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Incidence rates for oral leukoplakia and lichen planus in a Japanese population

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BACKGROUND: Data on the incidence rates of potentially malignant diseases of the oral cavity in different populations is meagre. This is the first study to report on the age-specific incidence of oral leukoplakia and oral lichen planus from an industrialized country.

METHODS: Annual screening for oral cancer and precancer was undertaken in Municipal Health Centres in Tokoname city, Japan from 1995 to 1998. A total of 9536 volunteers aged 40–95 years participated in this programme. A cohort of 6340 (67%) subjects attended annual mouth examinations following a negative screen result at entry, allowing 13 072 person-years of observations. Some associated risk factors (tobacco and alcohol misuse) and health-related variables were also evaluated.

RESULTS: Over a 4-year follow-up period, 18 new oral leukoplakias (all homogenous; 11 idiopathic and seven tobacco-associated) and 24 oral lichen planus (22 reticular, one erythematous and one ulcerative) were detected at screening and confirmed by re-examination at specialist units. The age-adjusted incidence rate for leukoplakia was 409.2 (95% CI: 90.6–727.9) in male and 70.0 (95% CI: 17.9–121.8) in female per 100 000 person-years observations. For lichen planus, the corresponding rates were 59.7 (95% CI: 7.4–112.1) and 188.0 (95% CI: 96.0–280.1). The age-adjusted incidence rate for tobacco-associated leukoplakia in males was almost 12 times compared with female (560.3 vs. 45.2 per 100 000). Age-specific incidence rates for oral leukoplakia varied by age groups. New oral leukoplakias were more prevalent on gingival/alveolar ridge (33.3%) than in other oral sites, and lichen planus at buccal site (33.3%). Prevalence of smoking habits among those positive for leukoplakia (38.9%) was higher compared with the screen-negatives (26.4%) but these differences did not reach statistical significance ($P = 0.232$). Regular drinking was not related to occurrence of either oral leukoplakia or oral lichen planus. In cases with diabetes mellitus, relative risk for oral lichen planus adjusted by logistic regression was 6.4 (95% CI: 2.4–17.6), suggesting an association.

CONCLUSIONS: The reported incidence rates for oral leukoplakia in this Japanese population are somewhat higher to those reported from India, the risk habits of the two groups being markedly different. The reported rates for oral leukoplakia and lichen planus allow estimation of service needs in specialist oral medicine clinics and for the training of primary care dentists. A high incidence of idiopathic leukoplakia found in this study raises challenges to the strategy of screening high-risk populations aimed at conserving resources.

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Introduction

Incidence studies reporting on potentially malignant diseases of the oral cavity are meagre. The low prevalence of these lesions in a community, high cost of repeated examinations and potentially low participation rates at annual screening explain the lack of research data in the world. Few Indian studies reported the incidence rates of oral leukoplakia, lichen planus and oral submucous fibrosis following house-to-house mass screening conducted annually for 10 years from 1967 to 1977 (1–3). We have conducted an annual oral cancer/pre-cancer-screening programme in Japan from 1995 to 1998. About 67% of re-attendance was achieved for two or more follow-up examinations.

Annual screening allows estimation of the incidence rates of new lesions provided clinical criteria are standardized for detection. Such estimates along with prevalence data allow health planners to determine the

manpower needed for the provision of primary and secondary oral cancer care services. The rate of detection of new lesions may also provide an indication of risk exposures and trends in the screened community.

The objective of the study was to determine the age-specific incidence of potentially malignant oral diseases and associated demographic and clinical descriptors in a selected Japanese population. The risk factors such as smoking, alcohol drinking and some health-related variables were also evaluated.

Materials and methods

An annual screening programme for the detection of oral cancer/pre-cancer was conducted for the citizens living in Tokoname city in Japan. In 1996, this middle-sized city, had a population of 52 058 including its urban and suburban residents. Oral cancer/pre-cancer screening was a part of a community-based general health screening conducted by the local health authority in association with the Tokoname Dental Association. The study was in operation from 1995 to 1998 (inclusive) and the detailed methodology of the screening programme has been described in our previous reports (4–6).

During the 4-year period, 9536 subjects aged 40–95 years participated in screening at Municipal Health Centres following the receipt of postal invitations. In all 9362 were found to be screen-negative at their first examination. Those who subsequently participated for two or more annual examinations ($n = 6340$, 66.5%) were eligible for this analysis (Table 1). The screening was performed by dental examiners acting in pairs ($n = 42$) who were calibrated in one sitting, at least a week prior to their acting as screeners. The screen was recorded as positive for oral cancer or pre-cancer by WHO and Malmö Criteria (7, 8) if both examiners observed and agreed on the decision of an oral mucosal lesion being present, consistent with a clinical diagnosis of a carcinoma, leukoplakia, erythroplakia or lichen planus. Any other mucosal lesions detected were listed under 'other' category. If re-examination and/or treatment were required, this was arranged immediately by referral to any one of the three nearby Maxillofacial Departments attached to the Municipal Hospitals or the University Hospital. Those who did not report to the referral hospitals following the detection of a mucosal lesion were excluded from the analysis. Therefore, all positive cases recorded as a new oral leukoplakia or with oral lichen planus in this study were confirmed clinically by a second examination by a specialist, where necessary supported by biopsy.

Table 1 Age and sex distributions of the subjects

Age group	*Male, n (%)*	*Female, n (%)*	*Total*
40–49	195 (19.6)	802 (80.4)	997
50–59	359 (21.7)	1296 (78.3)	1655
60–69	964 (38.8)	1516 (61.2)	2480
70–79	439 (41)	632 (59)	1071
80–89	66 (48.5)	70 (51.5)	136
90+	1 (100)	0 (0)	1
Total	2024 (31.9)	4316 (68.1)	6340

The lesion sites were catalogued into eight anatomical sites by the WHO examination chart, modified for our purpose (7). Health-related information on age, sex and histories on smoking and alcohol drinking were collected by self-administered questionnaire before the examination. The medical history forms completed by the participants included answers to questions on hypertension and diabetes mellitus among 19 other diseases that were included as a part of general health screening. These two disorders have been speculated as being associated with oral lichen planus (9). Health histories were validated by an attending doctor measuring the blood pressure at screening and by a random capillary blood glucose test or by verifying the respective medications taken by individual subjects. Those who smoked on a daily basis in the past 12 months were considered regular smokers, and those who drank alcohol 6 or 7 days a week were categorized as regular drinkers.

Data analysis

The age standardization was done using Japan's population estimates (1985) (10). Age-adjusted incidence rates among previously screen-negative subjects were calculated based on person-years of observations for oral leukoplakia and oral lichen planus, and corresponding 95% confidence intervals (CI) were estimated (normal approximation) under the hypothesis that incidence rates follow the Poisson distribution. The age-specific incidence rates for the two disorders were calculated for each age group. Individuals who were diagnosed with any potentially malignant disease of the oral cavity at baseline screening were excluded from the computation of person-years for that specific lesion. Association between new oral leukoplakia/lichen planus and health-related variables were analysed by chi-square test. Odds ratios adjusted by logistic regression for age, sex, smoking and alcohol drinking and systemic disease were calculated using relative risk and corresponding 95% CIs. The data were analysed using the Statistical Package for Social Sciences (SPSS) software programme (version 10.0).

Results

Following annual screening, 18 oral leukoplakias (male 11: mean age 62.8 ± 13.3, female 7: mean age 62.4 ± 10.2) and 24 with oral lichen planus (male 5: mean age 66.4 ± 6.3, female 19: mean age 60.5 ± 8.3) were newly detected. Table 2 shows the intra-oral sites of new oral leukoplakia and oral lichen planus; for oral leukoplakia gingival/alveolar ridge (33.3%) was the most prevalent site (Figs 1 and 2). Seven cases (38.9%) had more than two sites affected or their lesions extended to neighbouring sites. All cases were homogenous type, and 11 (61%) of 18 cases were idiopathic leukoplakia and seven (39%) were tobacco-associated leukoplakia. For oral lichen planus buccal (33.3%) was most prevalent site followed by gingiva. Twelve cases

Table 2 Locations for new oral leukoplakia and oral lichen planus

Site	*Oral leukoplakia**	*Oral lichen planus†*
Lip	–	–
Commissure	2	2
Buccal	3	8
Sulcus	1	4
Gingiva/alveolar ridge	6	7
Tongue	5	2
Palate	–	–
Retromolar	1	1
Total	18	24

*Seven cases (38.9%) had more than one lesion on different sites or extended to neighbouring sites.
†12 cases (50%) had more than one lesion on different sites or extended to neighbouring sites.
Primary site of the lesion with the largest diameter is indicated in this table.

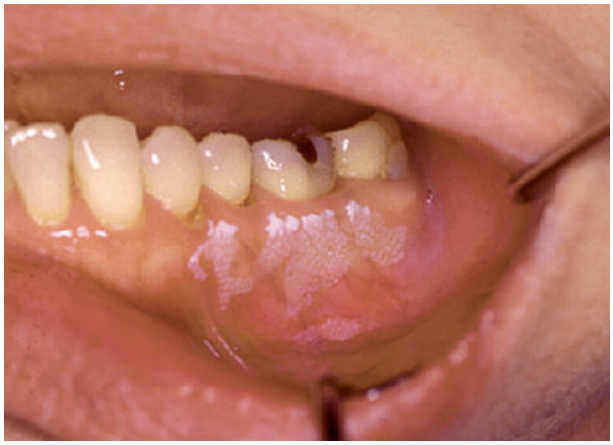

Figure 1 A patch of homogeneous leukoplakia on the gingiva extending to the lower buccal sulcus. Clinically or pathologically (Fig. 2) this white patch could not be diagnosed as any other disease entity and therefore by WHO criteria the diagnosis is consistent with oral leukoplakia.

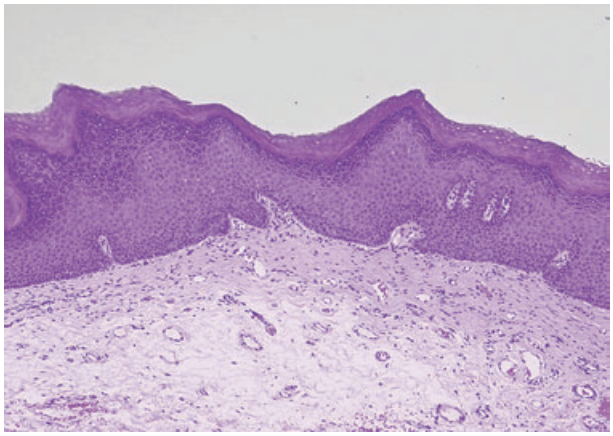

Figure 2 Photomicrograph showing the histology of the white lesion following biopsy of white patch shown in Fig. 1. This area shows hyperkeratosis with surface chevrons and mild basal cell hyperplasia. Other disease entities, e.g. lichen planus or a lichenoid reaction were excluded (H & E ×100).

(50%) had more than one site involved. Clinical diagnoses of 24 oral lichen planus cases consisted of 22 (92%) reticular, one erythematous (4%) and one ulcerative type (4%).

Tables 3 and 4 show the age-specific incidence rates for oral leukoplakia and oral lichen planus respectively. Age-adjusted incidence rate for oral leukoplakia was 409.2 (95% CI: 90.6–727.9) per 100 000 for male and 70.0 (95% CI: 17.9–121.8) per 100 000 for female. For oral leukoplakia age-specific incidence rate varied by age groups; 112.0–662.3 per 100 000 person-years for male and 33.0–252.3 per 100 000 for female. Excluding the single case in 80+ years age category the age-specific incidence for oral leukoplakia in males was higher for people aged 40–49 years compared with other age categories. Age-adjusted incidence rate for oral lichen planus was 59.7 (95% CI: 7.4–112.1) per 100 000 for male and 188.0 (95% CI: 96.0–280.1) per 100 000 for female.

Tables 5 and 6 show the age-adjusted incidence rates by clinical types for oral leukoplakia and oral lichen planus and for leukoplakia by risk habits. The person-years observations were lower for smokers compared with the larger group of non-smokers. The age-adjusted incidence rate for idiopathic leukoplakia was 136.0 (95% CI: 0–230.1) in male and 59.3 (95% CI: 11.6–107.0) in female per 100 000 person-years. For tobacco-associated leukoplakia it was 560.3 (95% CI: 22.9–1097.7) per 100 000 person-years in male smokers. Although the numbers of tobacco-associated leukoplakias detected were less than idiopathic leukoplakias, becuase of different person-years of observation the incidence rates ranked differently. The male rate was almost 13 times compared with 45.2 (95% CI: 0–133.8) per 100 000 of the female. The age-adjusted incidence rate for reticular type of oral lichen planus was 183.8 (95% CI: 95.8–271.7) per 100 000 in female, which was almost four times compared with the male [48.2 (95% CI: 1.0–95.5) per 100 000].

Treated or untreated hypertension was more common in both oral leukoplakia (27.8%) and oral lichen planus (25%) groups compared with all subjects (20.9%). No significant differences however, were noted among these groups. Subjects who had diabetes mellitus had a higher prevalence of oral lichen planus, this being significantly different between the oral lichen planus group and the screen-negative group ($P = 0.002$). In those with diabetes mellitus, relative risk for oral lichen planus was 6.4 (95% CI: 2.4–17.6) adjusted by logistic regression for age, sex, smoking and alcohol drinking.

Prevalence of smoking among leukoplakia cases (38.9%) was higher compared with the screen-negative group (26.4%) but these differences did not reach statistical significance ($P = 0.232$). Only two cases (11.1%) of 18 new leukoplakias and one case (4.2%) of 24 new oral lichen planus cases had reported both regular drinking and smoking, whereas 720 of 6298 screen-negative cases (11.4%) reported both habits. Prevalence of smoking (12.5%) in the group detected with oral lichen planus was lower than those without lichen planus. Regular drinking was not associated with

Table 3 Incidence rates for oral leukoplakia

	Male				*Female*			
Age group	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*
40–49	477	3	628.9 (0–1340.6)		1559	0	– (–)	
50–59	893	1	112 (0–331.5)		2680	3	111.9 (0–238.6)	
60–69	1914	3	156.7 (0–334.1)		3029	1	33 (0–97.7)	
70–79	1048	3	286.3 (0–610.2)		1189	3	252.3 (0–537.8)	
80+	151	1	662.3 (0–1960.3)		132	0	– (–)	
Total	4483	11	245.4 (100.4–390.4)	409.2 (90.6–727.9)	8589	7	81.5 (21.2–141.9)	70 (17.9–121.8)

Table 4 Incidence rates for oral lichen planus

	Male				*Female*			
Age group	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*
40–49	477	0	– (–)		1559	1	64.1 (0–189.9)	
50–59	893	0	– (–)		2680	9	335.8 (116.4–555.2)	
60–69	1914	4	209 (4.2–413.8)		3029	5	165.1 (20.4–309.8)	
70–79	1048	1	95.4 (0–282.4)		1189	4	336.4 (6.7–666.1)	
80+	151	0	– (–)		132	0	– (–)	
Total	4483	5	111.5 (13.8–209.3)	59.7 (7.4–112.1)	8589	19	221.2 (121.7–320.7)	188 (96.0–280.1)

the detection of either oral leukoplakia or oral lichen planus.

Discussion

To our knowledge this is the first study to report incidence rates for oral leukoplakia and oral lichen planus in an industrialized country. The study was carried out among a Japanese population mostly over the age of 40 years considered to be at risk for these two conditions. Japanese constitute a homogeneous population and the estimates reported here have no ethnic bias indicating the data could be representative. Metha et al. (1) and subsequently Gupta et al. (3) reported follow-up studies from India for oral cancer and pre-cancerous lesions. Table 7 reviews the results of their investigations, i.e. screening data from two geographically distant rural villages from 1967 to 1977. They examined nearly 10 000 subjects (age range 15–65 years and over) in each area and had 68% and 78% re-participation rates respectively. The age-adjusted incidence rate for oral leukoplakia in male was 240 per 100 000 persons/year. Overall age-adjusted incidence in males in our study was 409.2 per 100 000, higher than the reported Indian figure. For female it was three per 100 000 in India, while our study recorded 70.0 per 100 000. The studies from India are generally not applicable to other populations because of distinct risk habits associated with betel quid and chewing tobacco. Due to lack of published studies it is difficult to compare our results with any industrialized country.

Among Japanese, we demonstrated that the overall incidence of oral lichen planus was higher for reticular type than erosive. Bhonsle et al. (2) reported annual incidence by screening of the same subject population in one of the villages in India, referred to earlier from 1967 to 1977. Overall incidence rate reported for Indian females for oral lichen planus was 250 per 100 000 person-years, higher than that of Japan (188.0 per 100 000). Japan figures reflect histologically confirmed cases.

Gingiva/alveolar ridge was the most prevalent site (33%) for new oral leukoplakia followed by tongue (28%) and buccal mucosa (17%). Ikeda et al. (11) reported the distribution of oral leukoplakia among Japanese, and showed that most prevalent site was the alveolar ridge and the close by gingivae (34%). Our study is therefore confirmatory. On the contrary, among Swedes the most prevalent site for leukoplakia was the buccal mucosa or commissure (89.5%) (12), in Hungary the tongue (36.5%) (13). In the USA population, among several reported mucosal lesions the most common lesion found in floor of mouth in both males and females and in the labia oris in males was leukoplakia (14). Tobacco usage also determines the anatomical site of oral leukoplakia; one study in Europe reporting the floor of mouth leukoplakia is more common among smokers (15).

Finding of a higher frequency of idiopathic leukoplakias and in an unusual site, i.e. on gum in this Japanese population may question the validity of our diagnoses. All leukoplakias detected were by WHO (7) and Axell et al. (8) criteria and confirmed by biopsy to

Table 5 Incidence of new lesions by aetiopathological or clinical profile

	Male				*Female*				*Total*			
Clinical types	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*
Homogenous leukoplakia	4483	11	245.4 (100.4–390.4)	409.2 (90.6–727.9)	8589	7	81.5 (21.2–141.9)	66.9 (16.9–116.8)	13 072	18	137.7 (74.1–201.3)	143 (67.6–218.5)
Nodular/speckled leukoplakia	4483	0	– (–)	– (–)	8589	0	– (–)	– (–)	13 072	0	– (–)	– (–)
Tobacco-associated leukoplakia*	1868	6	321.2 (64.2–578.2)	560.3 (22.9–1097.7)	1486	1	67.2 (0–199.2)	45.2 (0–133.8)	3354	7	208.7 (54.1-363.3)	266.4 (39.6–493.2)
Idiopathic leukoplakia	4483	5	111.5 (13.8–209.3)	136 (0–230.1)	8589	6	69.9 (14.0–125.8)	59.3 (11.6–107.0)	13 072	11	84.2 (34.4–133.9)	76.1 (26.2–126.0)
Keratotic (reticular, etc.) lichen planus (LP)	4483	4	89.2 (1.8–176.7)	48.2 (1.0–95.5)	8589	18	209.6 (112.8–306.4)	183.8 (95.8–271.7)	13 072	22	168.3 (98.0–238.6)	142.7 (58.3–175.5)
Erosive or ulcerative LP	4483	1	22.3 (0–66.0)	11.5 (0–34.1)	8589	1	11.6 (0–34.5)	10.6 (0–31.3)	13 072	2	15.3 (0–36.5)	12.6 (78.9–206.5)

*Calculated by current smokers

Table 6 Age-adjusted incidence rates for oral leukoplakia and oral lichen planus among risk groups

		Male				*Female*			
Diseases	*Risk habits*	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*	*Number of person-years of observations*	*Number of new cases*	*Incidence rate per 100 000 person-years (95% CI)*	*Age-adjusted incidence rate per 100 000 person-years (95% CI)*
Oral leukoplakia	Smoking	990	4	404 (8.1–880.0)	496 (0–1194.2)	813	1	123 (0–364.1)	86.4 (0–255.7)
	Drinking	283	0	– (–)	– (–)	413	0	– (–)	– (–)
	Smoking and drinking	878	2	227.8 (0–543.5)	635.5 (0–1516.2)	673	0	– (–)	– (–)
	Non-smoking and drinking	2332	5	214.4 (26.5–402.4)	233 (0–480.4)	6690	6	89.7 (18.0–161.5)	80 (16.0–144.1)
Oral lichen planus	Smoking	990	1	101 (0–299.0)	56.5 (0–167.1)	813	1	123 (0–364.1)	175.6 (0–519.6)
	Drinking	283	1	353.3 (0–1045.9)	172.2 (0–509.6)	413	1	242.1 (0–716.7)	141.5 (0–418.9)
	Smoking and drinking	878	1	113.9 (0–337.1)	62.2 (0–184.1)	673	0	– (–)	– (–)
	Non-smoking and drinking	2332	2	85.8 (0–204.6)	50.2 (0–119.8)	6690	17	254.1 (133.3–374.9)	213.6 (111.3–316.0)

Table 7 Review of reported incidence rates by investigations for oral leukoplakia and oral lichen planus

Disease	*Author*	*Year*	*Period (years)*	*Country*	*Setting*	*Population*	*Number of subjects examined**	*Number of subjects examined repeatedly*	*Age range (mean ± SD)*	*Age-adjusted incidence rate per 100 000 persons/year§*		*Age-adjusted incidence rate per 100 000 persons/ year among smokers*	
										Male	*Female*	*Male*	*Female*
Oral leukoplakia	Gupta et al. (3)	1967–1977	10	India	Rural village	N/A	10 071	8174†	15–65 and over	240	3	290–670¶	–
					Rural village	N/A	10 287	8918†	15–65 and over	210	130	70	–
	Nagao et al.**	1995–1998	4	Japan	Suburb city	52 058‡	9536	6340	40–93 (57.8 ± 9.8)	409	70	496	86
Oral lichen planus	Bhonsle et al. (2)	1967–1977	10	India	Rural village	N/A	10 287	8918†	15–65 and over	210	250	130	430
	Nagao et al.**	1995–1998	4	Japan	Suburb city	52 058‡	9536	6340	40–93 (57.8 ± 9.8)	60	188	57	176

*Including first examinations.
†Calculated from original literature.
‡In 1996.
§Including betel chewers in India.
¶Bidi and clay pipe included.
**This study.

exclude lichen planus or other known clinical entities that appear as white patches. We are therefore confident that the incidence rates reported here are accurate for this population. Further epidemiological study would be necessary to clarify the site/aetiological differences for oral leukoplakia among Japanese compared with the rest of the world. In terms of clinical presentation of oral leukoplakia, all cases were homogenous type (Fig. 1). Clinical type of leukoplakia is known to partly determine the prognosis (16).

Buccal is most prevalent site for oral lichen planus in Swedes (17), however, there were more variant sites among Japanese cases. The question of malignant transformation of lichen planus has generated lot of controversy and debate. Although only few cases will transform, prospective and retrospective studies suggest the condition is potentially malignant and needs follow up.

Any associations between systemic diseases and oral leukoplakia have not been systematically examined or reported widely. A secondary analysis of data from a large USA survey (NHANES III) recently reported diabetes as an independent risk factor for oral leukoplakia (18). In our study none of the systemic diseases examined showed a statistically significant relationship with oral leukoplakia. On the contrary, diabetes mellitus was found to be an independent predictor for oral lichen planus. Associations between diabetes mellitus and oral lichen planus have been widely reported in the Hungarian literature (19).

The finding that idiopathic leukoplakia was more frequent among new cases compared with tobacco-associated leukoplakia was rather unexpected and needs further investigation. Perhaps tobacco histories need further validation by biochemical assays during general health screening. In India, all positive detections for oral leukoplakia reported were in people who either smoked and/or had a tobacco betel quid chewing habit (3). In our study, among 723 high-risk individuals who reported both smoking and regular alcohol drinking –11.4% of the screened population – only two leukoplakias (0.3%) and one oral lichen planus (0.1%) were newly detected. Although there is no doubt of the close relationship between tobacco use and oral leukoplakia (12), many of the new leukoplakia lesions detected in this Japanese population could not be accounted as a result of smoking. This result however, may be biased as a regular smoker was less likely to attend 3 consecutive years of follow up (4).

The study raises an important question whether screening high-risk populations, as has been done in Europe (20, 21) may be relevant to a Japanese population or not. The high-risk strategy conserves valuable resources by directing services where the need and potential benefits are likely to be greatest. However, the high-risk approach appears to have potential drawbacks in this situation where new cases of leukoplakia in the population screened will be missed if they are non-tobacco users. Thus, the population approach as was carried out in Tokaname city is to be recommended for future screening. Strengths and weaknesses of a

high-risk strategy for screening need further investigation. In discussing strengths of preventive medicine Rose (22) claims that a large number of people exposed to a small risk may generate more cases than a small number exposed to high risk. However, it is noteworthy to understand that heavy smokers – strongest known risk factor for oral leukoplakia (18) – may have selectively not attended voluntary screening thus contributing to a lower incidence of tobacco-associated leukoplakia.

In USA (23), it is estimated that cancer risks consist of poor diet (30%), tobacco habits (30%), genetic factors (5%), alcohol (3%) and others (16%). Among the same cohort screened in our study, we examined the serum levels of antioxidant micronutrients such as retinol, α-tocopherol and carotenoids, and reported that serum β-carotene and lycopene levels in oral leukoplakias in males were significantly lower than that of normal subjects (24). On the contrary, in oral lichen planus there was no relationship between serum carotenoids levels and oral lichen planus except atrophic/erosive type, which had significantly, lower levels of lycopene (25). Serum antioxidant micronutrients levels in smokers are known to be significantly lower than that of non-smokers (26). International Agency for Research on Cancer (IARC) (27) also estimates that a higher intake of fruit and vegetables possibly reduces the risk of cancers of the mouth, pharynx and several other organs. It is widely recognized that Japanese in the past have had traditional dietary intakes mainly of vegetables and grains, however, the lifestyles have changed to western diets, and they now are likely to take pre-cooked or less vitamin-rich foods. These trends are thought to contribute to the rising incidence of cancers.

Most follow-up studies have a tendency to demonstrate a lower incidence rate than actual population figure unless risk groups are more likely to attend or coverage extends to the entire population. Health conscious groups are likely to show up at annual mass screening programmes but high-risk groups need additional rewards for attendance. Study of factors that determine non-attendance (28, 29) will allow future programmes to be targeted to those who do not 'show up' following an invitation to attend screening. It is also important to determine the best follow-up practice for individuals testing positive and to design practical and feasible approaches to the rapid development of new agents to treat and prevent oral pre-cancer (30). A randomized-clinical trial exploring chemoprevention is currently in progress for many of these screen-detected subjects (31).

In conclusion, we report here the incidence rates of two potentially malignant diseases of the oral cavity, following an annual screening programme that allowed estimation of the new disease burden of a population. This knowledge could be used, in association with known prevalence rates for this population, to plan specialist service needs in oral medicine clinics that manage white and red patches in population sectors of a heath authority.

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