Recent Lung Cancer Patterns in Younger Age-Cohorts in Ireland

Ulster Med J 2007; **76 (2)** 83-87

Paper

Recent lung cancer patterns in younger age-cohorts in Ireland

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Accepted 6th February 2007

ABSTRACT

Background: Smoking causes 85% of all lung cancers in males and 70% in females. Therefore, birth cohort analysis and annual-percent-changes (APC) in age-specific lung cancer mortality rates, particularly in the youngest age cohorts, can explain the beneficial impacts of both past and recent anti-smoking interventions.

Methods: A long-term time-trend analysis (1958-2002) in lung cancer mortality rates focusing on the youngest age-cohorts (30-49 years of age) in particular was investigated in Ireland. The rates were standardised to the World Standard Population. Lung cancer mortality data were downloaded from the WHO Cancer Mortality Database to estimate APCs in death rates, using the Joinpoint regression (version 3.0) program. A simple age-cohort modelling (log-linear Poisson model) was also done, using SAS software.

Results: The youngest birth cohorts (born after 1965) have almost one-fourth lower lung cancer risk relative to those born around the First World War. A more than 50% relative decline in death rates among those between 35 and 39 years of age was observed in both sexes in recent years. The youngest age-cohorts (30-39 years of age) in males also showed a significant decrease in death rates in 1998-2002 by more than 3% every five years from 1958-1962 onwards. However, death rate declines in females are slower.

Conclusions: The youngest birth cohorts had the lowest lung cancer risk and also showed a significant decreasing lung cancer death rate in the most recent years. Such temporal patterns indicate the beneficial impacts of both recent and past tobacco control efforts in Ireland. However, the decline in younger female cohorts is slower. A comprehensive national tobacco control program enforced on evidence-based policies elsewhere can further accelerate a decline in death rates, especially among the younger generations.

Key words: Birth cohort; Lung cancer; Ireland; Smoking Ban

INTRODUCTION

Lung cancer is currently the most common cancer in the world[1], accounting for almost 1,500 deaths annually in the Republic of Ireland alone[2]. It has been argued that both cigarette consumption rates and smoking prevalence data are necessary to explain a tobacco epidemic, especially when using lung cancer death rate as an index of smoking-attributable mortality[3]. However, historical smoking history data, such as annual age and sex-specific cigarette consumption rates, are not available nationwide for many countries[4]. Also, it has been difficult to quantify the benefits of large scale, preventive interventions. Therefore, it is necessary to have alternative approaches to explaining the beneficial impacts of both recent and past tobacco control efforts.

Because 85% of male lung cancer deaths are attributed to tobacco smoking, any decline or deceleration in the observed lung cancer death rates could be attributed to anti-smoking interventions in the past[5]. Ireland does not have a comprehensive tobacco control program but pockets of tobacco control efforts were in place over the past 40 years or so. Lung cancer trends in young adults (30-39 years of age in particular) have been used as an early indicator of progress in tobacco control[6], and therefore any observed decline among the youngest age-cohorts would indicate the beneficial impacts of more recent anti-smoking activities. In addition, the relative change in lung cancer mortality rates between successive time-periods would also signal the need for additional aggressive anti-smoking strategies. However, in Ireland, it is premature to use age-specific lung cancer death rates to monitor the early consequences of the nationwide workplace smoking ban that was only introduced in March 2004[7].

This study estimates the annual-percent-changes in lung cancer mortality rates from 1958 to 2002 using the Joinpoint regression model (version 3.0) of the US National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) program[8], with special emphasis on the youngest age-cohorts (between 30 and 49 years of age). A simple age-cohort modelling was also performed to explain the temporal patterns.

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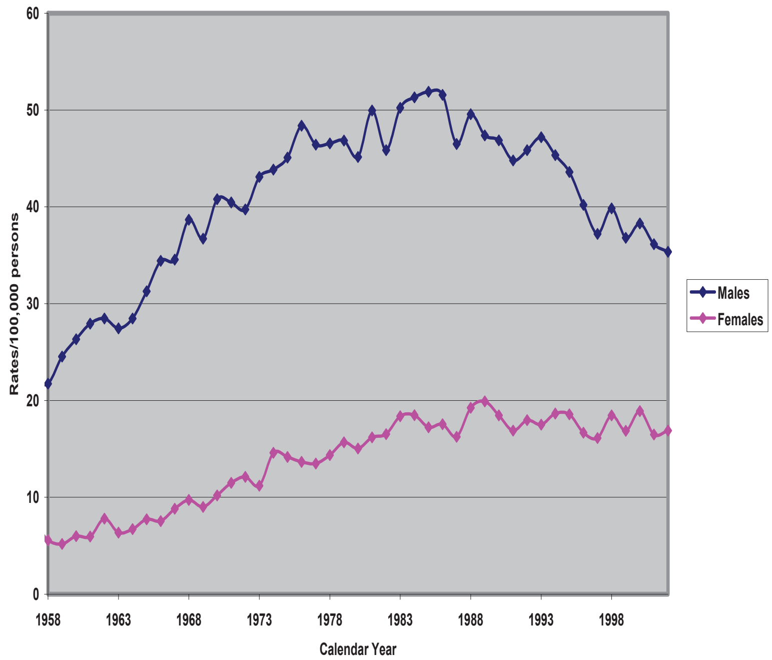

Fig 1. Age standardised (world population standard) lung cancer death rates in the Republic of Ireland (0-85 + age groups) for both sexes, 1958-2002

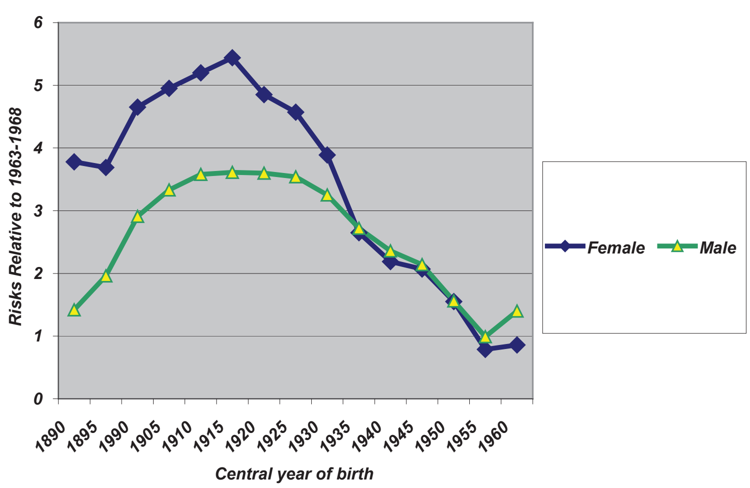

Fig 2. Relative Risk (RR) estimates of Lung Cancer deaths in the Republic of Ireland across different birth-cohorts.

METHODS

Lung cancer mortality data from 1958 to 2002 were downloaded from the WHO Cancer Mortality Database[9]. Age-sex specific adjusted lung cancer death rates standardised to the World Population are also available from the WHO Cancer Mortality Database[9]. Age-specific population estimates for the periods studied were obtained from the Irish Central Statistics Office website (www.cso.ie).

We looked at age-specific lung cancer death rates across the year of birth. In other words, a 'synthetic' birth cohort for each age group was created based on the year and age of death of each individual, using 5-year age and 5-year calendar-period intervals. Each birth cohort could be identified by the central year in the interval. To look at trends across birth cohorts, we employed a simple age-cohort modelling technique. Log-linear Poisson regression modelling (with an offset) was employed to estimate the effects across each birth cohorts adjusting for age relative to the youngest cohorts for both sexes, using the GENMOD procedure in SAS software (version 8.0). However, the use of classical age-period-cohort (APC) modelling techniques could have improved the "fit" of the model (albeit at the expense of extra degrees of freedom), but the random variation associated with parameter estimates might lead to erratic predictions[10]. The classical APC models are also limited with the "non-identifiability" problem. In addition, lung cancer temporal studies consistently show an age-cohort phenomenon rather than an age-period phenomenon in several APC model studies.

For continuous changes in lung cancer death rates across different time-periods, log-linear Poisson regression models were used to calculate APC and joinpoint analyses has been extensively used recently for estimating such temporal effects[11,12]. Because the focus of this study is on younger age-cohorts, we employed jointpoint regression analyses for estimating temporality only for age-groups between 30 and 49 years. Fewer lung cancer deaths per year for each of these younger age-groups necessitated to collapse every 5-calendar year periods into an average age-standardised lung cancer death rate for each of the 5-year age-groups studied (30-34, 35-39, 40-44, 45-49 years of age).

In brief, the Joinpoint[8] analysis fits a series of joined straight lines on a log scale to the age-specific and age-standardised lung cancer death rates. Line segments are joined at points called joinpoints. Each joinpoint denotes a statistically significant change in trend. In joinpoint analysis, the best-fitting points are the years of death that change significantly (increasing or decreasing trends). The analysis starts with the minimum number of joinpoints, and tests whether one or more joinpoints are statistically significant and should be added to the model. A maximum of three joinpoints can be added to the final model. Because of collapsed 5-year calendar periods from 1958 to 2002 and not using the single calendar year death rates for lung cancer trends, the joinpoint analysis could only test a maximum of two joinpoints for this particular study design.

RESULTS

Figure 1 shows the peaking of male lung cancer death rates in the late eighties and the beginning of stabilisation in female death rates when calendar periods were considered. When we looked at the effects across birth cohorts, males born ten years before the First World War had the highest lung cancer risk relative to the youngest cohorts, and females born around the First World War had the highest risk of dying from lung cancer (Figure 2, Table I). While females had a greater risk relative to the youngest cohorts when compared with males' lung cancer risk, those born around and after the Second World War showed a consistent decline in lung cancer risks, with little gender variations (Figure 2). So, those born after 1965

Table I.

Relative Risk (RR) estimates with 95% Confidence Intervals (CI) of Lung Cancer deaths in the Republic of Ireland across different birth-cohorts.

Birth-Cohorts	Males	Females
Central year of birth	RR (95% CI)	RR (95%CI)
1888-1892	1.42 (0.64, 3.13) *	3.78 (1.29, 11.08)
1893-1897	1.96 (0.94, 4.09) *	3.69 (1.37, 9.99)
1898-1902	2.91 (1.47, 5.81)	4.65 (1.84, 11.76)
1903-1907	3.33 (1.75, 6.37)	4.95 (2.09, 11.75)
1908-1912	3.58 (1.96, 6.58)	5.20 (2.33, 11.61)
1913-1917	3.61 (2.05, 6.38)	5.44 (2.59, 11.43)
1918-1922	3.60 (2.12, 6.13)	4.85 (2.45, 9.63)
1923-1927	3.54 (2.16, 5.81)	4.57 (2.43, 8.57)
1928-1932	3.25 (2.05, 5.16)	3.89 (2.18, 6.92)
1933-1937	2.72 (1.76, 4.19)	2.65 (1.57, 4.49)
1938-1942	2.36 (1.58, 3.53)	2.19 (1.36, 3.54)
1943-1947	2.14 (1.45, 3.15)	2.07 (1.33, 3.23)
1948-1952	1.56 (1.06, 2.28)	1.55 (1.02, 2.37)
1953-1957	0.99 (0.60, 1.60) *	0.79 (0.45, 1.38) *
1958-1962	1.40 (0.93, 2.10) *	0.86 (0.54, 1.37) *
1963-1967	Reference (RR=1)	Reference (RR=1)

* Not Statistically Significant

did have the lowest lung cancer risk in both sexes.

In figures 3 and 4, the age-specific lung cancer death rates were relatively high among males across all age-cohorts (same age groups across different calendar periods of birth), but were highest among the oldest age-cohorts (80-84 year olds) for both sexes. Not only lung cancer death rates are low among the youngest age-cohorts, but those between 30 and 39 years of age in males are also showing a dramatic decline in death rates across successive cohorts. There has been more than 80% relative decline in death rates in males between 35 and 39 years of age from 1958 to 2002 (Table II). The females also have shown a 50% relative decline in death rates among the same age cohorts (Table II).

When joinpoint modelling was performed for the relatively young age-cohorts (30-49 years of age), a significant five-year decline was observed among the males in particular (Table III). For example, those male cohorts between 30 and 34 years of age had a 3.7% decline every five years from 1958 to 2002, and those between 35 and 39 years of age also had a significant decline in lung cancer death rates by 3.2% every five years. The females of the same age cohorts (30-39 years of age) did show a downward trend in lung cancer death rates but the findings were not statistically significant (Table III). In contrast, the female cohorts above 40 years of age were experiencing a rise in the 5-year death rate, and again the findings are not statistically significant (Table III).

Table II.

Relative change in lung cancer death rates/100,000 among younger age-cohorts between two five-year time-periods in the Republic of Ireland

	Age-Groups			
	30-34	35-39	40-44	45-49
Males				
1958-1962 (Rates)	2.8	7.0	13.1	32.7
1998-2002 (Rates)	0.9	1.3	5.2	16.9
Relative change	-68%	-81%	-60%	-48%
Females				
1958-1962 (Rates)	0.7	2.1	3.7	9.2
1998-2002 (Rates)	0.7	1.0	6.7	11.0
Relative change	No change	-52%	+81%	+20%

DISCUSSION

In Ireland, the overall lung cancer mortality rates from 1958 to 2002 shows a favourable trend for both sexes, especially among the youngest cohorts. This is consistent with the recent lung cancer incidence pattern[2], and also with the decreasing smoking prevalence in the relatively young adults[4]. The youngest birth cohorts not only had the lowest lung cancer risk but also showed significant decreasing rates in lung cancer death rates in most recent years. Such temporal patterns indicate the beneficial impacts of both the recent and the past anti-smoking interventions in Ireland. However, a slower relative decreasing rate among the youngest female age-cohorts identifies the need for additional and more aggressive tobacco control efforts targeting at specific population groups.

A recent study in Ireland reported a fall in teenage smoking prevalence from 20% in 1995 to 13% in 2003[13]. However it is too soon to estimate the effects on lung cancer rates of

Table III.

APC (Annual Percent Changes) with 95% CI (Confidence Intervals) of Lung Cancer Death Rates and Joinpoint Analysis among younger age-cohorts in the Republic of Ireland for both sexes, 1958-2002

Age-Groups	APC (95% CI) Males	APC (95% CI) Females
30-34	-3.7 (-6.7; -0.7)	-0.6 (-2.4; 1.3)
35-39	-3.2 (-4.5; -1.8)	-1.2 (-3.0; 0.7)
40-44	-2.4 (-3.6; -1.1)	0.5 (-1.4; 2.4)
45-49	-1.4 (-2.8; -0.2)	0.2 (-1.0; 1.3)

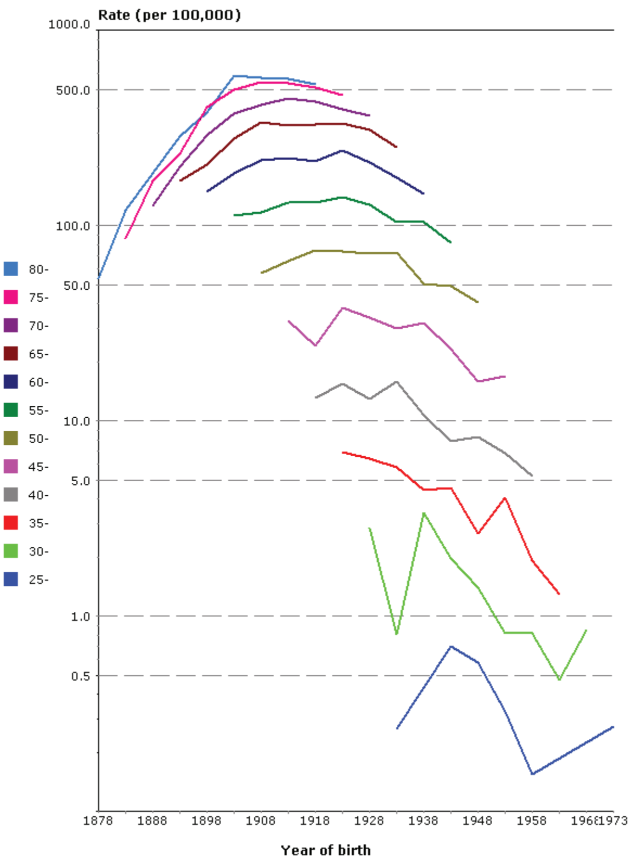

Fig3. Male age-specific standardised lung cancer death rates across different birth-cohorts in Ireland.

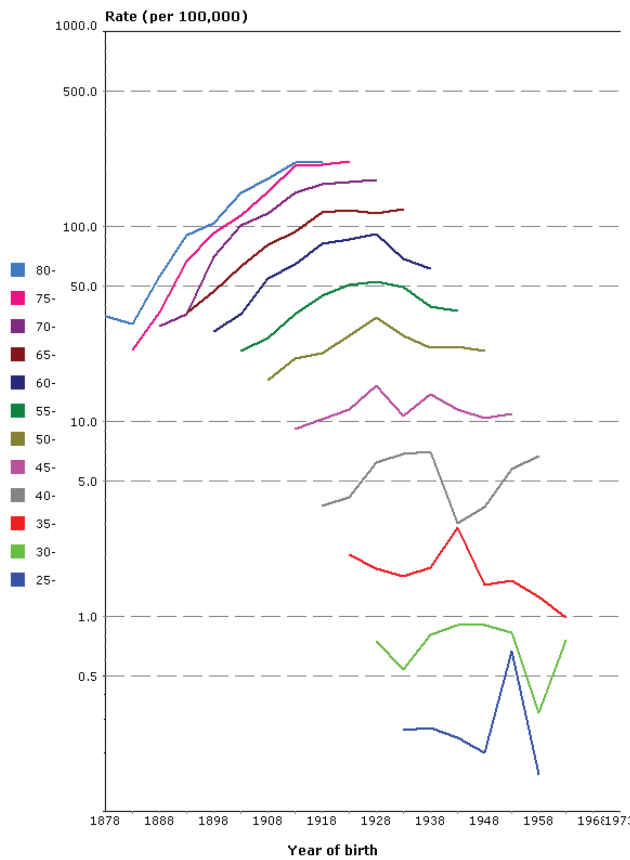

Fig 4. Female age-specific standardised lung cancer death rates across different birth-cohorts in Ireland.

high teen smoking initiation for the decade before 1995. Non cancer health gains are also evident following the nationwide workplace smoking ban[14,15]. Therefore, further health and social gains are realistically achievable if target populations, especially women, lower socio-economic groups and the youngest adults, are empowered and provided an enabling environment.

For further gains from the ill-health effects of smoking, especially on the younger generations, an accelerated decline in smoking prevalence and an increase in smoking quitting rates are essential. The Irish government is committed to a Tobacco Free Society[16]. However, for a faster decline in lung cancer rates, a comprehensive tobacco control program similar to the State of California that showed a 6% decline in lung cancer incidence within a decade has to be enforced[17]. With similar programs in Massachusetts in 1993[18], smoking prevalence in youths declined from 36% in 1995 to 30% in 1999 and from 17% in 1993 to 10% in 2000 in pregnant women[19]. Even smoking quit rates increased from 18% in 1993 to 26% in 2002[19]. In addition to smoke-free policies, both these states also exercised a regular increase in cigarette price. Evidence shows that a 10% increase in cigarette price can have a 4% decline in cigarette consumption rates and a 1-2% decrease in smoking prevalence in the developed world, particularly among youths[20]. Interestingly, a 10% increase in tax will also reduce lung cancer mortality rate by 1.2% in the first year[21].

In conclusion, current lung cancer death rates in Ireland are encouraging but an accelerated further annual decline is also realistically achievable in both sexes, especially among the younger generations, if evidence-based policies are introduced. Youths are price-sensitive and a 10% increase in cigarette price would allow 40,000 Irish smokers to quit smoking[16], and this would save thousands of productive life years lost due to tobacco-related premature deaths in Ireland. Future monitoring of the nationwide workplace smoking ban should assess trends in lung cancer death rates in young adults' once long-term lung cancer mortality data are available post ban.

ACKNOWLEDGEMENTS

The Royal City of Dublin Hospital (RCDH) Research Trust funded Dr Zubair Kabir (ZK) to undertake his PhD thesis in Trinity College Dublin. Currently, ZK is on a cancer research fellowship to the Harvard School of Public Health jointly funded by the US National Cancer Institute and the Health Research Board of Ireland. We thank Dr Kathleen Bennett for statistical advice on age-cohort modelling.

Conflict of interest – none declared

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