a given condition or disease. For the univariable and multivariable analysis, oral mucosal lesions were grouped into four outcomes: (1) premalignant lesions comprising leukoplakia and lichen planus; (2) proliferative lesions comprising proliferative non-neoplasic lesions and benign neoplasias; (3) abscess and fistulas; and (4) oral candidiasis. Other oral mucosal lesions were not included in the analysis due to its small prevalence. Demographic, socioeconomic, behavioral, and dental-related conditions were used as independent variables.

Socioeconomic status was scored by combining information about family economy using a standard Brazilian economy classification (CCEB) and the level of education of the individual.

The total exposure to cigarette smoking was calculated for current and former smokers combined. The total number of packyears consumed in a life time was calculated as the number of cigarettes consumed per day, multiplied by the number of years of habit, divided by 20 (1 pack). Subjects were classified into four groups: non-smokers (0 packyears), light (>0–7.5 packyears), moderate (>7.5–20 packyears), and heavy smokers (>20 packyears). Daily alcohol consumption was calculated by multiplying the number of drinks consumed in a week by the average content of alcohol in a glass of beer, wine, or cachaça (a typical Brazilian distillated alcoholic beverage made from sugar cane) divided by 7 days. The amount of alcohol by volume was estimated to be 10 ml in a glass of beer, 12 ml in a glass of wine, and 10 ml in a drink of cachaça. Alcohol by volume was converted to alcohol by weight using a conversion factor of 0.8. Drinkers were classified into four groups: non-drinkers (0 g/day), light (>0–2 g/day), moderate (>2–6 g/day), and heavy drinkers (>6 g/day).

Subjects with ≥30% teeth with at least one site with PAL ≥5 mm were classified as cases of periodontitis. Subjects not fulfilling this criterion were classified in the reference group. The percentage of sites with visible plaque, gingival bleeding, and supragengival calculus was used to assess oral hygiene status, and mean PAL and PPD were used to assess the periodontal status. These periodontal parameters were reported according to the presence of oral mucosal lesions.

Data analysis was performed using STATA software (Stata 9.2 for Windows; Stata Corporation, College Station, TX, USA) and using survey commands that take into account the survey design, including stratification, clustering, and weighing and robust variance estimation. A weight variable was therefore used to adjust for the potential bias in the population estimates (IBGE, 1996, Korn and Graubard, 1999). The sample weight was adjusted for the probability of selection and population distribution according to age, gender, and education. Probability of selection was calculated separately for the two economic strata, and the population was divided by the number of individuals sampled in each area. This procedure also permitted achieving the expansion weight. The distribution of the population (poststratification) was calculated using the 1996 census information for the metropolitan area of Porto Alegre (IBGE, 1996). The sample and the population were divided into various subgroups according to age, gender, and years of education. The final sample weight variable was calculated by multiplying the base weight with the poststratification adjustment.

Pairwise comparisons for demographic, socioeconomic and behavioral factors were carried out using the Wald test. The Wald test was also used to compare oral hygiene and periodontal status between subjects with and without oral mucosal lesions. The chosen level of statistical significance was 5%.

Survey logistic regression was used to model the relationship between different oral lesions and potential risk indicators in the univariable and multivariable analyses. Preliminary analysis was carried out using a univariable model, and variables showing associations with $P < 0.25$ were selected for the multivariable analysis. Confounding and effect modification were assessed. Variables were considered confounders if a

change of 30% or more on other variables in the model were observed. Effect modification was assessed by including interaction terms in the multivariable model. No statistically significant interactions were observed. The contribution of each variable to the model was assessed by means of the Wald statistic. Two multivariable models were estimated: one model including demographic, socioeconomic, and behavioral variables and a second model also including periodontitis. All participants were included in the first model, and only dentate participants were included in the second model.

Results

Demographic, socioeconomic, and behavioral factors

Table 1 describes the distribution of subjects with different oral mucosal lesions according to gender and age groups. Only one case of oral cancer was diagnosed in a 37-year-old non-smoker male with a history of HIV and drug abuse. Similar occurrences of leukoplakia (1.01%) and lichen planus (1.02%) were observed. No cases of erythroplakia were observed. Candidiasis was the most frequent finding affecting 14% of subjects. In this regard, almost all cases of candidiasis (217 out of 222 cases) were associated with the use of complete dentures (148 cases), removable partial dentures (39 cases) or provisional removable partial dentures made of acrylic (30 cases). Tongue conditions were observed in 1.21% of the subjects with geographic (0.82%) and fissured tongue (0.12%) being the most prevalent occurrence. Inflammatory hyperplasia was the most frequent proliferative non-neoplastic lesion found in this sample yielding a prevalence of 2.7%.

Premalignant lesions were significantly higher among males, moderate and heavy smokers, and heavy drinkers (Table 2). In the multivariable analysis, moderate and heavy smokers had 6.5 (95% CI 2.0–20.1) and 9.0 (95% CI 2.1–39.1) times higher chance of having premalignant lesions than never-smokers (Table 3). Compared with never-drinkers, heavy alcohol drinkers had 90% higher chance of having oral mucosal lesions. Other variables did not have a significant association with premalignant lesions after adjusting for smoking and drinking.

Proliferative lesions were significantly more prevalent in females, subjects who were older, with low socioeconomic status, moderate, and heavy drinkers, and denture wearers (Table 2). In the multivariable analysis, females were 70% more likely to have proliferative lesions than males (OR = 1.7; 95% CI 1.0–2.8). Moreover, older age (50+ years-old; OR = 8.9, 95% CI 3.4–23.7) and socioeconomic status (middle OR = 4.0, 95% CI 1.5–11.2; and low OR = 3.0, 95% CI 1.2–7.2) were also associated with higher odds of having proliferative lesions (Table 3).

Occurrence of candidiasis was more frequent in females, 30+ year-olds, subjects with low socioeconomic status, heavy smokers, drinkers, and denture wearers (Table 2). After adjusting for other factors, candidiasis was significantly associated with females (OR = 2.2, 95% CI 1.5–3.2), older age cohorts (30–49 years-olds: OR = 8.9, 95% CI 3.4–23.7; 50+ years-

Table 1 Prevalence of subjects with different oral mucosal lesions according to gender and age groups (N = 1586)

	Gender		*Age (years)*			
	Males (n = *719*), % ± *s.e.* (n)	*Females* (n = *867*), % ± *s.e.* (n)	*14–29* (n = *612*), % ± *s.e.* (n)	*30–49* (n = *557*), % ± *s.e.* (n)	*50+* (n = *417*), % ± *s.e.* (n)	*Total*, % ± *s.e.* (n)
Leukoplakia	1.16 ± 0.28 (9)	0.88 ± 0.27 (8)	0.20 ± 0.21 (1)	1.74 ± 0.35 (11)	1.00 ± 0.28 (5)	1.01 ± 0.17 (17)
Lichen planus	1.39 ± 0.34 (9)	0.70 ± 0.37 (5)	0.78 ± 0.78 (4)	1.43 ± 0.41 (7)	0.68 ± 0.47 (3)	1.02 ± 0.30 (14)
Proliferative non-neoplastic lesion	2.58 ± 0.55 (15)	4.15 ± 0.80 (38)	0.66 ± 0.40 (4)	2.72 ± 0.66 (13)	8.96 ± 1.84 (36)	3.40 ± 0.53 (53)
Benign neoplasia	0.66 ± 0.56 (3)	0.15 ± 0.14 (1)	0.69 ± 0.67 (2)	0.16 ± 0.18 (1)	0.35 ± 0.33 (1)	0.39 ± 0.24 (4)
Abscess	1.39 ± 0.52 (7)	1.03 ± 0.34 (7)	1.70 ± 0.66 (6)	1.43 ± 0.69 (8)	0 (0)	1.20 ± 0.33 (14)
Fistula	2.39 ± 0.46 (16)	1.85 ± 0.53 (15)	2.51 ± 0.70 (12)	2.18 ± 0.67 (13)	1.34 ± 0.51 (6)	2.11 ± 0.47 (31)
Necrotizing Gingivitis	0.14 ± 0.14 (1)	0 (0)	0 (0)	0.16 ± 0.17 (1)	0 (0)	0.07 ± 0.07 (1)
Herpes	0.53 ± 0.19 (5)	1.67 ± 0.33 (14)	1.59 ± 0.22 (10)	0.72 ± 0.36 (4)	1.12 ± 0.50 (5)	1.13 ± 0.24 (19)
Candidiasis	10.06 ± 1.91 (65)	17.71 ± 2.19 (157)	2.54 ± 1.49 (11)	14.76 ± 3.00 (82)	31.11 ± 2.95 (129)	14.09 ± 1.87 (222)
Ulceration	7.11 ± 1.04 (48)	6.81 ± 1.04 (60)	5.32 ± 1.14 (34)	7.38 ± 2.03 (40)	8.77 ± 1.66 (34)	6.96 ± 0.87(108)
Tongue conditions	1.81 ± 0.56 (13)	0.67 ± 0.16 (5)	0.80 ± 0.32 (5)	1.63 ± 0.65 (8)	1.09 ± 0.35 (5)	1.21 ± 0.31 (18)
Other	1.67 ± 0.44 (11)	1.03 ± 0.33 (10)	0.74 ± 0.31 (5)	1.71 ± 0.61 (9)	1.61 ± 0.58 ± (7)	1.33 ± 0.19 (21)

Prevalence estimates take in consideration the survey design, including stratification, clustering, weighing and robust variance estimation.

Table 2 Prevalence* of oral mucosal lesions according to demographics, socioeconomic status, behavioral variables, and prosthesis use ($N = 1586$)

	Premalignant lesions			*Proliferative lesions*			*Abscess and fistulae*			*Candidiasis*		
	%	*s.e.*	*P***	*%*	*s.e.*	*P***	*%*	*s.e.*	*P***	*%*	*s.e.*	*P***
Gender												
Male ($n = 719$)	2.55	0.26	Reference	3.24	0.73	Reference	3.78	0.83	Reference	10.06	1.91	Reference
Female ($n = 867$)	1.58	0.38	0.08	4.30	0.76	0.33	2.88	0.60	0.22	17.71	2.19	0.005
Age (years)												
14–29 ($n = 612$)	0.98	0.79	Reference	1.35	0.71	Reference	4.21	1.12	Reference	2.54	1.49	Reference
30–49 ($n = 557$)	3.17	0.43	0.09	2.87	0.64	0.15	3.62	0.88	0.66	14.76	3.00	<0.001
50+ (417)	1.68	0.55	0.49	10.38	3.04	0.02	1.32	0.72	0.04	32.37	3.37	<0.001
Socioeconomic status												
High ($n = 619$)	1.87	0.41	Reference	1.17	0.40	Reference	1.88	0.75	Reference	9.17	1.11	Reference
Middle ($n = 442$)	1.40	0.69	0.34	4.56	1.37	0.06	2.15	0.63	0.76	11.46	1.95	0.37
Low ($n = 525$)	2.52	0.63	0.44	5.06	0.92	0.008	4.92	1.13	0.03	18.86	3.62	0.03
Smoking status												
Never smoker ($n = 868$)	0.80	0.45	Reference	3.84	0.78	Reference	2.95	0.97	Reference	14.02	1.86	Reference
Light ($n = 344$)	1.07	0.43	0.74	2.60	1.13	0.42	3.11	1.29	0.93	12.26	2.73	0.50
Moderate ($n = 195$)	5.40	0.67	<0.001	4.59	1.94	0.71	3.99	1.70	0.61	12.59	3.08	0.66
Heavy ($n = 179$)	5.81	0.82	0.001	5.10	2.45	0.65	4.59	1.11	0.12	19.97	2.84	0.02
Alcohol												
Never drinker ($n = 902$)	1.65	0.29	Reference	4.53	0.77	Reference	3.66	0.65	Reference	16.63	2.24	Reference
Light ($n = 281$)	1.66	0.80	0.99	4.01	1.50	0.79	3.96	1.06	0.78	11.58	2.52	0.13
Moderate ($n = 217$)	1.55	0.79	0.91	1.83	0.98	0.02	1.46	0.75	0.04	11.22	3.88	0.16
Heavy ($n = 182$)	4.99	0.99	0.02	2.56	0.70	0.03	3.04	1.50	0.57	7.77	1.92	0.01
Upper removable prosthesis												
Non-user ($n = 1106$)	2.00	0.30	Reference	2.01	0.57	Reference	4.27	0.77	Reference	0.44	0.18	Reference
User ($n = 480$)	2.13	0.50	0.85	8.01	1.45	0.005	1.03	0.54	0.001	46.30	4.02	<0.001
Lower removable prosthesis												
Non-user ($n = 1295$)	2.00	0.28	Reference	3.19	0.54	Reference	3.74	0.73	Reference	8.56	1.80	Reference
User ($n = 291$)	2.19	0.49	0.77	6.57	1.40	0.04	1.34	0.56	0.02	39.40	4.23	<0.001
Total	2.03	0.22		3.80	0.56		3.31	0.64		14.09	1.87	

*Prevalence estimates take in consideration the survey design, including stratification, clustering, weighing and robust variance estimation.
***P*-value for the pairwise comparison against the reference category using Wald test.

Table 3 Multivariable logistic regression analysis of the effect of demographic, socioeconomic and behavioral variables on the occurrence of oral lesions ($N = 1586$)

	Premalignant lesions		*Proliferative lesions*		*Abscess and fistulae*		*Candidiasis*	
Variable	*OR*[a]	*95% CI*	*OR*[a]	*95% CI*	*OR*[a]	*95% CI*	*OR*[a]	*95% CI*
Gender								
Male ($n = 719$)			1.0				1.0	
Female ($n = 867$)			1.7*	1.0–2.8			2.2**	1.5–3.2
Age (years)								
14–29 ($n = 612$)			1.0		1.0		1.0	
30–49 ($n = 557$)			2.4	0.9–6.7	1.0	0.4–2.4	8.9**	4.0–19.8
50 + (417)			8.9**	3.4–23.7	0.3*	0.1–0.8	22.0**	8.0–60.8
Socioeconomic status								
High ($n = 619$)			1.0		1.0		1.0	
Middle ($n = 442$)			4.0**	1.5–11.2	1.1	0.5–2.8	1.4	0.9–2.1
Low ($n = 525$)			3.0*	1.2–7.2	2.9**	1.3–6.4	1.9*	1.0–3.5
Smoking status								
Never smoker ($n = 868$)	1.0				1.0			
Light ($n = 344$)	1.6	0.3–9.1			0.8	0.3–2.3		
Moderate ($n = 195$)	6.5**	2.0–20.7			1.3	0.5–3.6		
Heavy ($n = 179$)	9.0**	2.1–39.1			1.9*	1.1–3.2		
Alcohol								
Never drinker ($n = 902$)	1.0							
Light ($n = 281$)	1.2	0.4–3.4						
Moderate ($n = 217$)	0.8	0.2–2.6						
Heavy ($n = 182$)	2.0*	1.1–3.7						

*$P < 0.05$; **$P < 0.01$.
[a]Odds ratios and 95% confidence intervals.

olds: OR = 22.0, 95% CI 8.0–60.8), and individuals of low socioeconomic status (OR = 1.9, 95% CI 1.0–3.5) (Table 3).

A significantly higher prevalence of subjects with abscesses or fistulae was observed in the older age groups and in those with low socioeconomic status (Table 2). In contrast, moderate drinkers and denture users had lower occurrence of these conditions. Multivariable analysis indicated that subjects aged 50+ year-old (OR = 0.3, 95% CI 0.1–0.8) were 70% less likely to have this type of lesions than 14–29 year-olds (Table 3). In addition, it was observed that heavy smokers and subjects with lower socioeconomic status had a higher likelihood of having abscesses and fistulae when compared to never-smokers and subjects with high socioeconomic status (OR = 1.9, 95% CI 1.1–3.2; and OR = 2.9, 95% CI 1.3–6.4; respectively).

Oral hygiene, periodontal disease, and removable prosthesis

No significant differences in oral hygiene parameters were observed between subjects with and without oral premalignant lesions (Figure 1). In contrast, subjects with proliferative lesions, abscesses/fistulae, or candidiasis had significantly higher amounts of supragingival plaque, gingival bleeding, and supragingival calculus than subjects without oral lesions. Mean PAL was significantly higher among subjects with proliferative lesions and candidiasis, whereas mean PPD was significantly higher among subjects having abscess or fistula (Figure 2).

In the multivariable analysis, periodontitis was not significantly associated with premalignant lesions after adjusting for smoking and alcohol consumption (OR = 1.1, 95% CI 0.5–2.4). Similarly, no significant association was observed between periodontitis and proliferative lesions after adjusting for age, gender, and socioeconomic status (OR = 1.7, 95% CI 0.7–3.8). Using adjusted estimates, subjects with periodontitis were two times more likely to have abscesses or fistulas (OR = 2.0, 95% CI 1.2–3.4) and 40% more likely to have candidiasis (OR = 1.4, 95% CI 1.1–1.8) than subjects without periodontitis.

Removable prosthesis wearers had higher prevalence of proliferative lesions and candidiasis (Table 2). This finding was confirmed by the multivariable analysis with subjects wearing removable prosthesis having 2.8 times higher chance of having proliferative lesions after adjusting for age, gender, and socioeconomic status (OR = 2.8, 95% CI 1.5–5.1). Risk assessment could not be carried out for candidiasis due to its high occurrence (217 out of 222 cases) among removable prosthesis wearers. No association was observed between removable prosthesis and premalignant lesions, whereas an inverse association was observed between the use of removable prosthesis and the presence of abscess or fistulae (OR = 0.2, 95% CI 0.1–0.8).

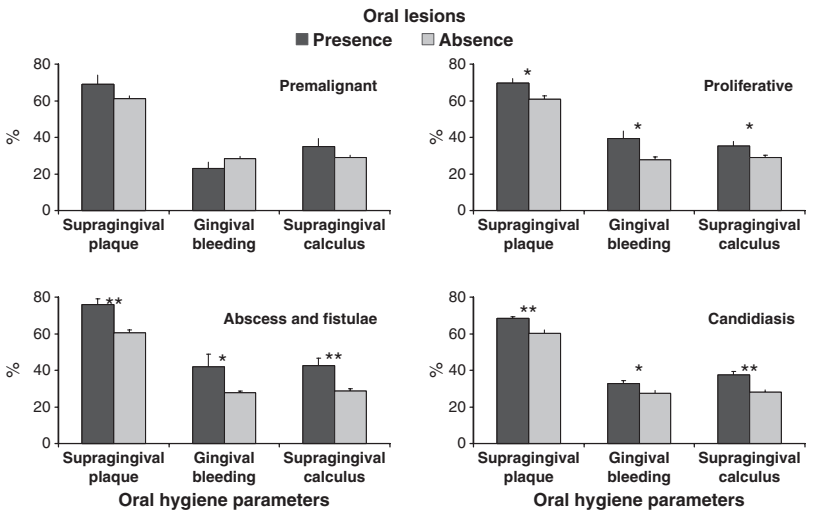

Figure 1 Percentage of sites with supragingival plaque, gingival bleeding, and supragingival calculus according to the occurrence of oral lesions (n = 1460; bars indicate standard-errors; $*P < 0.05$)

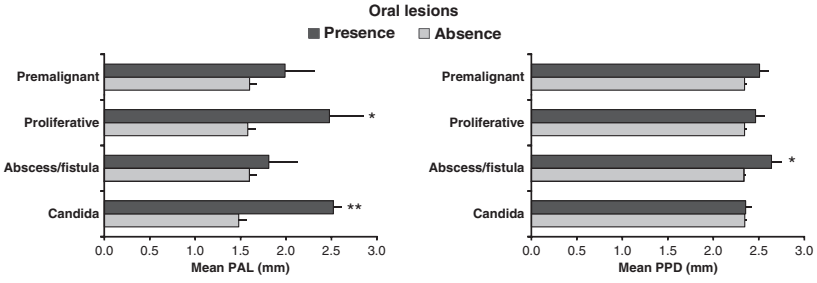

Figure 2 Mean periodontal attachment loss (PAL) and periodontal probing depth (PPD) according to the occurrence of oral lesions (n = 1460; bars indicate standard-errors; $*P < 0.05$)

Discussion

This study assessed the prevalence and risk indicators for oral mucosal lesions in an urban population in South Brazil. In this representative sample, approximately, one-third of the population had at least one oral lesion, and the most common lesions were oral candidiasis, ulcerations, and proliferative non-neoplastic lesions. Our findings show that premalignant lesions were significantly associated with tobacco smoking and alcohol consumption, whereas socio-demographic factors were significantly associated with other oral lesions. Subjects with periodontitis were more likely to have abscesses, fistula, and candidiasis even after accounting for important demographic, socioeconomic, and behavioral co-factors. Only one case of oral cancer was observed in this sample, thus accurate estimates of prevalence and risk assessment of this condition could not be performed.

To the best of our knowledge this is the first population-based study to assess oral lesions in a large urban area in Latin America. Recently, dos Santos *et al* have conducted a cross-sectional study in the central Amazon forest region and found a much lower prevalence of leukoplakia and candidiasis than reported in this study (dos Santos *et al*, 2004). However, a direct comparison between these two studies may be unwarranted due to methodological and sample differences. The present sample was considerably older and differed in other aspects. In addition, the former study surveyed an Indian population without a history of smoking or alcohol consumption.

The incidence rates of oral cancer in Brazil are among the highest in the world (Wunsch-Filho, 2002). A recent report based on the Cancer Incidence in Five Continents registry showed that the age-standardized rate for oral cancer was 9.3/100 000 in males and 2.2/100 000 in females (de Camargo Cancela *et al*, 2009). Brazilian estimates for males were the highest in Latin America and the second highest in the world, and oral cancer incidence among Brazilian females was among the highest among developing countries. Direct comparisons between prevalence and incidence estimates are generally affected by survival bias in cross-sectional studies. In this study, survival bias probably lead to underestimation of cases of oral cancer as only prevalent cases, i.e. survivors, could be included. Moreover, differences in the clinical examination procedures, oral lesion criteria, and sampling strategy may hinder comparisons between studies.

Males generally have poorer health status than females, and this is also true for oral health (Susin *et al*, 2004, 2005a,b; Chattopadhyay, 2008). In the present population, males had poorer oral hygiene and higher prevalence and severe gingival inflammation and periodontal destruction. The higher occurrence of proliferative lesions and candidiasis in females than males may be partially explained by the higher frequency of use of removable prosthesis in females. Studies show that candidiasis was also more prevalent among Chilean (Espinoza *et al*, 2003), Swedish (Salonen *et al*, 1990), and Slovenian (Kovac-Kovacic and Skaleric, 2000) females than males, and these higher prevalence estimates were associated with higher frequency of removable prosthesis use among females. In this context, we have shown that females have higher occurrence of tooth loss (Susin *et al*, 2005a,b). It has been shown that females seek oral rehabilitation more often than males (van de Mheen *et al*, 1998). On the other hand, males showed significantly higher prevalence of oral premalignant lesions than females in the univariable analysis. However, when the effects of smoking and alcohol consumption were adjusted for in the model, gender no longer was a risk indicator. This is in accordance with the findings of Salonen *et al* (Salonen *et al*, 1990) and Pentenero *et al* (Pentenero *et al*, 2008) who observed higher occurrence of tobacco-related lesions in males.

Socioeconomic status has been associated with several general (Adler and Ostrove, 1999) and oral health conditions (van de Mheen *et al*, 1998; Hashibe *et al*, 2003; Sanders *et al*, 2006). In the present analysis, socioeconomic status was significantly associated with proliferative lesions and candidiasis. This finding can be explained by the use of provisional or inadequate removable prosthesis. In Brazil, provisional removable dental prosthesis is a low-cost rehabilitation treatment and it is provided by non-licensed vendors as well as licensed dentists, and it is an affordable treatment alternative often chosen by patients of low socioeconomic status. The association between low socioeconomic status and presence of abscesses and fistulae is probably due to the higher occurrence of endodontic and periodontal problems in individuals of low socioeconomic level, as this group also has a higher occurrence of decay (Ministry of Health, 2004) and periodontal diseases (Susin *et al*, 2004) than individuals of high socioeconomic status.

It is well documented that smoking (Salonen *et al*, 1990; Jaber *et al*, 1999; Espinoza *et al*, 2003; Shulman *et al*, 2004; Morse *et al*, 2007; Pentenero *et al*, 2008; Lubin *et al*, 2009) and alcohol consumption (Fioretti *et al*, 1999; Jaber *et al*, 1999; Chung *et al*, 2005; Morse *et al*, 2007; Subapriya *et al*, 2007; Pentenero *et al*, 2008; Lubin *et al*, 2009) are important risk factors for oral cancer and premalignant lesions. In this population, a significantly higher prevalence of these lesions was diagnosed in moderate/heavy smokers and heavy consumers of alcohol. Insofar the effect of smoking seemed more important than that of alcohol consumption, as in smokers the prevalence of lesions was higher and the odds ratio in the multivariable model was also higher. Nevertheless, studies show a clear relationship between smoking and alcohol consumption (Bobo and Husten, 2000).

Recently, Guha *et al* observed that poor oral hygiene, tooth loss, and gingival bleeding were significantly associated with squamous cell carcinoma of the head, neck, and esophagus (Guha *et al*, 2007). This association remained significant after adjusting for smoking and alcohol consumption. Using data from the Third National Health and Nutrition Examination Survey, Tezal *et al* found an increased likelihood of oral cancer and precancerous lesions in subjects with destructive

periodontal disease (Tezal *et al*, 2005). Similar to these findings, Marques *et al* found an association between oral cancer (squamous cell carcinoma) and gingival bleeding and lack of dental care using a hospital-based case–control study design (Marques *et al*, 2008). Contrarily to these findings, we found no significant association between periodontitis and premalignant lesions after adjusting for smoking and alcohol consumption in this population. However, periodontal parameters and oral hygiene were significantly more frequent in subjects with proliferative lesions, candidiasis, abscess, and fistulae.

Validity of health surveys' estimates is influenced by the accuracy of the sampling and magnitude of bias due to non-response. In our study, the non-response bias was reduced by using a weight variable based on Census information. Furthermore, the non-response analysis did not find major differences between respondents and non-respondents. The strategy used for the oral mucosa diagnosis yielded high consistency, with only three cases diagnosed as leukoplakia during the fieldwork, being recategorized as frictional keratosis (two cases) and lichen planus (one case) after diagnosis confirmation by the oral pathologists. The high measurement reproducibility achieved throughout the fieldwork also could have improved the validity of the clinical findings. Nevertheless, this study used a cross-sectional design, and it should be recognized that causality can only be established with prospective studies. Some associations observed in this investigation were borderline significant, thus caution should be used when interpreting odds ratios with wide confidence intervals or with confidence intervals approaching 1.

A common risk factor approach has been suggested as an appropriate strategy for prevention (Sheiham and Watt, 2000). In this context, targeting exposures that are risk factors for several diseases and conditions are likely to enhance benefits and effectiveness of public health interventions (Ezzati *et al*, 2002). Our findings corroborate the proposal that prevention of oral diseases could be included in ongoing or planned intervention campaigns designed to prevent smoking and alcohol-related diseases.

In conclusion, a large proportion of this population had oral lesions in need of proper management and treatment. Smoking and alcohol consumption were the most important indicators of premalignant lesions, whereas other oral lesions were more associated with socio-demographic disparities. The results suggest that smoking and alcohol-cessation programs have the potential to improve oral health, and that oral health promotion initiatives should be targeted especially at low socioeconomic status populations.

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