Estimating Smoking Related Cause of Death: a Cohort Approach Based on Lung Cancer Mortality in six European Countries

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Introduction

It is estimated (WHO, 2002; WHO, 2007) that in 2002 in Europe tobacco use represented the second most important risk factor for mortality accounting for 12.3% (2000) of years of life lost due to premature mortality and years lived in disability (DALYs). It is the principal cause of premature death, exceeding by two thirds that of any other addiction, exposure or injury (Lopez, Collishaw, and Piha, 1994; Peto et al. 2006).

Tobacco use increases the risk of lung cancer, oral cancer, coronary heart diseases and emphysema among others (Rogers et al. 2005; Ravenholt, 1990). According to Peto et al. (2006) in the period between 1960 and 2000 almost 24 million people have died from smoking in EU-25, of whom 13.3 million were in their middle age (35-69 years old).

International comparisons suggest that the impact of smoking on the burden of disease varies among countries and sexes depending on differences among cohorts in lifetime exposure to smoking (Janssen, Kunst, and Mackenbach, 2007; Preston and Wang, 2006)

Although it is widely recognised that many of the smoking related causes of death have a strong cohort effect, especially in the case of lung cancer, most of the estimates are period based (Peto, 1992). However, in the recent years, there has been renewed interest in cohort approaches (Preston and Wang, 2006).

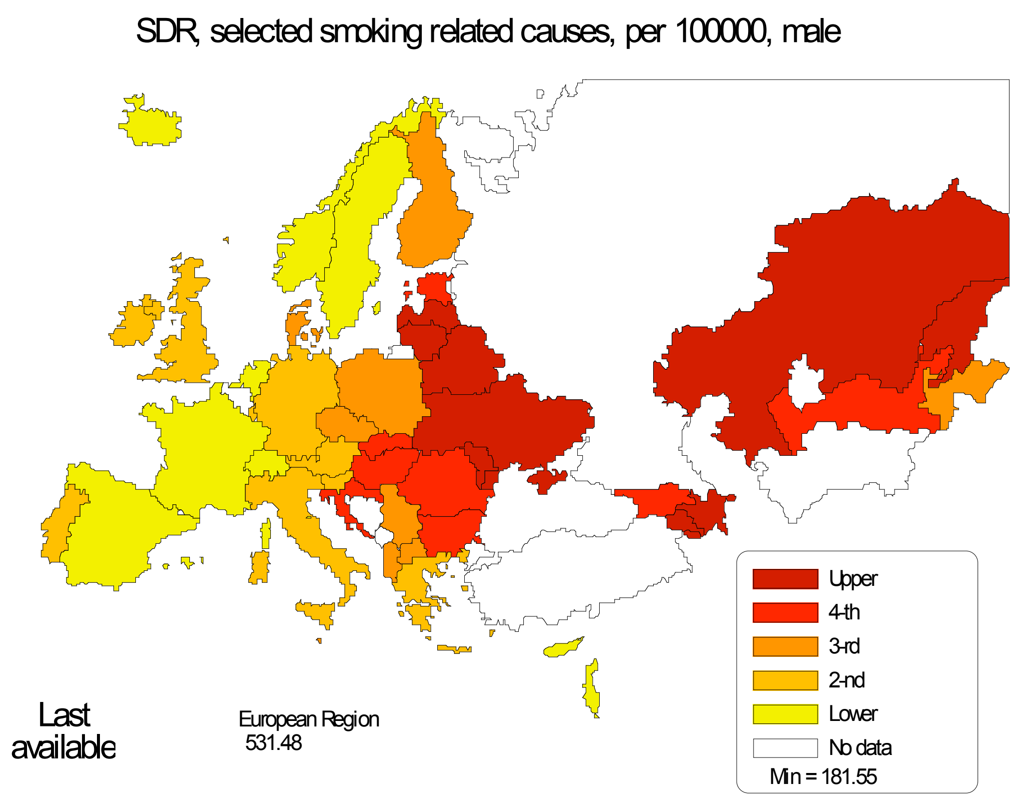
This paper presents cohort-based estimates for lung cancer mortality (using data from the WHO Mortality database) for six European countries that include a variety of levels and trends in smoking-related causes of death over recent decades- Austria, Denmark, Greece, Hungary, Netherlands, and United Kingdom – using Age-Period-Cohort models.

Preliminary descriptive evidence in six European Countries

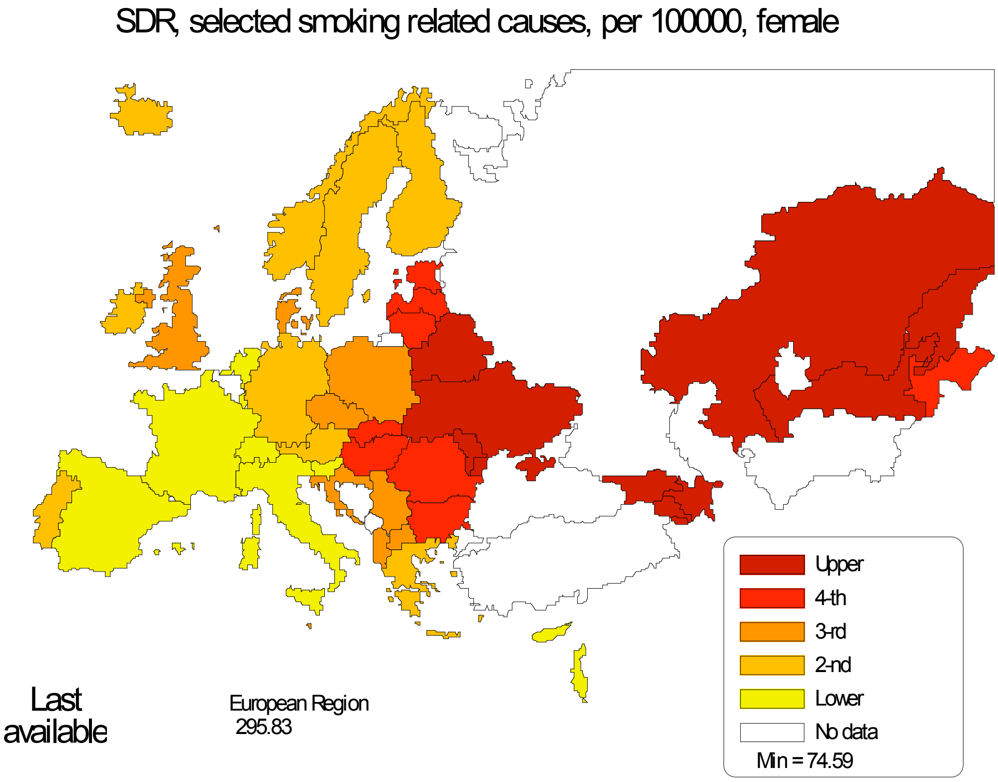
In 2002 (WHO, 2007) tobacco was ranked as the leading contributor to the burden of diseases in six countries - Austria, Denmark, Greece, Hungary, Netherlands, and United Kingdom - accounting for 11%, 18%, 13%, 21%, 17%, and 14% of DALYs respectively.

According to the age standardized death rate (SDR) for selected smoking related causes (cancer of mouth and pharynx, larynx, trachea, bronchus, lung, and oesophagus; ischemic heart diseases, cerebrovascular diseases, chronic obstructive pulmonary disease) for males and females, presented in Map 1 and Map 2, Europe is characterized by a highly heterogeneous pattern. The block of countries belonging to the Central Asian republics and the Central-Eastern European countries have the highest SDRs for smoking related causes of death for both males and females (upper quintile of countries shown). On the other hand Spain, France, the Netherlands, and Switzerland belong to the lowest quintile for both males and females.

For both sexes combined, Hungary belongs to the fourth quintile, Denmark to the third, United Kingdom, Greece, and Austria to the second, while Netherlands to the first quintile.



Map 1 – SDR, selected smoking related causes, per 100000, male (quintiles)
Source: European health for all database (HFA-DB), WHO/Europe (2009)



Map 2 – SDR, selected smoking related causes, per 100000, female (quintiles)
Source: European health for all database (HFA-DB), WHO/Europe (2009)

Mortality for malignant neoplasm of trachea, bronchus and lung is commonly used as indicator of smoking related cause of death since almost 90% of these kinds of cancers are due to tobacco use. As shown in Figure 1, among the current 27 EU countries, Hungary has the highest male mortality rate followed by Greece, the Netherlands, Denmark, United Kingdom, and Austria.

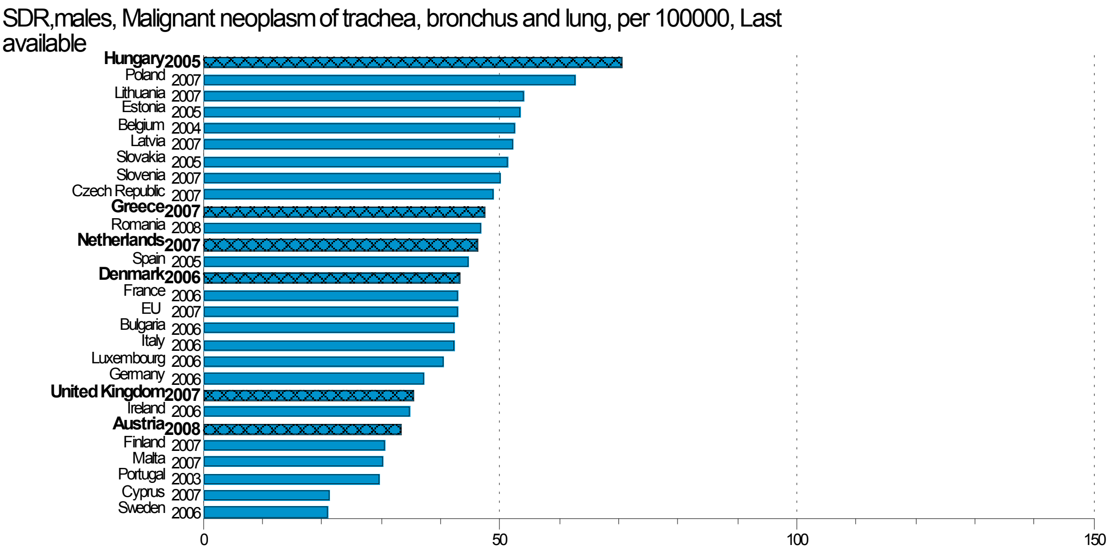


Fig 1 – SDR, malignant neoplasm of trachea, bronchus, and lung, per 100000, male
Source: European mortality database (MDB), WHO/Europe (2009)

A different pattern is observed among females (Figure 2), Denmark (with double the European female average), the Netherlands, United Kingdom, and Hungary, hold the first four position among the EU-27 countries, with Austria and Greece in 8th and 20th positions respectively.

According to the Peto et al. (2006) estimates, the trend observed in the last fifty years in the smoking-attributed proportion of deaths (all ages) shows a decreasing pattern in United Kingdom, the Netherlands, Austria, and Denmark for males, while in Hungary and Greece it is still increasing, with the proportion of deaths equal to 30% and 22% in the most recent period. In the female case, all six countries show an increasing pattern, with the proportion of smoking-attributed deaths ranging from 3.5% in Greece to 20% in Denmark. The highest gender gap is observed in Greece (18.5% absolute difference), while the lowest is observed in Denmark with only a 4 percentage point difference. Focusing on the gender difference in the smoking-attributed proportion of deaths among adults aged 35-69, Denmark is characterized by a higher proportion of deaths among women (29%) than men (28%). Moreover, the absolute gender gap among the young adults is reduced in all countries with the exception of Greece.

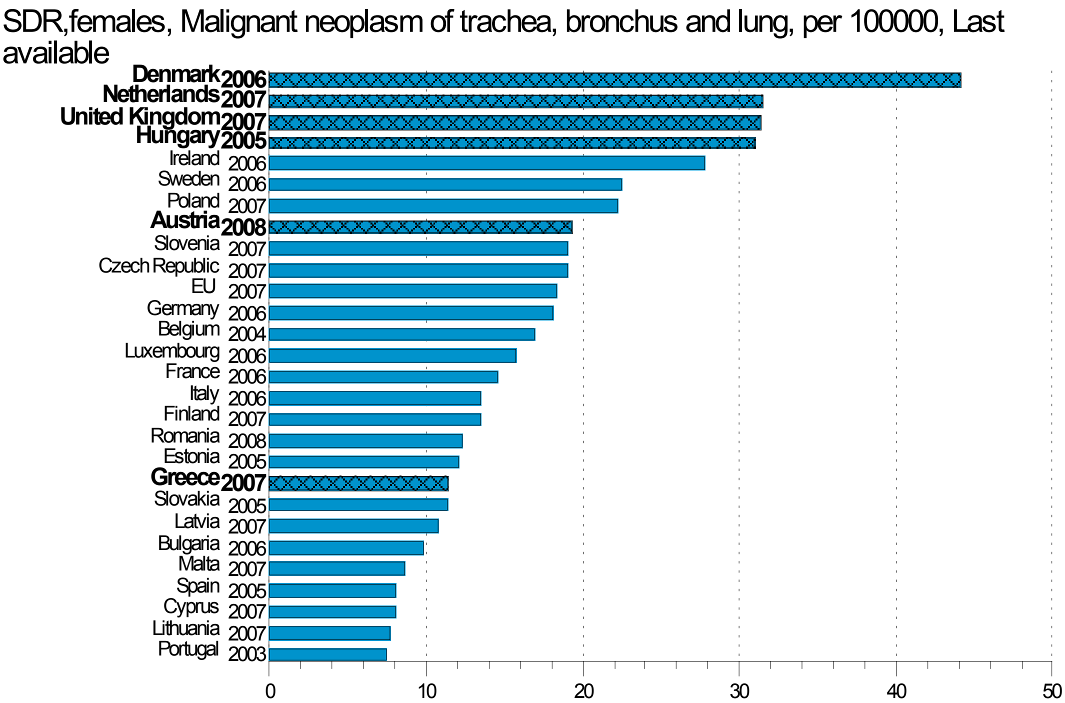


Fig 2 – SDR, malignant neoplasm of trachea, bronchus, and lung, per 100000, female
Source: European mortality database (MDB), WHO/Europe (2009)

Future analysis

While smoking is responsible for deaths from a variety of causes, we concentrate initially on deaths from malignant neoplasms of trachea, bronchus, and lung by sex and age (using registered deaths from WHO mortality database) because of the clear cut relationship of such causes with cohorts' smoking histories. Age-Period-Cohort (APC) models are used to separate age, period, and cohort effects (to the extent that such effects are separable) for people aged 35 and over(Carstensen, 2006).

The APC model for the log-death rates m_{apc}, at age *a*, in period *p* for persons in birth cohort *c*=*p*-*a*, is:

$$\ln(m_{apc}) = f(a) + g(p) + h(c)$$

The cohort function for lung cancer will be used as an indicator of total smoking attributable mortality to detect cohort specificities and gender differences within the six countries. The pace of increase and decease in lung cancer is related to the pace of cohorts' uptake and reductions in smoking, therefore we discuss estimation and use the first derivative of the *h(c)* cohort function to identify the most favoured cohorts in accordance with the tobacco use country profile, and how such models may provide improved mortality forecasts.

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