

# Changing incidence of gastric and oesophageal cancer subtypes in central Switzerland between 1982 and 2007

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**Abstract** Several Western countries have reported a decrease in the incidence of noncardia gastric adenocarcinoma and a strong increase in the incidence of oesophageal and cardia adenocarcinoma. We examined incidence rates of gastric and oesophageal cancer by subsite and histology in Central Switzerland over the last 26 years. Data on biopsy-diagnosed gastric and oesophageal carcinoma incidence during 1982–2007 were obtained from the Cancer Registry of the Institute of Pathology, Lucerne, the Medical Centre for Central Switzerland. Age-adjusted (standardized to the European standard population), and sex-specific incidence rates were calculated. In total, 2,322 cancers were diagnosed: 1,240 noncardia gastric adenocarcinomas, 459 cardia gastric adenocarcinomas, 248 oesophageal adenocarcinomas, and 375 squamous cell carcinomas. From 1982 to 2007, the incidence rates of noncardia adenocarcinoma decreased substantially from 17.9 (per 100,000) to 6.0 in men and 10.3 to 5.5 in women. In men, the incidence of gastric cardia adenocarcinoma decreased from 7.5 to 4.3, the incidence of oesophageal adenocarcinoma increased from 3.3 to 4.8, and the incidence of oesophageal squamous cell carcinoma decreased from 6.6 to 4.1; the incidence rates of these cancers were low in women (1.1–2.4). In conclusion, the incidence of gastric noncardia carcinoma has decreased substantially over the past 26 years. In contrast to other Western countries, the

incidence of gastric cardia adenocarcinoma did not increase in Central Switzerland. Whereas the rate of oesophageal adenocarcinoma increased, the rate of squamous cell carcinoma decreased. These results suggest substantial changes in environmental and life-style risk factors over the past 26 years.

**Keywords** Oesophageal adenocarcinoma and squamous cell carcinoma · Noncardia and cardia adenocarcinoma · Incidence rate · Trends

## Introduction

Until 1990, gastric carcinoma was the most common cancer worldwide. Although there was a dramatic drop in the incidence of gastric carcinoma in most Western countries during the Twentieth century, it remains the second most common cause of death due to cancer in the world [1, 2]. The dramatic drop in gastric carcinoma incidence was mainly due to a strong decrease in the intestinal-type of noncardia gastric cancer in which infection with *Helicobacter pylori* is thought to be the main etiologic factor [3, 4].

In contrast to noncardia gastric carcinoma, gastric cardia and oesophageal carcinoma were less common and occurred predominantly in high-risk groups, such as men with a history of smoking, alcohol use, or long-standing gastroesophageal reflux disease [5, 6]. However, trends toward increasing incidence rates were observed for oesophageal and gastric cardia adenocarcinoma in Western countries, associated with trends toward stabilizing or declining incidence rates for oesophageal squamous cell carcinoma, suggesting that these tumours might be associated with distinct risk factors [5–15]. When considering risk factors, gastric cardia adenocarcinoma has more in

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common with oesophageal adenocarcinoma than with noncardia gastric adenocarcinoma or oesophageal squamous cell carcinoma [12–15]. The incidence of oesophageal adenocarcinoma has been increasing in the United States [6, 7, 13, 16] and in several areas of Europe, including Norway [17], Denmark [18], Sweden [19], the West Midlands and the Oxford areas of England [20], the Swiss Canton of Vaud [8], New Zealand [21], and Australia [22, 23]. The upward trends were generally stronger for men. Among white men in the United States, the incidence of adenocarcinoma of the oesophagus increased over four-fold between the mid-1970s and the mid-1990s in several areas, surpassing squamous cell cancers around 1990 [6, 7, 9]. However, there are substantial geographical variations in both the incidence rates and trends for this disease over the last few decades. For example, no increase in the incidence of oesophageal adenocarcinoma was observed in three French cancer registries [24, 25], and Iceland, Bas Rhin (France), southern Ireland, and Eindhoven (the Netherlands) showed no clear increases in the combined incidence rates of oesophageal and cardia adenocarcinoma [10].

In Switzerland, the incidence of oesophageal adenocarcinoma increased between 1976 and 1994 for the Canton of Vaud without any associated change in the incidence of cardia gastric adenocarcinoma [8]. For the region of Basel, there was no clear increase in the combined incidence rates of oesophageal and gastric cardia cancers between 1981 and 1992 [10]. In Eastern Switzerland, there was no clear increase in the incidence of oesophageal adenocarcinoma between 1989 and 1999 [26]. The Swiss Association of Cancer Registries reported a substantial decline in gastric cancers (noncardia and cardia) between 1986 and 2005 [27]. The incidence rates for oesophageal cancer (adenocarcinoma and squamous cell carcinoma) are substantially higher in Latin Switzerland than in Alemannic Switzerland. The incidence rates of oesophageal carcinoma decreased between 1986 and 2005 in Latin Switzerland, while they increased in Alemannic Switzerland [27].

In this study, we evaluated changes in the incidence rates of (1) noncardia gastric adenocarcinoma, (2) cardia gastric adenocarcinoma, (3) oesophageal adenocarcinoma, and (4) oesophageal squamous cell carcinoma in Central Switzerland over the past 26 years.

## Patients and methods

Data on biopsy-diagnosed gastric and oesophageal carcinomas during 1982–2007 were obtained from the Cancer Registry of the Institute of Pathology Lucerne, the Medical Centre for Central Switzerland (population, 563,789 and 720,074 in 1982 and 2007, respectively). The local Ethics Committee approved this study. Anatomic site and histology definitions were according to the International Classification of Disease for Oncology, second edition (ICD-0-2), [28]. Gastroesophageal cancers were then allocated into four groups: (1) gastric noncardia (C16.1–C16.9), (2) gastric cardia (C16.0), (3) oesophageal adenocarcinoma (C15.0–C15.9), and (4) oesophageal squamous cell carcinoma (C15.0–C15.9). Malignant lymphomas of these sites were excluded. All data were analyzed a second time to ensure correct group assignments. We calculated age-adjusted and sex-specific incidence rates for these cancer subtypes with respect to the European standard population for six 4-year time periods and the last 2-year time period, beginning in 1982–1985 and extending through 2006–2007. We also calculated age-adjusted rates for three age-groups: younger than 50 years of age (<50 years), 50–69 years of age (50–69 years), and older than 70 years of age (>70 years).

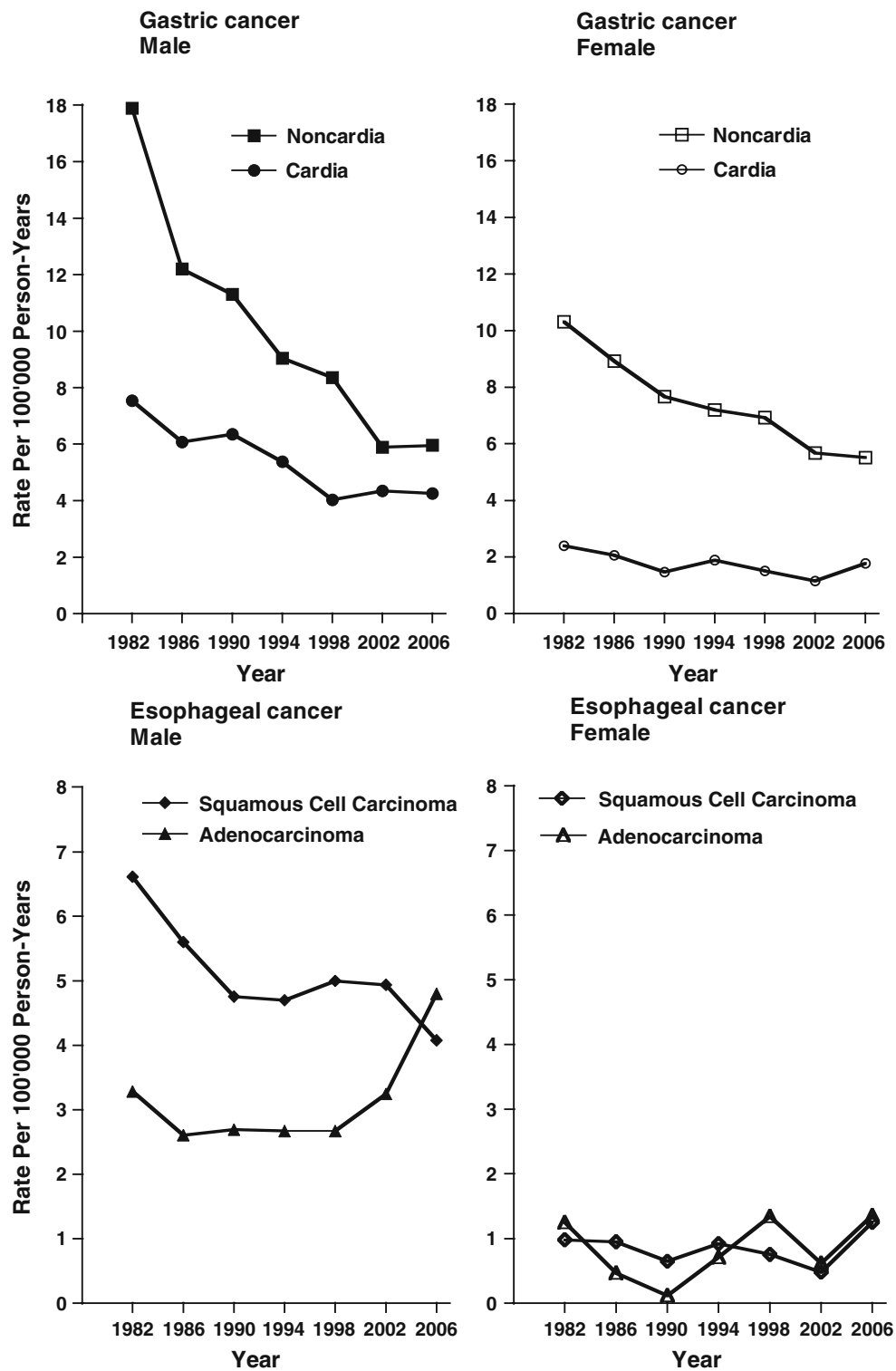
## Results

Between 1982 and 2007, 2,322 patients were diagnosed with gastric and oesophageal cancer; distribution of cancer types, sex ratios, and mean age at diagnosis for men and women are shown in Table 1. Gastric noncardia adenocarcinoma was the predominant gastroesophageal cancer, but the relative frequency decreased during the observed time-period (Table 1; Fig. 1). The sex ratio (M:F) for gastric noncardia adenocarcinoma decreased from 1.7 to 1.1 between the first period (1982–1985) and the last time-period (2006–2007).

Between the first (1982–1985) and last (2006–2007) time-periods, the incidence rates (standardized to the European standard population) of noncardia adenocarcinoma decreased from 17.9 to 6.0 (per 100,000) in men (3.0-fold) and from 10.3 to 5.5 (1.9-fold) in women (Fig. 1); the decrease occurred predominantly in the 50–69

**Table 1** Number of cases, male-to-female ratio, and mean age at diagnosis in the population of Central Switzerland between 1982 and 2007

	Number of Cases (%)	Sex ratio (M:F)	Mean age at diagnosis	
			Men	Women
Gastric noncardia adenocarcinoma	1,240 (54%)	1.3	70.7	72.7
Gastric cardia adenocarcinoma	459 (19%)	2.6	68.2	70.9
Oesophageal adenocarcinoma	248 (11%)	3.8	68.3	70.2
Oesophageal squamous cell carcinoma	375 (16%)	5.7	67.0	68.7

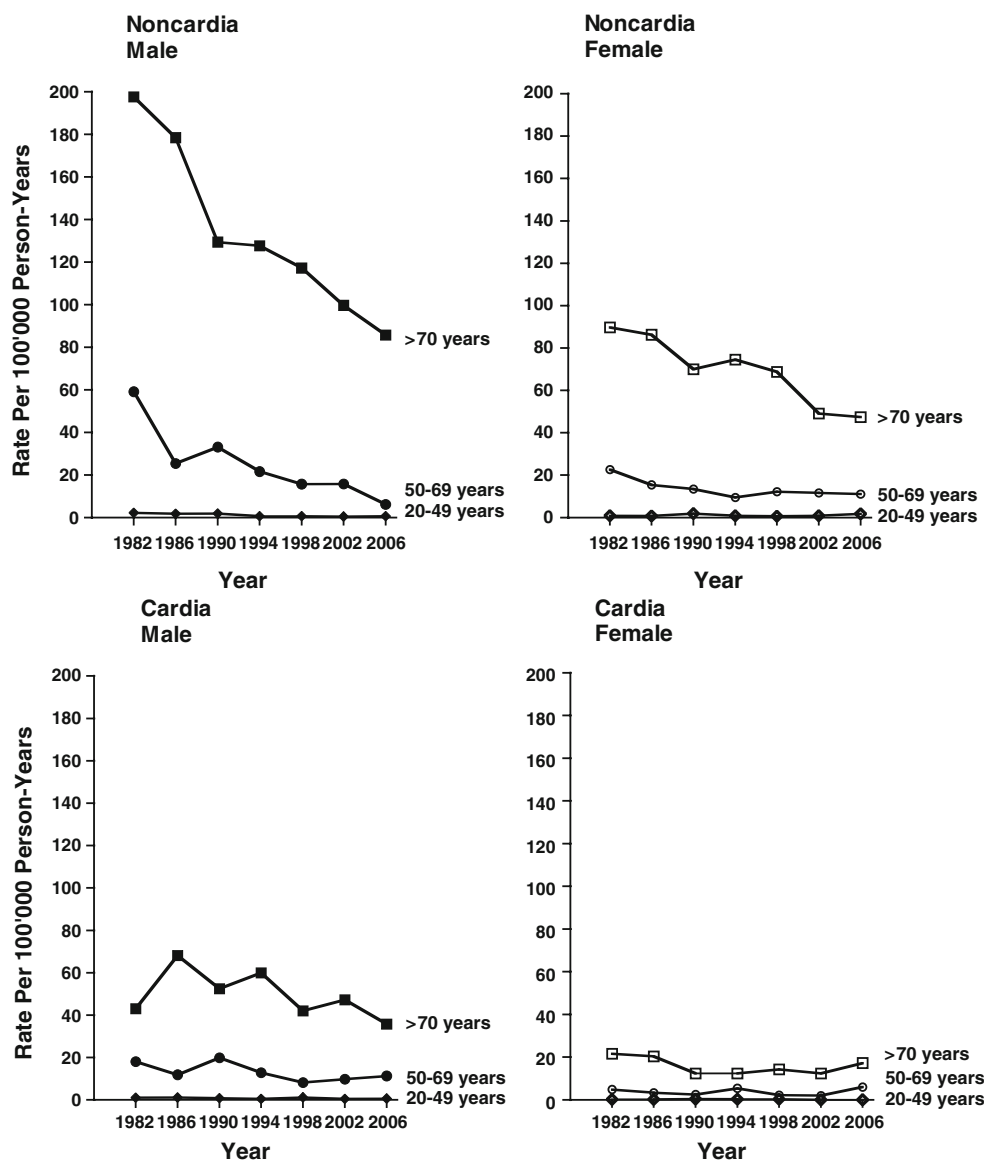


**Fig. 1** Trends in age-adjusted incidence rates (standardized to the European standard population) for gastric (*upper figures*) and oesophageal (*lower figures*) carcinoma among Central Swiss men (*left*) and women (*right*) during 1982–2007

and >70 year-old age-groups (Fig. 2). The incidence rates of gastric cardia adenocarcinoma changed between the first and last time-periods, from 7.5 to 4.3 in men and from 2.4

to 1.8 in women; no relevant changes occurred over the last 10 years (1998–2007; Figs. 1, 2). In the last time-period (2006–2007), the combined incidence rate for gastric

**Fig. 2** Trends in incidence rates (standardized to the European standard population) of gastric cancer for men and women in Central Switzerland during 1982–2007 according to age-group (20–49, 50–69, and >70 years of age)



cancer (noncardia plus cardia) was 10.3 in men and 7.3 in women.

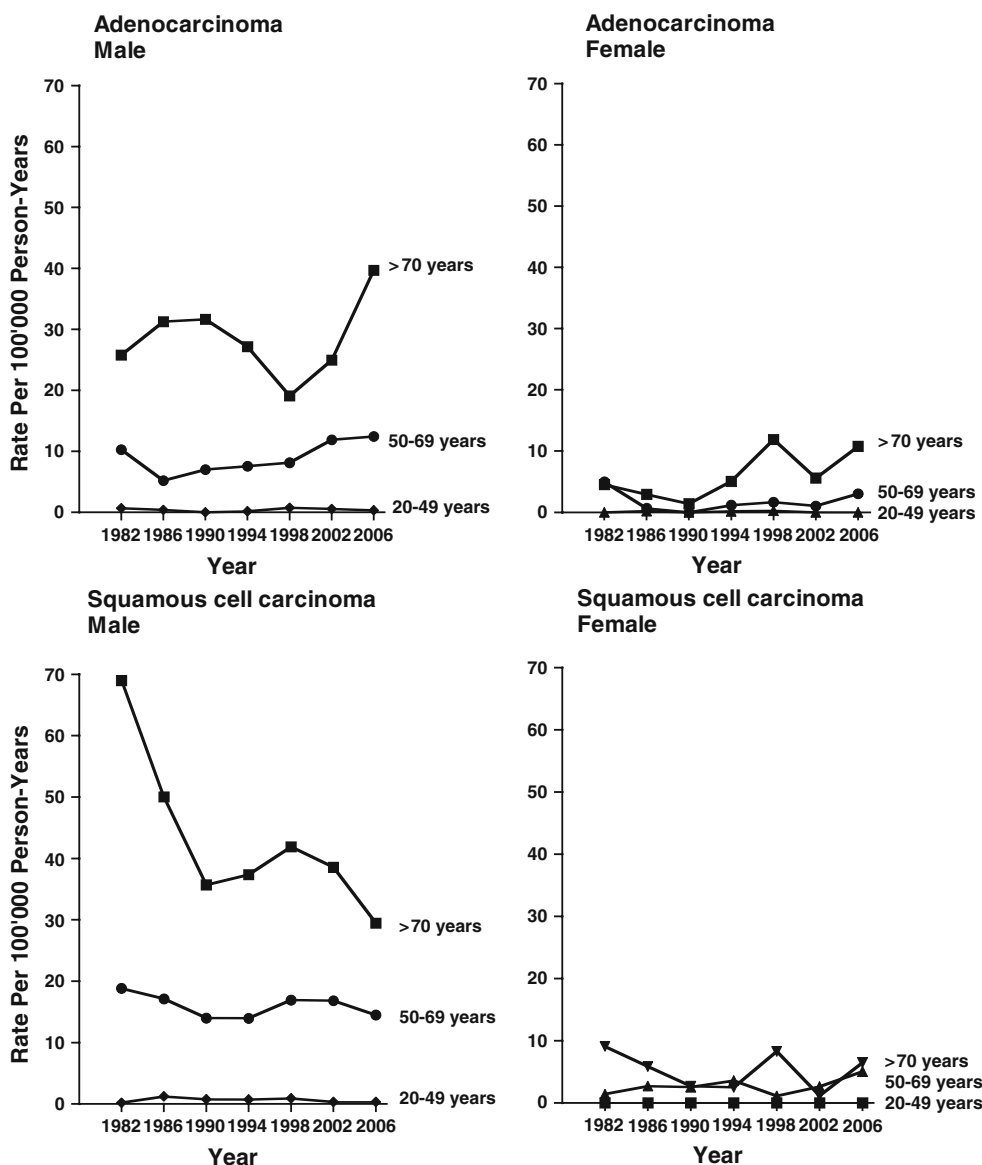
The incidence rates of oesophageal adenocarcinoma changed between the first and last time-periods, from 3.2 to 4.8 in men and from 1.3 to 1.4 in women. The incidence rates for men increased during the last 6 years, mainly due to higher incidence rates for the >70 year-old group and the increase the size of this population (Figs. 1, 3). The incidence rates of oesophageal squamous cell carcinoma changed between the first and last time-periods, from 6.6 to 4.1 in men (1.6-fold) and from 1.0 to 1.2 in women (Fig. 1); the decrease for men occurred predominantly in the >70 year-old group (Fig. 3). In the last time-period (2006–2007), the combined incidence rate for oesophageal cancer (adenocarcinoma plus squamous cell carcinoma) was 8.9 in men and 2.6 in women.

## Discussion

There was a substantial decrease in the incidence rate of noncardia adenocarcinoma for both men and women. The reason for this uniform decline is probably multifactorial. Decreased exposure to *H. pylori* infections among the youth of today as compared to the older birth cohorts is probably one contributing factor [29]. As well, the widespread use of food refrigerators has likely dampened the development of gastric cancer [29, 30]. Other dietary factors, such as higher intake of fresh fruits and vegetables, are also likely contributors [29, 30]. This dramatic drop in the incidence of noncardia adenocarcinoma has been observed in most Western countries [2, 29].

In contrast to other Western countries, incidence rates for cardia adenocarcinoma in Central Switzerland tended to

**Fig. 3** Trends in incidence rates (standardized to the European standard population) for oesophageal cancer in Central Switzerland during 1982–2007 according to age-group and sex



decrease between 1982 and 1997 and remained stable between 1998 and 2007. Similar to reports from other Western countries, the incidence rate of oesophageal adenocarcinoma in men increased in Central Switzerland; however, the increase was much smaller than that reported by other Western countries and was only observed during 2002–2007 [5–23].

The incidence rates for cardia (4.3/100,000) and oesophageal adenocarcinoma (4.8/100,000) in men in Central Switzerland during 2006–2007 are comparable to those in other European countries, such as Denmark, Iceland, Italy, France, and the Netherlands, but are up to two-fold lower than in high-incidence areas of the United States and Europe, such as Scotland [5–25, 31]. Regional incidence differences may reflect variable regional distribution of environmental or life-style risk factors. For example,

Utah (United States), which is a relatively low incidence area for oesophageal cancer, has a high percentage of the population (70%) who are members of the Church of Jesus Christ of Latter-Day Saints, a population with lower exposure levels to cigarettes and alcohol [31].

The unfavourable trends for cardia and oesophageal adenocarcinoma have been related to a number of risk factors that differ from those for oesophageal squamous cell carcinoma. Overweight and obesity have been consistently related to oesophageal adenocarcinoma but not to squamous cell carcinoma [32–35]. Indeed, body mass index seems to be inversely related to the risk of oesophageal squamous cell carcinoma. The influence of obesity on oesophageal adenocarcinoma and gastric cardia adenocarcinoma may be related to higher incidence of gastro-oesophageal reflux in obese persons, since the risk of

gastroesophageal reflux is strongly related to the risk for Barrett's oesophagus [34–37]. Tobacco smoking is a strong risk factor for oesophageal squamous cell carcinoma, but is only a weak risk factor for oesophageal adenocarcinoma. Alcohol drinking is a strong risk factor for oesophageal squamous cell carcinoma but is not consistently related to oesophageal adenocarcinoma [32–37]. Alcohol drinking and tobacco smoking account for over 80% of oesophageal squamous cell cancers in developed countries [32]. In summary, putative risk factors for oesophageal and cardia adenocarcinoma include gastroesophageal reflux, obesity, dietary factors, smoking, alcohol drinking, and gastric colonization with *H. pylori* [32–37].

The observed regional variations in the incidence rates of cardia and oesophageal adenocarcinoma may also be due in part to methodological problems. There are difficulties in the classification of cancers arising at the gastroesophageal junction [7]. Although a standardized set of diagnostic criteria and classification methods were used in the different epidemiological studies, the implementation of these criteria can vary between regions and studies. In particular, the classification of tumours near the gastroesophageal junction as either oesophageal or gastric in origin might differ between registries or over time. Therefore, it is important to analyze combined rates, such as all adenocarcinoma of the gastroesophageal junction and all types of gastric and oesophageal cancers.

The incidence rates and trends reported herein are well in line with the results of the Swiss Association of Cancer Registries [27]. Since the data from Swiss Association of Cancer Registries did not differentiate between noncardia and cardia gastric cancer and between oesophageal adenocarcinoma and squamous cell carcinoma, we could only compare combined incidence rates for all gastric (noncardia and cardia) and all oesophageal (adenocarcinoma and squamous cell carcinoma) cancers. In 2006–2007, the incidence rates for gastric cancers in Central Switzerland were 10.3 and 7.3 in men and women, respectively; corresponding rates for oesophageal cancers were 8.9 and 2.6 in men and women, respectively. These incidence rates are quite comparable to the reported incidence rates for Alemannic Switzerland [27]. The major trends of our data are also well in line with the results of the Swiss Association of Cancer Registries: all results show substantial declines in gastric cancer incidence rates over the past two decades. For oesophageal cancer, it is relevant to differentiate between Latin and Alemannic Switzerland because the incidence rates are approximately 50% higher in men from Latin Switzerland. Furthermore, Latin Switzerland reported a slight decrease, and Alemannic Switzerland a slight increase, in the incidence of oesophageal cancer [27]. Our epidemiological data suggest a clear shift from a predominance of squamous cell carcinoma to a predominance of

oesophageal adenocarcinoma, with minimal changes in the total oesophageal cancer incidence. This shift has been observed in several Western countries [5–27].

Because of the increased incidence of cardia and oesophageal adenocarcinoma in other countries, there has been substantial effort to detect premalignant stages of oesophageal adenocarcinoma, such as Barrett's oesophagus, by upper endoscopy [38]. However, recommendations for the detection of malignant changes and the detection and surveillance of premalignant changes in the stomach and oesophagus must be adjusted to local incidence rates of gastric and oesophageal cancers. Gastric and oesophageal carcinoma incidence rates are substantially lower than the incidence rates of lung, prostate, breast, and several other cancer types. Percentage distribution by site (incidence) for gastric cancer is 2.6 and 2.0% for men and women, respectively; corresponding data for oesophageal cancer are 1.8% and 0.8% for men and women, respectively [27].

In summary, as in other Western countries, the incidence of gastric noncardia carcinoma decreased substantially within the last 26 years in Central Switzerland for both sexes. In contrast to other Western countries, the incidence rates of adenocarcinoma of the cardia did not change over the past 10 years in either sex. The overall incidence of oesophageal cancer remained stable over the past 26 years; however, the incidence of squamous cell carcinoma decreased, whereas the incidence of oesophageal adenocarcinoma increased. These changes in incidence rates suggest substantial changes in environmental and life-style risk factors.

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