Lung cancer in France: will women's mortality levels ever reach those of men?

France Meslé and Jacques Vallin
INED, Paris

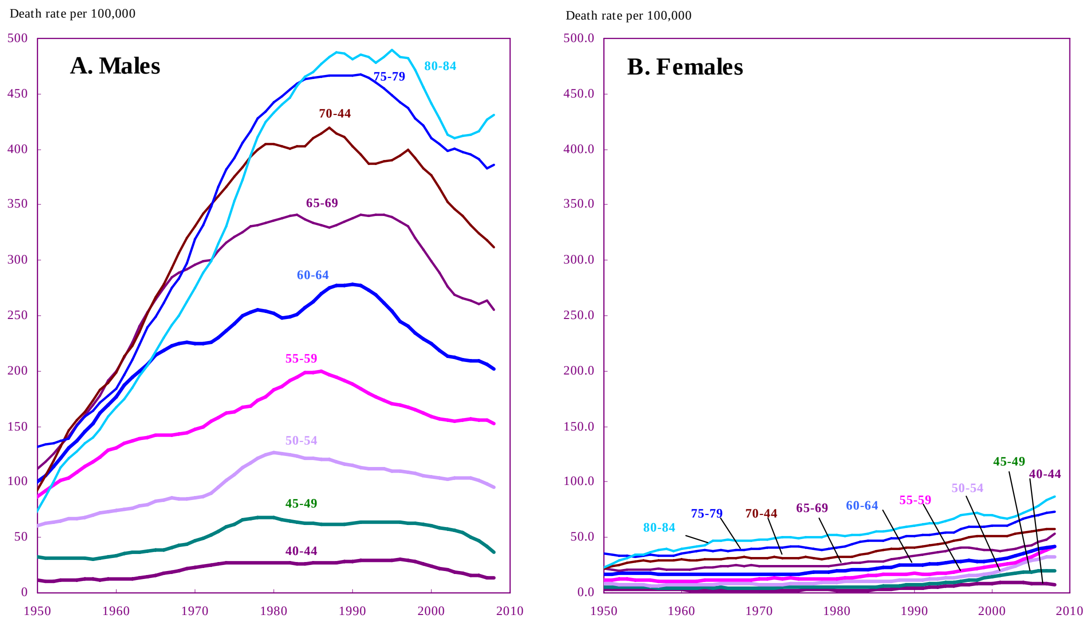
For several decades, highly contrasting trends in male and female lung cancer mortality have been observed in most developed countries. It has long been known that smoking is the main cause of lung cancer (Doll and Bradford, 1950; Doll and Peto, 1981) and these contrasting trends are the direct consequence of differing patterns of tobacco consumption between men and women (Samet and Soon-Young, 2001).

The decrease in lung cancer mortality among men has contributed significantly to male life expectancy improvement while its increase among women has prevented female life expectancy from improving as far as expected (Preston et al., 2010). First observed in England and Wales, and then in the USA, the phenomenon has spread to many European countries (Vallin and Meslé, 2001). In France the trend reversal for men occurred at the turn of the 1990s (Meslé, 2006), while female mortality continued to increase and has even slightly accelerated recently. However, female lung cancer mortality remains much lower than male mortality, with a standardized mortality rate of 1.6 per thousand for females versus 6.5 for males in 2008. Nevertheless it could be reasonable to wonder whether women's mortality will not overtake that of men in a foreseeable future.

Thanks to the cause-of-death time series reconstructed under a constant medical definition for France (Vallin and Meslé, 1988; Meslé and Vallin, 1996), it is very possible to analyse long-term trends in age-specific mortality rates by cause, both by period and by cohort. This makes it possible to evaluate different strategies for forecasting lung cancer mortality.

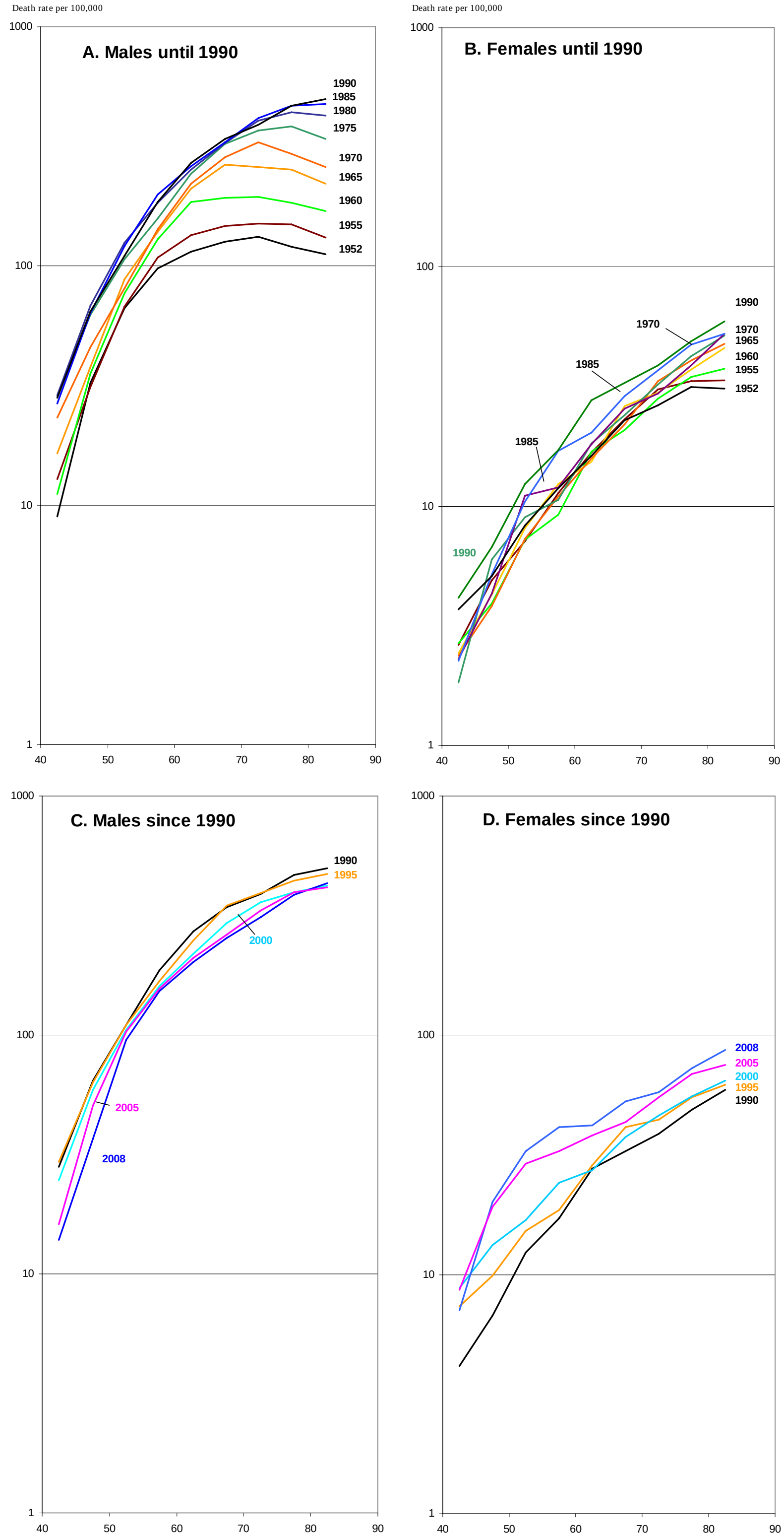
Looking at Figure 1, it might appear very easy to forecast mortality by extrapolating observed trends in age-specific mortality rates over the last two decades. This will be done in a first approach.

Figure 1. Trends in age-specific lung cancer mortality rate (France 1950-2008)



It would probably be naive to think that this leads to the best answer. Smoking habits are not only a matter of changes in the health environment with time, but are also related to changes in cohort behaviours. As shown in Figure 2, the combination of successive cohorts can affect the curves of period age-specific mortality rates quite considerably. It is very clear when looking at the change in the male curves from 1952 to 1990 (graph A of figure 2).

Figure 2. Lung cancer mortality by age at different times (France 1952-2008)



In 1952 rates are much lower at older ages than expected from young age levels. This can be explained by the fact that younger cohorts started smoking more and more while the older ones kept their traditional habit of relatively moderate smoking. It took time to reach a more plausible curve where mortality rates steadily increase with age until the older ages once all cohorts had adopted the new smoking behaviour.

On the contrary, from 1990, when behaviour changed again towards less and less smoking, all cohorts reduced their tobacco consumption at the same time and almost at the same pace, which resulted in lowering all successive curves without much change in their shape (graph C of figure 2).

Changes in female behaviour appear to follow a quite different pattern. The cohort effect was almost negligible until 1990 (graph B of Figure 1). It was perhaps even totally absent since the relatively low levels observed at ages 80-84 in 1952 and 1955 are probably more due to the under-diagnosis of lung cancer than to lower smoking of the cohorts concerned. The weakness or absence of a cohort effect may be due to the very low female level of smoking at that time and to its rather slow increase, as shown by Figure 1.

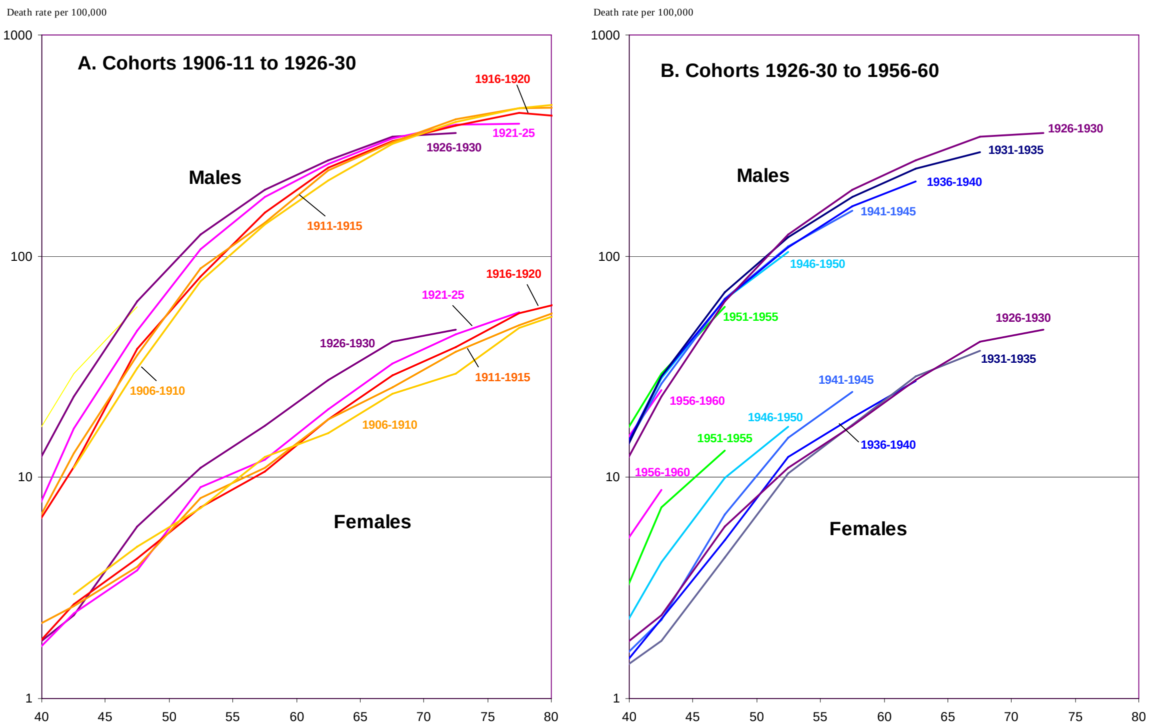
Conversely, from 1990, female curves started to rise more steadily at younger ages, especially at ages 45-60. This could suggest that young cohorts of women had started behaving in the same way as male cohorts several decades earlier. However, the female curves are quite parallel at older ages and their levels increase regularly with time, which suggests the predominance of a period effect.

Can cohort analysis help to better highlight the process of change in order to make mortality forecasts more reliable? Figure 3 displays age-specific death rates by cohort for males and females.

Graph A includes cohorts affected by the spread of smoking among men. From cohorts born in 1906-10 until those born in 1926-30, mortality increased at all ages but all the curves have a fairly similar shape between age 40 and 60 before converging towards the same level at age 70. At older ages, while mortality rates continue to increase for the cohorts 1906-10, they plateau for successive cohorts at the ages they had reached when massive anti-smoking campaigns were initiated. The first part of the curves clearly illustrates the fact that smoking increased from cohort to cohort but the second part indicates that, whatever the cohort, anti-smoking policy impacted smoking habits and lung cancer mortality 15-20 years later. Graph B of Figure 3 shows that the latter phenomenon impacted every younger cohort. As a result, the levels of the curves are lower and lower at almost all ages.

The female story is quite different. For the oldest cohorts (1906-10 to 1916-20), lung cancer mortality was very low and the increase with age closely followed a classical exponential line (Graph A of Figure 3). The cohorts 1926-30 clearly differ, with higher levels of mortality at ages 45-65, but this increase in mortality did not continue for the two next groups of cohorts which remained at the same level at all ages (Graph B of Figure 3). This large group of cohorts born between 1926 and 1940 reached age 20 between the end of WW2 and the beginning of the sixties. Post-war tobacco availability (especially blond tobacco) allied to changes in female behaviour favoured a jump in the very low female tobacco consumption, but this jump was limited in time and the next cohorts adopted the same behaviour without any further increase in tobacco consumption. It is only from cohorts 1941-45 that a steady increase occurred, with each new cohort smoking more than the previous one.

Figure 3. Lung cancer mortality by age for successive groups of cohorts in France



To forecast future female lung cancer mortality, taking account of cohort trajectories, different hypotheses will be discussed. The first one is to consider that the 1956-1960 female cohorts are rather close to the level reached by 1906-1911 male cohorts with the same slope by age. One can expect these cohorts and the next ones to experience the same trajectories as successive male cohorts. However, such a hypothesis is very probably unrealistic since for the three previous groups of female cohorts the rise in mortality with age had already been slowed down by the anti-smoking policies, at levels of consumption much lower than male ones. A better hypothesis is that the initial cohort effects among females will be counterbalanced by the period effect sooner and sooner across cohorts. Our second extreme hypothesis will be given by modelling female trajectories decelerating at younger ages than those of males.

According to this last hypothesis, it is by no means certain that women's lung cancer mortality will ever overtake that of men.

Finally, on the basis of these different hypotheses, the impact of lung cancer on life expectancy will be estimated for the coming decades.

References

Doll Richard and Hill Bradford A., 1950. – Smoking and carcinoma of the lung, *British Medical Journal*, vol. 2, p. 739-748.

Doll Richard and Peto Richard, 1981. – *The causes of cancer.* – New York, Oxford University Press, 2 vol. : 1197 + 1312 p.

Meslé France, 2006. – Recent improvements in life expectancy in France: men are starting to catch up, *Population-E*, vol. 61, n° 4, p. 365-388.

Preston Samuel H., Glei Dana A. and Wilmoth John R., 2010. – Contribution of smoking to international differences in life expectancy, *in :* Eileen M. Crimmins, Samuel H. Preston and Barney Cohen (eds), *International differences in mortality at older ages,* p. 105-131. – Washington D.C., The National Academies Press, 418 p.

Samet Jonathan M. and Soon-Young Yoon (ed.), 2001. – *Women and the Tobacco Epidemic. Challenges for the 21st century*. – Geneva, WHO, Institute for Global Tobacco Control, Johns Hopkins School of Public Health, 222 p.

Vallin Jacques and Meslé France, 2001. – Trends in mortality in Europe since 1950 : age-, sex- and cause-specific mortality, *in :* Jacques Vallin, France Meslé and Tapani Valkonen, *Trends in mortality and differential mortality,* p. 31-186. – Strasbourg, Council of Europe Publishing, 334 p. (Population Studies n° 36).