RESEARCH COMMUNICATION

Prevalence and Correlation of Oral Lesions among Tobacco Smokers, Tobacco Chewers, Areca Nut and Alcohol Users

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Abstract

<u>Introduction</u>: The incidence of oral premalignant and malignant lesions is on the rise due to an increased number of people taking in tobacco and alcohol related habits. <u>Material and Methods</u>: 1028 patients with tobacco, alcohol and areca nut habits attending our Department of Oral Medicine and Radiology formed the study sample. An interviewer based questionnaire was used to record the habit details. All the patients were then examined clinically for the presence of lesions. Chi square and Fisher exact tests were used to assess the statistical significance of the study parameters. <u>Results</u>: Males had a higher prevalence and comprised 87.9% of the sample. The commonest habit in this study sample was smoking (39.2%) followed by smokeless tobacco use (28.1%). Out of the 1028 patients with habits 40% had no clinically detectable changes in their mucosa. Of the mucosal changes leukoplakia (14%) was the commonest. <u>Conclusions</u>: This study provided information about the habit trends in the patients visiting this institution. The study may serve as a useful tool in educating the patients about the deleterious effects of oral tobacco, alcohol and betel exposure.

Keywords: Tobacco - betel chewers mucosa - leukoplakia - oral submucous fibrosis

Introduction

The concept of certain precancerous lesions proceeding into oral cancer has long been accepted (Gupta et al., 1989; Yen et al., 2007). According to a workshop co-ordinated by WHO in May 2005 at London the use of the term 'Potentially malignant disorders' was recommended. The usage of this terminology conveys that not all lesions and conditions described under this term may transform to cancer, instead there is a family of morphological alterations amongst which some may have an increased potential for malignant transformation (Warnakulasuriya et al., 2007; Chong et al., 2011).

Tobacco and alcohol have been established as risk factors for the development of such potentially malignant and malignant disorders of the oral mucosa (Jaber et al., 1999; Moreno-Lopez et al., 2000; Lee et al., 2003; Znaor et al., 2003; Saraswathi et al., 2006; Yen et al., 2007; Cebeci et al., 2009; Javed et al., 2010). In South India chewing betel quid/ paan (betel leaf enclosing sliced areca nut, catechu, lime and various other spices which may or may not contain tobacco) (Warnakulasuriya et al., 2002; Rani et al., 2003; Aruna et al., 2011) is a common habit but the evidence for cancer occurrence due to this habit without tobacco is limited (Znaor et al., 2003; Lee et al., 2005). 'Quid' has been defined as ' a substance or mixture of substances, placed in the mouth or chewed and remaining in contact with the mucosa usually containing one or both of the two basic ingredients, tobacco and/or areca nut, in raw or any manufactured of processed form (Mehta

et al., 1993; Jacob et al., 2004; Lee et al., 2005). Gutka is a mixture of powdered tobacco, areca nut, and slaked lime (aqueous calcium hydroxide). Some other forms of smokeless tobacco products commonly used in the Indian subcontinent are khaini, zarda which are mixtures of powdered tobacco and slaked lime and mishri a powdered form of tobacco which is rubbed on the gums (Rani et al., 2003; Javed et al., 2010). According to a re-evaluation in 2004 by the International Agency for Research of Cancer both betel quid and areca nut have been considered to be Group 1 or 'carcinogenic to humans' (Jacob et al., 2004; Lee et al., 2005). In India tobacco is most commonly smoked in the form of cigarettes or bidis. A bidi is a crude form of smoked tobacco which is 4-8 cm in length containing 0.25-0.50g of coarse ground tobacco, rolled into a cone in a dried piece of temburni leaf (Mehta et al., 1993; Znaor et al., 2003). Patients with a combination of these above mentioned habits are frequently found in the Indian population and are considered to be at a higher risk of developing oral lesions due to the added and prolonged exposure to carcinogens (Aruna et al., 2011).

There is a dearth epidemiologic studies which provide important information to understand the incidence, prevalence, and severity of oral disease in a specific population (Cebeci et al., 2009; Aruna et al., 2011; Goodson et al., 2011; Kumar et al., 2011). Especially little data has been published on dose-response relationships of oral habits and pre-malignancy. Establishing dose-response relationships is important because such information provides evidence to educate users about

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the deleterious effects of such habits and to reduce the quantity or completely stop such habits. The purpose of the present study was to know the prevalence of tobacco, areca nut, betel quid and alcohol associated lesions only among patients with these habits and to correlate the dose response relationship of oral habits with potentially malignant oral lesions among this subset of the population.

Materials and Methods

Study population

All individuals who had the habit of using tobacco (chewed or smoked forms), alcohol and areca nut and betel quid were included in the study. Patients who were unwilling to give the complete habit details were excluded. 1028 patients attending the Department of Oral Medicine and Radiology with alcohol, betel quid or tobacco associated habits formed the cohort of our study. An ethical clearance was obtained from the institutional review board and the study was carried out from July 2010 to March 2011.

Screening programme

All the patients were informed regarding the study and an informed consent was obtained. Following which they were interviewed for their adverse habits and examined by the same researcher for the presence of any oral lesions.

Along with patient's demographic details, information regarding the type of habit, duration, frequency, site of placement, period of contact with the mucosa and history of discontinuation of habit were recorded using the standardized interviewer based questionnaire. All the patients were then clinically examined using mouth mirrors under artificial illumination. If a lesion was clinically judged as suspicious for malignancy punch biopsy was performed.

Leukoplakia was defined as a raised white patch of the oral mucosa measuring 5mm or more, which could not be scraped off and could not be attributed to any other diagnosable disease. The diagnosis of leukoplakia was a provisional clinical diagnosis with a certainty factor C1 (Van der Waal et al., 2002). Oral lichen planus was diagnosed on the basis of presence of Wickham's striae and oral submucous fibrosis on the basis of presence of blanching and palpable fibrous bands. Betel chewers mucosa is a condition caused by direct chemical or indirect traumatic effects of quid leading to a desquamated or peeled mucosa which may have a wrinkled appearance. Quid-induced lichenoid oral lesion is an entity that resembles oral lichen planus. It is characterized by the presence of wavy white lines that radiate from a central erythematous area and occurs at the site of betel quid placement (Avon, 2004). All the lesions were diagnosed in accordance with international recommendations (World Health Organization, 1977; Axell et al., 1984; Gupta et al., 1989; Mehta et al., 1993; Zain et al., 1996; Rajalalitha et al., 2005).

Statistical analysis

Descriptive statistical analysis was carried out in the present study. Significance was assessed at 5 % level of
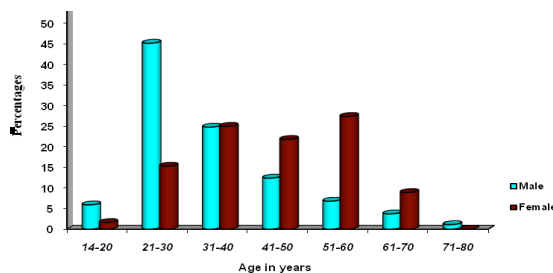
Figure 1. Depicting the Age and Gender Distribution of the Study Population

significance. Chi-square/ Fisher Exact test was used to find the significance of study parameters on categorical scale between two or more groups. The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1 ,Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data.

Results

Demographic data

The total sample size of 1028 patients consisted of 904 (87.9%) males and 124 (12.1%) females aged between 14 – 80 years. In males maximum of 41.6% (n=428) belonged to the 21-30 years age group and in females 27.4% (n=34) belonged to the 51-60 age group. Figure 1 shows declining number of male patients with habits as the age increased whereas a reverse was observed in females with increase in number as age progressed.

Based on education, 449 (49.7%) of the males had

Table 1. Distribution of the Study Population Based on Habits

Habits	Total		Male		Female	
	No	%	No	%	No	%
>1 habit	226	22.0	218	24.1	8	6.5
>2 habits	19	1.8	19	2.1	0	0.0
Alcohol	13	1.3	13	1.4	0	0.0
Areca nut habit	78	7.6	18	1.9	60	48.4
Smoked tobacco	403	39.2	403	44.6	0	0.0
Smokeless tobacco	289	28.1	233	25.8	56	45.2
Total	1028	100.0	904	100.0	124	100.0

Table 2. Depicts Prevalence of Various Lesions in the Study Population

Habits	Total		Male		Female	
	No	%	No	%	No	%
No changes	411	40.0	369	40.8	42	33.8
Smoker's melanosis	121	11.8	121	13.4	0	0.0
Smoker's palate	62	6.0	62	6.9	0	0.0
Leukedema	73	7.1	73	8.1	0	0.0
Betel chewers mucosa	29	2.8	6	0.7	23	18.5
Tobacco induced keratosis	42	4.1	37	4.1	5	4.0
Lichenoid reaction	23	2.2	23	2.5	0	0.0
Lichen planus	8	0.8	8	0.9	0	0.0
Leukoplakia	144	14.0	120	13.3	24	19.4
OSMF	84	8.2	65	7.2	19	15.3
Malignancy	8	0.8	2	0.2	6	4.8
> 1 lesion	23	2.2	18	1.9	5	4.0
Total	1028	100.0	904	100.0	124	100.0

Table 3. Prevalence of Lesions in Relation to Various habits and the Significance of Association

Lesion	Habits						P value
	>1 habit	>2 habits	Alcohol	Areca nut habit	Smoked tobacco	Smokeless tobacco	
No changes	70 (31%)	10 (52.6%)	12 (92.3%)	40 (51.3%)	154 (38.2%)	125 (43.3%)	<0.001**
Smoker's melanosis	23 (10.2%)	5 (26.3%)	0 (0%)	0 (0%)	93 (23.1%)	0 (0%)	<0.001**
Smoker's palate	14 (6.2%)	0 (0%)	0 (0%)	0 (0%)	48 (11.9%)	0 (0%)	<0.001**
Leukedema	28 (12.4%)	2 (10.5%)	1 (7.7%)	0 (0%)	42 (10.4%)	0 (0%)	<0.001**
Betel chewers mucosa	1 (0.4%)	0 (0%)	0 (0%)	18 (23.1%)	0 (0%)	10 (3.5%)	<0.001**
Tobacco induced keratosis	14 (6.2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	28 (9.7%)	<0.001**
Lichenoid reaction	3 (1.3%)	0 (0%)	0 (0%)	3 (3.8%)	0 (0%)	17 (5.9%)	<0.001**
Lichen planus	3 (1.3%)	0 (0%)	0 (0%)	0 (0%)	2 (0.5%)	3 (1%)	0.790
Leukoplakia	40 (17.7%)	1 (5.3%)	0 (0%)	7 (9%)	58 (14.4%)	38 (13.1%)	0.181
OSMF	20 (8.8%)	1 (5.3%)	0 (0%)	7 (9%)	0 (0%)	56 (19.4%)	<0.001**
Malignancy	2 (0.9%)	0 (0%)	0 (0%)	0 (0%)	1 (0.2%)	5 (1.7%)	0.331
> 1 lesion	8 (3.5%)	0 (0%)	0 (0%)	3 (3.8%)	5 (1.2%)	7 (2.4%)	0.034*
Total	226 (100%)	19 (100%)	13 (100%)	78 (100%)	403 (100%)	289 (100%)	-

*Moderately significant (P value:0.01<P ≤ 0.05), **Strongly significant (P value : P≤0.01)

Table 4. Dose Response Relationship between Frequency of Habits and Oral Lesions

Type of lesion	Frequency of habits			
	1-5 times	5-10 times	10-15times	>15times
No changes	304 (55.27%)	80 (27.77%)	14 (17.28%)	13 (11.92%)
Smoker's melanosis	49 (8.90%)	35 (12.15%)	14 (17.28%)	23 (21.10%)
Smoker's palate	21 (3.81%)	22 (9.64%)	5 (6.17%)	14 (12.84%)
Leukedema	21 (3.81%)	30 (10.41%)	14 (17.28%)	8 (7.33%)
Betel chewers mucosa	18 (3.27%)	9 (3.12%)	2 (2.46%)	-
Tobacco induced keratosis	25 (4.54%)	11 (3.81%)	2 (2.46%)	4 (3.66%)
Lichenoid reaction	12 (2.18%)	8 (2.77%)	1 (1.23%)	2 (1.83%)
Lichen planus	6 (1.09%)	2 (0.69%)	-	-
Leukoplakia	48 (8.72%)	53 (18.40%)	14 (17.28%)	29 (26.60%)
OSMF	39 (7.09%)	24 (8.33%)	11 (13.58%)	10 (9.17%)
Malignancy	2 (0.36%)	4 (1.38%)	-	2 (1.83%)
> 1 lesion	5 (0.90%)	10 (3.47%)	4 (4.93%)	4 (3.66%)
Total	550 (100%)	288 (100%)	81 (100%)	109 (100%)

an education till high school level whereas in females 93 (75%) of them were uneducated. According to occupation 572 (63.3%) men were unskilled and 289 (39.1%) were skilled, while in women the highest number were housewives 73 (58.9%) and 47 (37.9%) unskilled workers. Distribution of habits: Table 1 depicts the habits included in this study were smoked tobacco (cigarette and beedis), smokeless tobacco (betel quid with tobacco and refined tobacco products like gutkha, zarda and khaini), alcohol, areca nut habit (betel quid without tobacco, powdered areca nut like supari). More than 1 habit group included patients with combination of two habits both smoking and

drinking, smoking and chewed tobacco or chewed tobacco and drinking alcohol. More than 2 habits group included patients with three habits like smoking, chewed tobacco and drinking alcohol.

Table 2 depicts out of the 1028 patients studied, the overall prevalence of smoking was 39.2% (n=403), smokeless tobacco was 28.1% (n=289), areca nut habit was 7.6% (n=78) and only alcohol drinking was 1.3% (n=13). According to gender distribution, males had the highest frequency of smoking 44.6% (n=403) followed by smokeless tobacco 25.8% (n=233), while in females areca nut habit was the commonest habit 48.4% (n=60) followed by smokeless tobacco 45.2% (n=56). None of the female patients consumed only alcohol or used smoked tobacco. The frequency of habits was recorded with maximum patients lying in the 3-5times/ day 28.9% (n=298) and 5-10times/day 28.1% (n=288) groups. Based on the duration of habits, most of the men were in the 2-5 years 24.2% (n=251) to 5-10yrs 24.8% (n=243) group and 34.7% (n= 43) of females were in the more than 15years group.

Prevalence of Lesions (Table 3): Of the 1028 patients 40% (n=411) of patients revealed no clinically detectable changes in their mucosa. Of the remaining patients leukoplakia was the highest 14% (n=144), followed by smoker's melanosis 11.8% (n=121) and OSMF 8.2% (n=84). Among males the commonest lesions were smoker's melanosis 13.4% (n=121) leukoplakia 13.3% (n=120) and leukedema 8.1% (n=73) while in females it was leukoplakia 19.4% (n=24), betel chewer's mucosa 18.5% (n=23) and OSMF 15.3% (n=19).

Correlation of oral lesions to habits (Table 4): Among patients who used smoked tobacco the mucosa had no clinically detectable changes in 38.2% (n=154) patients, smoker's melsnosis 23.1% (n=93) was the most common condition followed by leukoplakia 14.4% (n=58) and smoker's palate 11.9% (n=48). Among smokeless tobacco users no clinically detectable changes were detected in 43.3% (n=125) patients, OSMF 19.4% (n=56), leukoplakia 13.1% (n=38) and tobacco induced keratosis 9.7% (n=28) were more commonly seen. Among areca

Table 5. Correlation of Lesions with Duration of Habits

Lesion	Duration of Habits					
	<6 months	6 m-2 years	2- 5 years	5-10 years	10-15 years	>15 years
No changes	33 (80.5%)	99 (53.8%)	143 (57%)	87 (35.8%)	18 (20%)	31 (14.2%)
Smoker's melanosis	0 (0%)	9 (4.9%)	16 (6.4%)	36 (14.8%)	18 (20%)	42 (19.2%)
Smoker's palate	0 (0%)	10 (5.4%)	7 (2.8%)	19 (7.8%)	4 (4.4%)	22 (10%)
Leukedema	0 (0%)	4 (2.2%)	14 (5.6%)	14 (5.8%)	12 (13.3%)	29 (13.2%)
Betel chewers mucosa	2 (4.9%)	3 (1.6%)	4 (1.6%)	6 (2.5%)	4 (4.4%)	10 (4.6%)
Tobacco induced keratosis	0 (0%)	10 (5.4%)	9 (3.6%)	13 (5.3%)	1 (1.1%)	9 (4.1%)
Lichenoid reaction	4 (9.8%)	12 (6.5%)	2 (0.8%)	4 (1.6%)	1 (1.1%)	0 (0%)
Lichen planus	0 (0%)	0 (0%)	3 (1.2%)	0 (0%)	0 (0%)	5 (2.3%)
Leukoplakia	0 (0%)	11 (6%)	23 (9.2%)	37 (15.2%)	23 (25.6%)	50 (22.8%)
OSMF	2 (4.9%)	17 (9.2%)	28 (11.2%)	22 (9.1%)	8 (8.9%)	7 (3.2%)
Malignancy	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	8 (3.7%)
> 1 lesion	0 (0%)	9 (4.9%)	2 (0.8%)	5 (2.1%)	1 (1.1%)	6 (2.7%)
Total	41 (100%)	184 (100%)	251 (100%)	243 (100%)	90 (100%)	219 (100%)

nut users no changes were detected in 51.3% (n=40) of patients, betel chewer's mucosa 23.1% (n=18) followed by OSMF 9% (n=7) and leukoplakia 9% (n=7) were the most commonly seen lesions. Of the 13 patients with the habit of consuming alcohol no changes were detected in 92.3% (n=12) patients and leukedema in 1 (7.7%) patient.

Of the 226 patients with a combination of two habits only 31% (n=70) had no detectable changes and the commonest lesions in the decreasing order of frequency were leukoplakia 17.7%, leukedema 12.4%, smoker's melanosis 10.2%, OSMF at 8.8% and 6.2% cases of smoker's palate and tobacco induced keratosis. Also 2 out of 8 cases of malignancy occurred in patients with more than 1 habit. Among the 1028 study population 19 patients had a combination of three habits. In these 19 patients 12 (52.6%) had no detectable lesions Smoker's melanosis at 26.3% was the commonest lesion among these patients followed by 10.5% leukedema 5.3% leukoplakia.

Table 5 depicts a significant correlation of occurrence of lesions with the duration of habit. All the 8 cases of malignancy were found in patients with duration of habits of more than 15yrs. A significantly high number of leukoplakias were also found as the duration of habits increased with 23 cases in 10 to 15yr duration and 50 cases in more than 15yrs group. Lesions like lichenoid reaction and OSMF showed a trend of early occurrence and were not associated with the duration of habit.

Discussion

Three routes for progression to cancer have been proposed: oral leukoplakia/ erythroplakia- cancer, oral submucous fibrosis – cancer sequence and oral lichen planus – cancer. (Yen et al., 2007). Hence knowing the prevalence of these precursor lesions and treating them before they progress to malignancy should be the goal of preventive oral health care workers (Van der Waal et al., 2011).

The prevalence of adverse oral habits was found to be much higher in males as compared to females in this study and is in accordance with the other studies (Jaber et al., 1999; Rani et al., 2003; Saraswathi et al., 2006;). The consumption of alcohol was 1.3% which was the lowest compared to other habits and coincides with a study

performed in Hubli India (Aruna et al., 2011). In this study population the overall education of 45.8% was till high school level while around 18% of patients were degree or diploma holders which is slightly lower when compared to a study conducted in 2004 at Chennai (Saraswathi et al., 2006). 75% of the female patients in this study were illiterate and the remaining with only school level education. The lack of awareness of the harmful effects of consumption of tobacco products is reflected by this low level of education.

Based on occupation the largest numbers of patients (60.2%) were unskilled which included people with occupations like laborers, daily wagers, cleaners, maids, drivers, farmers etc. Most of these occupations require a substantial amount of physical energy and a high level of concentration in case of drivers with odd work timings. This can be stressful which in combination of peer pressure can lead to the initiation of deleterious oral habits.

As this study population included only those patients with habits and not all the routine patients attending the department the prevalence of oral lesions is much higher than those recorded by most prevalence studies. The duration and frequency of habits has a significant effect on the development of oral lesions which can be noted in the findings of the present study as well as in another previous study (Yen et al., 2007; Aruna et al., 2011). Patients with the habit frequency of 5 to 10 times in a day had the maximum number of lesions. Patients with a combination of habits had fewer lesions, the possible reason being reduced time of contact or exposure to each individual habit.

In conclusion, the results of the present study throw some light on the habit trends in the institution where this study has been conducted. As parameters like education, occupation have been combined with the age and gender of the patients more meaningful information is obtained regarding the prevalence of deleterious habits. The limitations of this study include potential information bias as self reporting by the patient was used to collect the information hence underreporting of habits could have taken place. Another possible flaw could be detection bias as the researcher was aware of the habit history of the patient prior to oral examination. In future research the examiner can be blinded to the habit details and should

examine the oral cavity first to prevent such bias.

Further studies including comparisons of demographic data as well as dose response relationship with oral lesions with larger sample size and in the general population need to be performed. Studies observing the effects of cessation of oral habits are sparse (Martin et al., 1999; Lodi et al., 2008) hence there is no evidence regarding the chances of reversal of altered mucosa and studies need to be performed in this regard. The results of such studies can be a great tool in educating patients regarding the adverse effects of tobacco, alcohol and betel quid habits.

References

Aruna DS, Prasad KV, Shavi GR, et al (2011). Retrospective study on risk habits among oral cancer patients in Karnataka Cancer Therapy and Research Institute, Hubli, India. *Asian Pacific J Cancer Prev*, **12**, 1561-6.

Avon SL (2004). Oral mucosal lesions associated with use of quid. *J Can Dent Assoc*, **70**, 244-8.

Axell T, Holmstrup P, Kramer IRH, et al (1984). International seminar on oral leukoplakia and associated lesions related to tobacco habits. *Community Dent Oral Epidemiol*, **12**, 145-54.

Cebeci AR, Gülşahı A, Kamburoğlu K, et al (2009). Prevalence and distribution of oral mucosal lesions in an adult turkish population. *Med Oral Patol Oral Cir Bucal*, **14**, 272-7.

Goodson ML, Thomson PJ (2011). Management of oral carcinoma: benefits of early precancerous intervention. *Br J Oral Maxillofacial Surg*, **49**, 88-91.

Gupta PC, Bhonsle R, Murti PR, et al (1989). An epidemiologic assessment of cancer risk in oral precancerous lesions in India with special reference to nodular leukoplakia. *Cancer*, **63**, 2247-52.

Jaber MA, Porter SR, Gilthorpe, et al (1999). Risk factors for oral epithelial dysplasia the role of smoking and alcohol. *Oral Oncology*, **35**, 151-6.

Jacob BJ, Straif K, Thomas G, et al (2004). Betel quid without tobacco as a risk factor for oral precancers. *Oral Oncology*, **40**, 697-704.

Javed F, Chotai M, Mehmood A, et al (2010). Oral mucosal disorders associated with habitual gutka usage: a review. Oral Surg Oral Med Oral Pathol Oral Radiol Endod, **109**, 857-64.

Kumar Y, Mishra G, Gupta S, et al (2011). Cancer screening for women living in urban slums - acceptance and satisfaction. *Asian Pacific J Cancer Prev*, **12**, 1681-5.

Lee CH, Ko YC, Huang HL, et al (2003). The precancer risk of betel quid chewing, tobacco use and alcohol consumption in oral leukoplakia and oral submucous fibrosis in southern Taiwan. *Br J Cancer*, **88**, 366-72.

Lee KW, Kuo WR, Tsai SM, et al (2005). Different impact from betel quid, alcohol and cigarette: Risk factors for pharyngeal and laryngeal cancer. *Int J Cancer*, **117**, 831-6.

Lodi G, Porter S (2008). Management of potentially malignant disorders: evidence and critique. *J Oral Pathol Med*, **37**, 63-9.

Martin GC, Brown JP, Eifler CW et al (1999). Oral leukoplakia status six weeks after cessation of smokeless tobacco use. *J Am Dent Assoc*, **130**, 945-54.

Mehta FS, Hamner JE (1993). Tobacco related oral mucosal lesions and conditions in India. New Delhi, Jaypee Brothers Medical Publishers.

Moreno-Lopez LA, Esparza-Gomez GC, Gonzalez-Navarro A, et al (2000). Risk of oral cancer associated with tobacco smoking, alcohol consumption and oral hygiene: a case-control study in Madrid, Spain. *Oral Oncol*, **36**, 170-4.

Rajalalitha P, Vali S (2005). Molecular pathogenensis of oral submucous fibrosis – a collagen metabolic disorder. *J Oral Pathol Med*, **34**, 321-8.

Rani M, Bonu S, Jha P, et al (2003). Tobacco use in India: prevalence and predictors of smoking and chewing in a national cross sectional household survey. *Tobacco Control*, **12**, 4.

Saraswathi TR, Ranganathan K, Shanmugan S, et al (2006). Prevalence of oral lesions in relation to habits: Cross sectional study in South India. *Ind J Dent Res*, **17**, 121-5.

Siar CH, Mah MC, Gill PP (2011) Risk of the contralateral mucosa in patients with oral potentially malignant disorders. *Asian Pac J Cancer Prev*, **12**, 631-5.

Van der Waal I, Axell T (2002). Oral leukoplakia: a proposal for uniform reporting. *Oral Oncol*, **38**, 521-6.

Van der Waal I, de Bree R, Brakenhoff R et al. (2011). Early diagnosis in primary oral cancer: is it possible? *Med Oral Patol Oral Cir Bucal*, **16**, 300-5.

Warnakulasuriya S, Trivedy C, Peters TJ (2002). Areca nut use: an independent risk factor for oral cancer. *BMJ*, **324**, 799-800.

Warnakulasuriya S, Johnson NW, van der Waal I (2007). Nomenclature and classification of potentially malignant disorders of the oral mucosa. *J Oral Pathol Med*, **36**, 575-80.

World Health Organization (1977). Guide to epidemiology and diagnosis of oral mucosal diseases and conditions. *Community Dent Oral Epidemiol*, **8**, 1-26.

Yen AM, Chen SC, Chen TH (2007). Dose-response relationships of oral habit associated with the risk of oral pre-malignant lesions among men who chew betel quid. *Oral Oncology*, **43**, 634-8.

Zain RB, Ikeda N, Gupta PC, et al (1996). Oral mucosal lesions associated with betel quid, areca nut and tobacco chewing habits: consensus from a workshop held in Kuala Lumpur, Malaysia, 1996. *J Oral Pathol Med*, **28**, 1-4.

Znaor A, Brennan P, Gajalakshmi V, et al (2003). Independent and combined effects of tobacco smoking, chewing and alcohol drinking on the risk of oral, pharyngeal and esophageal cancers in Indian men. *Int J Cancer*, **105**, 681-6.