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Oral Oncology/Epidemiology

Is the incidence of oral and pharyngeal cancer increasing in Finland? An epidemiological study of 17 383 cases in 1953–1999

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OBJECTIVE: The aim of this study was to describe the occurrence of oral and pharyngeal cancer in Finland over the last half century.

MATERIALS AND METHODS: The study included all lip, oral and pharyngeal cancer cases diagnosed in Finland and reported to the nation-wide Finnish Cancer Registry between 1953 and 1999.

RESULTS: The study comprised 17 383 new cancer cases: 11 666 in males and 5717 in females. Of these, 83% were squamous cell carcinomas. By the end of the study, 1999, the mean age at diagnosis had increased to 63 years for males and 67 for females. The age-adjusted incidence of oral and pharyngeal cancer decreased in males from 12.5 per 10^5 to 8.4 per 10^5 while it increased in females from 3.0 per 10^5 to 3.9 per 10^5. This was because of a decrease in lip cancer incidence in males, while the incidence of tongue, mouth and salivary gland cancers increased in both genders. The annual number of new oral cancer cases increased, however, in both genders.

CONCLUSION: The incidence of lip cancer decreased in males, probably because of a decrease in smoking and in outdoor work. The incidence of intra-oral cancers increased in both genders, possibly because of increased alcohol consumption.

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Keywords: epidemiology; Finland; incidence; mouth neoplasms; oral cancer; squamous cell carcinoma

Introduction

Oral and pharyngeal cancer can be defined as malignant tumours of the lip (C00), the tongue (C01–02), other sites of the mouth (C03–06), salivary glands (C07–08) and the pharynx (C09–14). In Finland, these cancers constitute 2.1% of all malignant tumours (2.6% in males and 1.5% in females), with oral cancer accounting for approximately 1.6% of all cancer deaths (Finnish Cancer Registry, 2002).

Oral cancer is the fifth most common cancer in the world, but its incidence shows wide geographical variation (Parkin *et al*, 1993; Moore *et al*, 2000a,b). The highest rates of tongue and mouth cancer occur in India and other parts of south Asia (Globocan 2000) with the highest rates of lip cancer reported from Australia and Spain (Parkin *et al*, 1992; Moore *et al*, 1999; Sugerman and Savage, 1999). In the Nordic countries, the incidence of tongue and mouth cancer has increased since the end of the 1950s, while the incidence of lip cancer in males has decreased. In the Nordic countries these trends are expected to continue up to the year 2022 (Moller *et al*, 2002). Epidemiological studies from Finland, other parts of Europe and the USA have shown that the incidence of oral cancer is increasing, especially among young men (Hindle *et al*, 1996; Kari *et al*, 1997; Alho *et al*, 1999; Shiboski *et al*, 2000).

The risk factors for oral cancer are quite well known. The most important risk factors for lip cancer include tobacco use and outdoor occupation (Lindqvist, 1979; Pukkala *et al*, 1994), and the two most important ones for tongue and mouth cancer are tobacco and excess alcohol, especially if consumed simultaneously and in large quantities (Marshall *et al*, 1992; Bundgaard *et al*, 1995; Lewin *et al*, 1998; Moreno-Lopez *et al*, 2000). Other risk factors for tongue and mouth cancers include oral HPV-infection (Syrjänen, 2000; Miller and Johnstone, 2001) and precancerous lesions (Mashberg and Feldman, 1988; Schepman *et al*, 1998). Optimal consumption of vitamins C and E, carotene, fruits, vegetables, fish and milk-products have been linked to a decreased risk for oral cancer, while red meat and eggs have been linked

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to an increased risk (Marshall *et al*, 1992; Levi *et al*, 1998; Negri *et al*, 2000).

The purpose of this study was to describe the occurrence of oral and pharyngeal cancer in Finland over the last half century using data from the nationwide Finnish Cancer Registry.

Materials and methods

The study included all cases of oral cancer (ICD10 C00–C14) diagnosed in Finland and reported to the Finnish Cancer Registry between 1953 and the end of 1999. Data on malignant tumours of the lip (C00), the tongue (C01–02), other sites of the mouth (gingiva C03, base of the mouth C04, palate C05, mucous membranes and other parts of the oral cavity C06), salivary glands (C07–08) and the pharynx (C09–14) are presented. We defined cancers of the tongue (C01–02) and mouth cancers (C03–06) as intra-oral cancers (C01–06). Tumours of the skin of the lip and precancerous lesions were excluded. The diagnoses were histologically confirmed in almost all cases over the years, and in 1999, 96% of the cases in women and 98% in men were histologically verified. Incidence rates have been adjusted for age to the 'world standard population' and are presented per 100 000 population per annum. The annual numbers of new cancer cases are presented as averages on 5-year periods in 1955–1959 and 1995–1999.

Founded in 1952, the population-based, nation-wide Finnish Cancer Registry, Institute for Statistical and Epidemiological Cancer Research is supervised by the National Research and Development Centre for Welfare and Health, and run by the Cancer Society of Finland. All hospitals, practising physicians and dentists, and pathological and haematological laboratories are requested to report to the Finnish Cancer Registry all cases of cancer that come to their attention. Reporting began in 1953 and has been compulsory since 1961. In addition, all death certificates bearing mention of cancer are transferred to the Registry, which maintains files on nearly 100% of all cases involving solid tumours diagnosed in Finland since 1953 (Teppo *et al*, 1994).

Statistics Finland compiles data on the consumption of tobacco products using industrial production statistics and sales figures from the export and import of tobacco products (Statistics Finland, 2002). Two surveys served as the basis for data on smoking habits in Finland: Suomen Gallup Oy has gathered data from personal interviews conducted in 1949 and 1960–1978 (Rimpelä, 1978; Valtonen and Rimpelä, 1984), while post-1979 the data are based on a National Health Institute survey (Helakorpi *et al*, 2002). Data on the consumption of alcohol are based on statistics from the retail sale and serving of alcoholic beverages in Finland, from alcohol imports and exports, and from production of alcohol. The National Research and Development Centre for Welfare and Health then compiles the data from different registers [STAKES (National Research and Development Centre for Welfare and Health), 2002].

Table 1 The number of oral and pharyngeal cancer cases in different sub sites in Finland in 1953–1999

	Male	*Female*	*Total (%)*
Lip (C00)	6242	1127	7369 (42)
Tongue (C01–02)	1195	1109	2304 (13)
Mouth other (C03–06)	1183	1136	2319 (13)
Salivary glands (C07–08)	919	995	1914 (11)
Pharynx (C09–14)	2127	1350	3477 (20)
All (C00–14)	11 666	5717	17 383

Results

In Finland, during the study period from 1953 to 1999, a total of 17 383 new oral and pharyngeal cancer cases (C00–C14) occurred: 11 666 (67%) in males and 5717 (33%) in females (Table 1). Most cases (83%) were squamous cell carcinomas; the rest included lymphomas (mostly in tonsils), adenocarcinomas (mostly in parotid glands), sarcomas and melanomas.

While the annual number of new oral cancers (C00–C14) increased from 236 to 304 among males and from 79 to 196 among females during the study period, the incidence of oral cancer (C00–C14) decreased in males and increased slightly in females (Table 2).

Over the entire 50-year period the incidence of oral cancer increased with increasing age. From 1953 to 1999, the mean age at diagnosis increased from 51 to 63 years in males, 60 to 67 years in females. The proportion of patients under 50 years was highest in the beginning of the study period (22% in males, 21% in

Table 2 Age-adjusted (to 'world standard population') incidence rates (per 100 000 population per annum) of oral cancer in different sub sites in different time periods in Finland

	Age-adjusted incidence	
	Male	*Female*
Lip (C00)		
1955–1959	8.3	0.43
1975–1979	5.0	0.45
1995–1999	2.6	0.64
Tongue (C01–02)		
1955–1959	0.85	0.54
1975–1979	0.82	0.62
1995–1999	1.3	0.86
Mouth other (C03–06)		
1955–1959	0.92	0.58
1975–1979	0.81	0.54
1995–1999	1.5	0.92
Salivary glands (C07–08)		
1955–1959	0.79	0.62
1975–1979	0.73	0.67
1995–1999	0.94	0.74
Pharynx (C09–14)		
1955–1959	1.64	0.83
1975–1979	1.94	0.92
1995–1999	2.06	0.74
All (C00–14)		
1955–1959	12.5	3.0
1975–1979	9.3	3.2
1995–1999	8.4	3.9

females in 1955–1959), and decreased until the 1980s (13% in males, 9% in females in 1980–1984). Since the 1980s, the proportion of patients under 50 years has increased slightly. In the 1990s, nearly 85% of new oral cancer patients were over 50 years at diagnosis.

Lip cancer
A total of 7369 new cases of lip cancers (C00) (6242 in males, 1127 in females) were diagnosed in Finland from 1953 to 1999 (Table 1). These comprised 42% of all oral cancer cases: 54% of male cases and 20% of female cases. In 1999, almost all cases (98% in females, 100% in males) were verified histologically and nearly all involved squamous cell carcinomas. The mean age at diagnosis was 70 years in males and 77 in females in 1999. Over the entire study period, the annual number of new lip cancer cases decreased in males from 157 to 99, but increased in females from 12 to 45. Likewise, from 1953 to 1999, the incidence of lip cancer decreased considerably in males, but increased slightly in females (Table 2, Figure 1).

The consumption of tobacco products increased in Finland rapidly from the late 1940s after the Second World War and began to decrease in the 1970s (Statistics Finland, 2002). After the 1950s, the proportion of daily smokers in males decreased but increased in females until the 1980s, and has remained quite unchanged since (Rimpelä, 1978; Valtonen and Rimpelä, 1984; Helakorpi *et al*, 2002) (Figure 1).

Intra-oral cancer
Intra-oral cancer includes malignant tumours of the tongue (C01–02) and other sites of the mouth (C03–06). Of the 4623 new intra-oral cancers (2378 in males, 2245 in females) diagnosed during the study period 50% were tongue cancers (Table 1). Intra-oral cancers constituted 26% of all oral cancer cases (20% of male cases, 39% of female cases), most of which (98% in males, 96% in females in 1999) were verified histologically. Almost all were squamous cell carcinomas. In 1999, the mean age at diagnosis of tongue cancer patients was 59 in males and 66 in females, and the respective ages of mouth cancer patients were 60 in males and 62 in females. The annual number of new intra-oral cancers increased during the study period from 34 to 100 in males and from 29 to 85 in females, while the incidence decreased in males from the early 1950s to the 1970s, and has increased since the 1970s. In females, the incidence did not change much from the 1950s to the 1970s, and has increased since the 1970s (Table 2, Figure 2).

The consumption of alcohol in Finland has increased considerably since the 1950s. The increase was highest in the 1970s. Since the 1980s the rate of increase has slowed, but the overall rate is still high [STAKES (National Research and Development Centre for Welfare and Health), 2002] (Figure 2).

Cancer of the salivary glands
During the study period, a total of 1914 new cases of salivary gland cancers (919 in males, 995 in females) were diagnosed – 11% of all oral cancer cases (Table 1). In 1999, 91% of the cases in males and 94% in females were verified histologically. Of these cases, 41% were squamous cell or unspecified carcinomas, 22% were adenocarcinomas, 14% mixed tumours and 11% lymphomas. The mean age at diagnosis in 1999 was 61 in males and 67 in females. During the study period, the annual number of new salivary gland cancers increased in males from 15 to 33 and in females from 16 to 33. The incidence, however, decreased in males until the mid 1970s and has increased thereafter (Table 2). In females, the change in incidence has been modest with the lowest incidence in the early 1980s.

Cancer of the pharynx
From 1953 to 1999 a total of 3477 new cases of pharynx cancer (C09–14) (2127 in males and 1350 in females) were diagnosed in Finland – 20% of all oral cancer cases (Table 1). In 1999, all cases in males and 94% in females were verified histologically, and most were squamous cell carcinomas, some were lymphomas (mostly in the tonsils) and some were of other histological types. In 1999, the mean age at diagnosis was 59 in males and 60 in females. During the study period, the annual number of new cases increased in males from 30 to 72 and in females from 22 to 33 while the incidence of pharynx cancer increased in males and decreased in females (Table 2).

Discussion

In Finland, as well as in the other Nordic countries, the registration of cancers is population-based and nationwide, thus enabling the Finnish Cancer Registry to cover nearly 100% of solid tumours (Teppo *et al*, 1994). In Finland, the population registry is based on a unique personal identifier (since 1967), which serves as a record-link between various registers such as the Registry of Causes of Death, Central Population Registry and the Finnish Cancer Registry. This provides for the availability of reliable incidence rates of cancers, and enables researchers to follow incidence trends from the early 1950s.

The term oral cancer includes many cancers of different sub sites in the oral region. These cancers have different aetiologies and different trends in incidence over the last 50 years. From 1953 to 1999, the incidence of oral and pharyngeal cancer (C00–14) has decreased in males and increased in females, mainly because of the change in lip cancer rates in males, while for females, the incidence of most oral cancers has increased.

The mean age of oral cancer patients at diagnosis has increased during the study period, mainly because of the ageing of the Finnish population. The mean age at diagnosis was higher in females than in males, because on an average women in Finland live longer than do men. The proportion of patients under 50 years at time of diagnosis has increased slightly since the 1980s, possibly the result of increased alcohol consumption among younger people. The ageing population in Finland, with its large number of post-World War II baby boomers presently in their 60s, will further influence the cancer burden of the population at large.

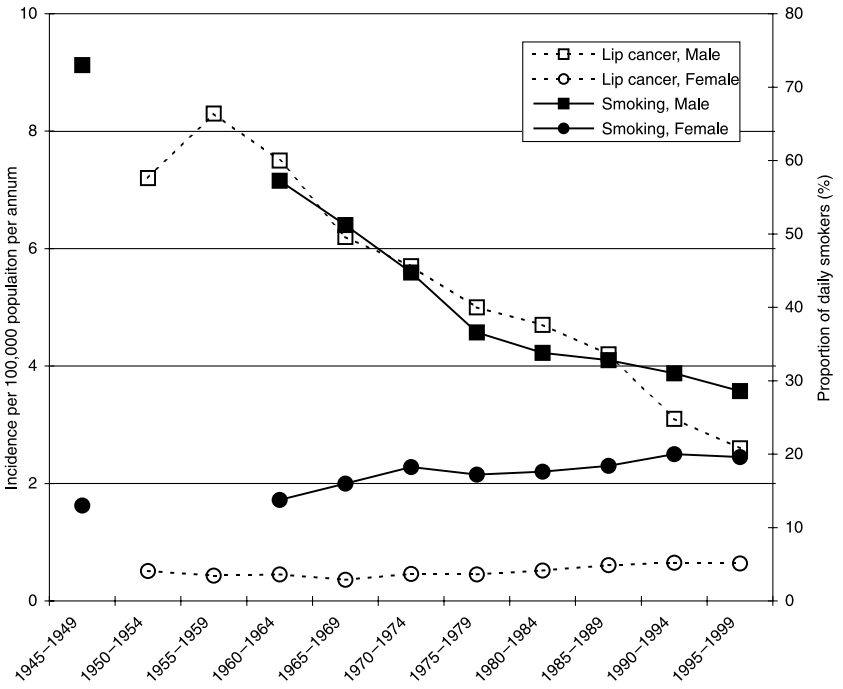

Figure 1 The age-adjusted (to 'world standard population') incidence of lip cancer per 100 000 population per annum from 1953 to 1999 and proportion of daily smokers (%) in Finland in 1949 and in 1960–1999

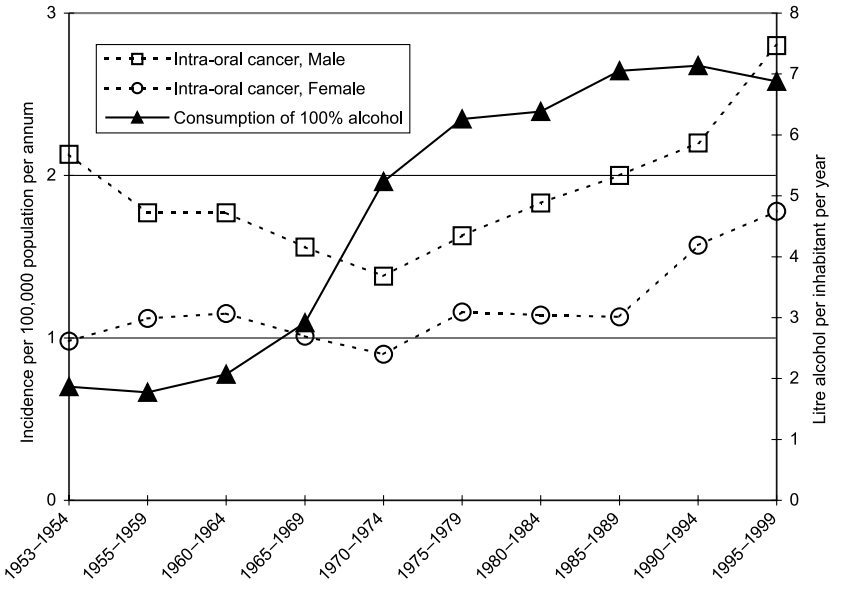

Figure 2 The age-adjusted (to 'world standard population') incidence of intra-oral cancer per 100 000 population per annum from 1953 to 1999 and consumption of alcohol (litre of 100% ethanol per inhabitant per year) in Finland in 1953–1999

Lip cancer is much more common among males than females, and the incidence of lip cancer is higher in Finland than in other western countries (Parkin *et al*, 1992; Moore *et al*, 1999; Hindle *et al*, 2000; Moller *et al*, 2002). The mean age at diagnosis was higher than that of other oral cancer patients. During the study period, the incidence decreased considerably in males while in females the incidence increased slightly, possibly because of the change in risk factors for lip cancer. The two most important risk factors are tobacco smoking and outdoor occupation (Lindqvist, 1979; Pukkala *et al*, 1994). Both smoking rates and the number of outdoor occupations have decreased among Finnish males during the study period (Rimpelä, 1978; Valtonen and Rimpelä, 1984; Helakorpi *et al*, 2002). Smoking among males has decreased since the 1950s while smoking among females has increased from the 1950s to the end of 1980s, and has since remained unchanged (Figure 1). In 2001, 29% of Finnish males and 20% of Finnish females smoked daily (Rimpelä, 1978; Valtonen and Rimpelä, 1984; Helakorpi *et al*, 2002). The total consumption of tobacco products (counted per person aged 15 or over) has, however, decreased since the 1970s (Statistics Finland, 2002). Trends in the incidence of lip cancer and smoking look quite similar (Figure 1). During the study period, both the incidence of lip cancer and smoking decreased considerably in males, while in females, both increased slightly. It seems that changes

in smoking habits may explain at least part of the changes in lip cancer incidence in Finland. The decrease in outdoor working together with decreased smoking may account for the decreased lip cancer incidence in males.

In Finland, the incidence of intra-oral cancers (C01–06) is lower than in other Nordic Countries, Europe, or Northern America (Globocan 2000; Moore *et al*, 2000a, b; Moller *et al*, 2002; Ries *et al*, 2003). The incidence of intra-oral cancers increased during the study period in both genders. Likewise, the consumption of alcohol has increased since the 1950s in both genders. The increase was highest in the 1970s and has been more modest since [STAKES (National Research and Development Centre for Welfare and Health), 2002] (Figure 2). When comparing trends for the consumption of alcohol and the incidence of intra-oral cancer in Finland, the incidence curve seems to follow that of alcohol consumption (Figure 2). Based on these trends and the fact that acetaldehyde is carcinogenic to mucous membranes (Salaspuro, 2003), alcohol may play an important role in the aetiology of intra-oral cancer given the synergistic effect of alcohol and smoking on the production of acetaldehyde in the oral cavity (Salaspuro, 2003).

The use of smokeless tobacco is one etiological factor for oral cancer. The use of oral snuff is quite rare in Finland; in 2002 about 3.5% of Finnish people used oral snuff daily or occasionally (Helakorpi *et al*, 2002). The snuff that Finnish people use is of Swedish origin. The risk for oral cancer associated with smokeless tobacco was reviewed recently (Warnakulasuriya, 2004).

In females, the incidence of pharynx cancer decreased during the study period while the incidence of lip, intra-oral and salivary gland cancers increased. The consumption of alcohol and tobacco among Finnish females has increased during the study period, but remains lower than among Finnish males [Rimpelä, 1978; Valtonen and Rimpelä, 1984; Helakorpi *et al*, 2002; STAKES (National Research and Development Centre for Welfare and Health), 2002]. These changes in risk factors could explain the increasing incidence rates for females.

Moller *et al* (2002) predict that the incidence of lip cancer in Finland will continue to decrease to levels similar to those in other Nordic countries by the year 2022 while the incidence of cancers of the tongue, mouth and pharynx will increase moderately. Reducing the consumption of alcohol and smoking, and identifying patients at high risk are key factors in prevention and control of intra-oral cancers in the future.

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