DIVERGING TRENDS IN LUNG CANCER SURVIVAL BETWEEN MALES AND FEMALES 1999-2008

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Contents

1. Introduction

In 2009, lung cancer was the second most common cancer in males and third most common amongst females in the UK with age-standardised incidence rates of 58.8 and 39.3 per 100,000 European standard population.[1] The one-year survival rate for patients diagnosed between 2005 and 2009 was higher among females (33.0%) than males (29.4%).[1] Although there have been reports of increasing lung cancer survival in England, the survival remains higher for females than males.[2-4]

Several factors may explain the difference in survival between males and females. In general, females have lower mortality and higher life expectancy than males. In addition, the age distribution of male and female lung cancer patients may be different, there may be a difference in socioeconomic factors, the distribution of histological type of lung cancer, and severity of comorbidity between males and females, and females may be more likely to undergo surgery.

In this report, we analysed whether the rate of improvement in lung cancer survival was similar among males and females in the period 1999 to 2008, and assessed which factors may explain the difference in survival improvement between males and females over this period.

2. Methods

Data

In England, information on all cancer diagnoses is collected by the eight regional cancer registries (Eastern Cancer Registration and Information Centre, North West Cancer Intelligence Service, Northern and Yorkshire Cancer Registry and Information Service, Oxford Cancer Intelligence Unit, South West Cancer Intelligence Service, Thames Cancer Registry, Trent Cancer Registry and West Midlands Cancer Intelligence Unit). Data collected from the different registries is quality-assured before being merged into the National Cancer Data Repository (NCDR). The data are then linked with the Hospital Episode Statistics (HES) records. Information on death of cancer patients is received from the Office for National Statistics (ONS).

We extracted data on 317,238 lung cancers (ICD-10 C33-C34) diagnosed in England between 1999 and 2008 from the NCDR. We excluded 17,244 (5%) lung cancers identified from a death certificate only, 933 patients with a missing NHS number, and only included the first lung cancer diagnosis of each patient, which led to the exclusion of a further 1,098 lung cancers. The final analyses were based on 297,963 patients.

Information on surgery for patients with a diagnosis of lung cancer was derived from linked HES inpatient and day-case records. Surgical procedures are coded according to codes from the Office Population, Censuses and Surveys Classification of Surgical Procedures, 4th version (OPCS-4).[5] Surgical procedures were classified as indicated in the Appendix Table 1.

In the analyses presented here, morphology was coded using the third edition of the International Classification of Diseases for Oncology (ICD-0-3). [6] These were then classified into small-cell, adenocarcinoma, large cell, non-small cell, squamous cell carcinoma, other specified, and unspecified lung cancer groups as indicated in Appendix Table 2.

Socioeconomic deprivation was based on the income domain of the Indices of Deprivation (ID) by lower super output areas (each compromising a population of around 1500 people), and grouped into quintiles. Each patient was then assigned to a socioeconomic deprivation quintile based on their postcode of residence. ID 2004 [7] was used for patients diagnosed between 1999 and 2002, ID 2007 [8] for patients diagnosed between 2003 to 2006 and ID 2010 for patients diagnosed between 2007 to 2008 [9].

For each patient, comorbidity information was obtained using diagnosis codes recorded in HES. All diagnoses from two years before to three months after the patient's date of diagnosis were classified according to the scores from the weighted Charlson comorbidity index,[10] and modified to exclude cancer as a comorbid condition. The resulting scores were aggregated into four categories of increasing severity of comorbidity (0, 1, 2, and 3+).

Statistical analysis

The number and proportions of patients in each age group, socioeconomic deprivation, comorbidity, histology and surgery were calculated by sex and year of diagnosis.

The Kaplan-Meier method was used to calculate one-year survival estimates by year of diagnosis and sex. Patients were divided into two groups based on the median age at diagnosis, and thus consisted of a <75 and ≥75 year age group. We used a log-rank test (at 5% significance level) to test the null hypothesis that survival in the <75 and ≥75 year age groups is identical between males and females across the 10-year study period.

Since the Kaplan-Meier survival graphs indicated a divergence in one-year survival between males and females in the <75 age group only, we further analysed that group to identify potential factors that may explain the divergence, using Cox proportional hazards modelling. The basic model included sex, diagnosis year and an interaction term between sex and diagnosis year. We then adjusted the analysis for five-year age group, socioeconomic deprivation, histology, comorbidity and surgery separately to investigate which factor may explain the divergence. Survival time was calculated from date of diagnosis until date of death or censored at one-year.

3. Results

Table 1a: Number of lung cancer patients by sex and year of diagnosis, England, 1999-2008

		1999		2000		2001		2002		2003		2004		2005		2006		2007		2008	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
	Total	17,823	10,977	17,962	11,380	17,789	11,467	17,183	11,438	16,981	11,889	17,537	11,997	17,390	12,528	17,869	13,040	17,809	13,426	17,765	13,713
Age group	0-54	1,275	968	1,291	1,048	1,280	1,034	1,165	1,003	1,096	955	1,146	996	1,132	1,007	1,138	997	1,099	975	1,057	1,004
	55-59	1,288	760	1,325	800	1,313	821	1,371	876	1,314	926	1,378	952	1,342	998	1,351	1,074	1,292	1,038	1,203	979
	60-64	2,029	1,083	2,037	1,115	1,975	1,148	1,967	1,146	1,933	1,181	2,034	1,208	2,017	1,339	2,135	1,386	2,106	1,598	2,097	1,669
	65-69	2,758	1,567	2,838	1,607	2,722	1,442	2,597	1,396	2,581	1,535	2,642	1,649	2,632	1,725	2,646	1,740	2,657	1,821	2,684	1,842
	70-74	3,726	2,314	3,608	2,240	3,455	2,193	3,310	2,159	3,207	2,030	3,180	2,034	3,061	2,025	3,076	2,082	3,044	2,065	3,131	2,135
	75-79	3,634	2,241	3,620	2,204	3,527	2,266	3,335	2,360	3,296	2,333	3,382	2,300	3,229	2,369	3,397	2,370	3,270	2,326	3,211	2,463
	80-84	1,896	1,163	2,021	1,385	2,160	1,524	2,219	1,514	2,348	1,837	2,483	1,792	2,484	1,884	2,528	2,015	2,620	2,037	2,517	2,041
	85+	1,217	881	1,222	981	1,357	1,039	1,219	984	1,206	1,092	1,292	1,066	1,493	1,181	1,598	1,376	1,721	1,566	1,865	1,580
[a]**Socioeconomic deprivation**	1 (most affluent)	2,321	1,415	2,458	1,399	2,367	1,365	2,406	1,446	2,421	1,512	2,391	1,577	2,444	1,668	2,522	1,747	2,530	1,806	2,533	1,809
	2	2,989	1,748	3,034	1,867	3,111	1,861	2,979	1,885	2,924	2,051	3,143	1,997	3,047	2,199	3,217	2,150	3,247	2,305	3,167	2,404
	3	3,504	2,115	3,568	2,226	3,511	2,288	3,371	2,155	3,412	2,361	3,493	2,370	3,558	2,529	3,625	2,676	3,537	2,731	3,595	2,751
	4	4,161	2,537	4,007	2,648	4,019	2,713	3,947	2,736	3,939	2,717	4,025	2,821	3,888	2,894	4,023	3,044	4,006	3,090	3,991	3,150
	5 (most deprived)	4,848	3,162	4,895	3,240	4,781	3,240	4,480	3,216	4,285	3,248	4,485	3,232	4,453	3,238	4,482	3,423	4,489	3,494	4,479	3,599
Histology	Adenocarcinoma	2,583	1,999	2,743	2,114	2,852	2,232	2,693	2,261	2,766	2,334	2,933	2,502	2,954	2,630	3,166	2,793	3,314	3,049	3,309	3,213
	Large cell	735	432	746	428	488	285	359	232	359	236	311	237	284	201	272	199	198	163	218	158
	Non-small cell	108	47	407	241	1,093	703	1,804	1,100	1,892	1,273	2,129	1,309	2,387	1,528	2,601	1,766	2,744	1,966	3,091	2,256
	Squamous cell carcinoma	5,794	2,375	5,449	2,374	4,967	2,194	4,682	2,034	4,390	1,990	4,412	1,866	4,101	1,903	4,155	1,863	4,198	1,894	3,959	1,831
	Small-cell	2,213	1,730	2,296	1,784	2,208	1,638	2,155	1,655	1,968	1,650	2,060	1,716	2,027	1,757	2,064	1,783	2,092	1,716	1,991	1,730
	Other specified	31	17	30	20	35	14	33	19	26	18	36	23	32	22	34	22	26	24	32	26
	Unspecified	6,359	4,377	6,291	4,419	6,146	4,401	5,457	4,137	5,580	4,388	5,656	4,344	5,605	4,487	5,577	4,614	5,237	4,614	5,165	4,499
Co-morbidity	0	10,459	6,752	10,317	6,739	10,063	6,762	9,559	6,581	9,152	6,712	9,239	6,649	8,484	6,555	8,450	6,513	7,902	6,482	7,627	6,266
	1	3,748	2,118	3,857	2,306	3,980	2,472	3,926	2,644	4,080	2,810	4,369	2,926	4,691	3,307	4,950	3,548	5,166	3,696	5,160	4,041
	2	1,031	518	1,132	634	1,208	630	1,292	709	1,404	758	1,582	852	1,723	1,033	1,872	1,179	1,943	1,291	2,080	1,373
	3+	534	231	655	294	696	310	744	323	787	390	930	429	1,078	512	1,282	659	1,495	792	1,578	909
	Missing	2,051	1,358	2,001	1,407	1,842	1,293	1,662	1,181	1,558	1,219	1,417	1,141	1,414	1,121	1,315	1,141	1,303	1,165	1,320	1,124
Surgery	No	16,374	10,179	16,495	10,502	16,334	10,517	15,792	10,514	15,631	10,908	16,148	11,078	16,001	11,489	16,410	11,943	16,227	12,195	16,172	12,363
	Yes	1,449	798	1,467	878	1,455	950	1,391	924	1,350	981	1,389	919	1,389	1,039	1,459	1,097	1,582	1,231	1,593	1,350

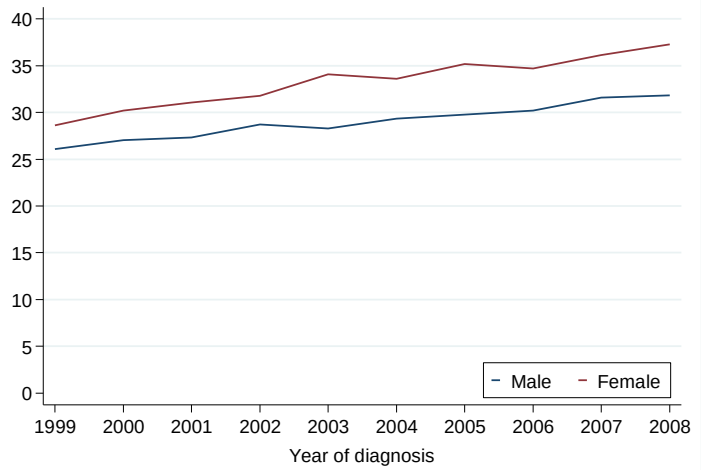
*Using ID 2004 for patients diagnosed between 1999 and 2002, ID 2007 for patient diagnosed between 2003-2006 and ID 2010 for patients diagnosed between 2007-2008

Table 1b: Proportion of lung cancer patients by sex and year of diagnosis, England, 1999-2008

		1999		2000		2001		2002		2003		2004		2005		2006		2007		2008	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Total	61.9	38.1	61.2	38.8	60.8	39.2	60.0	40.0	58.8	41.2	59.4	40.6	58.1	41.9	57.8	42.2	57.0	43.0	56.4	43.6
Age group	0-54	7.2	8.8	7.2	9.2	7.2	9.0	6.8	8.8	6.5	8.0	6.5	8.3	6.5	8.0	6.4	7.7	6.2	7.3	6.0	7.3
	55-59	7.2	6.9	7.4	7.0	7.4	7.2	8.0	7.7	7.7	7.8	7.9	7.9	7.7	8.0	7.6	8.2	7.3	7.7	6.8	7.1
	60-64	11.4	9.9	11.3	9.8	11.1	10.0	11.5	10.0	11.4	9.9	11.6	10.1	11.6	10.7	12.0	10.6	11.8	11.9	11.8	12.2
	65-69	15.5	14.3	15.8	14.1	15.3	12.6	15.1	12.2	15.2	12.9	15.1	13.8	15.1	13.8	14.8	13.3	14.9	13.6	15.1	13.4
	70-74	20.9	21.1	20.1	19.7	19.4	19.1	19.3	18.9	18.9	17.1	18.1	17.0	17.6	16.2	17.2	16.0	17.1	15.4	17.6	15.6
	75-79	20.4	20.4	20.2	19.4	19.8	19.8	19.4	20.6	19.4	19.6	19.3	19.2	18.6	18.9	19.0	18.2	18.4	17.3	18.1	18.0
	80-84	10.6	10.6	11.3	12.2	12.1	13.3	12.9	13.2	13.8	15.5	14.2	14.9	14.3	15.0	14.2	15.5	14.7	15.2	14.2	14.9
	85+	6.8	8.0	6.8	8.6	7.6	9.1	7.1	8.6	7.1	9.2	7.4	8.9	8.6	9.4	8.9	10.6	9.7	11.7	10.5	11.5
[a]Socioeconomic deprivation	1 (most affluent)	13.0	12.9	13.7	12.3	13.3	11.9	14.0	12.6	14.3	12.7	13.6	13.1	14.1	13.3	14.1	13.4	14.2	13.5	14.3	13.2
	2	16.8	15.9	16.9	16.4	17.5	16.2	17.3	16.5	17.2	17.3	17.9	16.7	17.5	17.6	18.0	16.5	18.2	17.2	17.8	17.5
	3	19.7	19.3	19.9	19.6	19.7	20.0	19.6	18.8	19.6	18.8	19.9	19.8	20.5	20.2	20.3	20.5	19.9	20.3	20.2	20.1
	4	23.4	23.1	22.3	23.3	22.6	23.7	23.0	23.9	23.2	22.9	23.0	23.5	22.4	23.1	22.5	23.3	22.5	23.0	22.5	23.0
	5 (most deprived)	27.2	28.8	27.3	28.5	26.9	28.3	26.1	28.1	25.2	27.3	25.6	26.9	25.6	25.9	25.1	26.3	25.2	26.0	25.2	26.3
Histology	Adenocarcinoma	14.5	18.2	15.3	18.6	16.0	19.5	15.7	19.8	16.3	19.6	16.7	20.9	17.0	21.0	17.7	21.4	18.6	22.7	18.6	23.4
	Large cell	4.1	3.9	4.2	3.8	2.7	2.5	2.1	2.0	2.1	2.0	1.8	2.0	1.6	1.6	1.5	1.5	1.1	1.2	1.2	1.2
	Non-small cell	0.6	0.4	2.3	2.1	6.1	6.1	10.5	9.6	11.1	10.7	12.1	10.9	13.7	12.2	14.6	13.5	15.4	14.6	17.4	16.5
	Squamous cell carcinoma	32.5	21.6	30.3	20.9	27.9	19.1	27.3	17.8	25.9	16.7	25.2	15.6	23.6	15.2	23.3	14.3	23.6	14.1	22.3	13.4
	Small-cell	12.4	15.8	12.8	15.7	12.4	14.3	12.5	14.5	11.6	13.9	11.8	14.3	11.7	14.0	11.6	13.7	11.8	12.8	11.2	12.6
	Other specified	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Unspecified	35.7	39.9	35.0	38.8	34.6	38.4	31.8	36.2	32.9	36.9	32.3	36.2	32.2	35.8	31.2	35.4	29.4	34.4	29.1	32.8
Co-morbidity	0	58.7	61.5	57.4	59.2	56.6	59.0	55.6	57.5	53.9	56.5	52.7	55.4	48.8	52.3	47.3	50.0	44.4	48.3	42.9	45.7
	1	21.0	19.3	21.5	20.3	22.4	21.6	22.9	23.1	24.0	23.6	24.9	24.4	27.0	26.4	27.7	27.2	29.0	27.5	29.1	29.5
	2	5.8	4.7	6.3	5.6	6.8	5.5	7.5	6.2	8.3	6.4	9.0	7.1	9.9	8.3	10.5	9.0	10.9	9.6	11.7	10.0
	3+	3.0	2.1	3.7	2.6	3.9	2.7	4.3	2.8	4.6	3.3	5.3	3.6	6.2	4.1	7.2	5.1	8.4	5.9	8.9	6.6
	Missing	11.5	12.4	11.1	12.4	10.4	11.3	9.7	10.3	9.2	10.3	8.1	9.5	8.1	9.0	7.4	8.8	7.3	8.7	7.4	8.2
Surgery	No	91.9	92.7	91.8	92.3	91.8	91.7	91.9	91.9	92.1	91.8	92.1	92.3	92.0	91.7	91.8	91.6	91.1	90.8	91.0	90.2
	Yes	8.1	7.3	8.2	7.7	8.2	8.3	8.1	8.1	8.0	8.3	7.9	7.7	8.0	8.3	8.2	8.4	8.9	9.2	9.0	9.8

*Using ID 2004 for patients diagnosed between 1999 and 2002, ID 2007 for patient diagnosed between 2003-2006 and ID 2010 for patients diagnosed between 2007-2008

A



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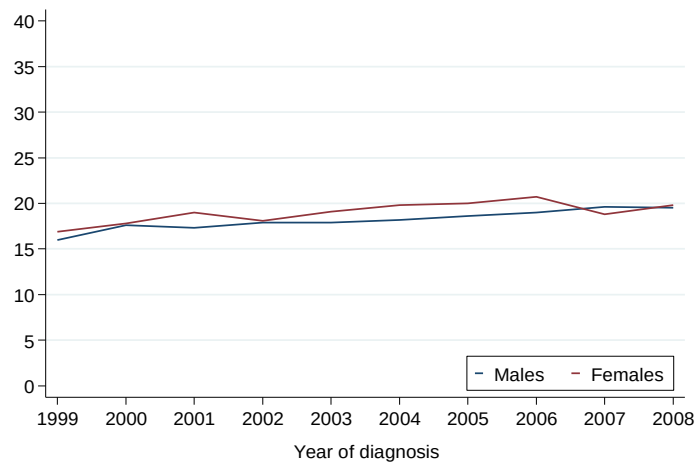

Table 1: One-year survival estimates (%) in lung cancer, by year of diagnosis and sex in the <75 year age group (A), and in the ≥75 year age group (B), England, 1999-2008.

Table 2: Hazard ratio and 95% confidence interval for patients diagnosed among the <75 year age group, England, 1999-2008

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Sex and diagnosis year interaction			0.993*** (0.989-0.997)	0.994** (0.990-0.998)	0.993*** (0.989-0.997)	0.995* (0.991-0.999)	0.993*** (0.990-0.997)	0.997 (0.993-1.001)
Sex								
Male	1.000		1.000	1.000	1.000	1.000	1.000	1.000
Female	0.884*** (0.873-0.894)		0.923*** (0.901-0.946)	0.929*** (0.906-0.952)	0.921*** (0.899-0.944)	0.889*** (0.867-0.911)	0.930*** (0.908-0.954)	0.913*** (0.891-0.936)
Diagnosis year trend		0.980*** (0.978-0.982)	0.983*** (0.981-0.986)	0.983*** (0.981-0.986)	0.983*** (0.981-0.986)	0.986*** (0.983-0.988)	0.981*** (0.979-0.984)	0.983*** (0.981-0.985)

a) Using IMD2004 for patients diagnosed between 1999 and 2002, IMD2007 for patient diagnosed between 2003 and 2006, IMD2010 for patients diagnosed between 2007 and 2008
b) HR analysis excludes missing
Model 1: Sex (unadjusted)
Model 2: Diagnosis year (unadjusted)
Model 3: Sex, diagnosis year and interaction between sex and year of diagnosis
Model 4: Sex, diagnosis year, interaction between sex and year of diagnosis and age of diagnosis
Model 5: Sex, diagnosis year, interaction between sex and year of diagnosis and socioeconomic deprivation
Model 6: Sex, diagnosis year, interaction between sex and year of diagnosis histology
Model 7: Sex, diagnosis year, interaction between sex and year of diagnosis and co-morbidity
Model 8: Sex, diagnosis year, interaction between sex and year of diagnosis and surgery
*** $p \leq 0.001$
** $0.001 < p \leq 0.01$
* $0.01 < p \leq 0.05$

Patient characteristics

A total of 297,963 lung cancer patients were included in the analysis. Patient characteristics are listed in Table 1. Overall, 176,108 (59.1%) were males and 121,855 (40.9%) were females. However, over the 10-year study period there was a decrease in the proportion of male lung cancer patients from 61.9% in 1999 to 56.4% in 2008, and an increase in the proportion of female lung cancer patients from 38.1% to 43.6%. Males and females had a median age at diagnosis of 72 and 73, respectively.

The proportion of patients with lung cancer was higher in the most deprived areas compared to the most affluent areas. Between 1999 and 2008 the proportion of lung cancer in the affluent areas increased from 13.0% to 14.3% among males, and from 12.9% to 13.2% among females. In contrast, the proportion of lung cancer patients in the most deprived areas decreased from 27.2% to 25.2% in males and from 28.8% to 26.3% in females.

Among females, adenocarcinoma was the most frequently diagnosed histological type and among males it was squamous cell lung cancer. Large cell was the least frequent cell type in both males and females. The proportion of patients who were diagnosed with large cell, squamous cell and small cell decreased, while the proportion of patients with adenocarcinoma increased from 14.5% to 18.6% among males and from 18.2% to 23.4% among females over the 10-year study.

The proportion of patients with comorbid conditions increased between 1999 and 2008. The proportion of male lung cancer patients without comorbidity decreased from 11.5% to 7.4% in males and from 12.4% to 8.2% in females.

More males and more females underwent surgical resection between 1999 and 2008; however, the increase was greater among females. In the most recent year a higher proportion of females (9.8%) underwent surgery compared to males (9.0%).

Survival

Figure 1 presents the one-year lung cancer survival among the <75 age group (A) and the ≥75 age group (B) by year of diagnosis and sex. Survival of lung cancer was lower in the ≥75 age group compared to the <75 age group. Between 1999 and 2008 there was a significant difference in one-year survival between males and females in the <75 age group (log-rank test: χ^2=437.32, p<0.0001), and survival between males and females diverged over the time period. Over the 10-year period in the ≥75 age group there was a significant difference between males and females (log-rank test: χ^2=13.80, p=0.0002), but there was no indication of divergence in survival between males and females.

Table 3 illustrates the survival analysis among the <75 age group (n=174,426 (58.5%)) by sex (Model 1), diagnosis year (Model 2), the basic interaction model for divergence (Model 3) and the adjusted models (Model 4-Model 9).

Female lung cancer patients had a significantly lower hazard ratio overall of 0.88 (95% CI (0.87-0.89)) compared with males (Model 1). There was a 2% decrease in relative risk of death per year

among patients with lung cancer (Model 2). Confirming what was observed in the graph (Figure 1B), our basic model (Model 3) indicated there was a significant interaction between sex and diagnosis year in the <75 year age group (Wald test $p<0.001$), confirming the divergence in survival between males and females over time.

Adjustment for five-year age (Model 4), socioeconomic deprivation (Model 5) and comorbidity (Model 7) did not materially change the estimates and the interaction term remained significant, indicating that these factors are unlikely to explain the divergence in survival by sex over time. Histological type appeared to explain the divergence to some extent (Model 6, Wald test for the interaction term $p=0.019$). However, surgery appeared to explain most of the divergence in survival over time by sex as the interaction term was non-significant (Model 8, Wald test for the interaction term $p=0.397$).

4. Conclusion

This report shows the improvement in one-year survival of lung cancer patients over the ten-year period 1999-2008. Although female lung cancer survival is higher than male lung cancer survival, this difference was greater in the younger age group. Moreover, we observed that the improvement in one-year survival over time was greater among females than males in the <75 age group.

Analysis of the potential factors that could explain this divergence in survival between males and females, showed that the difference in surgical resection rate between males and females is the most likely explanation for this. Previously, we have shown that lung cancer surgical resection rates have increased between 1998 and 2008 and that the one-year increment in surgical resection rate was slightly higher among females than males.[11] Restricting this analysis to the <75 age group for this time period confirmed that between the start and end of the time period under study here, females became more likely to undergo surgery than males (data not shown), which may contribute to the divergence in survival.

5. References

1. Cancer Research UK. CancerStats Key Facts lung cancer and smoking 2012 [21/112012]; Available from: http://publications.cancerresearchuk.org/downloads/Product/CS_KF_LUNG.pdf

2. Holmberg L, Sandin F, Bray F, *et al.* National comparisons of lung cancer survival in England, Norway and Sweden 2001-2004: differences occur early in follow-up. *Thorax*. 2010;**65**:436-41.

3. Office for National Statistics (ONS). Statistical Bulletin: Cancer survival in England: Patients diagnosed 2005-2009 and followed up to 2010. 2011 [cited 2011]; Available from: http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-239726

4. Rachet B, Maringe C, Nur U, *et al.* Population-based cancer survival trends in England and Wales up to 2007: an assessment of the NHS cancer plan for England. *Lancet Oncol*. 2009;**10**:351-69.

5. The Health and Social Care Information Centre. HES online: OPCS-4 2011 [15 Febuary 2012]; Available from: http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=156.

6. World Health Organization. International Classification of Diseases for Oncology Third Edition April Fritz CP, Andrew Jack, Kanagartnam Shanmugaratnam, Leslie Sobin, D.Max Parkin, Sharim Whelan editor. Geneva2000.

7. Office of the Deputy Prime Minister. The English Indices of Deprivation 2004 (revised). Wetherby: ODPM Publications; 2004.

8. Noble M, McLennan D, Wilkinson K, *et al.* The English Indices of Deprivation 2007. London: Department for Communities and Local Government, 2008.

9. Department for Communities and Local Government. The English Indices of Deprivation 2010. 2011.

10. Charlson ME, Pompei P, Ales KL, *et al.* A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;**40**:373-83.

11. Riaz SP, Linklater KM, Page R, *et al.* Recent trends in resection rates among non-small cell lung cancer patients in England. *Thorax*. 2012;**67**:811-4.

6. Appendix

Table 1: Classification of surgical procedures according to Office of Population, Census and Surveys Classification of Surgical Operations and Procedures, fourth revision codes (OPCS-4).

Surgical Procedure		**Codes**
Pneumonectomy	Total pneumonectomy	E541
Lobectomy	Bilobectomy of lung,	E542
	Lobectomy of lung	E543
Wedge resection	Excision of segment of lung,	E544
	Partial lobectomy of lung NEC	E545
Sleeve resection	Sleeve resection of bronchus and anastomosis HFQ	E461
Other	Open excision of lesion of trachea,	E391
	Other specified partial excision of trachea,	E398
	Unspecified partial excision of trachea,	E399
	Excision of carina,	E441
	Other specified excision of lung,	E548
	Unspecified excision of lung,	E549
	Open excision of lesion of lung,	E552
	Unspecified open extirpation of lesion of lung,	E559
	Excision of lesion of chest wall,	T013
	Insertion of prosthesis into chest wall NEC	T023

Table 2: Codes for histology in NCDR (using the third edition of the international classification of diseases for oncology (ICD-0-3)).

Description	Code
Adenocarcinoma	
Adenocarcinoma NOS	8140
Scirrhous adenocarcinoma	8141
Superficial spreading adenocarcinoma	8143
Adenocarcinoma, interstitial type	8144
Carcinoma, diffuse type	8145
Monomorphic adenoma	8146
Cholangiocarcinoma	8160
Adenoid cystic carcinoma	8200
Cribriform carcinoma	8201
Tubular adenocarcinoma	8211
Solid carcinoma NOS	8230
Carcinoid tumour NOS (except of appendix M8240/1)	8240
Carcinoid tumour, argentaffin, malignant	8241
Goblet cell carcinoid	8243
Composite carcinoid	8244
Tubular carcinoid	8245
Neuroendocrine carcinoma	8246
Atypical carcinoid tumour	8249
Bronchiolo-alveolar adenocarcinoma	8250
Alveolar adenocarcinoma	8251
Bronchio-alveolar carcinoma, non-mucinous	8252
Bronchio-alveolar carcinoma, mucinous	8253
Bronchio-alveolar carcinoma, mixed mucinous and non-mucinous	8254
Adenocarcinoma with mixed sub-types	8255
Papillary adenocarcinoma NOS	8260
Adenocarcinoma in tubulovillous adenoma	8263
Oxyphilic adenocarcinoma	8290
Clear cell adenocarcinoma NOS	8310
Granular cell carcinoma	8320
Mixed cell adenocarcinoma	8323
Adrenal cortical carcinoma	8370
Mucoepidermoid carcinoma	8430
Cystadenocarcinoma NOS	8440
Mucinous cystadenocarcinoma NOS	8470
Mucinous adenocarcinoma	8480
Mucin-producing adenocarcinoma	8481
Signet ring cell carcinoma	8490
Lobular carcinoma NOS	8520

Acinar cell carcinoma	8550
Adenosquamous carcinoma	8560
Epithelial-myoepithelial carcinoma	8562
Adenocarcinoma with squamous metaplasia	8570
Adenocarcinoma with spindle cell metaplasia	8572
Adenocarcinoma with neuroendocrine differentiation	8574
Metaplastic carcinoma NOS	8575
Large cell	
Large cell carcinoma NOS	8012
Large cell neuroendocrine carcinoma	8013
Non-small cell	
Non-small cell carcinoma	8046
Squamous cell carcinoma	
Papillary carcinoma NOS	8050
Papillary squamous cell carcinoma	8052
Squamous cell carcinoma NOS	8070
Squamous cell carcinoma, keratinising NOS	8071
Squamous cell carcinoma, large cell, non-keratinising	8072
Squamous cell carcinoma, small cell, non-keratinising	8073
Squamous cell carcinoma, spindle cell	8074
Adenoid squamous cell carcinoma	8075
Squamous cell carcinoma, microinvasive	8076
Small cell carcinoma	
Small cell carcinoma NOS	8041
Oat cell carcinoma	8042
Small cell carcinoma, fusiform cell	8043
Small cell carcinoma, intermediate cell	8044
Small cell-large cell carcinoma	8045
Other specified	
Lymphoepithelial carcinoma	8082
Basaloid squamous cell carcinoma	8083
Basaloid carcinoma	8123
Malignant melanoma NOS	8720
Sarcoma NOS	8800
Spindle cell sarcoma	8801
Giant cell sarcoma (except of bone M9250/3)	8802
Small cell sarcoma	8803
Epithelioid sarcoma	8804
Fibrosarcoma NOS	8810
Fibromyxosarcoma	8811
Solitary fibrous tumour, malignant	8815
Fibrous histiocytoma, malignant	8830
Liposarcoma NOS	8850
Leiomyosarcoma NOS	8890
Angiomyosarcoma	8894
Rhabdomyosarcoma NOS	8900
Pleomorphic rhabdomyosarcoma	8901
Adenosarcoma	8933

Mixed tumour, malignant NOS	8940
Rhabdoid sarcoma	8963
Pulmonary blastoma	8972
Carcinosarcoma NOS	8980
Synovial sarcoma NOS	9040
Teratoma, malignant NOS	9080
Choriocarcinoma NOS	9100
Haemangiosarcoma	9120
Haemangioendothelioma, malignant	9130
Epithelioid haemangioendothelioma, malignant	9133
Lymphangiosarcoma	9170
Osteosarcoma NOS	9180
Mesenchymal chondrosarcoma	9240
Peripheral neuroectodermal tumour	9364
Primitive neuroectodermal tumour	9473
Neurofibroma	9540
Unspecified	
Neoplasm, malignant	8000
Tumour cells, malignant	8001
Malignant tumour, small cell type	8002
Malignant tumour, giant cell type	8003
Malignant tumour, fusiform cell type	8004
Carcinoma NOS	8010
Epithelioma, malignant	8011
Carcinoma, undifferentiated NOS	8020
Carcinoma, anaplastic type NOS	8021
Pleomorphic carcinoma	8022
Giant cell and spindle cell carcinoma	8030
Giant cell carcinoma	8031
Spindle cell carcinoma	8032
Pseudosarcomatous carcinoma	8033
Polygonal cell carcinoma	8034
Tumorlet	8040
Missing	

FIND OUT MORE:

Thames Cancer Registry is the lead cancer registry for lung cancer and mesothelioma.

The NCIN is a UK-wide initiative, working closely with cancer services in England, Scotland, Wales and Northern Ireland, and the NCRI, to drive improvements in standards of cancer care and clinical outcomes by improving and using the information it collects for analysis, publication and research. In England, the NCIN is part of the National Cancer Programme.