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# Prevalence of oral cancer and pre-cancer and associated risk factors among tea estate workers in the central Sri Lanka

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**BACKGROUND: To screen for oral cancer or not is being debated, but for high-risk populations with minimal access to regular dental care systematic oral examinations could provide some benefit.**

**METHODS: We undertook oral mucosal examinations of labourers employed in tea estate plantations in Sri Lanka. In a two-stage screening procedure, first by estate medical officers and then by visiting specialists, we examined 12 716 persons at their workplaces achieving a coverage of one-sixth of the total workforce.**

**RESULTS: Fourteen oral cancers and 848 subjects with oral pre-cancer (6.7%) were detected giving population prevalences of 46.1 per 1000 for leukoplakia and 16.4 per 1000 for oral submucous fibrosis. Among subjects with any oral mucosal disorder (*n* = 1159) proportions of current users of betel quid, smokers and alcohol use was recorded at 92%, 31% and 61% respectively. The synergistic effect of these three risk habits on the development of oral leukoplakia was evident in mixed habit groups.**

**CONCLUSIONS: The prevalence of oral pre-cancer in tea estate labourers was higher than estimates reported in previous studies. In the absence of state-sponsored preventive activities, it is necessary to improve the capacity of individual health practitioners and small medical centres to participate in oral health promotion and oral cancer/pre-cancer screening.**

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**Keywords:** alcohol; betel quid; leukoplakia; oral cancer; oral submucous fibrosis; pre-cancer; screening; tobacco

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## Introduction

Sri Lanka has the highest reported incidence of oral cancer in the world (1), Oral and pharyngeal cancers constitute the most common cancer for Sri Lankan men and ranks fourth for women (2). The prevalence of risk factors associated with oral cancer is reportedly high (3). Several oral cancer/pre-cancer-screening programmes have been conducted in Sri Lanka (4, 5) and an evaluation of the methodology used and outcome of these studies has shown satisfactory results in detecting oral mucosal lesions in comparison with other global studies (6, 7). Recently, a significant reduction in mortality of a screened population, particularly if they were tobacco users, has been confirmed by a randomized control trial (8). Most case finding studies to detect oral mucosal lesions have been undertaken in the volunteering general populations. A general lack of compliance in these settings has been discussed (9, 10).

Few reported studies on estate population workers suggest that this is a target group that could be accessed easily with the co-operation of their employers. The workforce in estates in south Asia is generally less literate than the general population and their knowledge on common oral health problems could be poorer.

The fact that oral cancer is still a major health problem in the Indian sub-continent is largely due to chewing of the betel quid or pan masala (11), but the prevalence of these risk habits among tea labourers is unknown.

The objective of this study was to obtain demographic data on risk factors associated with oral cancer and pre-cancer and to conduct and report the outcome of an oral mucosal examination on tea estate labourers in Sri Lanka, utilizing the locally available estate medical officers following a brief training.

## Materials and methods

*Training and examinations*

Seventy-three tea estates in the central province of Sri Lanka with an estate medical officer (EMO), resident in or attached to a nearby estate, were selected for the study. Prior, to undertaking the study all the participating EMOs ($n = 39$) were trained to carry out a systematic oral mucosal examination and on criteria for the visual detection of oral mucosal lesions. A training manual with guidelines for the detection of oral mucosal lesions (12) and a set of training slides illustrating the full range of oral mucosal disorders (OMDs) were used as resource material for training. A two-day training course was conducted by three specialists in oral medicine at the University Hospital.

Training and examinations were completed during the period February 1999 to September 1999. Initial examinations were done by EMOs at health centres in each tea estate, using the residents' register. A mobile dental light was used for illumination during examinations and plane dental mirrors were used for soft tissue retraction.

The second examination was performed by the specialist group who co-coordinated the training of EMOs, by visiting the health centres located at tea estates used for initial screening. All those with positive findings (2095 subjects) were re-examined by a specialist to confirm the clinical diagnosis and if cancer was suspected biopsies were performed at the field station.

*Interviews*

At the initial screenings prior to oral examination EMOs interviewed participating subjects using a validated two-part questionnaire. The demographic section included questions on age, gender, occupation and citizenship. The oral habits section included questions on regular habits, use of betel quid, smoking and alcohol consumption. Those reporting betel quid chewing were asked whether they retained the quid overnight without any hygiene measures. The current lifestyle habits recorded were those who regularly consumed betel quid, alcohol or smoked on a daily basis during 6 months prior to interviews.

*Statistical analysis*

The chi-squared tests were used for comparing demographic features of persons with OMD between men and women. The differences in prevalence rates of OMD between men and women were also tested by chi-squared tests, and in the case of small case numbers, the Fisher's exact tests were used instead. Odds ratios (OR) and 95% confidence intervals (95% CI) were computed to determine any association between subjects with risk habits and oral pre-cancer.

## Results

In this study, oral mucosal examinations were completed on 12 716 tea labourers over the age of 15 years employed by 73 tea estates in central Sri Lanka by EMOs. Over 90% of the estate workers were Tamil citizens and 88% worked as unskilled labourers employed as tea workers.

Following two-stage screening, 1159 subjects (9.1%) were detected with OMD. A higher proportion with positive findings were women (57.9%) and the majority (58.7%) were in the age group 41–55 years (Table 1). In the group with OMD, the proportions of current users of betel quid, smokers and regular alcohol users were found to be 92%, 31% and 61% respectively. The prevalence of these risk habits was strongly dependent on gender ($P < 0.001$) with significantly more women among chewers. Smoking and alcohol drinking habits were more prevalent among men (Table 1).

Oral mucosal disorders detected in the study population are listed in Table 2. Fourteen subjects, over the age of 40 years, were diagnosed with pathologically confirmed carcinomas (crude prevalence 14/12 716; 110 per 100 000). The most common potentially malignant disorder diagnosed in the group was oral leukoplakia amounting to 50% of all detections, with a population prevalence of 46.1 per 1000. There were no cases of proliferative verrucous leukoplakia detected in this study. More men were affected with leukoplakia compared with women (62.5% vs. 33.7%). On the contrary, more women ($n = 167$) than men ($n = 42$) had a diagnosis of oral submucoses fibrosis, with an overall prevalence of 16.4 per 1000. Excluding other benign mucosal diseases, potentially malignant disorders (i.e. leukoplakia, erythroplakia, palatal keratosis, oral submucous fibrosis and lichen planus) were found in 848 subjects (6.72%). Among benign disorders chewers' mucosa was present in 130 subjects (10.2 per 1000). Fifty-two (52) subjects (4.1%) among those with OMD had more than one soft tissue lesion; majority of these were subjects with oral submucous fibrosis (OSF) ($n = 41$) who also had patches of leukoplakia.

Table 3 displays the common potentially malignant disorders stratified by risk habits under study. Leukoplakia was the commonest lesion detected in all risk groups as well as in the non-smoking group. The synergistic effect of betel quid, smoking and use of alcohol on the development of oral leukoplakia was evident in the mixed habit groups. Alcohol-only group had the least number of subjects detected with oral lesions in this study. Thirteen of 14 cancers detected were in subjects with a known betel quid habit. Chewers' mucosa was limited to those with a reported betel quid habit.

Table 4 shows the relationship between oral pre-cancer and current habits of subjects. There were a total of 848 pre-cancers. The risk of pre-cancer among subjects reporting smoking, alcohol drinking and betel quid chewing were, respectively, 2.16-fold (95% CI 1.71–2.7), 1.41-fold (95% CI 1.16–1.7) and 3.01-fold (95% CI 2.25–4.0) significantly higher than abstainers.

## Discussion

Among global estimates at the turn of the century, Sri Lanka was recorded as having the highest incidence of oral cancer in the world (1).

**Table 1** Demographic features of persons with oral mucosal disorders (OMD); by men and women

| *Variables* | *Item* | *No. of persons* | *Men, n (%)* | *Women, n (%)* | *P-value of chi-squared test* |
|---|---|---|---|---|---|
| Total | | 1159 | 488 (42.1) | 671 (57.9) | |
| Age group (years) | 15–40 | 198 (17.1) | 83 (17.0) | 115 (17.1) | 0.0082 |
| | 41–55 | 680 (58.7) | 265 (54.3) | 415 (61.8) | |
| | >56 | 281 (24.2) | 140 (28.7) | 141 (21.0) | |
| Ethnicity | Sinhala | 73 (6.3) | 36 (7.4) | 37 (5.5) | 0.4234 |
| | Tamil | 1084 (93.5) | 451 (92.4) | 633 (94.3) | |
| | Moor | 2 (0.2) | 1 (0.2) | 1 (0.1) | |
| Occupation | Skilled worker | 114 (9.8) | 59 (12.1) | 55 (8.2) | 0.0280 |
| | Unskilled | 1045 (90.2) | 429 (87.9) | 616 (91.8) | |
| Diet type | Vegetarian | 65 (5.6) | 21 (4.3) | 44 (6.6) | 0.0996 |
| | Non-vegetarian | 1094 (94.4) | 467 (95.7) | 627 (93.4) | |
| Smoking habit | No | 800 (69.0) | 141 (28.9) | 659 (98.2) | <0.0001 |
| | Yes | 359 (31.0) | 347 (71.1) | 12 (1.8) | |
| Chewing habit | No | 93 (8.0) | 82 (16.8) | 11 (1.6) | <0.0001 |
| | Yes | 1066 (92.0) | 406 (83.2) | 660 (98.4) | |
| Alcohol habit | No | 452 (39.0) | 80 (16.4) | 372 (55.4) | <0.0001 |
| | Yes | 707 (61.0) | 408 (83.6) | 299 (44.6) | |
| Type of smoking | No habit | 800 (69.0) | 141 (28.9) | 659 (98.2) | <0.0001 |
| | Cigarette | 37 (3.2) | 37 (7.6) | 0 (0.0) | |
| | Bedi | 142 (12.3) | 135 (27.7) | 7 (1.0) | |
| | Cigars | 76 (6.6) | 74 (15.2) | 2 (0.3) | |
| | Others | 2 (0.2) | 2 (0.4) | 0 (0.0) | |
| | Mixed types | 102 (8.8) | 99 (20.3) | 3 (0.4) | |
| Type of chewing | No habit | 93 (8.0) | 82 (16.8) | 11 (1.6) | <0.0001 |
| | BQ + tobacco | 981 (84.6) | 368 (75.4) | 613 (91.4) | |
| | BQ (no tobacco addiction) | 83 (7.2) | 38 (7.8) | 45 (6.7) | |
| | Tobacco | 2 (0.2) | 0 (0.0) | 2 (0.3) | |
| Location of the quid | No habit | 93 (14.1) | 82 (16.8) | 11 (1.6) | <0.0001 |
| | Right | 184 (16.3) | 78 (16.0) | 106 (15.8) | |
| | Left | 222 (17.5) | 73 (15.0) | 149 (22.2) | |
| | Right + left | 660 (52.1) | 255 (52.3) | 405 (60.4) | |
| Keeping quid overnight | No habit | 93 (14.1) | 82 (16.8) | 11 (1.6) | <0.0001 |
| | Yes | 77 (6.2) | 22 (4.5) | 55 (8.2) | |
| | Not keeping in the mouth | 989 (79.7) | 384 (78.7) | 605 (90.2) | |
| Type of alcohol | No habit | 452 (46.1) | 80 (16.4) | 372 (55.4) | <0.0001 |
| | Arrack | 288 (23.0) | 127 (26.0) | 161 (24.0) | |
| | Toddy | 21 (1.6) | 14 (2.9) | 7 (1.0) | |
| | Kassippu | 9 (0.5) | 6 (1.2) | 3 (0.4) | |
| | Beer | 23 (2.1) | 4 (0.8) | 19 (2.8) | |
| | Foreign liquor | 23 (1.5) | 15 (3.1) | 8 (1.2) | |
| | Multiple types | 343 (25.2) | 242 (49.6) | 101 (15.1) | |
| More than one lesion | No | 1109 (95.7) | 468 (95.9) | 641 (95.5) | 0.7579 |
| | Yes | 52 (4.1) | 20 (3.7) | 32 (4.5) | |

Several pioneering oral mucosal-screening programmes were conducted in rural/semi urban populations in Sri Lanka documenting the effectiveness of the primary healthcare approach for case finding, contributing to early detection of oral cancer and pre-cancer (4, 5). However, studies on the estate labourer populations have been sparse with a single report on one tea estate indicating 6% prevalence of oral pre-cancer following examinations of 228 tea labourers (13).

Tea industry in Sri Lanka contributes to 1.37% of the total GDP with a workforce of 317 000 (14). The lifestyle, socio-economic status and the standard of living of tea labourers are dramatically different from the rest of the population in the island. Poverty, boredom due to restrictions of access to the cities due to the terrain of estates, language barriers and poor education all contribute a different lifestyle that encourage addictive habits such as smoking, alcohol drinking and betel quid use. Tea labourers are therefore a special group in the island who could be at a higher risk of oral cancer and pre-cancer. Industrial screening – health examination of people at workplace – provides an opportunity for case finding by utilizing available health resources at workplace. This screening model was used by training EMOs who had never done any oral examinations prior to this study to carry out the initial screening examinations. The model included a second examination by specialists to confirm the validity of detection by EMOs.

The majority of tea estates in Sri Lanka are located in the central province where this study was undertaken. The coverage achieved in this study was close to one-sixth of the total tea labour workforce in Sri Lanka. The study findings therefore could represent the general workforce of the tea industry in Sri Lanka.

Risk habits of tea estate labourers in Sri Lanka have not been documented in any detail. This survey provides evidence that betel quid chewing is widespread among this socially deprived group of workers. A national survey conducted by the Ministry of Health (15)

**Table 2** Oral mucosal disorders (OMD) detected: comparison between men and women

| | | *Total* | | *Men* | | *Women* | | |
|---|---|---|---|---|---|---|---|---|
| *Variables* | *Item* | *No. of persons W/OMD* | *Prevalence per 1000 (n = 12 716)* | *No. of persons W/OMD* | *Prevalence per 1000 (n = 5468)* | *No. of persons w/OMD* | *Prevalence per 1000 (n = 7248)* | *P-value of chi-squared tests for comparing prevalence rates between men and women* |
| Total | | 1159 | 91.1 | 488 | 89.2 | | | 0.5182 |
| Name of lesions | Carcinoma | 14 | 1.1 | 7 | 1.3 | 7 | 1.0 | 0.5966 |
| | Leukoplakia | 586 | 46.1 | 342 | 62.5 | 244 | 33.7 | <0.0001 |
| | Erythroplakia | 4 | 0.3 | 2 | 0.4 | 2 | 0.3 | 1.0000[a] |
| | Lichen planus | 35 | 2.8 | 9 | 1.6 | 26 | 3.6 | 0.0386 |
| | OSMF | 209 | 16.4 | 42 | 7.7 | 167 | 23.0 | <0.0001 |
| | Smokers keratosis | 14 | 1.1 | 13 | 2.3 | 1 | 0.1 | 0.6500 |
| | Benign lesions[b] | 297 | 23.4 | 73 | 15.7 | 224 | 31.0 | <0.0001 |
| Cancer or pre-cancerous lesions | Yes | 848 | 66.7 | 402 | 73.5 | 446 | 61.5 | 0.0016 |
| | No | 311 | 24.3 | 86 | 15.7 | 225 | 31.0 | <0.0001 |
| second lesions | Present | 52 | 4.1 | 20 | 3.7 | 32 | 4.5 | 0.1891 |
| | No | 1107 | 87.1 | 468 | 85.6 | 639 | 88.2 | 0.6103 |
| Name of second lesions | Leukoplakia | 41 | 3.2 | 14 | 2.6 | 27 | 3.7 | 0.2514 |
| | Angular cheilitis | 8 | 0.6 | 4 | 0.7 | 4 | 0.6 | 0.6892[a] |
| | Chewer's mucosa | 3 | 0.2 | 2 | 0.4 | 1 | 0.1 | 0.4076[a] |
| leukoplakia type | Flat and smooth | 432 | 34.0 | 228 | 41.7 | 204 | 28.1 | <0.0001 |
| | Speckled | 118 | 9.3 | 83 | 15.2 | 35 | 4.8 | <0.0001 |
| | Nodulospeckled | 74 | 5.8 | 44 | 8.0 | 30 | 4.1 | 0.0041 |
| | Nodular | 1 | 0.1 | 1 | 0.2 | 0 | 0.0 | 0.4300[a] |
| lichen planus type | Erosive | 7 | 0.6 | 1 | 0.2 | 6 | 0.8 | 0.2509[a] |
| | Ulcerated | 1 | 0.1 | 1 | 0.2 | 0 | 0.0 | 0.4300[a] |
| | Reticular/papular | 28 | 2.2 | 7 | 1.3 | 21 | 2.9 | 0.0541 |

[a]Fisher's exact tests were used instead as the cell size was less than five.
[b]Chewer's mucosa, angular cheilitis, frictional keratosis, polyps and other benign lesions.

**Table 3** Oral cancers or potentially malignant disorders detected*, stratified by habits

| *Habit* | | *Cancer, n (%)* | *Leukoplakia, n (%)* | *OSMF, n (%)* | *Lichen planus, n (%)* |
|---|---|---|---|---|---|
| BQ + smoking + alcohol | 213 | 5 (2.3) | 187 (87.8) | 19 (8.9) | 2 (0.9) |
| BQ + smoking | 22 | 0 (0.0) | 20 (90.9) | 1 (4.5) | 1 (4.5) |
| BQ + alcohol | 270 | 5 (1.9) | 175 (64.8) | 78 (28.9) | 12 (4.4) |
| Smoking + alcohol | 50 | 0 (0.0) | 49 (98.0) | 0 (0.0) | 1 (2.0) |
| BQ | 268 | 3 (1.1) | 142 (53.0) | 108 (40.3) | 15 (5.6) |
| Smoking | 11 | 1 (9.1) | 9 (81.8) | 0 (0.0) | 1 (9.1) |
| Alcohol | 2 | 0 (0.0) | 2 (100.0) | 0 (0.0) | 0 (0.0) |
| No reported habit | 8 | 0 (0.0) | 2 (25.0) | 3 (37.5) | 3 (37.5) |
| All | 844 | 14 (1.7) | 586 (69.4) | 209 (24.8) | 35 (4.1) |

*Excluding 4 subjects with erythroplakia.

**Table 4** Risks of smoking/chewing/alcohol habits on pre-cancerous lesions

| | | | | | *Univariate* | | | *Mutually adjusted*[a] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Variables* | *Item* | *No. of persons* | *Pre-cancer lesion, n (%)* | *lo pre-cancer lesion, n (%)* | *Odds ratio* | *95% confidence interval* | *P-value* | *Odds Ratio* | *95% confidence interval* | *P-value* |
| Total | | 2095 | 848 (40.5) | 1247 (59.5) | | | | | | |
| Smoking habit | No | 1527 | 544 (35.6) | 983 (64.4) | 1.00 | | | | 1.00 | |
| | Yes | 568 | 304 (53.5) | 264 (46.5) | 2.08 | 1.71–2.3 | <0.0001 | 2.16 | 1.71–2.7 | <0.0001 |
| Chewing habit | No | 326 | 79 (24.2) | 247 (75.8) | 1.00 | | | | 1.00 | |
| | Yes | 1769 | 769 (43.5) | 1000 (56.5) | 2.40 | 1.84–3.15 | <0.0001 | 3.01 | 2.25–4 | <0.0001 |
| Alcohol habit | No | 968 | 312 (32.2) | 656 (67.8) | 1.00 | | | | 1.00 | |
| | Yes | 1127 | 536 (47.6) | 591 (52.4) | 1.91 | 1.60–2.28 | <0.0001 | 1.41 | 1.16–1.7 | 0.0007 |

[a]Adjusted odds ratios were computed from a logistic regression model with effects of quid chewing, alcohol drinking and smoking.

reported betel quid chewing prevalence estimates of 34–48% for the adult general population in Sri Lanka. Among a rural adult population in the Central province betel quid chewing habits were reported by 54% men and 42% of women (3). Ninety-two per cent of the tea estate labourers in this study reported betel quid

chewing. This is considerably higher than reported population estimates for Sri Lanka, as well are for any adult south Asian population reported so far [for review, see Ref. (16)].

Adult smoking rates in the Sri Lankan general population is reported at 41% (17) and has shown a slight decline in smoking in the past few years. In this study, the smoking prevalence of tea labourers was 31%. The most prevalent type of tobacco use was bedi smoking; 9.4% of smokers used this product. Bedi is a locally manufactured smoking product with crude sun-dried tobacco wrapped in a leaf and is considerably cheaper than cigarettes. A recent meta-analysis has shown that bedi smoking carries a higher risk (OR 3.1, CI 2.0–5.0) for oral cancer compared with cigarette smoking (18).

Adult per capita absolute consumption of alcohol in Sri Lanka is reported at 3.2 l. The latest available results of a survey of adults in one district in Sri Lanka have shown that 38% of men and 2% of women consumed alcohol regularly (19). In this study, close to 61% of tea labourers (both men and women) reported regular consumption of alcohol. This reported use of alcohol among tea labourers is much higher than in the general population suggesting that tea labourers are a high-risk group for oral cancer. Arrack, a locally produced distilled spirit drink was the commonest alcohol product used and the consumption of beer or imported spirits was extremely low.

The synergistic effects of smoking, betel quid use and alcohol drinking have been documented for oral leukoplakia and cancer for populations in south Asia (20, 21). In view of the combined exposure to these three common risk factors as found in this demographic survey of tea labourers public health approaches to screening high-risk groups and encouragement for prevention need to be strengthened in the estate sector using available EMOs.

The population prevalence of oral pre-cancer in Sri Lanka based on one large epidemiological survey on the general population was estimated at 4.2% (4). The methodology used in this study was a house-to-house survey that examined adult people in one of the municipalities in the Central province. In this present study conducted using similar clinical criteria for detection, the prevalence of oral pre-cancer was 6.7%. The higher prevalence of pre-cancer in the special group may represent significant risk habits among tea labourers compared with the general population or a particular ethnic bias in view of the fact that the current study was mainly undertaken on Tamil citizens.

Leukoplakia is the most common potentially malignant disorder reported in most oral mucosal surveys (22, 23). Half of the positive detections made in the survey were oral leukoplakias and the population prevalence was recorded as 46 per 1000 people. Among all the lesions and conditions recorded, leukoplakia showed the highest prevalence in mixed habit groups that included a betel quid habit (Table 3). Cessation advice to people with risk habits remains an important public health policy that needs to be instituted in the estate sector. There is no state-sponsored preventive measure regarding the promotion of social norms or other alternatives to betel quid chewing for their benefit. As betel quid (areca nut) has an addictive potential similar to many other leisure drugs (24) the Federation of Non-governmental Agencies on Drug Abuse in Sri Lanka that coordinates the activities of voluntary sector non-governmental organizations (NGOs) need to consider high-level activities on public education focused on special groups such as tea labourers. Smoking and regular alcohol use are both known major risk factors for oral leukoplakia and cancer. About a third of the income of low-income families is spent on tobacco and alcohol in Sri Lanka (25). Rising trends in alcohol consumption reported for the adult Sri Lankan population and that during 1975–1995 period the number of deaths for alcohol-related liver diseases has risen from 42 to 55 per 100 000 (25) are all indicators for advancing social and health problems related to alcohol use. Rising trends of oral cancer are also linked to increased per capita alcohol consumption in different nations (26, 27). Although alcohol advertizing is not permitted on television and radio in Sri Lanka, alcohol products are widely promoted in printed media and in billboards in the country. The estate sector is not immune to those advertising campaigns. Several NGOs have established voluntary treatment centres for alcohol users in Sri Lanka and this service should be extended to the estate sector.

Oral submucous fibrosis is a debilitating disorder with the potential for malignant transformation (28). The disease is encountered in Asians with heavy areca chewing habits (29), aboriginal Taiwanese (21, 30) and southern Chinese (31). The prevalence of this disorder varies from 0.03% to 3.0% based on diagnostic criteria used in global surveys. In this study, on estate tea labourers the prevalence of OSF was 1.6%. As expected all OSF cases were reported in areca nut (betel quid) chewers. Early detection of this disorder is reported to prevent serious health consequences and subsequent malignant transformation (32), and annual screening examinations of areca quid chewers could help in the detection of early forms of OSF (33, 34).

Finding of 14 overt oral cancers during screening examinations indicates the lack of awareness of symptoms of oral cancer and lack of interest in reporting to healthcare facilities, although tea estates in Sri Lanka, in general, have a central clinic served by a resident EMO. The number of oral cancers detected in other reported oral cancer-screening programmes has been far smaller (35) and in view that the screening EMOS in this study had only a brief training in oral examination, the outcome of this study has been remarkably good. Research on oral cancer screening in south Asia and their impact on policy and practices were reviewed recently (36). Data from this study is encouraging in that estate medical officers can be trained to carry out oral screening. To do so, it is recommended to improve the capacity of individual health practitioners and small medical centres to participate in oral health promotion and screening. Oral cancer screening, as an opportunistic activity whenever a tea labourer presents for other

heath-related ailments or as an annual activity in each estate could be recommended as a future health policy. Previous studies on the natural history of periodontal diseases of tea estate labourers in Sri Lanka had no interventional components (37) and have regrettably not contributed to any translational public health activity to improve estate workers' knowledge on oral diseases. It is proposed that NGOs working in the estates sector, EMOs in the region, the commercial co-operatives employing the labour force and relevant Government Ministries would be forwarded an executive summary of this study to harness support in oral cancer control in this socially and educationally deprived society in Sri Lanka. Crete and Kaohsiung declarations (2005) that refer to recommended health policies and actions to control oral cancer in the world and in particular in south Asia (38, 39) need to be promoted and innovative global health forums should facilitate such translational activates from published research.

## Conclusions

The study has shown the ability to train EMOs in oral cancer screening and that estate tea labourers could carry high risks for oral cancer and pre-cancer. Estimated prevalances for potentially malignant disorders were higher than in most studies reported so far. Due to high prevalence of risk habits associated with oral cancer opportunistic and annual screening is recommended using available resources in the estate sector that could be further harnessed to prevent and detect oral diseases. This could contribute to reductions in mobility and mortality and a healthy workforce in this national industry.

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