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Cross-sectional study of oral mucosal conditions among a central Amazonian Indian community, Brazil

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BACKGROUND: A cross-sectional study on the oral mucosal conditions among the Waimiri Atroari Indians from central Amazonia, Brazil, has been conducted. These Indians keep their traditional way of life and are free from habits such as smoking, alcohol drinking, and use of pacifiers.

METHODS: Clinical examinations of a representative, randomly selected sample of patients during routine dental treatment, following ethical procedures recommended by Brazilian laws were made.

RESULTS: Out of 922 individuals, 587 were examined, among which 52.57% of the children up to 12 years old and 73.44% of patients aged 13 years or older presented at least one oral mucosal condition. The conditions more frequently observed were, in decreasing order of prevalence: fissured tongue, focal epithelial hyperplasia (FEH), lesions of traumatic origin, geographic tongue, Fordyce's spots, and candidiasis. Only one case of leukoplakia was identified.

CONCLUSIONS: Conditions observed among theses Indians were essentially the same that have been described in other populations around the world, except for FEH, which, as a characteristic lesion of Indians, had high prevalence (20.95%). The lesions observed were related to the way of life of this specific population.

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Introduction

Waimiri Atroari Indians are a restricted ethnic group from central Amazonia, Brazil, still living according to their traditions as far as food, dwelling, sexual matching, and social organization and interaction with environment are concerned. This population receives regular health care, including medical and dental assistance, vaccines, and other preventive measures. During dental assistance, a noteworthy frequency of individuals affected by focal epithelial hyperplasia (FEH) had been observed among them, but its exact prevalence was not known, as well as the prevalence of other oral mucosal conditions that could affect these Indians was ignored. FEH is regarded as a benign lesion caused by human papillomavirus (HPV) type 13 or 32, associated with communal lifestyle, hygiene habits, and poverty (1–3).

The Waimiri Atroari are absolutely free from the habits of alcohol drinking and tobacco smoking. Both these cultural habits have been extensively implied in the occurrence of pre-malignant lesions and oral cancer (4, 5). In this population, no other cultural habit of regular consumption of beverages, chewing quids, or smoking any other product than tobacco has been identified. In South-east Asian countries, the use of quids made with typical products with carcinogenic properties, as betel and areca – either alone or associated with tobacco – have been associated with higher prevalences of oral pre-malignant lesions and oral cancer, in different populations, including aborigines (6, 7).

Based on the particular characteristics of the Waimiri Atroari Indians, and the lack of evidence of oral health impairment because of chronic habits among these Indians, the purpose of this study was to verify the prevalence of oral mucosal conditions among them, including individuals of the whole age span of the population, and to examine the relationship between the most important lesions observed and clinical and social factors such as age, sex, and lifestyle.

Subjects and methods

According to data provided by the legal representatives of the Waimiri Atroari community, Programa Waimiri-Atroari (PWA), these Indians numbered 922 individuals in January 2002. The average age was 16.89 years (SD $\pm$ 16.24), and the median of age was 11.55 years. They were distributed in 17 villages in a reserved territory with 25 000 km^2, located in the Brazilian states of Amazonas and Roraima (1°00′N to

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2°30′S; 50°30′ to 61°30′W). Sample size was calculated as proposed by WHO (8) based on a 99% confidence interval (CI) and an expected frequency of 64.0% affected individuals, according to information obtained from dental charts of the Indians, rendering a minimum of 568 individuals to be examined. Sampling was obtained by a random number table generated by computer package EpiInfo 6.04c (CDC/WHO, 1997), based on the unique health chart number that each subject has in the files of PWA. This procedure guaranteed that Indians of all ages, both sexes, and coming from all villages had similar chances to be included in the survey. The National Ethics Committee had previously approved this study, and written consent was obtained from the participants before examination.

Clinical examinations were performed during routine dental care activities developed in regular dental offices existing inside the Waimiri Atroari Reserve, between February and April 2002. One examiner (P.J.B.S.) previously trained in the diagnosis of oral conditions made all examinations. An initial intraobserver calibration was conducted, obtaining a satisfactory result of 87.5% of agreement (9). Before all examinations, a brief anamnesis was conducted, within the limits of communication because of language problems and strong recall hindrances presented by the people examined. No history information was objectively accounted for results, in consequence of recall unreliability. Both extraoral and intraoral examinations were largely based on visual inspection and palpation, and other complementary examination techniques were used when necessary, as for instance inspection through a glass slide for ruling out superficial vascular lesions. Artificial light provided by common dental equipment was used, as well as all other facilities available for the examination, such as sterilized gauze, plane dental mirrors #05, and disposable saliva extractors, gloves, and other biohazard protection material.

Diagnostic criteria were those established by Axéll (10) and WHO (11), complemented by some additional criteria proposed by Flink et al. (12) and Witkop & Barros (13). All examinations were recorded on a special chart developed for this survey, following the recommendations of WHO (11).

In the present study, a distinction was made between oral conditions because of pathologic processes, with either specific etiology, treatment needs, or prognosis, which were here classified as *lesions* or *diseases*, and conditions that, even with a well-established pathogenesis, represented no health impairment, consisted of no treatment need, and have been described in many texts as common and not hazardous to oral health, which were here classified as *variations of normal*. The main purpose of such a distinction was to assess the impact represented by the oral conditions observed on the oral health status of the Indians, and the obvious consequences for the planning and executing of oral health care programs. Examinees were divided into six age strata according to dental as well as social characteristics, but the greater part of age analysis was performed considering only one age cut-point, 0–12 and 13 or more years old. The former group was classified as children, and the latter adults.

Statistical analysis was performed with EpiInfo 2000 (CDC, 2002), and the tests used were chi-square and Fisher's exact tests. The significance level was 0.05. Logistic regression was conducted with the purpose of ruling out confounding in all instances where a statistical result <0.20 was obtained.

Table 1 Composition of sample, according to age group and sex (Waimiri Atroari, 2002)

Age group (years)	*Sex*		*Total, (%)*	*Cumulative percentage (%)*
	Female	*Male*		
0–2	29	39	68 (11.58)	11.58
3–6	65	57	122 (20.78)	32.36
7–12	72	69	141 (24.02)	56.38
13–18	41	32	73 (12.44)	68.82
19–44	81	74	155 (26.41)	95.23
45	10	18	28 (4.77)	100.00
Total	298 (50.77%)	289 (49.23%)	587 (100.00)	

Results

Out of the 922 individuals of the entire population, 587 were examined. Table 1 displays the composition of the sample, which did not differ from the composition of the population itself as regarding age, sex, or village of origin. There were no differences in the rate of individuals from both sexes presenting at least one mucosal condition ($P = 0.417$). On the other hand, differences in this rate were obtained between children and adults: nearly 52.6% of children and 73.4% of adults were affected by at least one oral mucosal condition (Table 2).

The 10 more prevalent conditions were responsible for 87.9% of all cases. The profile of distribution of lesions by number was similar to what has been described in other studies (5): among the 362 individuals with oral mucosal conditions, 68.8% presented only one kind of condition; 25.7%, two superimposed conditions, and 5.5%, three or more conditions. Table 3 depicts the oral conditions found among the Waimiri Atroari, and Table 4 exhibits the clinical and demographic factors associated with some oral mucosal conditions, as shown by logistic regression results.

Discussion

The results of prevalence are in strong accordance with the rate of affected individuals reported in many other studies, involving either children or adults, especially those conducted with similar methodology (one or few examiners, consistently trained in oral diagnosis, covering restricted populations; 5, 14–18), which ranged from 39.0% (15) to 81.3% (5). A few studies with a large geographic area of coverage, with the enrolling of many examiners, not always

Table 2 Rate of examinees affected by oral mucosal conditions among Waimiri Atroari people according to age group (Waimiri Atroari, 2002)

Age group (years)	*Oral mucosal conditions, (%)*		*Total*
	Absent	*Present*	
Children (0–12)	157 (47.43)	174 (52.57)	331
Adults (13+)	68 (26.56)	188 (73.44)	256
Total	225 (38.30)	362 (61.70)	587 (100.0%)

$\chi^2 = 26.58$ (01 degree of freedom); $P < 0.001$.

Table 3 Prevalence of oral mucosal conditions among the Waimiri Atroari (Waimiri Atroari, 2002)

Oral mucosal conditions	*0–12 years*		*13+ years*		*Total, N*	*Overall prevalence (%)*	*P*
	N	*Prevalence (%)*	*n*	*Prevalence (%)*			
Lesions							
Focal epithelial hyperplasia	67	20.1	56	21.9	123	21.0	0.63[a]
Traumatic lesions	15	4.5	20	7.8	35	6.0	0.10[a]
Candidiasis	12	3.6	10	3.9	22	3.7	0.86[a]
Melanotic macule	7	2.1	7	2.7	14	2.4	0.63[a]
Mucocele	9	2.7	4	1.6	13	2.2	0.35[a]
Actinic cheilitis	3	0.9	7	2.7	10	1.7	0.11[b]
Recurrent aphtae	4	1.2	1	0.3	5	0.9	0.39[b]
Perioral nevic lesions	3	0.9	2	0.8	5	0.9	1.00[b]
Amalgam tatoo	0	0.00	5	2.0	5	0.9	0.02[b]
Frictional keratosis	2	0.6	3	1.2	5	0.9	0.66[b]
Scars	3	0.9	2	0.8	5	0.9	1.00[b]
Impetigo	4	1.2	0	0.0	4	0.7	0.14[b]
Reactive lesions	0	0.0	4	1.6	4	0.7	0.04[b]
Vascular lesions	3	0.9	1	0.4	4	0.7	0.64[b]
Fistulae from retained roots	0	0.0	2	0.8	2	0.3	0.19[b]
Primary herpetic gengivostomatits	2	0.6	0	0.0	2	0.3	0.50[b]
Recurrent herpes	1	0.3	0	0.0	1	0.2	1.00[b]
Leukoplakia	0	0.0	1	0.4	1	0.2	0.44[b]
Other lesions	4	1.2	3	1.2	7	1.2	0.73[b]
Total	139	–	128	–	267	–	–
Variations of normal							
Fissured tongue	43	13.00	117	45.7	160	27.3	<0.001[a]
Geographic tongue	25	7.6	4	1.6	29	4.9	<0.001[a]
Fordyce's spots	1	0.3	21	8.2	22	3.8	<0.001[a]
Gingival cysts of newborn	7	2.1	0	0.0	7	1.2	0.02[b]
Leukoedema	6	2.0	0	0.0	6	1.00	0.04[b]
Gingival fibrous nodule	2	0.6	1	0.4	3	0.5	1.00[b]
Lingual varicosities	0	0.0	1	0.4	1	0.2	0.44[b]
Total	83	–	145	–	228	–	–

[a]Chi-square test.
[b]Fisher's exact test.
n = number of persons presenting the condition within the age group.
N = number of persons presenting the condition in both age groups.
Prevalence = (number of persons presenting the condition/number of examinees within the age group) × 100.
Overall prevalence = (number of persons presenting the condition/number of examinees in both age groups) × 100.

previously trained in oral diagnosis, have reported lower rates of individuals presenting oral mucosal conditions (4.1% among children (19) and 9.7% among adults (20)). Such methodologic variability may explain the differences obtained, as they may change diagnostic criteria and ability, and consequently the sensitivity of the survey as a whole.

The distinction made between lesions and variations of normal rendered important conclusions with regard to the assessment of the oral mucosal status of the population as a whole. No differences were found on the rate of patients with oral mucosal diseases as regarding essential demographic criteria of sex, age group, and village of origin. It means that, in the context of oral mucosa health, people of one sex were not less healthy than the other, neither people from one village less healthy than people form other villages, and there were no increase of oral diseases with the ageing of the population. The increase in the rate of patients with oral mucosa conditions with age was because of variations of

Table 4 Associations of clinical or demographic factors to the occurrence of oral mucosal conditions according to logistic regression results (Waimiri Atroari. 2002)

Condition studied	*Variable (demographic or clinical factor)*	*OR*	*95% CI*		*P*
			Lower	*Higher*	
Traumatic lesions	Age in years	1.022	1.001	1.043	0.038
Candidiasis	Use of prosthetic appliances	8.452	2.822	25.316	<0.001
Fissured tongue	Adult age group	5.828	3.873	8.768	<0.001
	Male sex	1.745	1.174	2.591	0.006
Geographic tongue	Group of patients comprising children under 2 years old + pregnant/nursing women	9.244	4.149	20.595	<0.001
	Children age group	6.993	2.320	20.833	<0.001
Fordyce's spots	Adult age group	33.437	4.430	252.380	<0.001

normal, and not caused by diseases. All differences obtained between patients form different groups of these demographic criteria referred to variations of normal, as expected by the characteristics of the conditions themselves. A clear example was fissured tongue, which was found more prevalent among men from the adult age group, and this profile of occurrence of this condition has been reported in many studies (13, 21, 22). Some specific conditions will be discussed separately below.

Focal epithelial hyperplasia

Focal epithelial hyperplasia was the most prevalent lesion of the oral mucosa among the Waimiri Atroari, reaching 21.0%, with no differences between age and sex group. This condition represented the only diagnosis in 13.3% of children and 8.6% of adults. The finding of a high prevalence of this condition is not surprising, as it was initially been described as typical of Indian communities of the American continents and Eskimo people (23, 24), although later it has been described in many other populations and patients (2, 25). Praetorious-Claussen (24) had informed the prevalence of FEH as 35.8% in Greenland, and Garrafa (26) reported it as 7.4% among Xavante and Bororo Indians in Brazil. So, the prevalence of this condition among the Waimiri Atroari was intermediate between what is stated in these reports. Younger patients with FEH had multiple lesions, which were predominantly nodular, fairly exophytic, whereas older patients had few or even single lesions, with a great tendency to be more flat and papular. The occurrence of FEH among the Waimiri Atroari Indians can be understood according to the statement of Harris & van Wyk (2): their communal way of life, sharing of food and objects, limited hygiene conditions, and possibly dietary factors may be responsible for its prevalence, as it is an infectious disease.

Traumatic lesions

Traumatic lesions together constituted a group of lesions that had the second higher prevalence among the Waimiri Atroari. No differences were found as regarding sex or age group. However, in logistic regression results, age was associated with the occurrence of all traumatic lesions altogether, as confirmed by the finding of an odds ratio (OR) = 1.022 to each year of increase in age (95% CI: 1.001–1.043; $P = 0.04$). Axéll (10) and Reichart (27) reported diminution of prevalence of traumatic lesions with the increase of age; both investigators studied adult populations. Bessa (28), on the other hand, found the inverse among children aged 0–12 years, reporting greater prevalence of traumatic lesions in the age group 5–12 years old as opposed to age group 0–4 years old. The similarity of the present results and the latter may be explained by the young composition of the sample. Perhaps, were the Waimiri Atroari older, with more significant dental history such as loss and substitution of teeth by prosthetic appliances with passing of age, as it is common in adult Western populations, the occurrence of traumatic lesions would follow the same patterns.

Candidiasis

Candidal infection of the oral mucosa was the third more prevalent pathologic process observed among the Waimiri Atroari. Although candidiasis was diagnosed in children as often as in adults, no case of the pseudomembranous clinical form ('trush') was found. Erythematous candidiasis was the main clinical form identified, followed by angular cheilitis. No age or sex difference was found, and logistic regression showed that it was undoubtedly associated with the use of prosthetic appliances (OR = 8.452; 95% CI: 2.822–25.316; $P < 0.001$). This is in accordance to the majority of studies about candidiasis (27, 29). No other clinical factors were associated with the occurrence of candidiasis, as though in Western civilization some other habits were proved to be related to it, as the use of pacifiers by children or use of antibiotics (29). As the Waimiri Atroari do not have these habits, this lack of association of candidiasis to clinical factors except the use of prosthetic appliances was expected.

Actinic cheilitis (AC)

Actinic cheilitis was found in the Waimiri Atroari population mainly in an acute clinical form, with typical desquamative, eroded lesions of the inferior lip in people with tanned or sun-burned skin. Out of 10 cases, 9 had this aspect, but 1 had the typical features of chronic AC. Although 1.7% does not seem to be a high prevalence for an oral mucosal condition, it is noteworthy when one considers that chronic AC is recognized as a pre-malignant lesion (30). AC could become a public health problem for all Waimiri Atroari Indians, as they live in a land trespassed by the Equator line, with intense sun irradiation, and they expose themselves to sunlight for long periods during the day. Preventive measures should be implemented to avoid the occurrence of this lesion, and treatment and close follow-up are urged to be given to patients affected. Similar worries were exposed by Lookingbill et al. (31), among albino people in Tanzania, dealing not only with mouth lesions but also with skin damage to intense sun exposure.

Herpetic lesions

Curiously, herpetic lesions constituted very few cases (two cases of primary herpetic gingivostomatitis (HG) and one *herpes labialis* (HL)). It is still noteworthy that, considering only clinically present lesions – as reliable history of herpes could not be obtained – HG was more diagnosed than recurrent HL, and both conditions were found only in children; no adult had herpetic lesions. Despite the reduced number of diagnosis of this infection, some comments may be made. This pattern of manifestation of herpes simplex infection is in accordance to the model of circulation of pathogens within closed primitive communities proposed by Black (32), which suggests that ancient pathogens could be maintained in small primitive societies because they attained an equilibrium with the hosts. This model of infection has been used to explain the benign pattern of infection of many viruses and bacteria within primitive societies. For instance, human herpes virus 8 (HHV-8) has been found to be hyperendemic among Brazilian Indians, not causing Kaposi's sarcoma (33). Besides this, the finding of herpetic disease in children to be more frequent than in adults might be explained by the age profile of the population studied, as HG is far more frequent among children. Solar exposure did not seem to act as an important predisposing factor to HL

among the Waimiri Atroari Indians, as reported elsewhere (34).

Fissured tongue (FT)
A high prevalence of fissure tongue, in comparison to many reports (21, 22, 35), was found among the Waimiri Atroari (27.3%). However, Kovac-Kavcic & Skaleric (18) reported the prevalence of this condition in Ljubljana, Slovenia, as being 21.1%, using quite simple and sensitive criteria. Diagnostic criteria of Witkop & Barros (13) were used in the present survey, and they are also simple and sensitive. It may have contributed to the finding of a high prevalence. FT was one of the two conditions that had different prevalences between sexes, being more prevalent among men (as well as the other condition, Fordyce's spots). FT was also more prevalent in the older age group, and both these characteristics of higher prevalences in men and in older people are in accordance to the literature (21, 22, 35).

Geographic tongue (GT)
Geographic tongue had an overall prevalence of 4.9%, similar to data found in literature (22, 35, 36). This condition, classified as variation of normal, occurred frankly in higher prevalence among children, reflecting what is known in the literature about its tendency to affect younger patients (21, 22). Nevertheless, an interesting result was disclosed by logistic regression, which was a positive OR associating GT to a group of patients composed of children up to 2 years old and pregnant or nursing women (OR = 9.244; 95% CI: 4.149–20.595; $P < 0.001$). As the majority of GT patients were very young children, this result must be interpreted only in favor to the well-established association of GT and young age, as only four patients with this condition were in the adult age group. As the survey was going on, all GT cases were identified among very young children, and the first three cases of GT in adults were identified precisely among pregnant or nursing women. Only one case was diagnosed in an adult male. The attempt to find a common characteristic of pregnant or nursing women with all other GT patients was addressed to hormonal characteristics, based on the report of Waltimo (37), of GT related to the hormonal cycle of a female patient in use of oral contraceptives. In the present series, growth hormone and other related hormones were thought to possibly play a role in the development of GT. However, the methodology of the study and the small number of patients with the condition prevent any conclusion to be drawn. Other studies are necessary to elucidate the subject.

Fordyce's spots
Fordyce's spots were diagnosed exclusively among men, and almost exclusively among adults. Its overall prevalence was 3.8% and exclusively among adults 8.2%. Data of prevalence of this condition in Eastern populations tend to show low numbers (38, 39), whereas in Western countries, much higher prevalences have been reported (10, 27). Axéll (10) reported its prevalence as high as 82.8% in Sweden. Many studies have reported Fordyce's spots to be more prevalent among men than among women (10, 27). Nevertheless, this condition has been reasonably identified in women, what did not occur at all in this survey. Environmental and genetic factors might play a role in this difference, which remains unexplained for the time being.

Leukoplakia
Only one case of leukoplakia was diagnosed, in a man in the sixtieth decade of life. This only case can be explained on an idiopathic basis. Corbet et al. (38) found a similar prevalence among elderly Chinese and also explained their finding as leukoplakia of idiopathic origin. A low prevalence of leukoplakia was expected, as the Waimiri Atroari remain free from oral habits of tobacco consumption, either smoked or not, and alcohol drinking, and as they are not known to consume any other carcinogenic product.

Conclusions

With the exception of FEH, the oral mucosal conditions observed among the Waimiri Atroari group were essentially the same that have been reported as common in the literature, with similar prevalences. The occurrence of oral mucosal conditions in this group is related to its communal, traditional way of life, and also to the interaction with environment. Clear examples of this are FEH or actinic cheilitis. The absence of oral habits in this population reflects positively in their oral mucosal health, as can be seen by the low prevalence of candidal infection among children and the rarity of leukoplakia.

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