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Contrasting temporal trends in lung cancer incidence by socioeconomic status among women in New South Wales, Australia, 1985–2009

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ABSTRACT

Objective: We examined long-term trends in lung cancer incidence for women by socioeconomic groups in New South Wales (NSW), Australia.
Methods: Data on lung cancer incidence for women were extracted from the NSW Cancer Registry database. We divided the study cohort into five quintiles according to an area-based index of education and occupation (IEO) and calculated annual age-standardised incidence rates by IEO quintile for the period 1985–2009. The age-standardised incidence ratio (SIR) was estimated for IEO quintiles and 5-year period of diagnosis using the highest IEO quintile as the reference.
Results: Overall, lung cancer incidence for women aged 25–69 years increased gradually from 19.8 per 100,000 in 1985 to 25.7 per 100,000 in 2009. The trends by IEO quintile were somewhat comparable from 1985 through to 1995, but from then on rates remained relatively stable for women residing in the highest quintile while increasing for women residing in the remaining four quintiles. Consequently, the SIR for all four of the lower IEO quintiles increased significantly over the 25-year period. For example, the SIR in the lowest IEO quintile increased from 1.16 (95% CI, 0.99–1.37) during 1985–1989 to 1.70 (95% CI, 1.50–1.93) during 2005–2009. The corresponding estimates for women aged 70 years or older showed no clear pattern of socioeconomic gradient.
Conclusion: The increasing gap in lung cancer incidence between women in the highest socioeconomic group and all others suggests that there is a continued need for the broad implementation of tobacco control interventions, so that smoking prevalence is reduced across all segments of the population and the subsequent benefits are shared more equitably across all demographic groups.

1. Introduction

Lung cancer is the leading cause of cancer death in Australia by a significant margin and has the fifth highest incidence [1]. Both the overall incidence of, and mortality from, lung cancer have declined in Australia over the last three decades [1], mainly due to the decrease in smoking prevalence [2] that has resulted from the implementation of successful tobacco control policies in Australia [3]. This observed reduction in lung cancer incidence is not, however, consistent across the whole population. In particular, while the incidence of lung cancer for Australian men has been declining since the mid-1980s, over the same period an upward trend in incidence was observed for Australian women [4,5]. The upward trend for women is thought to reflect a later relative increase in smoking prevalence (which peaked at 33% in 1976 compared with 72% for men in 1945) and the time lag associated with lung cancer diagnosis [2]. Whether this increasing pattern in lung cancer incidence among Australian women is uniform across socioeconomic groups is unknown.

It is well known that there is a strong relationship between lung cancer incidence and tobacco use, with lung cancer trends

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closely mirroring generational trends in smoking prevalence [4,5]. Research in Australia has shown that a social gradient exists in smoking prevalence and lung cancer rates, with an inverse relationship between socioeconomic status and smoking or lung cancer rates, meaning that lung cancer incidence tends to be higher for lower socioeconomic groups within a population [2]. International evidence has also shown that lung cancer incidence is associated with socioeconomic status based on education, occupation or income, with people of lower socioeconomic status having elevated rates of lung cancer [6]. While there have been previous Australian studies which have confirmed the pattern of lung cancer incidence tending to be higher in populations of lower socioeconomic status [4,7], these estimates were based on only short periods of time (1987–1991 [7] and 2003–2007 [4]), and provided only a relative measure of socioeconomic inequality, comparing the rate for the highest socioeconomic group (top 20%) to that for the lowest socioeconomic group (bottom 20%). Our aim in this study was to build on this previous research by using data from a longer period of time and by using both relative and absolute measures of differences in lung cancer incidence.

Monitoring trends in lung cancer incidence rates by socioeconomic position is important for the development and promotion of evidence-based tobacco control policies. The aim of this study was to investigate lung cancer incidence rates across socioeconomic groups for New South Wales (NSW) women over the period 1985–2009 using data from a long-standing Australian population-based cancer registry and two measures of inequality.

2. Methods

2.1. Data

Incidence data for women with first primary lung cancer (ICD-O3: C33-C34) [8] for the period 1972–2009 were available from the NSW Cancer Registry. Notification of cancer has been a statutory requirement for all NSW public and private hospitals, radiotherapy departments and nursing homes since 1972, and for pathology departments since 1985 [9]. The Registry generally has high standards of data completeness and quality, and the data are accepted by the International Agency for Research on Cancer for publication in Cancer Incidence in Five Continents (Volumes IV to X) [10]. The proportion of death certificate only (DCO) cases, an indicator of the quality of a cancer registry, is generally low (1.0% for 1993–1997 [11] and 0.9% for 2004–2008 [12]). While data are available from 1972 we chose to only use data from 1985 onwards because prior to 1985, when reporting by pathology laboratories became compulsory, the proportion of histologically verified cases was lower (47.9% in 1973 and 76.8% in 1984).

Cases diagnosed before the age of 25 were excluded, as diagnoses of lung cancer are rare in younger people. Cases diagnosed after age 69 years were also excluded from the primary analysis because socioeconomic inequality tends to diminish in relative terms for older age groups [13–15], and social gradients in health are generally less consistent for the older population than those for population groups of working age [13]. To define the upper bound of the age range for the primary analysis in this study we tried three alternative age thresholds, 65, 70, and 75 years, and found that the resulting patterns of socioeconomic variation were similar for the three age thresholds. We therefore used data for cases in the age range of 25–69 in the primary analysis for this study, and performed further analysis of the trends for those aged 70 years or older to also provide some insight into patterns across the whole age spectrum.

Lung cancer histological types were classified as previously defined by Lewis and colleagues [16] for small cell carcinoma, adenocarcinoma, and squamous cell carcinoma. Data for large cell lung cancer, however, were not separated into a unique histological type but instead were grouped with other specified/not otherwise specified carcinoma, as the incidence rates were low and there is some inconsistency in the classification of large cell carcinoma [4,16].

Socioeconomic characteristics are not routinely collected by the Registry, so for this study we used an area-based "Index of Education and Occupation" (IEO) [17], derived from the 2001 Australian Bureau of Statistic's Census of Population and Housing. The index has been extensively reviewed and validated using nine different methods and has been found to be highly correlated with the Index of Advantage/Disadvantage, which measures both socioeconomic advantage and disadvantage [17]. The IEO has been used as a socioeconomic measure in numerous previous studies of health outcomes in Australia [18–21]. A high score on this index indicates that the area has a larger proportion of residents with higher education qualifications and who are employed in higher skilled occupations compared to an area with a lower score. Cases were grouped into five quintiles based on their residential address (Local Government Area (LGA)) at the time of diagnosis, with quintile 1 being the group with the highest IEO scores and quintile 5 the lowest IEO scores. The scores on this index are re-calculated every five years, and the ranking of an area may change across censuses. We used the index score based on the 2001 census data because it is difficult to match the population denominators exactly with the new cancer cases (numerators) because of LGA boundary changes (due to splits or amalgamations) over time. The Australian Bureau of Statistics' estimated mid-year NSW resident populations (for women) for the LGAs (collapsed into IEO quintiles) by 5 year age groups for 1985–2009 were used as population denominators.

2.2. Statistical analyses

Using the 2001 Australian standard population, annual age-standardised incidence rates (per 100,000) were calculated for the period 1985–2009, using direct standardisation, for the whole population and by IEO quintile.

We then divided the data into five 5-year periods, from 1985–1989 to 2005–2009, and calculated the age-standardised incidence ratio (SIR) stratified by period for each of the four lower IEO quintiles, using the highest IEO quintile as the reference group. This was done using the indirect method by dividing the observed number of lung cancer cases by the expected number in a specific IEO quintile. The expected numbers of new cases were determined based on the age-specific rates for the highest IEO quintile and the age distributions for each of the other four IEO quintiles. As the population in each IEO quintile (for which the SIR was calculated) is independent of that in the highest IEO quintile, the confidence intervals for the SIR were obtained using the exact method assuming a beta distribution, as described by Silcocks [22], which allows for error in the expected numbers and assumes no covariance between the observed and expected numbers.

To test whether there was a significant change over time in the variation in lung cancer incidence by IEO quintiles, a Poisson regression model was fitted with age groups, IEO quintile (one linear term) and period of diagnosis (one linear term). Significance of the association between IEO quintile and period of diagnosis was tested by adding to the model an interaction term between IEO quintile and period and then performing a likelihood ratio test for the nested models, with a P-value <0.05 indicating statistical significance.

To further illustrate the impact of variation in lung cancer incidence between IEO quintiles, we calculated the "excess" numbers of lung cancers diagnosed as being the difference between the observed and expected numbers of cases for IEO quintiles 2–5. A chi-square test was then used to determine if the proportions of