Journal of Epidemiology and Community Health 1991; 45: 273–276

Oesophageal cancer mortality: relationship with alcohol intake and cigarette smoking in Spain

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Abstract

***Study objective*—The aim of the study was to explore temporal changes in mortality from oesophageal cancer that could be related to tobacco and alcohol consumption.**

***Design*—The study used mortality trends from oesophageal cancer over the period 1951–1985. In addition, available trends on per capita consumption of alcohol and cigarettes are also presented.**

***Setting*—Data for this study were derived from Spain's National Institute for Statistics.**

***Main results*—Age standardised mortality rates from oesophageal cancer have increased significantly among men in Spain from 1951 to 1985 ($p < 0.01$). Mortality rates in women have not changed significantly during the same period, although there is evidence of a certain decrease in recent years. Trends of per capita cigarette consumption from 1957 to 1982 related positively with oesophageal cancer mortality among men, whereas no significant relationship was observed in women. Trends of beer, spirits, and total alcohol consumption were also positively correlated with oesophageal cancer mortality in men. Among women, a weaker relationship was found. Wine consumption showed no relationship with oesophageal cancer mortality either in men or women.**

***Conclusions*—These results are similar to those found in other studies, supporting a role of alcohol (spirits and beer) and cigarette consumption in causation of oesophageal cancer. No relationship was observed with wine consumption.**

Cancer of the oesophagus is probably the tumour showing the widest geographical variation since there is a 300-fold variation in incidence across the world.[1] There is also evidence that the frequency of this cancer is rising over time in some regions.[2–4] Geographical and temporal variations strongly suggest that environmental factors might play an important role in the aetiology of oesophageal cancer, even though they are not yet fully elucidated. Cigarette smoking and alcohol consumption have been the factors most consistently implicated by epidemiological studies as the major determinants of oesophageal cancer in most Western societies.[5–7]

In order to explore temporal changes in mortality from oesophageal cancer that could be related to tobacco and alcohol consumption, this paper presents the results of a study carried out in Spain on mortality trends from oesophageal cancer over the period 1951–1985. Cross sectional rates by age and sex were used. In addition, available trends on per capita consumption of alcohol and cigarettes are also presented.

Methods

The numbers of deaths attributed to cancer of the oesophagus were obtained from Spain's National Institute for Statistics (INE) for the years 1951–1985, as the latter was the last year for which data were available (6–9th Revision, *International classification of disease*, code 150).[8]

The trend of per capita consumption of cigarettes from 1957 to 1982 was derived from the statistics published by the Spanish National Monopoly of Tobacco.[9] Data on per capita consumption of alcohol beverages were obtained through publications issued by the Ministry of Health.[10]

Death rates per 100 000 person-years were calculated using decennial census population figures for each five year calendar period. Intercensal populations were estimated by linear interpolation method. Age standardised oesophageal cancer mortality rates were calculated by the direct method, using the world standard population.[11] The age specific oesophageal cancer death rates for the five year age categories 40–44, 45–49, . . ., 70–74 and 75–79 years were calculated for the same time period.

Linear regression analyses were performed to determine whether changes in time trends were statistically significant. In order to explore the relationship between exposure variables (alcoholic beverages and cigarette consumption) and mortality from oesophageal cancer, linear regression analyses were also performed using age standardised mortality rates as the dependent variable.

Results

Mortality from oesophageal cancer among men showed an average increase of 4·58% per year from 1951 to 1985 in Spain (fig 1). The total increase throughout the period was 160·5%, corresponding to a statistically significant change in rates from 2·05 in 1951 to 5·34 in 1985 (table III).

Oesophageal cancer mortality trend for women showed two different phases. In the first phase, from 1951 to 1968, the rates increased at about 5·03% per year, whereas in the second phase, from 1968 to 1985, the rates stabilised and even showed a slight decline at the end of the period. Age standardised mortality rates among women

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Accepted for publication January 1991

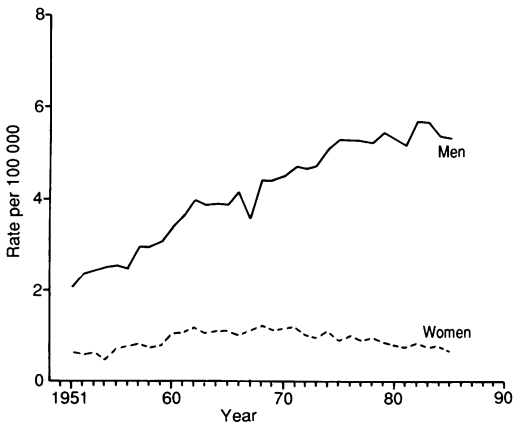

Figure 1 Age standardised mortality trends from oesophageal cancer. Spain 1951–1985.

were much lower than those observed in men, as they fluctuated around one per 100 000 person-years over the whole study period.

The different mortality experienced by each sex brought about a change in the sex ratio: while the male rates were about threefold higher than the female rates in 1951, in 1985 they were about eightfold higher.

Age specific death rates for men and women are shown in tables I and II. Figure 2 present same data plotted in semilogarithmic scale. Because few deaths took place among young people, analysis was restricted to mortality patterns in people aged 40 years and over. Statistically significant upward trends were observed for men in all age groups (table III), especially in the youngest age categories, whereas a levelling off has been manifest for men aged 65 years and older during the last two decades. Women generally showed flat trends though age specific rates slightly decreased towards the end of the period for most of the age groups.

When rates were analysed by birth cohorts (not shown), a cohort effect was apparent for men, as mortality for any age group was consistently higher in successive birth cohorts. For women, no cohort effect resulted since oesophageal cancer mortality rates remained quite stable from those cohorts born around the beginning of the century or even decreased in the youngest cohorts.

Per capita consumption of cigarettes in Spain from 1957 to 1982 is shown in fig 3. Unfortunately, it has not been possible to obtain earlier data from the Spanish National Monopoly of Tobacco. Tobacco consumption doubled during the period, from 3·62 cigarettes per adult-day in 1957 to 6·67 in 1982. Consumption of different alcoholic beverages (litres per capita of pure ethanol) in Spain from 1955 to 1975 is also shown in fig 3. Total alcohol consumption doubled during the period, from 7·83 litres of ethanol per capita in 1955 to 14·87 in 1975; this was due to an increase in the consumption of spirits and beer, since wine consumption fluctuated around 8 litres per capita per year along the whole study period.

The results of regression analyses between mortality rates from oesophageal cancer and consumption of cigarette and alcoholic beverages are presented in table IV. Positive slopes were observed among men for cigarettes, spirits, beer, and total alcohol consumption ($p < 0.01$). Among women no significant slopes (β values) have been found either for cigarette or wine consumption. Though slopes from simple linear regression analyses of the relationship between mortality rates and spirits, beer, and total alcohol were positive and statistically significant, they were of much lower magnitude than those obtained for men.

Table III Regression coefficients for oesophageal cancer mortality rates. Spain 1951–1985

		Men β	*Women β*
Crude rate		0·161†	0·024†
Age adjusted rate		0·107†	
Age specific rates	40–44	0·086†	−0·003 NS
(5 year bands)	45–49	0·195†	−0·007 NS
	50–54	0·274†	−0·006 NS
	55–59	0·348†	−0·018 NS
	60–64	0·432†	0·001 NS
	65–69	0·515†	−0·001 NS
	70–74	0·561†	0·048 NS
	75–79	0·730†	0·092 NS

† $p < 0.01$
β = regression coefficient

Table I Mortality from oesophageal cancer. Spain 1951–1985. Males. Age specific mortality rates per 100 000 person-years

	Age (years)								*Crude*	*Adjusted*
Year	*40–44*	*45–49*	*50–54*	*55–59*	*60–64*	*65–69*	*70–74*	*75–79*	*rate*	*rate**
1951/55	0·8	2·3	4·3	7·4	9·8	13·9	18·7	22·3	2·2	2·4
	(35)†	(90)	(149)	(211)	(237)	(253)	(244)	(166)	(1524)	
1956/60	1·0	2·6	5·1	8·3	13·4	18·1	24·1	27·3	2·9	2·9
	(45)	(108)	(218)	(277)	(364)	(348)	(360)	(233)	(2137)	
1961/65	1·1	2·9	7·7	11·6	17·3	23·9	27·1	35·6	4·0	3·8
	(61)	(132)	(307)	(418)	(517)	(584)	(466)	(388)	(3190)	
1966/70	1·8	4·0	6·5	12·7	18·7	25·3	30·9	42·8	4·6	4·2
	(115)	(203)	(273)	(477)	(647)	(731)	(607)	(470)	(3957)	
1971/75	2·4	4·8	8·7	13·1	20·7	30·3	39·2	43·9	5·6	4·9
	(131)	(288)	(501)	(599)	(770)	(884)	(891)	(639)	(5299)	
1976/80	3·2	5·8	10·5	16·1	22·8	30·0	37·2	46·2	6·4	5·3
	(173)	(366)	(571)	(817)	(867)	(901)	(859)	(710)	(5956)	
1981/85	3·1	8·6	13·3	17·8	22·6	27·8	32·9	41·2	6·90	5·5
	(131)	(389)	(554)	(726)	(774)	(786)	(695)	(604)	(5273)	

* World standard population was used
† Number of deaths on which rates were based given in parentheses

Table II Mortality from oesophageal cancer. Spain 1951–1985. Females. Age-specific mortality rates per 100 000 person-years

	Age (years)								*Crude*	*Adjusted*
Year	*40–44*	*45–49*	*50–54*	*55–59*	*60–64*	*65–69*	*70–74*	*75–79*	*rate*	*rate**
1951/55	0·4	0·6	0·9	1·3	2·2	2·7	5·1	7·4	0·7	0·6
	(20)†	(25)	(35)	(42)	(67)	(64)	(92)	(85)	(525)	
1956/60	0·4	0·6	1·3	2·4	3·1	4·9	6·7	8·5	1·0	0·8
	(17)	(23)	(43)	(81)	(102)	(124)	(137)	(119)	(806)	
1961/65	0·5	0·7	1·2	2·8	3·7	5·9	8·0	14·4	1·5	1·1
	(25)	(37)	(58)	(113)	(123)	(174)	(197)	(225)	(1220)	
1966/70	0·4	0·7	1·4	2·4	3·4	5·9	10·9	15·3	1·6	1·1
	(19)	(38)	(77)	(96)	(137)	(207)	(261)	(247)	(1435)	
1971/75	0·3	0·6	1·3	1·6	3·3	5·2	9·7	12·6	1·6	1·0
	(17)	(30)	(58)	(77)	(132)	(172)	(270)	(247)	(1412)	
1976/80	0·3	0·4	1·1	1·4	3·1	4·1	7·8	12·3	1·6	0·9
	(21)	(19)	(51)	(73)	(126)	(139)	(248)	(297)	(1407)	
1981/85	0·3	0·3	0·7	1·4	2·3	3·4	6·3	9·7	1·5	0·7
	(20)	(26)	(57)	(86)	(128)	(173)	(230)	(233)	(1392)	

* World standard population was used
† Number of deaths on which rates were based given in parentheses

Table IV Regression coefficients between oesophageal cancer mortality rates and per capita consumption of cigarettes and alcoholic beverages. Spain 1957–1985

	Men β	*Women β*
Cigarettes (units/adult day)	0·738†	−0·012 NS
Alcoholic beverages		
Total	0·352†	0·042*
Wine	0·317 NS	0·033 NS
Spirits	0·727†	0·106†
Beer	0·970†	0·102*

* $p < 0.05$ † $p < 0.01$
β = regression coefficient

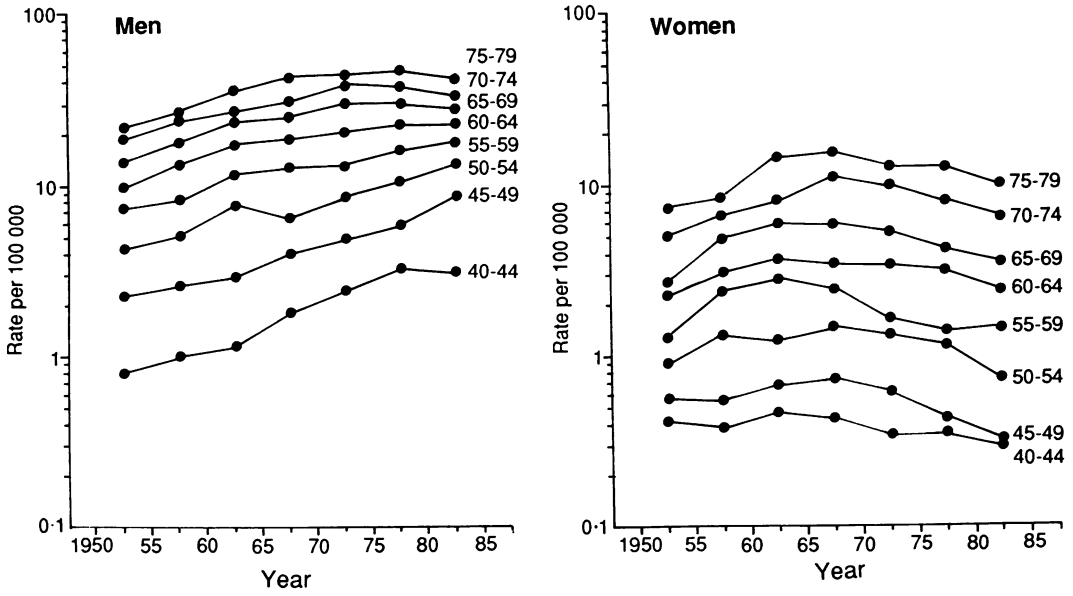

Figure 2 Age specific mortality trends from oesophageal cancer, by sex. Spain 1951–1985.

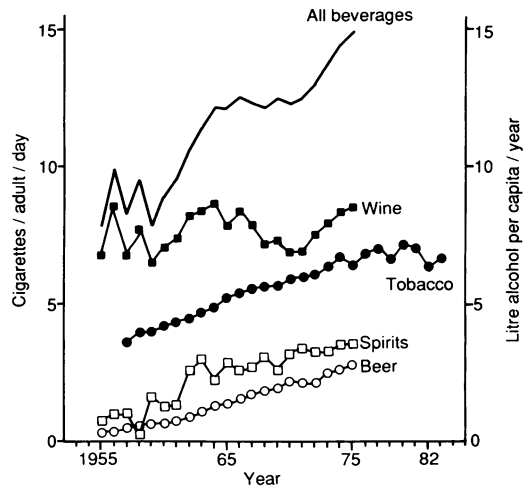

Figure 3 Trends in per capita consumption of cigarettes (cigarettes per adult over 15 years of age per day), and alcoholic beverages (litres per capita of pure ethanol per year). Spain 1957–1982 (cigarettes) and 1955–75 (alcoholic beverages).

Discussion

Our data show a significant increase in mortality trend from oesophageal cancer among men, and a levelled off trend among women in Spain. This pattern is quite similar to that observed in other countries such as France, Italy and Portugal, and different to that seen in north European countries.[12 13] The data from this study also suggest that these trends will not change in the short term, as most recently born cohorts have the highest rates at almost all ages in men and the lowest in women. The different mortality rates experienced by men and women along the period exclude in part the possibility of an artefact due to better diagnosis or reporting. A coding artefact may also be excluded as an explanation for these trends since oesophageal cancer has had the same heading in the three ICD revisions used.

It seems more likely, however, that the distinct mortality pattern by sex could be due to a differential exposure experienced by men and women in Spain, which has been increasing during the last few decades. This is further supported by the fact that a substantial increase in the sex ratio occurred over the study period.

It is now accepted that oesophageal cancer is predominantly of environmental origin, and tobacco and alcohol consumption would be the main risk factors at an individual level for this malignancy, especially in intermediate and low incidence areas.[14–18] Although inferences about the causes of oesophageal cancer cannot be made from this descriptive study, further support for this environmental hypothesis could emanate from the comparison between mortality trends and those of the incriminated risk factors (alcohol and tobacco consumption) at population level.

Two major difficulties in relating these secular trends are the absence of information about alcohol or tobacco consumption by specific age groups and sex, and of a suitable temporal correspondence between their trends and mortality (with assumptions about latency periods that this correspondence could imply). Although the data on per capita cigarette consumption are not available by sex, the trend is mainly determined by male consumption in Spain.[19] In addition, there is also evidence that alcohol consumption is primarily determined by male consumption since Spanish men consumed four times as much alcohol than women, as reported in a national survey on alcohol consumption and drinking habits.[10] Thus these crude average consumption figures are the only useful index we can relate to mortality trends from oesophageal cancer.

We found positive slopes (β values) among men between the mortality trend from oesophageal cancer and per capita consumption of cigarettes, spirits, and beer, but not wine. These findings are partially in accordance with those found by other studies carried out in England and Wales, and in the USA,[14 20 21] in the sense that spirits would represent a greater risk for oesophageal cancer than other types of alcoholic beverages (eg, wine). Two other sets of regression analyses were performed allowing for a five year and a 10 year lag respectively between age standardised mortality rates and exposure variables (not shown). The highest coefficients were found when no time lag was used, which might support the hypothesis that a short rather than a long latent period could be the relevant factor, and that alcohol might act by facilitating cancer precipitation ("precipitator hypothesis").[22] The correlation with beer consumption also reported

at population level in a prior study is at least debatable as no excess of oesophageal cancer has been found in some populations with a high beer intake.[7]

Among women we found a less clear pattern in relation to the different types of alcoholic beverage. The positive relationships found with spirits, beer, and total alcohol consumption are probably meaningless because of the fluctuations and low magnitude of mortality rates among women, and, probably even more importantly, because of the low weight of women's consumption in determining the overall alcohol consumption with which rates are analysed.

It has been also suggested that nutritional deficiencies (eg, of vitamins A and C) could play an important role.[22–24] However the rise in the trend for men has occurred in spite of a general improvement in nutritional status among the Spanish population.[25] As opposed to the observations in men, the lack of massive cigarette and alcoholic beverage use, together with the trend to nutritional improvement, might have caused the decreasing mortality trend observed in women at the end of the study period.

Supported in part by grants from the Spanish Medical Research Fund (FIS 89/0827) and the Valencian Institute of Public Health (IVESP-1989).

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