Understanding the impact of heterogeneity in the smoker population

Daniel Ryan discusses the issues.

It is only 60 years ago that the potential beneficial effects of smoking were trumpeted with subtle promptings from the tobacco industry. Daily individual cigarette consumption by the 1940s had increased to three times the level seen in the 1910s. However, once Professor Doll confirmed the link between smoking and lung cancer in 1954 and advanced the cause of evidence-based medicine, attitudes changed dramatically and smoking cessation or reduction became the primary goal of a series of far-reaching public health interventions.

Smoking has been banned in public places throughout the UK since 2007, and earlier steps to curtail tobacco advertising are being strengthened by the Health Bill 2009 which will remove tobacco displays at point-of-sale and restrict the sale of cigarettes from vending machines. And yet, despite all these warnings and restrictions, the most recent evidence from the Office for National Statistics (ONS) General Household Survey (2007) is that 30 per cent of young men and women aged 20-24 are still smokers.

Insights from longitudinal studies

The prototype cohort study of 34,000 UK male doctors over a 50-year period, and other studies such as the American Cancer Society's Cancer Prevention Studies, have implicated smoking in principal causes of death such as cancers of the lung, stomach, pancreas and bladder, ischemic heart disease, stroke and chronic obstructive pulmonary disease. Of these, lung cancer is most strongly associated with smoking, with the mortality risk for smokers being 10 to 20 times that for non-smokers. However, evidence of the long-term perils of smoking is perhaps more nuanced than is often portrayed, in that it is only a minority of smokers who go on to develop chronic obstructive disease and lung cancer, and only half of smokers are believed to have died as a result of their smoking.

Nicotine and carcinogens from cigarette smoke have a multitude of direct and indirect cumulative effects ranging from inflammatory damage to arterial walls and lung air spaces to damage to cell DNA that could provoke a variety of different cancers. A lung cancer prediction risk model developed from the Carotene and Retinol Efficacy Trial (CARET) with 18,000 participants highlighted the key importance of cumulative exposure to smoke and the timed benefits of abstinence. However, variations in the individual's repair capacity, taking levels of the DNA repair enzyme OGG1 as an example, have been advanced as explaining the marked variation in lung cancer incidence between different smoker populations and the incidence of lung cancer in non-smokers from other sources of carcinogens.

Recent analysis by the British Heart Foundation Health Promotion Research Group has estimated that 27 per cent of male deaths and 11 per cent of female deaths in 2005 were directly attributable to smoking, and that direct costs to the NHS of treating smoking-related illness were then £5.2 billion. This estimate did not include productivity losses, sickness payments or informal care costs. However, at the same time duty and VAT on tobacco products was expected to have raised £10 billion for HM Treasury. This economic analysis clearly illustrates the continuing importance of long-term smoking patterns to preventable disease and death in society, but also may explain in part the reluctance to impose more stringent restrictions on smoking.

The General Household Survey has constructed 'pseudo-cohorts' of lives based on the average experience of sampled individuals from a common year of birth between 1972 and 2005. Watson Wyatt has developed multi-state transition models from such experience and differentials between smoker and non-smoker mortality experience that quantify the importance of changes in smoker prevalence to the relatively high mortality improvements seen in those born in the 1930s, as noted by the Continuous Mortality Investigation (CMI) and the Government Actuary's Department. These highlight the inherent dangers of making projections of mortality from unadjusted historical trends where elements may not be repeatable in the future.

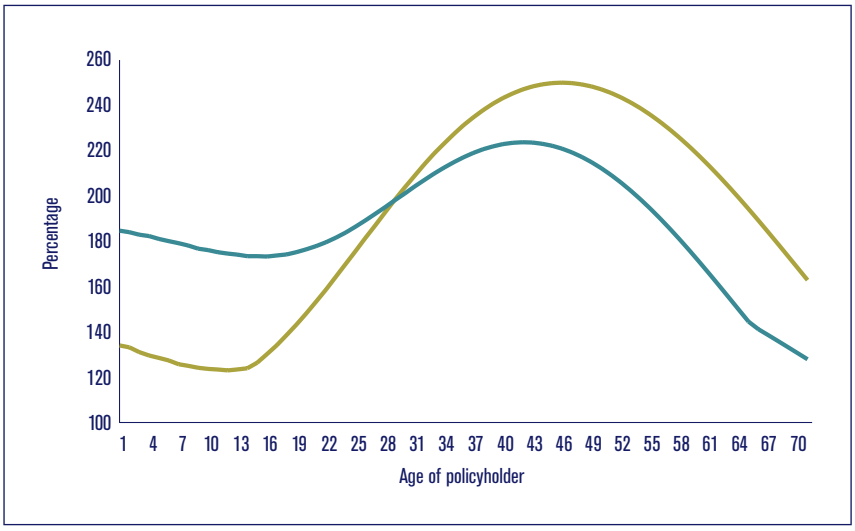
Differences in mortality between smokers and non-smokers

Peto and Doll further contrasted trends in mortality rates over the 50-year period of the UK Doctors Study. They showed mortality rates for lifelong non-smokers approximately halved whilst those for continuing smokers actually increased as the average duration and intensity of smoking increased. They further found that there were significant benefits from smoker cessation even close to retirement, with life expectancy increasing by three years for men who stopped smoking at age 60.

The '00' series tables produced by the CMI were the first that provided separate mortality rates for smokers and non-smokers, but still only covered the assured lives, as smoking status is not recorded for standard annuitants. The age pattern of the excess smoker mortality (as seen in Figure 1) clearly illustrates the cumulative nature of the damage caused by smoking, with subsequent narrowing at older ages reflecting the heterogeneous nature of the risk experienced by different groups of smokers.

There is considerable interest in both the provision of enhanced annuities and the impact of increasing market share for such annuities on the mortality experience of standard annuitants. Some insurers have offered specific annuities to smokers, and there are clearly significant moral hazards to be addressed. However, perhaps less well highlighted is the potential impact of significant heterogeneity in future life expectancy for different groups of smokers. Insurers may be subject to significant anti-selection, with some smokers living much longer than they might expect if they do not capture data such as the current age or age at death of parents. Policyholders may be more likely to choose an annuity option if they already knew that their parents smoked and lived well into old age, reflecting perhaps a genetically enhanced ability to deal with the damaging effects of smoking.

Figure 1 | Ratio of smoker to non-smoker mortality for assured lives (%)



Source: Continuous Mortality Investigation (CMI)

> **While it is unclear whether there will be a shift in the numbers of those starting to smoke, there is still significant potential for further reductions in smoking prevalence.**

Future expectations for smokers

The proportion of smokers at each age has reduced dramatically for later cohorts born in the first half of the 20th century across all social classes. However, there are significant differences for those born after 1955, with continued reductions in the proportion of smokers for non-manual workers as opposed to stability for manual workers. More recently, the 'Smoking Toolkit' study has investigated the impact of the 2007 ban on smoking in public places in the UK. This showed a reduction in smoking prevalence of 2.6 per cent for social classes A, B and C1 and of 1.5 per cent for social classes C2, D and E in 2008, but no changes in 2009.

While it is unclear whether there will be a shift in the numbers of those starting to smoke, there is still significant potential for further reductions in smoking prevalence. Current treatments such as nicotine replacement therapy and the anti-depressant drug zyban (buproprion) may be complemented in the future by nicotine vaccines, such as NicVax. This vaccine is about to enter phase III clinical trials, and such vaccines use the immune system to prevent nicotine reaching key target sites in the brain involved in addiction and withdrawal. Vaccines are relatively inexpensive and reduce the need for hospital based treatments. Vaccines against smoking could be available in perhaps five years.

Any improvements in smoker cessation rates will clearly lead to longer life expectancy for current smokers, but innovations in spiral computer tomography (CT) screening that are currently being investigated by the International Early Lung Cancer Action Program (I-ELCAP) could benefit former and continuing smokers by identifying nodules in the lungs which with early removal could prevent subsequent lung cancers. However, in contrast to other cancers that are more easily accessed such as cancers of the cervix, breast and prostate, this could be a taxing invasive procedure with the possibility that the nodules may not have gone on to develop into cancers.

Conclusion

Smoking prevalence is likely to decrease further as newer cost-effective interventions assist individuals who wish to quit. However, the overall impact on all-cause mortality can only be less significant in the future than it has been in the past. Future initiatives in screening and treatment will need to identify those that are at most risk in the smoker population, and insurers in particular will need to recognise that some smokers will continue to be healthy.

For further information contact

Daniel Ryan
+44 (0) 20 7227 2478
daniel.ryan@watsonwyatt.com