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ORIGINAL ARTICLE

Declining oral cancer rates in Sri Lanka: are we winning the war after being at the top of the cancer league table?

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OBJECTIVES: To investigate the age-standardized incidence, demography, recent trends and patterns of incidence of oral cancer in Sri Lanka between 1985 and 2005.
MATERIALS AND METHODS: Data on oral and oropharyngeal cancers were obtained from the published hospital-based cancer registry reports in the years 1985, 1990, 1995, 2000, and 2005. The data were analyzed by gender, age (<40 or >40 years), and by site. A linear regression analysis was performed on the age-standardized oral and oropharyngeal cancer incidence rates to examine the trends over a 20-year period.
RESULTS: There was a steady decline in the age-standardized incidence of lip and oral cavity cancers over the past 20 years in both men and women. A significant reduction of 1.9% per year is noted over this period. Contrary to this, cancers of the oropharynx (C09, C10, and C14) showed a slight increase over the same period.
CONCLUSIONS: Reversal of betel quid use and smoking must be considered in accounting for declining trends for oral cancer. Increasing rates of oropharyngeal cancer raises the issue whether risk factors for the oropharynx are different to those of the oral cavity, and this may need further investigation.
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Keywords: oral cancer; mouth neoplasms; trends; smoking; betel quid; Sri Lanka

Introduction

Oral cancer remains a leading cause of cancer in several South Asian countries (Moore *et al*, 2009) and from time immemorial; Sri Lanka has had the highest incidence of oral cancer among all countries in the South Central Asia (IARC, 2004). A 15-fold variation in the incidence of oral cancer has been reported in the globe (Warnakulasuriya, 2009). Differences in the pattern of oral cancer occurrence worldwide reflect variations in the prevalence of specific risk factors within the regions. A high incidence of lip cancer is found in white-skinned people exposed to solar radiation, and intra-oral cancer is relatively high in communities with high consumption of tobacco, alcohol, or betel quid (BQ).

Variations in the trends of occurrence of oral and pharyngeal cancers have been reported. In some industrialized countries (e.g. Denmark, the Netherlands, Japan, and the UK), a rising incidence of oral cancer has been reported since 1970s (Conway *et al*, 2006; Braakhuis *et al*, 2009; Blomberg *et al*, 2011), while there has been a decline in oral cancer mortality in other countries, e.g. USA, China, Hong Kong, Italy, Spain, France, Germany, and Australia (Yako-Suketomo and Matsuda, 2010). Notably, oral cancer incidence has also declined in Thailand, a country which at one time has had a high incidence, particularly because of the decline in BQ chewing habit (constituents; leaf of *Piper betle*, areca nut, lime prepared from limestone or seashells, cutch (catechu) and frequently air- and sun-dried tobacco) in their population (Reichart *et al*, 2003). Studying the burden of oral cancer in Sri Lanka is of special relevance as this is the most common cancer among men in Sri Lanka (National Cancer Control Programme, Sri Lanka, 2009). Our aim is therefore to examine the age-standardized incidence, demography of oral cancer in Sri Lanka with a particular focus on recent trends and patterns of incidence between 1985 and 2005.

Materials and methods

Data on oral cancer were obtained from the published hospital-based cancer registry reports in the years 1985, 1990, 1995, 2000, and 2005. The international classification of diseases (ICD)-10 was used for data retrieval and ICD -9 for former years (1985–95) transcribed to ICD-10 codes. The cancers included in

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this study were 'lip and oral cavity,' which includes lip (ICD 10; C00), tongue (C01 and C02), gum (C03), floor of mouth (C04), palate and other unspecified parts of mouth (C05 and C06). Cancers of tonsil (C09), oropharynx (C10), and other ill-defined sites and pharynx (C14) were considered separately under the cancers of the 'oropharynx'. Malignant neoplasms of salivary glands (C07–08) and other pharyngeal sites, e.g. naso and hypopharynx (C11–13) were excluded from the analysis. To compute age-standardized data, annual midterm population estimates for the period by age and sex were obtained from the United Nation's world population prospects, 2008 revision (World population prospects, United Nations, 2009).

The raw data were reanalyzed to calculate crude, age-specific, and age-standardized incidence rates. Segi's standard population and the direct method were used to calculate the age-standardized incidence rates (Boniol and Heanue, 2007). Cumulative rates were calculated for the life span 0–74 years.

Independent sample *t*-test was carried out to determine the statistical significance of sex and age on the incidence (crude data) using SPSS version 11 (SPSS Inc., Chicago, IL, USA) for windows. Linear regression analysis on trends was performed using STATA 9.0 (Stata Corp LP, TX, USA) statistical package. *P*-value <0.05 was considered statistically significant in this study.

Results

Incidence of oral cancer in Sri Lanka was 3–4 times higher in men than women; in 2005, M/F ratio was 3 : 1. Table 1 shows the sex distribution of oral cancer incidence (crude rates) from 1985 to 2005. Independent sample *t*-test revealed that there was a significant difference between male and female rates, for both lip and oral cavity cancers ($t(8) = 16.874$, $P = 0.0001$) and oropharyngeal cancers ($t(8) = 7.025$, $P = 0.002$).

Oral cancer was more common in adults over the age of 45 years (Table 1). The difference between the young (below 45) and the old (above 45) was significant for both lip and oral cavity cancers ($t(8) = -42.166$, $P = 0.0001$) and oropharyngeal cancers ($t(8) = -8.923$, $P = 0.001$).

Figure 1 shows the age distribution of oral cancer incidence over the period from 1985 to 2005. Oral cancer incidence as seen here increases with the advancing age; the highest incidence was reported in the age group 70–74 years.

Figure 2 shows a summary of the age-standardized incidence rates of oral and oropharyngeal cancers according to the site of involvement. Palate and other unspecified sites (C05 and 06) when considered together gives the highest incidence out of all oral and oropharyngeal cancers. Tongue cancers (C01 and 02) have been the second leading cancer out of all oral cancers reported in Sri Lanka with a negligible decline over the years. In the year 2005, the ratio of oral cancer to oropharyngeal cancer was 5 : 1, a rise in oropharyngeal site compared to 1985 (10 : 1).

Table 2 shows the age-standardized incidence rates for lip and oral cavity cancers (C00–06) and oropharynx cancer (C09, C10 and C14) and overall incidence for both sexes by the study period. There was a steady

Table 1 Sex and age distribution of oral and oropharyngeal cancers in Sri Lanka from 1985 to 2005

Cancer site	*1985*	*1990*	*1995*	*2000*	*2005*	P-*value*	*95% CI*	
Lip and oral (C00–06)								
Males								
*n**	856	801	767	855	864			
CR**	10.43	9.18	8.38	9.14	8.95	0.0001	5.20248	6.84952
Females								
n	243	302	308	296	280			
CR	3.05	3.53	3.39	3.14	2.84			
Aged below 45 (both sex)								
n	93	91	98	69	99			
CR	0.71	0.66	0.72	0.51	0.70	0.0001	−3.50541	−3.07459
Aged above 45 (both sex)								
n	1006	1012	977	1082	1045			
CR	32.94	29.19	21.33	20.81	19.18			
Oropharynx (C09, C10, and C14)								
Males								
n	88	100	133	157	181			
CR	1.07	1.15	1.45	1.68	1.87	0.002	0.67342	1.51058
Females								
n	21	38	31	38	32			
CR	0.26	0.44	0.34	0.40	0.32			
Aged below 45 (both sex)								
n	12	18	14	15	16			
CR	0.09	0.13	0.10	0.11	0.11	0.001	−31.50579	−16.55421
Aged above 45 (both sex)								
n	97	120	150	180	197			
CR	3.18	3.46	3.27	3.46	3.62			

*n**, number of cases out of total population; CR**, crude rate per 100 000 population.

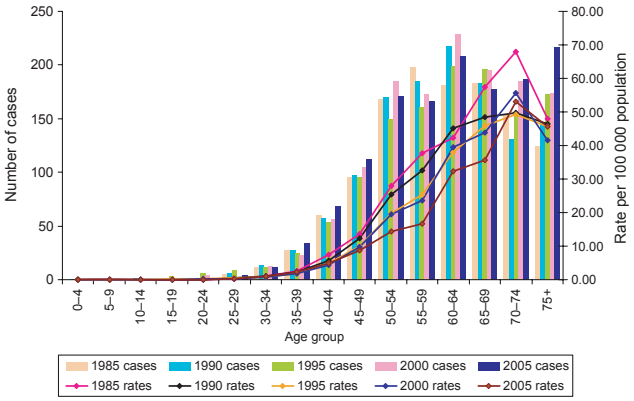

Figure 1 Age distribution of oral and oropharyngeal cancers in Sri Lanka from 1985 to 2005 for both sexes

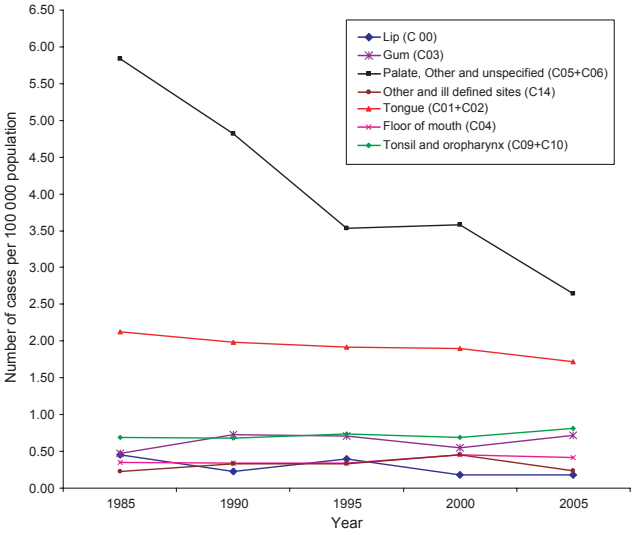

Figure 2 Trends in age-standardized incidence rates per 100 000 for oral and oropharyngeal cancer incidence in the Sri Lankan population based on the different sites for both sexes

decline in the incidence of lip and oral cavity cancers over the past 20 years with highest reported incidence being in 1985 (Age-standardized rate 9.23/100 000) and the lowest in 2005 (5.69/100 000). A reduction of 1.9% per year is noted over the 20-year period. Similarly, lifetime risk of oral cancer also has declined over the same period. However, the incidence of oropharyngeal cancers had slightly increased over the years while the lifetime risk remained more or less the same during this period. Comparing the ratio of oropharyngeal to oral cancer, the comparative change in incidence of cancers in the oropharynx is clear.

We examined the output of these results by a regression analysis. With respect to the lip and oral cavity cancer (C00–C06) incidence against the time trend showed that the model is significant at a probability level of 0.05 ($F = 83.18$; $P = 0.0028$). The R^2 value of 0.9652 showed that 96% of the variation in the cancer incidence is explained by time where the coefficient of decline is 0.17 in every 5 years ($t = -9.12$; $P = 0.0028$).

Cancer of the oropharynx (C09, C10, and C14) showed a slight increase over the years (0.0092, $t = 3.38$, $P = 0.043$) having the highest incidence reported in 2005 (1.09/100 000). When lip and oral cavity cancers and pharyngeal cancers were considered together, the trend analysis showed a declining trend (−0.16, $t = -9.10$, $P = 0.003$) (Figure 3).

Discussion

The demographic factors indicated oral cancer was higher among men, and the incidence increased with advancing age. The trends observed were, however, intriguing and will be discussed here.

There have been numerous global reports on oral cancer incidence rates in the second part of the last century that described the trends as declining, stable, or increasing in different regions of the world and countries (Reichart *et al*, 2003; Conway *et al*, 2006; Braakhuis *et al*, 2009; Warnakulasuriya, 2009; Blomberg *et al*, 2011; Yako-Suketomo and Matsuda, 2010). There are no clear reasons for these evolving trends, and in some countries, e.g. France and Italy, there has been a recent decline in oral cancer mortality. The most plausible explanation has been lifestyle changes, particularly the reduction in smoking rates (Garavillo *et al*, 2010). In France, world-standardized incidence rates of lip-oral cavity-pharynx cancers have decreased by 42.9% for men while the same increased by 48.6% for women particularly related to oropharynx. Declining prevalence of smoking among men in the general population, while slight increase in tobacco use in women could be attributable for this difference (Ligier *et al*, 2011). Contrary to this, declining trends for both men and women have been observed among ethnic communities in the United States reflecting the reductions in smoking prevalence and alcohol consumption in their population (Brown *et al*, 2011).

It appears that the decline in incidence of oral cancer in Sri Lanka probably started many decades ago. In early 1980s, the relative frequency of oral cancer was reported at 29.8% (Warnakulasuriya, 1989) and by the time of the start of our study period it reflected a further decline to 24% (National Cancer Control Programme, Sri Lanka, 1990). Relative frequency is a crude estimate and for the first time we report here age-standardized data to confirm this trend. Changes in traditional oral habits such as BQ chewing and smoking of traditional cigars seem to have resulted in a marked decrease in oral cancer in Thailand. Our analysis of data from Sri Lanka is consistent with findings described in Thailand (Reichart *et al*, 2003).

It is necessary to examine whether this decline in incidence rate is simply an artifact because of under-reporting. All cancers are registered at the National Cancer Control Programme (NCCP) in Sri Lanka, and based on our understanding NCCP cancer data are retrieved from hospital statistics. Their reports indicate that cancer rates in the country are rising (data not

Table 2 Oral cancer incidence from 1985 to 2005 for both sexes

	1985	*1990*	*1995*	*2000*	*2005*
Lip and oral cavity (C00–C06)					
n (%)	1099 (90.9)	1103 (88.9)	1075 (86.7)	1151 (85.5)	1144 (77.7)
ASR	9.23	8.10	6.90	6.65	5.69
CuR %	1.17	1.00	0.85	0.86	0.72
Oropharyngeal cancers (C9, C10, and C14)					
n (%)	109 (9.1)	138 (11.1)	164 (13.3)	195 (14.5)	213 (22.3)
ASR	0.92	1.01	1.07	1.13	1.09
CuR %	0.12	0.12	0.13	0.14	0.12
All oral and pharyngeal cancers					
n (%)	1208 (100)	1241 (100)	1239 (100)	1346 (100)	1357 (100)
ASR	10.16	9.1	7.97	7.78	6.74
CuR %	1.29	1.12	0.99	1.20	0.84

ASR, age-standardized rate per 100 000 (world standard population); CuR %, percentage figure of cumulative risk for life span 0–74 years.
n, number of cases out of total population; % out of all lip, oral, and pharyngeal cancers.

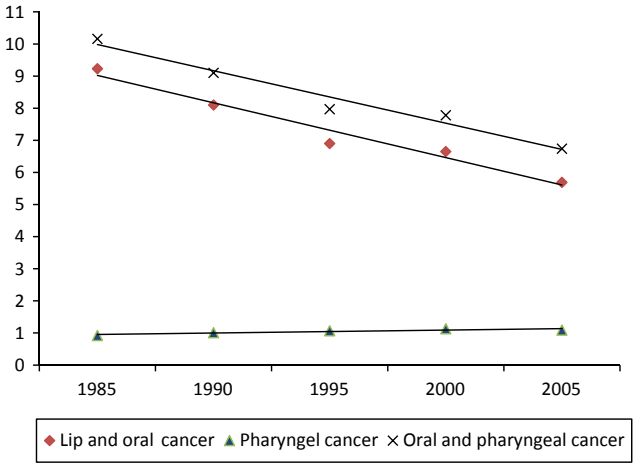

Figure 3 Trends analysis for lip and oral cavity cancer, pharyngeal cancer, and both oral and pharyngeal cancers for the period from 1985 to 2005 for both sexes

shown). We cannot therefore account for any incompleteness of data or miscoding for oral cancer in more recent years.

One of the strengths of this study is the long time span of 20 years that is confirming the decline of oral cancer in both sexes. While rates of oral cancer are falling, we observed that oropharyngeal cancer rates are stable and this immediately raises the question whether different risk factors are operating for oropharyngeal cancer compared to oral cancer. At present, oropharyngeal cancer is the fastest growing cancer in some countries, e.g. Scotland (Junor *et al*, 2010). Data from the western countries suggest that human papillomavirus is responsible for rising incidence of oropharyngeal cancers (Shiboski *et al*, 2000; Auluck *et al*, 2010; Blomberg *et al*, 2011; Marur *et al*, 2010; Mehanna *et al*, 2010), and this probably needs further research in Sri Lanka.

It is of interest to consider the plausible factors contributory to these declining trends. Because of population aging, cancer is likely to exert a heavy burden on health care in most of the countries. Nevertheless, as the incidence rates of oral cancer are falling in both men and women, these changes almost certainly reflect arrest or reversal of trends of major risk factors.

Reversal of major risk factors specific for Sri Lankan nationals such as BQ use and smoking must be considered in accounting for declining trends. BQ chewing habit has deep-seated links to social and cultural practices throughout the history of civilization in Sri Lanka. The earliest record was around 504 BC in the 'Mahawamsa' the great chronicle on the history of Sri Lanka written in Pali language (Krenger, 1942). A case–control study on oral cancer and lifestyle habits in Sri Lanka conducted in 1964 reported that BQ had the highest attributable risk (RR = 18.1) (Hirayama, 1966). Although exact BQ prevalence data over a long period are meager, we examined available cross-sectional studies to identify any changes in the population's use of BQ. In early 1980s BQ use was reportedly high amounting to some 54% in men and 42% in women (Warnakulasuriya, 1992). National Oral Health Survey conducted in 1994/95 has reported BQ chewing prevalence estimates of 34–48% in the adult general population (Ministry of Health Sri Lanka, 1998). A recent inter-country study (2009–2010) on prevalence and practices of BQ use in South, South East, and Eastern Asia regions showed that 18% of men and 13.5% women in Sri Lanka were current BQ chewers (Lee *et al*, 2011). These data do indicate a gradual decline in the BQ habit in the Sri Lankan population.

Prevalence of adult smoking among men in Sri Lanka had been relatively high for many decades. A national study conducted in 1988 reported that 54.8% of the adult men and 0.8% adult women were smokers (National Cancer Control Programme, Sri Lanka, 1989). By 2006, according to the WHO age-standardized prevalence estimates, a decline in adult smoking prevalence in Sri Lankan general population was noted: 32.0% in men and 2.0% in women (World Health Organization, 2009). There has also been a further significant decline in the usage of cigarettes over the last decade (Alcohol and Drug Information Centre, Sri Lanka 2007).

These data show a dramatic decline in the habit of BQ usage and smoking in Sri Lanka. It is therefore conceivable that reduction in BQ use and smoking contributed to the decline in the incidence of oral cancer observed in this study. However, per capita consumption of alcohol has shown an increase over the years from 6.5 litres in 2002 to 7.3 in the year 2007 (Alcohol and Drug Information Centre, Sri Lanka, 2009).

Other factors of importance for analyzing disease evolution are literacy, awareness, and primary health care (PHC) programmes. It is known that Sri Lanka has the highest rate of literacy in the region (average 91.3% in 2008), which is comparable with the developed countries (Central Bank Annual Report, 2009), and in the sociocultural aspect of BQ chewing in a nation with such a high literacy rate it should be possible to translate awareness to cessation. Increasing awareness on the risk factors for oral cancer and the improvements in the primary preventive strategies may also have contributed to the observed decline in the incidence of oral cancer. Two recent studies – a hospital-based survey (Ariyawardana and Vithanaarachchi, 2005) and a cross-sectional community-based study (Amarasinghe *et al*, 2010) – showed good awareness and knowledge of BQ causing oral cancer.

Furthermore, PHC approaches to screen and earlier detect oral cancer in two regions in Sri Lanka in early 1980s under the auspices of the WHO may have contributed to interventions by PHC workers on oral cancer control (Warnakulasuriya *et al*, 1984; World Health Organization, 1984; Warnakulasuriya and Nanayakkara, 1991).

Although the incidence of oral cancer is declining over the years, it is pivotal to strengthen the preventive strategies as the overall oral cancer incidence in Sri Lanka is still relatively high. Emphasis should be given to special population groups such as the estate workers as a study has shown estate laborers to have high lifestyle risks (Ariyawardana *et al*, 2007).

It is noteworthy that the Sri Lankan government had made a strong initiative to control tobacco and alcohol burden in the country in view of preventing adverse impacts on health and the society. In the year 2006, Sri Lanka enacted a Tobacco Control Act for comprehensive tobacco control and established the National Authority on Tobacco and Alcohol to implement it.

Currently, the WHO is developing a strong policy agenda on non-communicable diseases (NCD) for its member states (Mendis, 2010). Development of NCD policies on combating common risk factors to further reduce the burden of the disease and to catalyze multisectorial approaches to win over NCDs by supporting healthy lifestyles and behaviors will be appropriate in many countries of the region.

Limitations of our study were that data gathered from the National Cancer Registry reports are published every 5 years. Therefore, an analysis of annual incidence was not possible in this study. A population-based cancer registry is not available in Sri Lanka, and as the data were based on hospital-based cancer registries, some under-reporting is inevitable. Furthermore, tumor stage was not recorded, and abstracting tumor, node and metastasis would have helped to analyze any improvements in staging of the disease. As only five sets of data were available, we could not undertake joinpoint analysis but we resorted to a simple regression analysis.

Summary

The decline in incidence rates of oral cancer in Sri Lanka is encouraging. This is occurring both in men and in women and in all age groups. Furthermore, while oral cancer rates are declining, there is flattening of rates of oropharyngeal cancer. This raises the issue whether risk factors for oropharyngeal cancer are different to that of oral cancer as noted globally.

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Author contributions

A. Ariyawardana contributed to data analysis, and writing of the manuscript. S. Warnakulasuriya contributed as the supervisor of the first author during his fellowship and editing and the revision of the manuscript.

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