ITALIAN JOURNAL OF PUBLIC HEALTH

Tobacco smoke in Piedmont: attributable morbidity and impact on hospital costs

Elisabetta Versino[1,2], Maria M. Gianino[1], Giovanni Renga[1]

[1] *Ddipartimento di Sanità Pubblica e Microbiologia, Università di Torino, Via Santena 5 bis, 10126 Torino, Italia*
[2] *Osservatorio epidemiologico regionale per le dipendenze, Via Sabaudia 164, Grugliasco (Torino),Italia*
Correspondence to: Maria M. Gianino, Dipartimento di Sanità Pubblica e Microbiologia, Università di Torino, vai Santena 5 bis, 10126 Torino, Italia. E-mail: mariola.gianino@unito.it

Abstract

Background: Tobacco smoke is the main cause of mortality and morbidity in most industrialized countries. The aim of this research is to estimate the smoke attributable morbidity for Piedmont residents in the years 1997-2002 and the related costs for the regional health service, using as an indicator the number of hospital admissions caused by smoke and as an instrument the DRG rates.
Methods: extraction of hospital admissions for smoking-related diseases; estimate of the proportion of hospital admittances attributable to smoking; estimate of the overall cost and the smoke attributable cost for each year.
Results: The attributable proportion in men is clearly higher than in women. In men it decreases from 10.6% in 1997 to 8.2% in 2002, while values among women seem to have reached a plateau. The economic value of the attributable admissions, at current prices, shows a downward trend for men from 1997 to 2001 and an upward one in the year 2002, while for women the trend is fluctuating.
Conclusions: This method demonstrates the following original features: we used metanalytic relative risks real prevalence data, considering a fifteen-year latency period between exposure and effect on health.The model that we developed adheres more adherent to the natural history of the disease and to the local health problem, giving us a useful tool for planning purposes.Furthermore, the economic estimate is made for each single DRG instead of applying medium rates for MDC, which happens more frequently at the national level.

Key words: smoking, attributable morbidity, hospital costs

Aknowledgements: *The study has been financed by the Piedmont Region (prot. N°11504/27.001).*
Versino E. is responsible for the construction of the epidemiologic model and for the epidemiologic analyses.
Gianino M.M. is responsible for the construction of the economic model and for the economic analysis.
Versino E. and Gianino MM cooperated in the article drawing up.
Renga G. is responsible for the article revision.

Introduction

Tobacco smoke is the main cause of mortality and morbidity in most industrialized countries: each year tobacco consumption is responsible for about 3.5 million deaths.

It has been estimated that globally about 1 billion people smoke and this number is destined to increase, reaching 1.6 billion smokers by 2025.[1]

It is estimated that smoking in Italy causes 90,000 deaths per year (equal to 15% of the overall deaths) with a decrease in life expectancy of 7.5 years [2]. More than 25% of deaths occur in the 35 – 65 age group. [1]

Furthermore, smoking is responsible for:

- 64% of respiratory pathologies among men and 20% among women
- 50% of tumours among men and 5% among women
- 32% of cardio- and cerebrovascular diseases among men and of 6% among women [2,3].

Even if mortality represents one of the most finite indicators for the negative effects of smoking on health, morbidity is still extremely useful not only for determining the economic burden imposed by smoking, but also in order to evaluate the appropriateness of the relationship between supply and demand of hospital services, in order to support the efficient allocation of resources.

The economic burden imposed by smoking has been estimated in various countries: in Australia and in Canada it is 0.4% and 0.56% of the gross domestic product respectively [4]; in Korea, 0.59% [5]; while in China it fluctuates between 0.3% and 0.43%. [4] The smoke attributable cost in the USA is higher: ranging between 0.6%-0.85% of the gross domestic product, while the cost is definitely lower in the UK, where it is 0.16%.[4]

In Italy some of the costs imposed by smoking on society have been estimated, for example, the calculation of healthcare costs linked to hospital admittances for smoking related diseases and to

the total working hours lost amongst patients of working age. [1,6]

These studies show that the cost of hospital assistance for smokers exceeds the cost for non-smokers by 40%, with a smoke attributable cost of 10,007,580 billion (euros) equal to 0.4% of the gross domestic product for the year 1999.

Despite the fact that in Piedmont [7] the proportion of smokers is lower among both men and women, when compared to the national and north western regional Italian averages, smoking represents a priority health problem.

The aim of this research is to estimate the smoke attributable morbidity for Piedmont residents in the years 1997-2002 and the related costs for the regional health service, using as an indicator the number of hospital admittances caused by smoke and as an instrument the Diagnosis Related Group (DRG) rates.

Materials and methods

In order to estimate hospital costs related to tobacco smoking:

1. We extracted data for Piedmont residents from the Hospital Discharge Records (SDO) for smoking-related hospital admissions using the classification ICD-IX-CM for eight five-year age groups from 30 to 70 + years of age for the years 1997-2002.
2. We estimated the proportion of hospital admittances attributable to smoking starting from the relative risks (RR) for smokers and non-smokers and from the prevalence of smokers and non-smokers in every age group.
3. We estimated the overall cost and the smoke attributable cost for each year, starting from the rate attributable to each DRG, stratified on the basis of cause, gender and age.

Smoke-related diseases have been identified on the basis of data presented in systematic reviews [8] as well as the specific metanalytic RR, stratified for smokers and non-smokers (Table 1).

Though the spectrum of smoke-related diseases in the literature is diverse [9,10] and in some cases also quite wide [8], we selected only those causes for which there is sound evidence of a relationship with smoking and those which represent the most important costs for the Regional Health Service (RHS).

From the SDO, we extracted the data relating to hospital admissions for the causes presented in table 1 for the years 1997-2002.

Table 1. Metanalityc RR and 95% CI for specific causes (English, 1995-modified)

Cause (ICD-9-CM)	Ex smoker	Smoker
Oropharyngeal cancer *(141;143-146;148;149)*	1.76 (1.47-2.11)4.55 (3.97-5.20)	
Oesophageal cancer *(150)*	1.79 (1.51-2.13)4.01 (3.37-4.77)	
Stomach cancer *(151)*	1.11 (1.01-1.21)	1.41 (1.29-1.55)
Pancreatic cancer *(157)*	1.15 (1.07-1.24)	1.86 (1.73-2.00)
Laryngeal cancer *(161)*	2.86 (1.87-4.39)	7.48 (4.77-11.7)
Lung cancer *(162)*	M 6.75 (6.16-7.40 F 5.07 (4.66-5.51)	M 13 (12.2.-13.7)) F 11.4 (10.5-12.3)
Bladder cancer *(188)*	1.66 (1.57-1.75)	2.72 (2.60-2.85)
Renal pelvic cancer *(189.1)*	1.95 (1.44-2.64)	3.96 (2.93-5.36)
IHD *(410-414)*	Age ‹65: 1.45 (1.41-1.50) Age 65+: 1.12 (1.07-1.16)	Age ‹65: 3.06 (3.00-3.13) Age 65+: 1.66 (1.59-1.74)
Stroke *(430-438)*	Age ‹65: 1.30 (1.12-1.50) Age 65+: 1.15 (1.07-1.24)	Age ‹65: 3.12 (2.80-3.47) Age 65+: 1.65 (1.52-1.79)
Arteriosclerosis *(440-448)*	1.82 (1.70-1.95)	2.54 (2.42-2.67)
Pneumonia and influence *(480-487)*	1.29 (1.15-1.45)	1.47 (1.33-1.61)
COPD *(490-492;496)*	6.70 (6.20-7.20)	9.8 (9.2-10.2)
Peptic ulcer *(531-534)*	2.24 (2.05-2.45)	2.07 (1.95-2.20)

The data relating to the prevalence (P) of smoking habits have been drawn from the National Institute of Statistics (ISTAT) surveys for the years 1980; 1983-84; 1987 [11,12,13]: it should be noted that, because of the 15-year latency period that elapsed between smoke exposure and health outcomes [14], the prevalence of smoking habits for a certain period has been applied to the morbidity data for the following 15 years, considering the shift of birth cohorts.

Once the admissions had been extracted from the data, using the prevalence of smokers and ex-smokers and the cause specific RR, we estimated the hospitalization rate on the basis of cause for smoking, non-smoking and ex-smoking patients, stratified by age groups.

The algorithm which links the crude hospitalisation rate ($T_{population}$) for each age group in the general population to the rate representing the specific exposure categories ($T_{smokers}$ and $T_{ex\ smokers}$) is as follows [15]:

$$T_{population} = T_{non\ smokers} *[(P_{non\text{-}smokers}) + (P_{ex\text{-}smokers} *RR_{ex\text{-}smokers})+(P_{smokers} *RR_{smokers})] \quad (a)$$

The proportion (PAR%) for classes of morbidity events related to the status of smoker or ex-smoker has been estimated thanks to the following algorithm:

PAR% = (T smokers-T non-smokers/T population)* P smokers (b)

PAR % = (T ex-smokers-T non-smokers / T population)* P ex-smokers (c)

Starting with this hospitalization rate we then proceeded to evaluate the impact of smoke-related diseases on the cost charged to the regional health system. The economic evaluation is limited to the most relevant portion, such as the one connected to hospital admissions. Using the DRG classification system, we proceeded to determine the costs of each specific admission event attributable to the causes identified in Table 1, considering the various admission types and setting of care - ordinary hospital stay, day hospital or day surgery – as well as the length of stay and the presence or absence of complications. The total costs have been determined either on current values, using the DRG current rates in Piedmont for the relevant years, or on deflated values (base:1997).

The expense related to smoke-related admissions were determined, for each year, using the following formula:

$$\sum_{J=i}^{2} \sum_{K=1}^{2} \sum_{w=1}^{9} \sum_{i=1}^{n} [PAR\%_{jiwk} * \text{total costs admissions}_{jiw}]$$

where J stands for male and female gender, K stands for smoker and ex-smoker categories, W stands for age groups (30-34; 35-39; 40-44; 45-49; 50-54; 55-59; 60-64; 65-69; 70-75+) and I for the specific causes.

In order to know the time evolution of the value of the costs attributable to admissions for smoke-related diseases, the costs have been estimated not only for current values but also for deflated values.

Results

1. Trend of the number of admissions related to smoking and of the attributable proportion

Admissions for all causes have decreased from 1997 to 2002, in both men and women; a similar trend is present in smoking attributable admissions (Tables 2,3). The first cause of hospital admissions, both in the general and in the portion of smoking-attributable diseases, is that of cardiovascular disease, followed by tumorous and non-tumorous diseases of the respiratory system.

If we look at the trend of the attributable proportion, fundamental differences between men and women can be observed.

In men, the attributable proportion is clearly higher than in women, because of the higher prevalence of smokers; however in men this proportion decreases from 10.6 % in 1997 to 8.2% in 2002, while values among women plateau (Tables 2,3).

2. Trend of economic values of smoke-related admissions

The economic value, at current prices, of the attributable admissions, estimated using the DRG current rates in Piedmont in the single years, decreases for men in 2002 compared to 1997 (Table 4) while it increases for women (Table 4). From 1998 to 2001 the economic value of the attributable admissions shows a downward trend for men (1998:86.817; 1999: 85.783; 2000: 82.447; 2001: 81.767), while the trend fluctuates for women (1998:17.149; 1999: 18.083; 2000: 18.004; 2001: 18.470).

The percentage of burden for smoke-related expenses on the amount of costs sustained for admissions for all causes shows a downward trend in men, from 48,83% in 1997 to 46,55% in 1998, to 45,48% in 1999, to 44,23% in 2000, to 43,15% in 2001, to 42.05% in 2002; contrarily in women it is from 16.58% in 1997 to 16.27% in 1998, to 16.98% in 1999, to 17.08% in 2000, to 17.17% in 2001, to 17.55% in 2002. If we consider both genders the percentage decreases in the six years as follows: 37.4% in 1997, 35.6% in 1998, 35.2% in 1999, 34.4% in 2000, 33.7% in 2001 and 33.5% in 2002.

With regards to the total costs sustained by the Region for all of the admissions, the economic value

Table 2. Admissions, total and attributable to smoking, stratified by cause. Piedmont, men aged 30-75+. 1997-2002

Cause	1997		1998		1999		2000		2001		2002	
	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)
Oropharyngeal cancer	970	651 (67,1)	1030	679 (65,9)	822	539 (65,6)	695	456 (65,6)	763	495 (64,9)	732	479 (65,4)
Oesophageal cancer	661	418 (63,2)	548	340 (62,0)	422	259 (61,4)	369	225 (61,0)	396	243 (61,4)	380	234 (61,6)
Stomach cancer	1613	305 (18,9)	1410	261 (18,5)	1093	200 (18,3)	978	176 (18,0)	954	168 (17,6)	901	153 (17,0)
Pancreatic Cancer	789	256 (32,4)	754	236 (31,3)	694	216 (31,1)	576	177 (30,7)	606	182 (30,0)	544	162 (29,8)
Laryngeal Cancer	1007	797 (79,1)	992	774 (78,0)	761	589 (77,4)	644	500 (77,6)	660	512 (77,6)	616	475 (77,1)
Lung Cancer	7501	6608 (88,1)	6809	5897 (86,6)	5771	4995 (86,6)	4288	3702 (86,3)	4049	3485 (86,1)	3576	3069 (85,8)
Bladder Cancer	5456	2765 (50,7)	5564	2742 (49,3)	5496	2690 (48,9)	5189	2507 (48,3)	4718	2247 (47,6)	4618	2166 (46,9)
Renal Pelvic Cancer	103	64 (62,1)	87	52 (59,8)	59	37 (62,7)	86	53 (61,6)	86	53 (61,6)	79	48 (60,8)
IHD	16809	6909 (41,1)	16161	6375 (39,4)	15821	6167 (39,0)	15679	5964 (38,0)	16591	6207 (37,4)	16803	6154 (36,6)
Stroke	11405	3838 (33,7)	11281	3641 (32,3)	11079	3539 (31,9)	10051	3112 (31,0)	9765	3001 (30,7)	9732	2948 (30,3)
Arteriosclerosis	5661	2773 (49,0)	5731	2727 (47,6)	5577	2635 (47,2)	5066	2362 (46,6)	4937	2277 (46,1)	4616	2099 (45,5)
Pneumonia and influence	4257	951 (22,3)	4410	956 (21,7)	4545	975 (21,5)	4418	934 (21,1)	3923	824 (21,0)	3966	812 (20,5)
COPD	6459	5485 (84,9)	6309	5228 (82,9)	5481	4534 (82,7)	5063	4176 (82,5)	4216	3472 (82,4)	3882	3192 (82,2)
Peptic ulcer	2270	972 (42,8)	1922	802 (41,7)	1821	761 (41,8)	1665	691 (41,5)	1470	603 (41,0)	1303	533 (40,9)
Other causes	244847	0 (0,0)	238377	0 (0,0)	233952	0 (0,0)	225263	0 (0,0)	226613	0 (0,0	221838	0 (0,0)
All causes	309808	32792 (10,6)	301385	30710 (10,2)	293394	28136 (9,6)	280030	25035 (8,9)	279747	23769 (8,5)	273586	22524 (8,2)

Tot A = total admission for a specific cause
Attr A = smoking attributable admissions for a specific cause
PAR% = smoking aethiologic fraction

of the attributable admissions is equivalent to 13% in 1997 and 12% in the following five-year period. The higher absorption of resources, both for the total amount of admissions and for the smoke-related fraction, is determined by the same causes both in women and in men and in the six years. Those conditions with a decreasing burden are cardiovascular diseases followed by non-tumoral and tumoral diseases of the respiratory system (Table 4).

The admission costs on deflated prices (1997) show in men a downward trend from 1997 to 2001 (1997: 98.467 thousand euros; 1998: 85.703 thousand euros; 1999: 82.962 thousand euros; 2000: 77.342 thousand euros; 2001: 79.974 thousand euros) and an increase in 2002 to 84.640 thousand euros (Figure 1).

Among women costs show a fluctuating trend with the following values: 1997: 18.287 thousand euros; 1998: 16.929 thousand euros; 1999 17.484 thousand euros; 2000: 16.884 thousand euros; 2001: 16.932 thousand euros; and in 2002: 19.067 thousand euros.

Data shows that in 2002 larger quantities of resources, in true value, were allocated to smoking related admissions.

From the analysis of economic data stratified by age group (see tables 5 and 6), during the six-year period, we can remark that in both men and women the age group 70-75+ used the largest portion of the resources, either for total admissions, or for those related to smoking. The absorption quota of the overall hospital

Table 3. Admissions, total and attributable to smoking, stratified by cause. Piedmont, women aged 30-75+. 1997-2002

Cause	1997		1998		1999		2000		2001		2002	
	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)	Tot A	Attr A (PAR%)
Oropharyngeal cancer	304	104 (34,2)	264	90 (34,1)	294	107 (36,4)	282	111 (39,4)	239	91 (38,1)	279	109 (39,1)
Oesophageal cancer	143	44 (30,8)	168	52 (31,0)	122	36 (29,5)	93	29 (31,2)	98	29 (29,6)	117	37 (31,6)
Stomach cancer	1029	61 (5,9)	918	53 (5,8)	718	42 (5,8)	566	32 (5,7)	581	35 (6,0)	577	35 (6,1)
Pancreatic Cancer	754	88 (11,7)	746	83 (11,1)	657	73 (11,1)	630	69 (11,0)	579	67 (11,6)	604	71 (11,8)
Laryngeal cancer	117	60 (51,3)	83	41 (49,4)	71	38 (53,5)	68	35 (51,5)	72	38 (52,8)	63	32 (50,8)
Lung Cancer	1512	952 (63,0)	1383	873 (63,1)	1221	759 (62,2)	1065	660 (62,0)	990	624 (63,0)	900	570 (63,3)
Bladder Cancer	1072	215 (20,1)	1155	233 (20,2)	1281	260 (20,3)	1220	258 (21,1)	1109	237 (21,4)	1065	232 (21,8)
Renal pelvic Cancer	20	6 (30,0)	34	8 (23,5)	26	7 (26,9)	38	12 (31,6)	30	8 (26,7)	36	11 (30,6)
IHA	7663	995 (13,0)	7034	919 (13,1)	6819	911 (13,4)	6903	925 (13,4)	7399	1030 (13,9)	7244	984 (13,6)
Stroke	12390	1153 (9,3)	12274	1183 (9,6)	11700	1157 (9,9)	10602	1053 (9,9)	10389	1112 (10,7)	10170	1095 (10,8)
Arteriosclerosis	2775	481 (17,3)	2792	489 (17,5)	2544	461 (18,1)	2230	406 (18,2)	2346	434 (18,5)	2290	443 (19,3)
Pneumonia and influence	2920	188 (6,4)	2993	189 (6,3)	3513	229 (6,5)	3308	216 (6,5)	2841	191 (6,7)	2878	192 (6,7)
COPD	3392	1776 (52,4)	3289	1675 (50,9)	3192	1642 (51,4)	3087	1611 (52,2)	2409	1299 (53,9)	2444	1324 (54,2)
Peptic ulcer	1435	212 (14,8)	1257	179 (14,2)	1188	173 (14,6)	1154	168 (14,6)	1101	159 (14,4)	872	132 (15,1)
Other causes	310666	0 (0,0)	303260	0 (0,0)	296615	0 (0,0)	286644	0 (0,0)	284137	0 (0,0)	281274	0 (0,0)
All causes	346192	6335 (1,8)	337650	6067 (1,8)	329961	5895 (1,8)	317890	5585 (1,8)	314320	5354 (1,7)	310813	5267 (1,7)

Tot A = total admission for a specific cause
Attr A = smoking attributable admissions for a specific cause
PAR% = smoking aethiologic fraction

admissions never drops below 42% in men and 66% in women and the smoke-related quota never falls below 38% in men and 42% in women. The next largest portion of resources is attributable, for both genders, to the next age group of 60-69 years. Which in the six-year period accounts for, in men, 30-32% of the overall hospital admissions and 33% of the smoke-related admissions, while in women, it accounts for around 19% of the overall admissions and from 28,8% in 1997 to 24,8% in 2002 of smoke-related admissions.

The age group which has the smallest expenditure is that of the 30-39 year olds: its portion of resource absorption, both in overall admissions and in smoke-related admissions, never exceeds 3.1%, in both men and women.

Discussion

The aim of this study was to estimate the smoke-related morbidity for the residents in Piedmont who were treated there during the years 1997-2002 and the relative costs for the RHS, using as an indicator, the number of induced admissions and as an instrument, the DRG rates.

The methods used have some original features including the fact that relative risks were derived from the metanalysis of several studies in order to produce its estimates [8] as well as the use of real prevalence data, taking into account a fifteen-year latency period between exposure and effect on health.

This approach is dramatically different from the one usually applied as it uses evaluations of the attributable proportion drawn from surveys from

Table 4. Total and smoke-related costs for admissions stratified by cause. Piedmont, men-women 30-70+. 1997-2002 (current values in Euros/000) * weight of the specific cause on the column total

Cause	men				women			
	1997		2002		1997		2002	
	Total costs (%)*	Smoke-related (%)*	Total costs (%)*	Smoke-related (%)*	Total costs (%)*	Smoke-related (%)*	Total costs (%)*	Smoke-related (%)*
Oropharyngeal cancer	3.284 (1,6)	2.206 (2,2)	3.074 (1,4)	2.018 (2,1)	863 (0,8)	298 (1,6)	982 (0,8)	393 (1,8)
Oesophageal cancer	1.883 (0,9)	1.190 (1,2)	1.525 (0,7)	933 (1,0)	430 (0,4)	125 (0,7)	441 (0,4)	135 (0,6)
Stomach cancer	5.172 (2,6)	977 (1,0)	4.835 (2,1)	821 (0,9)	3.415 (3,1)	188 (1,0)	2.846 (2,3)	170 (0,8)
Pancreatic cancer	2.582 (1,3)	840 (0,9)	2.432 (1,1)	726 (0,8)	2.643 (2,4)	296 (1,6)	2.410 (2,0)	291 (1,4)
Laryngeal cancer	4.002 (2,0)	3.168 (3,2)	2.993 (1,3)	2.304 (2,4)	393 (0,4)	201 (1,1)	275 (0,2)	137 (0,6)
Lung cancer	19.483 (9,7)	17.162 (17,4)	12.439 (5,5)	10.673 (11,3)	4.053 (3,7)	2.541 (13,9)	3.172 (2,6)	2.022 (9,5)
Bladder tcancer	11.843 (5,9)	5.996 (6,1)	11.678 (5,2)	5.465 (5,8)	2.444 (2,2)	474 (2,6)	2.744 (2,3)	588 (2,8)
Renal pelvi cancer	422 (0,2)	262 (0,3)	476 (0,2)	289 (0,3)	64 (0,1)	18 (0,1)	188 (0,2)	58 (0,3)
IHD	62.512 (31,0)	25.911 (26,3)	87.097 (38,6)	31.934 (33,7)	24.412 (22,1)	3.304 (18,1)	33.028 (27,1)	4.618 (21,6)
Stroke	37.290 (18,5)	12.763 (13,0)	43.449 (19,3)	13.725 (14,5)	42.539 (38,6)	4.131 (22,6)	43.324 (35,6)	5.088 (23,8)
Atherosclerosis	20.193 (10,0)	9.902 (10,1)	23.282 (10,3)	10.574 (11,2)	8.955 (8,1)	1.495 (8,2)	10.318 (8,5)	1.985 (9,3)
Pneumonia and influence	12.023 (6,0)	2.691 (2,7)	15.179 (6,7)	3.114 (3,3)	7.985 (7,2)	490 (2,7)	10.253 (8,4)	681 (3,2)
COPD	15.259 (7,6)	12.957 (13,2)	12.806 (5,7)	10.502 (11,1)	8.436 (7,6)	4.206 (23,0)	8.804 (7,2)	4.749 (22,2)
Peptic ulcer	5.685 (2,8)	2.443 (2,5)	4.196 (1,9)	1.720 (1,8)	3.667 (3,3)	520 (2,8)	2.963 (2,4)	445 (2,1)
Tot. **Tot. %**	201.633 (100,0)	98.467 (100,0)	225.460 (100,0)	94.797 (100,0)	110.300 (100,0)	18.287 (100,0)	121.747 (100,0)	21.361 (100,0)

Figure 1. Costs on deflated and current values (thousand euros), by gender

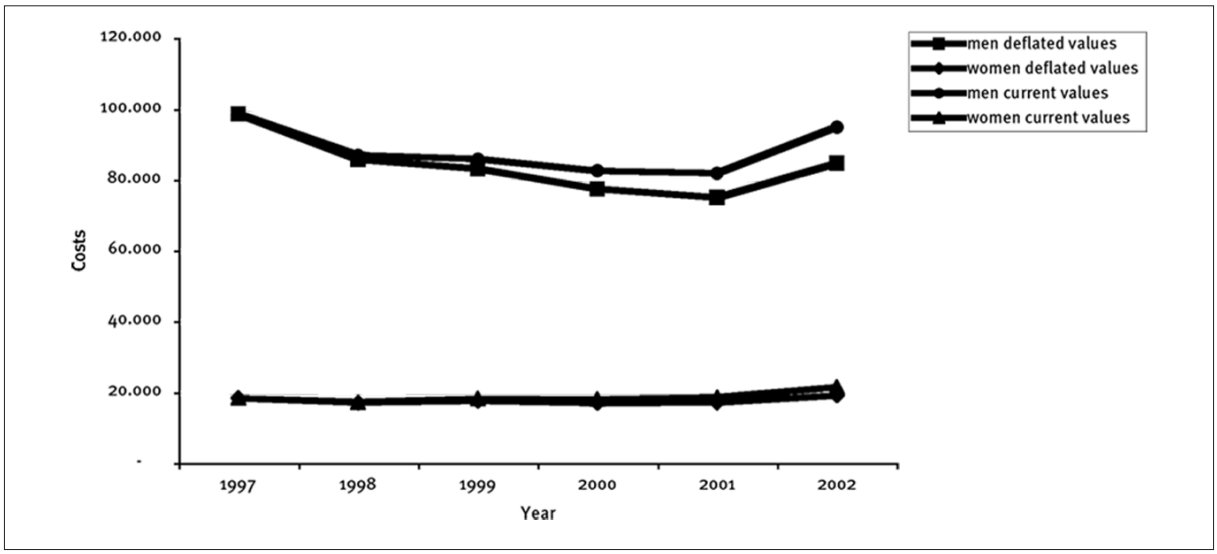

Table 5. Total and smoke-related costs for admissions stratified by age. Piedmont, men-all causes. 1997-2002 (current values in Euros/000) * weight of the specific age class on the column total

Age	1997		1998		1999		2000		2001		2002	
	Total expense	Smoke-related expense	Total expense	Smoke-related expense	Total expense	Smoke-related expense	Total expense	Smoke-related expense	Total expense	Smoke-related expense	Total expense	Smoke-related expense
	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*
30-39	3.571 (1,8)	1.355 (1,4)	3.050 (1,6)	1.130 (1,3)	3.172 (1,7)	1.217 (1,4)	2.636 (1,4)	1.007 (1,2)	2.619 (1,4)	1.066 (1,3)	3.031 (1,3)	1.275 (1,3)
40-49	12.324 (6,1)	6.730 (6,8)	10.726 (5,8)	5.858 (6,8)	10.056 (5,3)	5.463 (6,4)	9.246 (5,0)	5.093 (6,2)	9.386 (5,0)	5.243 (6,4)	11.381 (5,0)	6.485 (6,8)
50-59	34.972 (17,3)	20.088 (20,4)	29.869 (16,0)	16.686 (19,2)	28.702 (15,2)	15.909 (18,5)	28.012 (15,0)	15.292 (18,6)	28.055 (14,8)	14.987 (18,3)	33.688 (14,9)	17.850 (18,8)
60-69	64.726 (32,1)	32.491 (33,0)	58.905 (31,6)	28.281 (32,6)	60.343 (32,0)	28.825 (33,6)	57.117 (30,6)	26.572 (32,2)	57.742 (30,5)	26.703 (32,7)	67.675 (30,0)	31.115 (32,8)
70+	86.040 (42,7)	37.803 (38,4)	83.948 (45,0)	34.863 (40,2)	86.353 (45,8)	34.368 (40,1)	89.411 (48,0)	34.482 (41,8)	91.688 (48,4)	33.768 (41,3)	109.684 (48,7)	38.072 (40,2)
Tot. **Tot. %**	201.633 (100,0)	98.467 (100,0)	186.498 (100,0)	86.817 (100,0)	188.626 (100,0)	85.783 (100,0)	186.422 (100,0)	82.447 (100,0)	189.491 (100,0)	81.767 (100,0)	225.460 (100,0)	94.797 (100,0)

Table 6. Total and smoke-related costs for admissions stratified by age. Piedmont, women-all causes. 1997-2002 (current values in Euros/000) * weight of the specific age class on the column total

Age	1997		1998		1999		2000		2001		2002	
	Total expense	Smoke-related expense	Total expense	Smoke-related expense	Total expense	Smoke-related expense	Total expense	Smoke-related expense	Total expense	Smoke-related expense	Total expense	Smoke-related expense
	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*	(%)*
30-39	2.004 (1,8)	559 (3,1)	1.746 (1,7)	494 (2,9)	1.723 (1,6)	422 (2,3)	1.372 (1,3)	305 (1,7)	1.349 (1,3)	292 (1,6)	1.520 (1,3)	293 (1,4)
40-49	3.651 (3,3)	1.470 (8,0)	3.273 (3,1)	1.364 (8,0)	3.583 (3,4)	1.421 (7,9)	2.929 (2,8)	1.124 (6,2)	3.599 (3,4)	1.336 (7,2)	4.026 (3,3)	1.473 (6,9)
50-59	9.723 (8,8)	3.233 (17,7)	7.857 (7,5)	2.578 (15,0)	7.864 (7,4)	2.667 (14,7)	8.242 (7,8)	2.901 (16,1)	8.635 (8,0)	3.077 (16,7)	9.065 (7,5)	3.420 (16,0)
60-69	21.282 (19,3)	5.269 (28,8)	20.632 (19,6)	5.189 (30,3)	20.287 (19,0)	5.098 (28,2)	19.812 (18,8)	4.687 (26,0)	20.696 (19,2)	4.825 (26,1)	23.475 (19,3)	5.298 (24,8)
70+	73.639 (66,8)	7.756 (42,4)	71.878 (68,2)	7.524 (43,9)	73.055 (68,6)	8.475 (46,9)	73.046 (69,3)	8.986 (49,9)	73.287 (68,1)	8.939 (48,4)	83.661 (68,7)	10.876 (50,9)
Tot. **Tot. %**	110.300 (100,0)	18.287 (100,0)	105.385 (100,0)	17.149 (100,0)	106.511 (100,0)	18.083 (100,0)	105.400 (100,0)	18.004 (100,0)	107.567 (100,0)	18.470 (100,0)	121.747 (100,0)	21.361 (100,0)

the Unites States, which do not consider the real prevalence of exposiure in the counry [16,17]. Even though the last method is extremely useful as it supports the provision of a general evaluation and international comparisons, especially for those countries for which there is no smoking prevalence data available, the model we developed adheres more stringently to the natural history of the disease and to local health problems, giving us a useful tool for planning purposes.

Furthermore, an economic estimate is made for each single DRG instead of applying medium rates for Major Disease Categories (MDC) which often happens at the national level.

The application of a rate for DRG, the calculation of which implies the sum of all of the productive factor costs used for a single admission, allows us to overcome the limitations of an evaluation restricted to a few productive factors, while at the same time producing a value for the real expenses sustained by the local government.[18,19,20,21]

Finally, the whole analysis was carried out considering those disease categories for which the causal relation with smoke-exposure was strongly demostrated rather than only same of them as hoter authors did. [9,10]

The economic analysis was carried out from the RHS point of view and as such we considered the cost values that it sustained. Surely, if the analysis were carried out in the optic of society, we should also consider the indirect costs.[4,5,22]

Results show how tobacco smoking is related with the most widespread admission causes for the Piedmont's population, also with a very high association degree. Some of these cases could be avoided if we reduced smoke exposure.

The decrease trend demonstrated in men is certainly linked to a reduction in the prevalence of smokers and an increase in the prevalence of non-smokers, as a consequence of the anti-tobacco campaign undertaken in the last twenty years.

With regards to women, the situation is more worrisome; as a matter of fact, even though the number of smoke-related admissions is still relatively slow, the trend seems to be one of stabilization, probably sustained by an increase in the prevalence of women smokers in the last 20 years.

The cost results linked to smoke-related admissions, show, in relation with the costs of admissions for the causes identified in table 1, a decreasing trend. If compared with the total costs of admissions, they register a phase of stabilization, phenomenon which underlines that smoke-related pathologies are economically heavier than non-smoke related pathologies.

Such evidence leads to the conclusion that tobacco is a Public Health priority.

The systematic reviews by the *Guide to Community Preventive Services* (*Community Guide*) [23] of the effectiveness of interventions to reduce or prevent tobacco use is focused on three areas:

- Preventing tobacco product use initiation
- Increasing cessation
- Reducing exposure to environmental tobacco smoke (ETS)

The Community Guide recommends several strategies to achieve these objectives, in particular, increasing the price of tobacco products, mass media education campaigns combined with other interventions, a reduction of client out-of-pocket costs for effective cessation therapies, smoking bans and restrictions.

A deeper insight into tobacco related costs and an evaluation of cost effectiveness of the cited interventions could provide our RHS with new strategies for the reallocation of resources for tobacco control.

References

1) Russo R, Scafato E. Fumo e salute: impatto sociale e costi sanitari.[Smoking and health: social and health costs] Roma: OssFAD, ISS; 2002.

2) Doll R, Peto R, Wheatley K, Gray R, Sutherland I. Mortality in relation to smoking: 40 years' observations on male British doctors. Br Med J 1994; 309: 901-11.

3) La Vecchia C, Faggiano F, Versino E, Jannucci L' andamento della prevalenza del fumo in Italia.[Smoking prevalence trend in Italy] Seminario "Salute 2000", Roma, Istituto Superiore di Sanità, Settembre 2002.

4) Parrot S, Godfrey C.. Economics of smoking cessation. BMJ 2004; 328: 947-949.

5) Kang HY, Kim HJ, Park TK, Jee SH, Nam CM, Park HW . Economic burden of smoking in Korea. BMJ 2003 12:37-44.

6) Sgambato A, Cicchetti A, Papa A, Macinati MS, Sposi A, Cittadini A. Analisi dell'impatto economico e sociale delle patologie fumo-correlate in Italia.[Analysis of economic and social costs of smoke related diseases] Roma: Centro di Ricerche Oncologiche "Giovanni XXIII", Istituto di Patologia Generale, Istituto di Igiene, Università Cattolica del Sacro Cuore; 2001.

7) ISTAT. Stili di vita e condizioni di salute. Indagine Multiscopo annuale su "Aspetti della vita quotidiana" - Anno 2001.[Lifestyles and health status. Annual Multiscopo survey on 'everyday life'] Roma: Istituto Nazionale di Statistica; 2002.

8) English DR, Holman CDJ, Milne E, et al.The quantification of drug caused morbidity and mortality in Australia. Commonwealth department of human services and health. Canberra 1995.

9) Barendregt JJ, Bonneux L, van der Maas PJ.The health care costs of smoking. N Engl J Med 1997;337:1052–7.

10) Warner KE, Hodgson TA, Carroll CE. Medical costs of smoking in the United States: estimates, their validity, and their implications.Tobacco Control 1999;8:290–300.

11) ISTAT. Indagine statistica sulle condizioni di salute ed il ricorso ai servizi sanitari – novembre 1980. [Statistical analysis on health condition (of the population) and on health services need – November 1980] ISTAT. Roma , 1983.

12) ISTAT. Indagine statistica sulle condizioni di salute della popolazione e sul ricorso ai servizi sanitari. Novembre 1983. ISTAT. Roma, 1986.

13) ISTAT. Indagine statistica sulle condizioni di salute della popolazione e sul ricorso ai servizi sanitari. Novembre 1986 - Aprile 1987. [Statistical analysis on health condition (of the population) and on health services need. November 1986-April 1987] ISTAT. Roma, 1991.

14) Lopez AD, Collishaw NE, Piha T.A descriptive model of the cigarette epidemic in developed countries. Tobacco Control 1994; 3:242-247.

15) Rothman KJ, Greenland S. Modern Epidemiology, 2Nd edition. Lippincott-Ravens Publishers. Philadelphia, 1998.

16) Peto R Lopez AD, Boreham, J, Thun, M, Heath, L. Mortality from smoking in developed countries 1950-2000, 1994 Oxford University Press, London.

17) Peto R, Lopez AD, Boreham, J, Thun, M. Mortality from smoking in developed countries 1950–2000. Oxford: Oxford University Press, 1994. Update to 1995 of analyses of mortality from smoking in 15 European Union countries, 1998.

18) Luce BR, Schweitzer SO. Smoking and alcohol abuse: a comparison of their economic consequences. N Engl J Med 1978;298:569–71.

19) Rice DP, Hodgson TA, Sinsheimer P, Browner W, Kopstein AN.The economic costs of the health effects of smoking, 1984. The Milbank Quarterly 1986; 4:489–547.

20) Bartlett JC, Miller LS, Rice DP, Max WB. (US Centre for Disease Control and Prevention). Medical expenditures attributable to cigarette smoking. United States,1993. MMWR 1994: 43; 469-72.

21) Miller VP, Ernst C, Collin F. Smoking-attributable medical care costs in the USA. Soc Sci Med 1999;48:375–91.

22) Drummond MF, O'Brien Bernie, Stoddart GL, et al. Cost-benefit analysis. In: Methods for the economic evaluation of health care programmes, 2nd ed. New York: Oxford University Press, 1997:209–12.

23) Changing risk behaviors and addressing environmental challenges. Guide to Community Preventive Services Website. Centers for Disease Control and Prevention. www.thecommunityguide.org/mvoi/.