

## The incidence rate of female breast cancer in England, United Kingdom: An observational descriptive epidemiological analysis of data from National Statistics Office 2000-2014

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### Abstract

**Background:** This study provides descriptive epidemiological data on female breast cancer cases diagnosed from 2000 to 2014 among women in England, United Kingdom, including the frequency number of cases, the age specific incidence rate, the age-standardised incidence rate (ASIR), and the age-standardised mortality rate (ASMR), stratified by year of diagnosis, age group, and region.

**Methods:** This is a retrospective descriptive epidemiological analysis of female breast cancer cases recorded in England by the National Statistics Office, from 2000 to 2014. The statistical analyses were performed using descriptive statistics and non-parametric tests with the Statistical Package for the Social Sciences version 20 (SPSS).

**Results:** The South West of England had the highest overall ASIRs of malignant neoplasm of breast and carcinoma in situ at (155 and 21.8) per 100,000 population. London recorded the lowest average ASIRs of malignant neoplasm of breast and carcinoma in situ at (120.7 and 14.2) respectively. In addition, the highest overall age specific incidence rates per 100,000 population

(1036.5 and 853) of malignant neoplasm of breast were observed in women 60-74 and 75-89 years of age, while the highest rate of breast carcinoma in situ (131.8 and 124.1) was documented in women aged 60-74 and 45-59.

**Conclusion:** This study revealed that the South West of England had the highest overall ASIRs of both malignant neoplasm of breast and carcinoma in situ. In contrast, London was the lowest overall ASIRs of both malignant neoplasm of breast and carcinoma in situ. The majority of female breast cancer cases in England occurred among older women. However, further analytical epidemiological studies should be conducted in the South West of England and London, to determine the potential risk and protective factors of breast cancer.

**Keywords:** Cancer epidemiology; Female breast cancer; England; United Kingdom; Incidence rate; malignant neoplasm of breast; Carcinoma in situ

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## 1. Introduction

Breast cancer is a major health problem among women worldwide, and it is the most common causes of cancer-related mortality. Hundreds of thousands of breast cancer cases throughout the world have been clinically diagnosed among women.<sup>1-3</sup> The incidence rates of female breast cancer in developed and developing countries will continue to increase.<sup>4-6</sup>

The burden of female breast cancer has increased in world, it estimated that nearly 1.7 million new breast cancer cases are detected in 2012, accounting approximately 25% of all incident cases among women. The number of deaths from breast cancer has also increased globally with an estimated 521,900 in 2012. In Europe, it is estimated that the number of new breast cancer cases was 458,337, and 131,259 deaths registered in 2012.<sup>7</sup>

In United Kingdom (UK), the International Agency for Research on Cancer estimated that the age-standardized incidence rate (ASIR) for female breast cancer was 95.0 per 100,000 population in 2012, and the age-standardized mortality rate (ASMR) was 36.4 per 100,000 population.<sup>8-9</sup> Furthermore, in England in 2014, the national statistics office registered 46,085 new cases of malignant neoplasm of breast, and 6824 new cases of carcinomas in situ. Moreover, the number of breast cancer deaths among women was estimated at 9,497.<sup>9</sup>

The purpose of this study was to describe the pattern of female breast cancer in England from 2000 to 2014, with focusing on the age specific incidence rate, ASIR and ASMR stratified by year of diagnosis, age group, and region.

## **2. Materials and methods**

This is a retrospective descriptive epidemiological study of all women with breast cancer cases diagnosed between 2000 and 2014 in England, UK. The data were available and easily accessible from the website of UK's Office for National Statistics, which is providing statistical data and census in England and Wales every 10 years.<sup>9</sup> Based on these data, there are comprehensive statistical tables for 9 regions in England from 2000 to 2014, exploring the number of cases, age

specific incidence rate, ASIR and ASMR, stratified by year of diagnosis, age group, and region. Therefore, this study was conducted using these statistical tables to extract all information from the National Statistics Office with the aim of describing the pattern of female breast cancer in England.

For data analysis, the Statistical Package for the Social Sciences version 20.0 (SPSS) was used. The descriptive statistics of the data was performed by calculating the average number of breast cancer cases, the ASIR and the ASMR stratified by year of diagnosis, age group, and region. Non-parametric test was used to test the differences in rates of female breast cancer in England. Furthermore, the ASIRs of malignant neoplasm of breast between 2000 and 2014 were tested to identify any significant differences in the trend of female breast cancer among different regions of England.

### **3. Results**

#### **A- Malignant neoplasm cancer (Overall number of cases and percentages)**

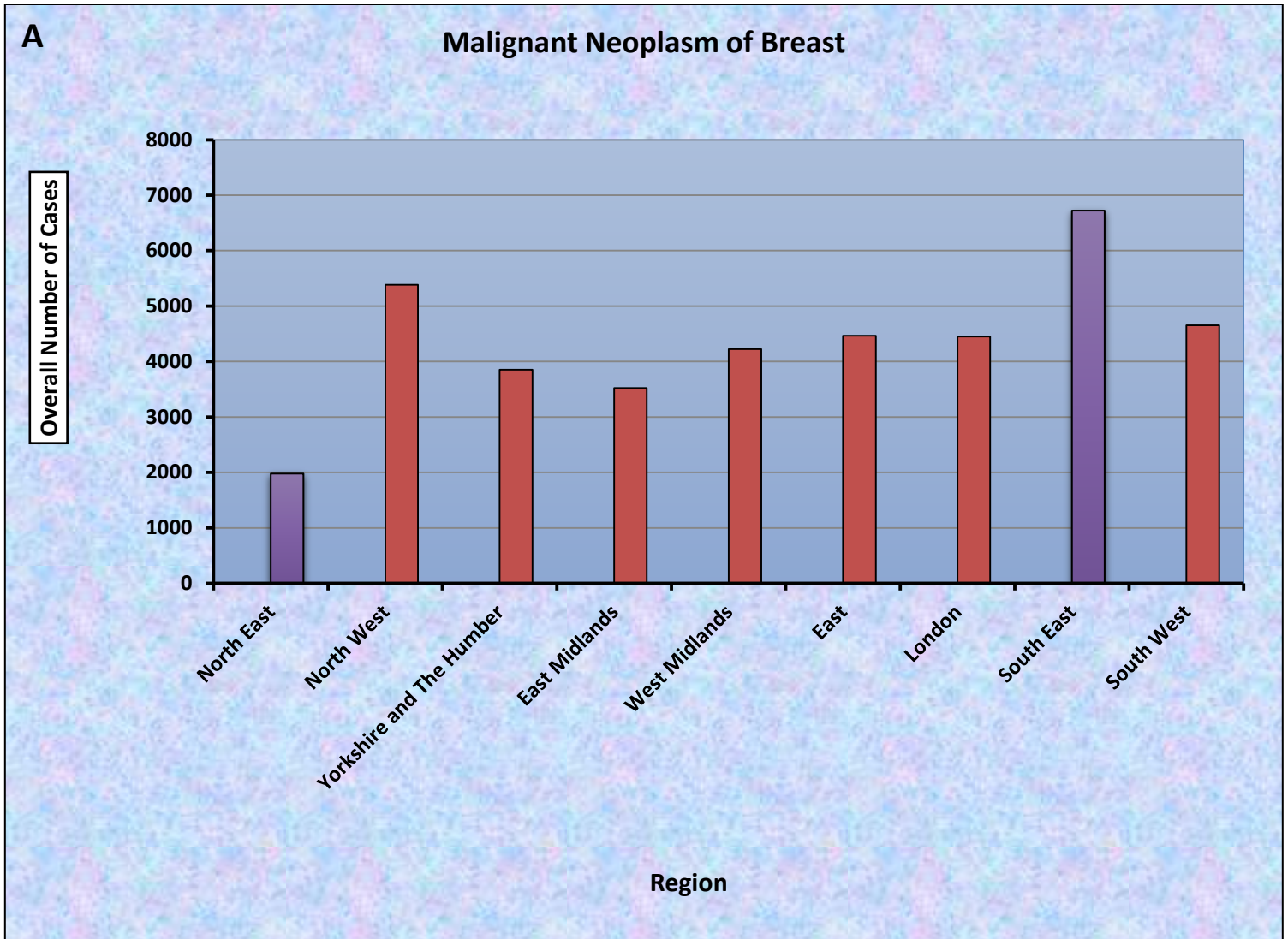
##### **A-1 Distribution of cases by region of England**

A total of 586,044 malignant neoplasm cancer cases were recorded in the National Statistics Office from 2000 to 2014, with an estimated average 39,070 cases per year (**Table 1**).

**Table 1: Overall number of malignant neoplasm of breast cases distribution by the region of England from 2000 to 2014**

Year of Diagnosis	Overall number of malignant neoplasm of breast									
	Regions									
	North East	North West	Yorkshire and The Humber	East Midlands	West Midlands	East	London	South East	South West	Total
2000	1,663	4,589	3,268	2,910	3,700	3,775	3,991	5,866	4,067	33,829
2001	1,715	4,792	3,346	2,874	3,688	3,793	4,009	5,911	4,219	34,347
2002	1,696	4,742	3,381	2,976	3,778	3,908	4,009	5,761	4,068	34,319
2003	1,892	5,020	3,585	3,239	3,947	4,045	4,155	6,190	4,456	36,509
2004	1,960	5,232	3,662	3,521	3,985	4,035	3,838	6,148	4,558	36,939
2005	1,968	5,323	3,844	3,375	4,224	4,310	4,139	6,410	4,619	38,212
2006	2,010	5,382	3,748	3,548	4,083	4,181	4,030	6,380	4,642	38,004
2007	1,828	5,269	3,848	3,341	4,209	4,254	4,140	6,404	4,755	38,048
2008	2,063	5,357	4,051	3,727	4,332	4,617	4,347	6,681	4,506	39,681
2009	2,048	5,611	4,068	3,624	4,224	4,597	4,629	6,901	4,558	40,260
2010	2,049	5,512	4,047	3,800	4,456	4,706	4,833	7,120	4,736	41,259
2011	2,024	5,746	3,981	3,866	4,456	4,665	4,764	7,137	4,848	41,523
2012	2,143	5,779	4,103	3,832	4,458	5,062	4,751	7,352	5,009	42,489
2013	2,178	5,973	4,272	3,876	4,697	5,243	5,175	7,886	5,240	44,540
2014	2,338	6,073	4,300	4,028	4,822	5,343	5,681	8,154	5,346	46,085
<b>Total</b>	<b>29,575</b>	<b>80,400</b>	<b>57,504</b>	<b>52,535</b>	<b>63,059</b>	<b>66,534</b>	<b>66,491</b>	<b>100,301</b>	<b>69,627</b>	<b>586,044</b>
<b>Overall</b>	<b>1,972</b>	<b>5,360</b>	<b>3,834</b>	<b>3,502</b>	<b>4,204</b>	<b>4,436</b>	<b>4,433</b>	<b>6,687</b>	<b>4,642</b>	<b>39,070</b>
<b>Overall %</b>	<b>5</b>	<b>13.7</b>	<b>9.8</b>	<b>8.9</b>	<b>10.7</b>	<b>11.4</b>	<b>11.3</b>	<b>17.1</b>	<b>11.8</b>	<b>100</b>

The highest overall number and percentage of malignant neoplasm cancer cases (6,687, 17.1%) was recorded in the South East of England, while the lowest overall number and percentage (1972, 5%) being in the North East of England. In fact, the number of malignant neoplasm cancer cases is not a good indicator for making a comparison between South East and North East of England, because the age structures of these populations are not the same.<sup>9</sup> However, South East of England has the highest proportions of older residents population, while North East of England has the lowest proportions of older residents population (**Figure. 1A**).



**Figure 1: A:** Overall number of malignant neoplasm of breast cases distribution by the region of England from 2000 to 2014

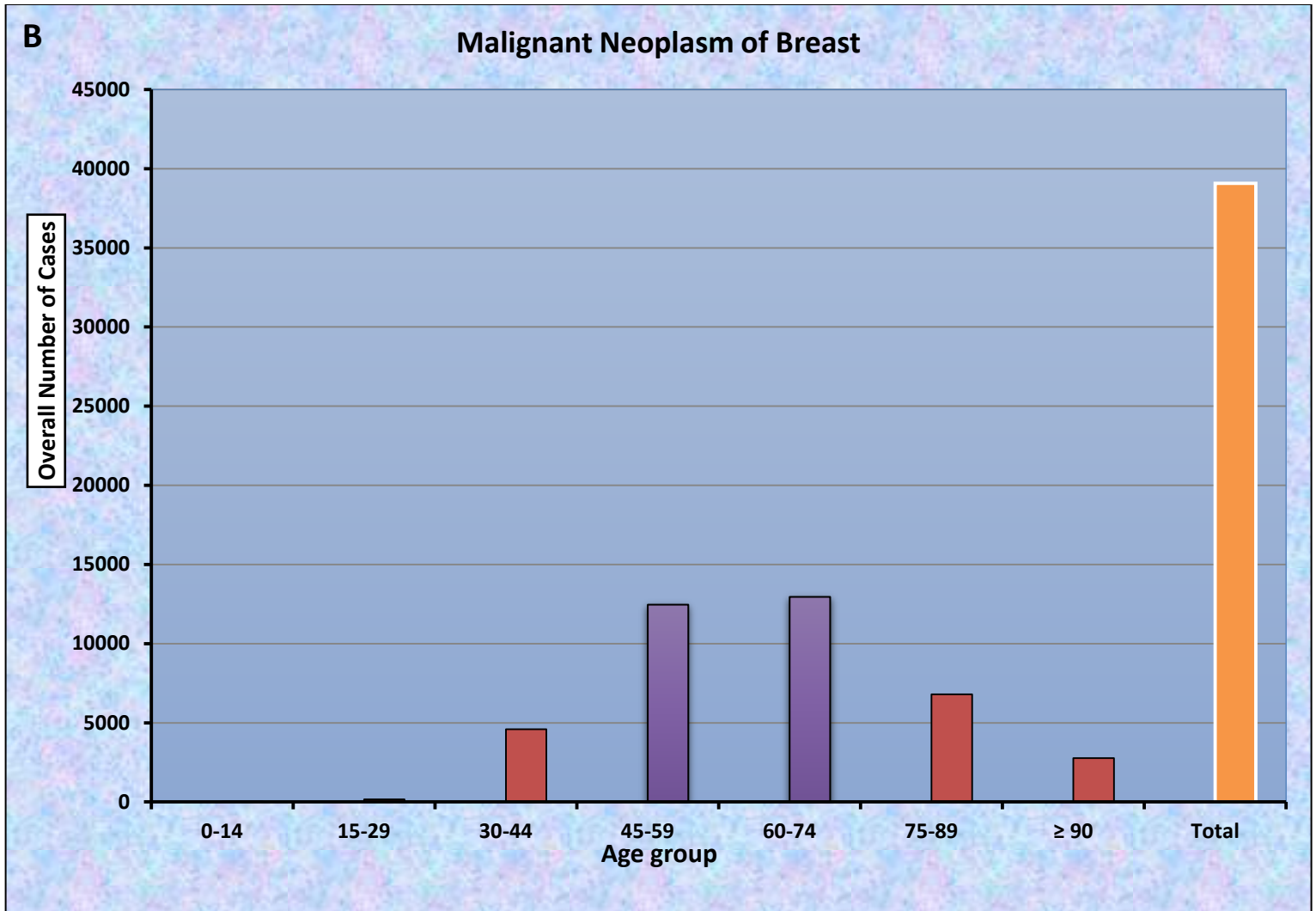
**A-2 Distribution of cases by age groups**

The overall number and percentage of malignant neoplasm cancer cases between 2000 and 2014, stratified by age groups, was calculated from the UK’s Office for National Statistics (**Table 2**).

**Table 2: Overall number of malignant neoplasm of breast cases distribution by age group of women in England from 2000 to 2014**

Year of Diagnosis	Overall number of malignant neoplasm of breast							Total
	Age groups							
	0-14	15-29	30-44	45-59	60-74	75-89	≥ 90	
2000	2	163	3,720	11,423	10,096	5,562	2,863	33,829
2001	1	135	3,740	11,678	10,133	5,759	2,901	34,347
2002	0	143	3,677	11,575	10,585	5,592	2,747	34,319
2003	0	117	3,920	12,251	11,458	5,962	2,801	36,509
2004	0	149	3,916	12,134	11,904	6,148	2,688	36,939
2005	0	146	4,116	11,956	12,766	6,253	2,975	38,212
2006	0	148	4,003	12,005	12,626	6,226	2,996	38,004
2007	0	160	3,982	11,633	12,957	6,194	3,122	38,048
2008	0	174	3,892	12,340	13,579	6,318	3,378	39,681
2009	0	215	3,988	12,434	13,711	6,457	3,455	40,260
2010	1	168	4,157	12,806	14,057	6,565	3,505	41,259
2011	2	185	3,904	13,034	14,331	6,520	3,547	41,523
2012	0	236	3,885	13,297	14,676	9,054	1,391	42,489
2013	1	206	4,013	14,050	15,480	9,304	1,486	44,540
2014	0	240	3,929	14,295	15,933	10,119	1,569	46,085
<b>Overall</b>	<b>0.5</b>	<b>172</b>	<b>3,923</b>	<b>12,461</b>	<b>12,953</b>	<b>6,802</b>	<b>2,762</b>	<b>39,070</b>
<b>Overall %</b>	<b>0</b>	<b>0.4</b>	<b>10</b>	<b>31.8</b>	<b>33.1</b>	<b>17.4</b>	<b>7</b>	<b>100</b>

The age groups were classified into the following categories: 00-14, 15-29, 30-44, 45-59, 60-74, 75-89, and over the age of 90 years. According to the overall frequency numbers and percentages of cases from 2000 to 2014, the age groups that were most affected by malignant neoplasm cancer were women aged 60-74 and 45-59, with an estimated average per year (12,953 and 12,461) cases representing (33.1%, 31.8%) of the total overall number of malignant neoplasm cancer cases. However, the age groups that were least affected by malignant neoplasm cancer were women aged 15-29 years, at 0.4%, followed by those older than 90 years, at 7.0% (**Figure. 1B**).

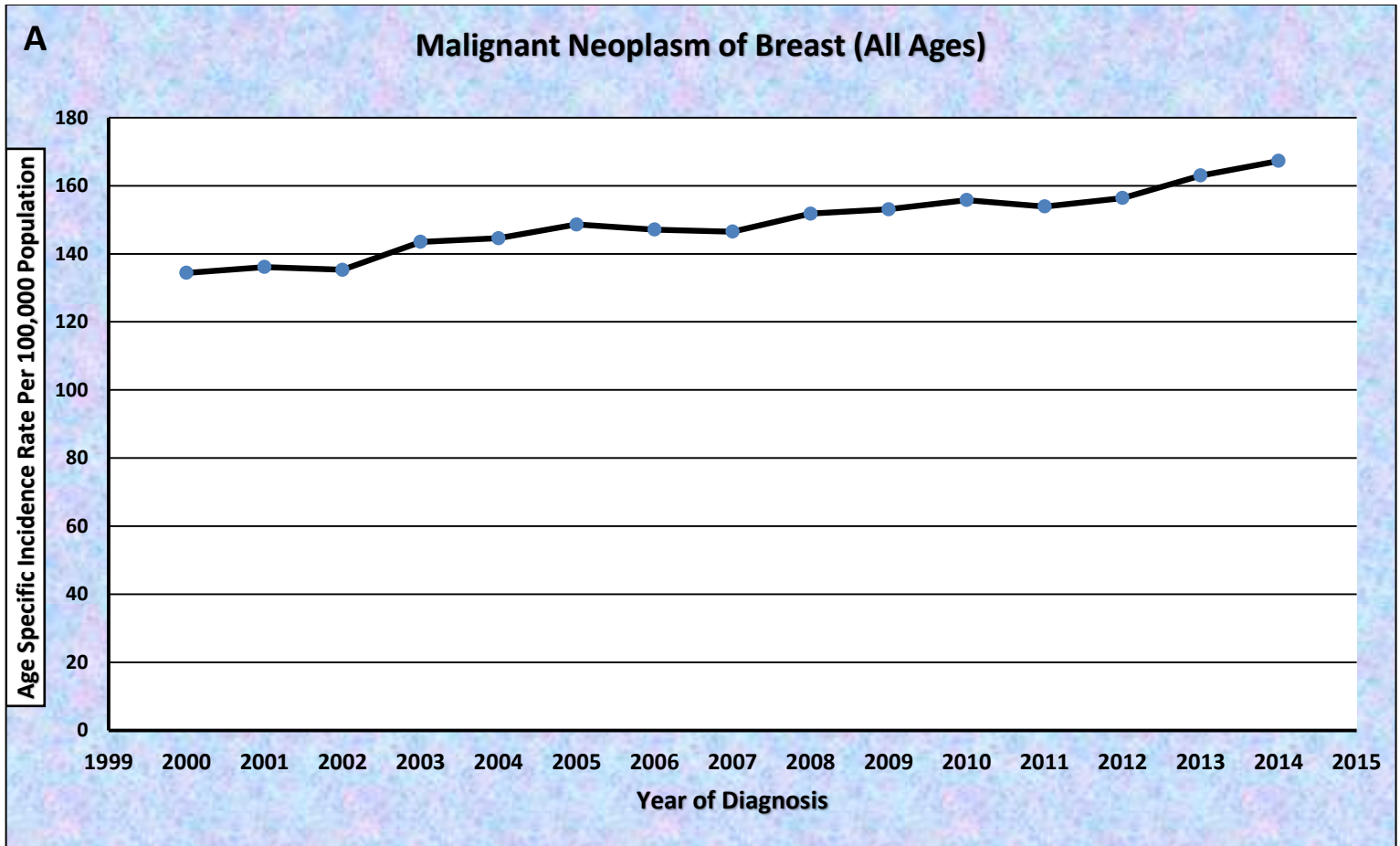


**Figure 1: B:** Overall number of malignant neoplasm of breast cases distribution by age group of women in England from 2000 to 2014.

**A-3 Age specific incidence rate of malignant neoplasm cancer**

The age specific incidence rate of malignant neoplasm cancer adjusted by year of diagnosis from 2000 to 2014 per 100,000 population indicate a steady increase of the disease in England (Figure. 2A).



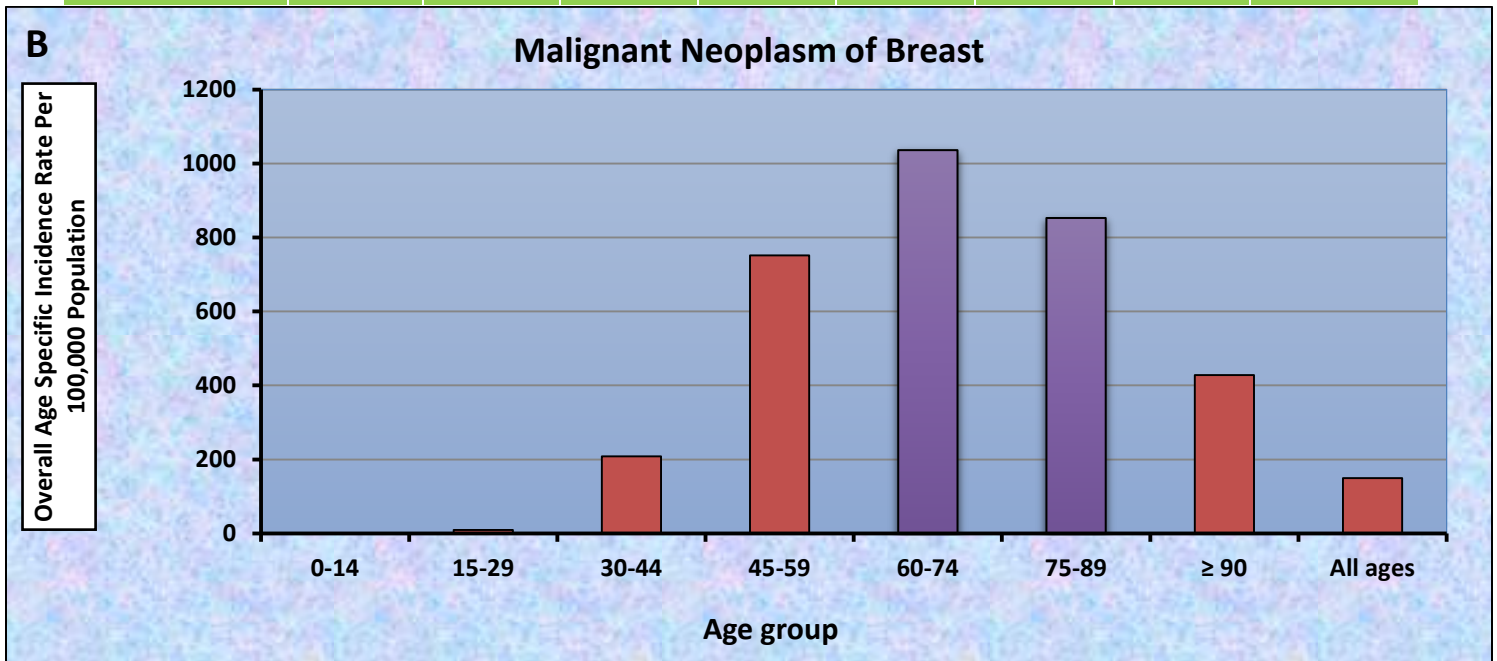


**Figure 2: A: The age specific incidence rate of malignant neoplasm of breast in England from 2000 to 2014.**

The overall age specific incidence rate of malignant neoplasm cancer from 2000 to 2014 was calculated, with an estimated average 149.2 per 100,000 population per year. The highest overall age specific incidence rates of malignant neoplasm cancer cases were observed in the age groups 60-74 and 75-89, with an average (1,036.5, SD=78.0 and 853, SD=243). In addition, a Kruskal-Wallis test showed that there was a significant difference in the age specific incidence rates between the different age groups,  $\chi^2(6) = 98.410$ ,  $p = 0.001$ . However, the lowest overall age specific incidence rates were recorded in the age groups 15-29 and 30-44, with average cases (9.5, SD=2.8 and 208.6, SD=6.6) (Table 3) and (Figure. 2B).

**Table 3:** Overall age specific incidence rate of malignant neoplasm of breast in England from 2000 to 2014

Year of Diagnosis	Overall age specific incidence rate of malignant neoplasm of breast							
	Age groups							
	0-14	15-29	30-44	45-59	60-74	75-89	≥ 90	All ages
2000	0.5	9.8	205.8	743	887	680.7	416.5	134.4
2001	0.1	8.3	203.1	748.3	892.8	695.8	419.8	136.1
2002	0	9.1	195.9	729.8	929.9	667.9	400.1	135.3
2003	0	7.6	206.7	764.6	997.8	703.8	418.8	143.5
2004	0	10	204.5	752	1,022.7	724	403.0	144.6
2005	0	9.1	213.6	737	1,085	744	426.8	148.6
2006	0	9.0	207.3	733.6	1,062.4	750.8	409.7	147.1
2007	0	10	206	714	1,054.2	747.5	412.1	146.5
2008	0	10.3	204	755	1,069	766	436.5	151.8
2009	0	12.5	210.5	750	1,053	785	438.8	153.1
2010	0	9.5	222.3	758.4	1,064	795.3	435.5	155.8
2011	0	1.2	207.9	758.1	1,073.9	789.2	441.5	153.9
2012	0	12.8	206.5	757.4	1,082.1	1,269.7	439	156.4
2013	0	11.1	218.2	787.4	1,125.6	1,291.6	459.9	163
2014	0	12.9	216	788.4	1,147.7	1,383.2	468.6	167.3
Mean	0.0	9.5	208.6	751.8	1,036.5	853.0	428.4	149.2
Std. Deviation	0.1	2.8	6.6	19.7	78.0	243.2	428.4	



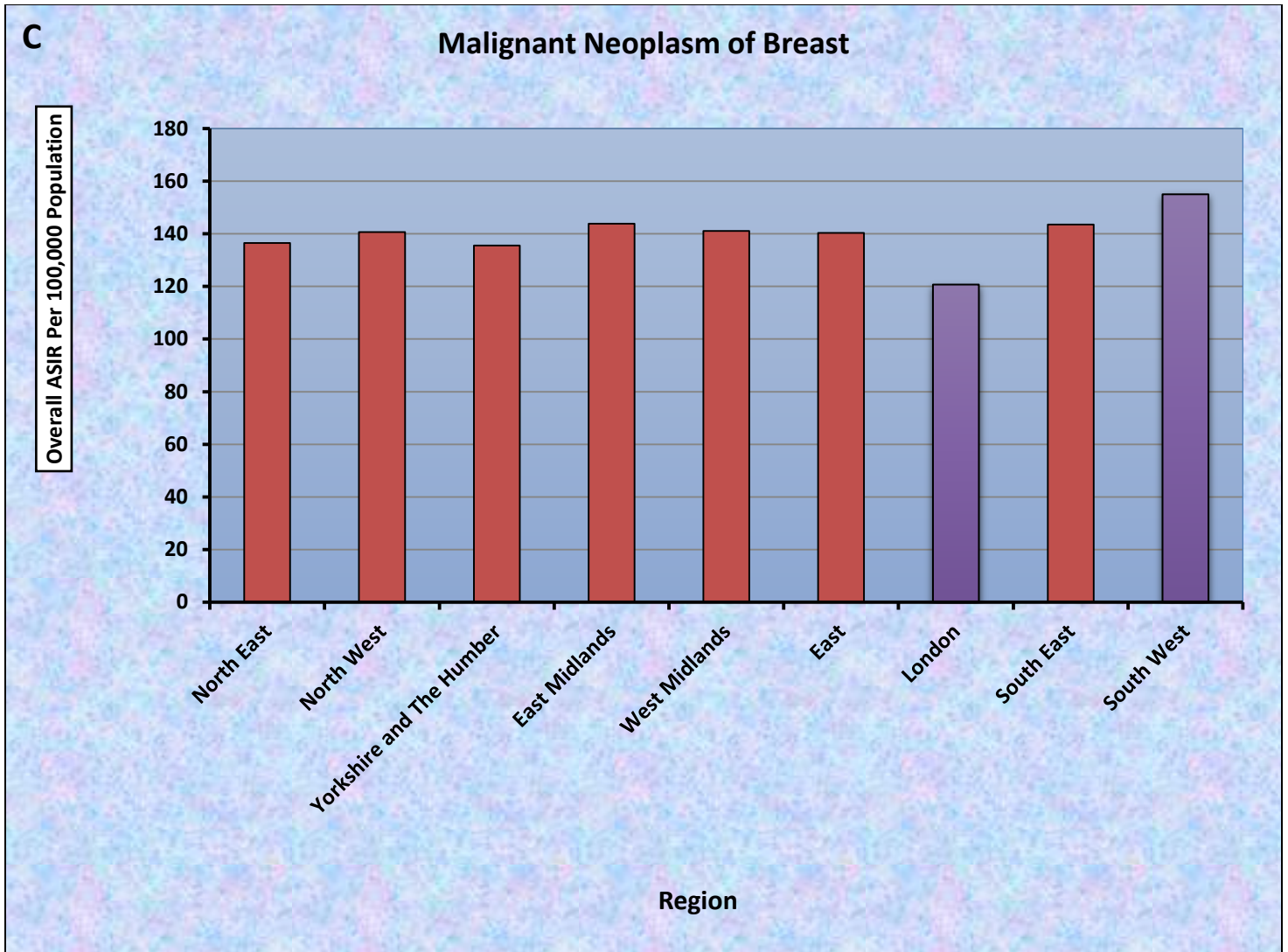
**Figure. 2B:** Overall age specific incidence rate of malignant neoplasm of breast in England from 2000 to 2014.

**A-4 Age standardised incidence rate of malignant neoplasm cancer in England**

The overall ASIR of malignant neoplasm cancer cases by region of England, from 2000 to 2014 per 100,000 population was calculated from the UK's Office for National Statistics. The highest overall ASIR of malignant neoplasm cancer cases were documented in South West of England, with an estimated average (155, SD=22.3). However, the overall ASIR of malignant neoplasm cancer cases in South West of England were significantly higher compared to other different parts of England,  $\chi^2(8) = 26.436$ ,  $p = 0.001$  (Table 4) and (Figure. 2C).

**Table 4: Overall age standardised incidence rate of malignant neoplasm of breast in England from 2000 to 2014**

Year of Diagnosis	Overall age standardised incidence rate of malignant neoplasm of breast								
	Regions								
	North East	North West	Yorkshire and The Humber	East Midlands	West Midlands	East	London	South East	South West
2000	127.9	132.1	128.4	137.5	137.7	137.6	108.4	143.5	161.1
2001	132.2	137.6	131.0	135.3	137.0	137.8	108.1	144.2	166.5
2002	129.9	136	132	138.8	139.9	141.4	107.2	140.2	159.6
2003	144.9	143.7	138.9	150	145.8	145.4	111.1	150.1	173.8
2004	149.9	149.4	142.0	162.2	146.8	144.4	102.2	148.6	176.7
2005	150.3	152.2	147.6	154.0	155.3	152.1	109.8	153.4	177.6
2006	123.8	124.9	117.8	129.4	120.6	117.3	106.7	122.6	133.1
2007	108.8	123.1	119.8	120.6	124.5	118.4	107.8	120	133.6
2008	124.7	123.3	124.7	132.4	127.5	125.6	112	123.9	125.3
2009	122.1	128	124.1	127	123	123.6	117.8	125	125
2010	120.9	124.8	122.8	130.6	127.9	125.3	121.2	127.7	129.4
2011	117.8	128.4	120.3	131.6	126.8	121.2	116.1	127.7	131.6
2012	160.6	165.3	157.4	167.4	162.0	169.1	150.0	167.6	173.0
2013	162.0	169.6	162.9	167.7	169.6	172.8	159.8	177.4	178.9
2014	171.9	171.1	162.5	171.8	171.9	172.8	172.3	180.7	180.5
Mean	136.5	140.6	135.5	143.8	141.1	140.3	120.7	143.5	155.0
Std. Deviation	18.7	17.1	15.6	16.9	17.1	19.3	21.6	19.8	22.3
Median	130.0	136.0	131.0	137.5	137.7	137.8	111.0	143.5	161.0



**Figure 2C:** Overall age standardised incidence rate of malignant neoplasm of breast in England from 2000 to 2014.

Although the South West of England had the highest overall ASIR of malignant neoplasm cancer cases, it had the lowest change in the ASIR documented during the year 2000 and 2014 with an estimated difference  $(19.4) = (ASIR \text{ in } 2014 = 180.5 - ASIR \text{ in } 2000 = 161.1)$ , which considered not statistically significant  $p\text{-value} = 0.2$ . Alternatively, London recorded the lowest overall ASIR of malignant neoplasm cancer cases in England, with estimated average  $(120.7, SD=21.6)$ .

Although the region of London in England had the lowest overall ASIR of malignant neoplasm cancer cases, it had the greatest change in ASIR documented during the year 2000 and 2014 with an estimated difference (63.9) = (ASIR in 2014 = 172.3 - ASIR in 2000 = 108.4), which considered a very statistically significant p-value = 0.005 (Table 5).

**Table 5: The changes in age standardised incidence rate of malignant neoplasm of breast in England from 2000 to 2014. (P-value was considered after calculating z-score)**

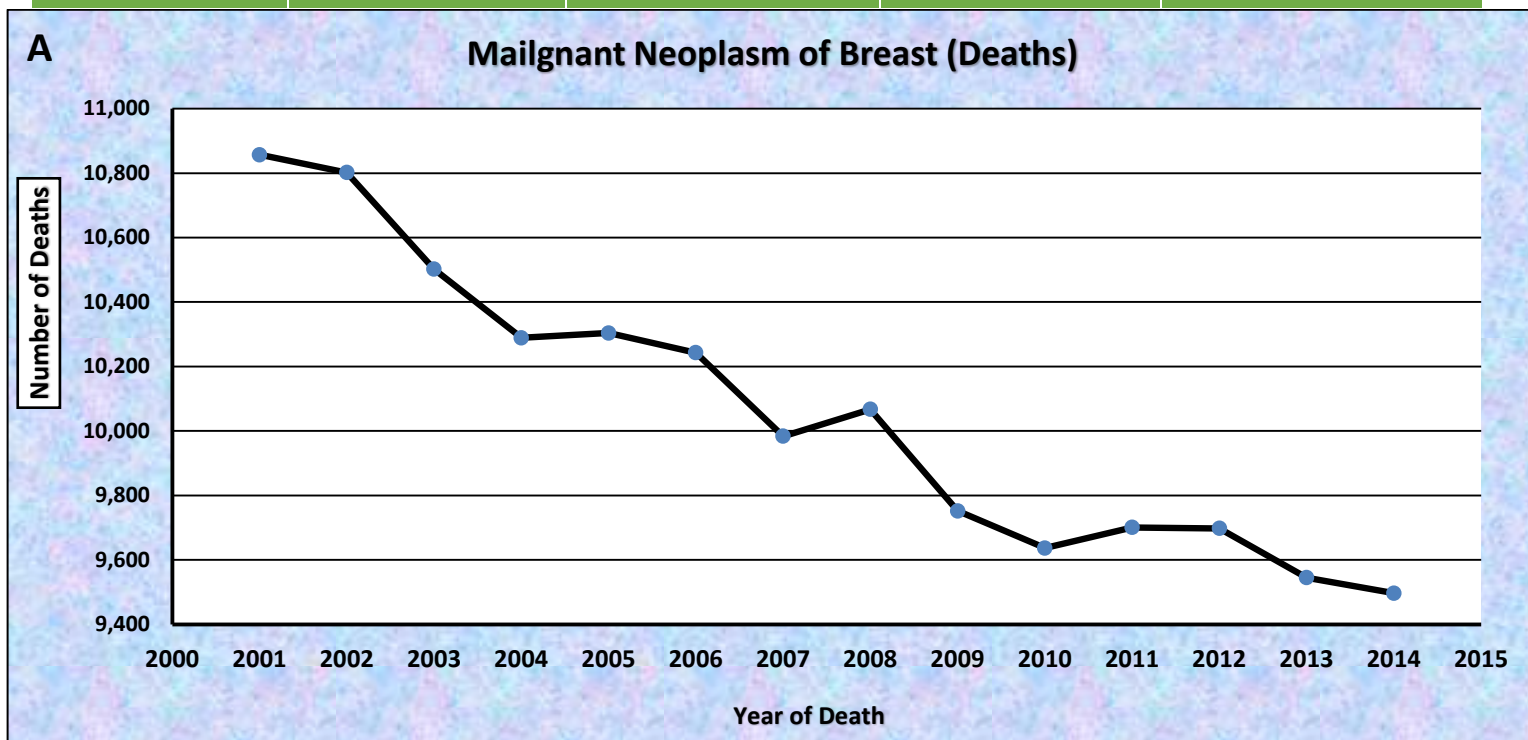
Regions	Malignant neoplasm of breast				Breast carcinoma in situ			
	ASIR Per 100,000 population				ASIR Per 100,000 population			
	2014	2000	difference	P-value	2014	2000	difference	P-value
North East	171.9	127.9	44	0.01	25.3	10.5	14.8	0.01
North West	171.1	132.1	39	0.02	25.9	10.9	15	0.01
Yorkshire and The Humber	162.5	128.4	34.1	0.04	22.9	12.9	10	0.08
East Midlands	171.8	137.5	34.3	0.05	25.7	12.4	13.3	0.03
West Midlands	171.9	137.7	34.2	0.05	24.9	8.7	16.2	0.005
East	172.8	137.6	35.2	0.04	24.2	14.2	10	0.10
London	172.3	108.4	63.9	0.001	27.7	7.1	20.6	0.005
South East	180.7	143.5	37.2	0.03	27.5	12.3	15.2	0.01
South West	180.5	161.1	19.4	0.2	28.3	15.3	13	0.05

#### A-5 Age standardised mortality rate of malignant neoplasm cancer in England

A total of 140,878 malignant neoplasm cancer deaths were recorded in the National Statistics Office from 2000 to 2014, with an estimated average 10,063 deaths per year (Table 6) and (Figure. 3A).

**Table 6:** Age standardised mortality rate and number of deaths from malignant neoplasm of breast in England from 2000 to 2014

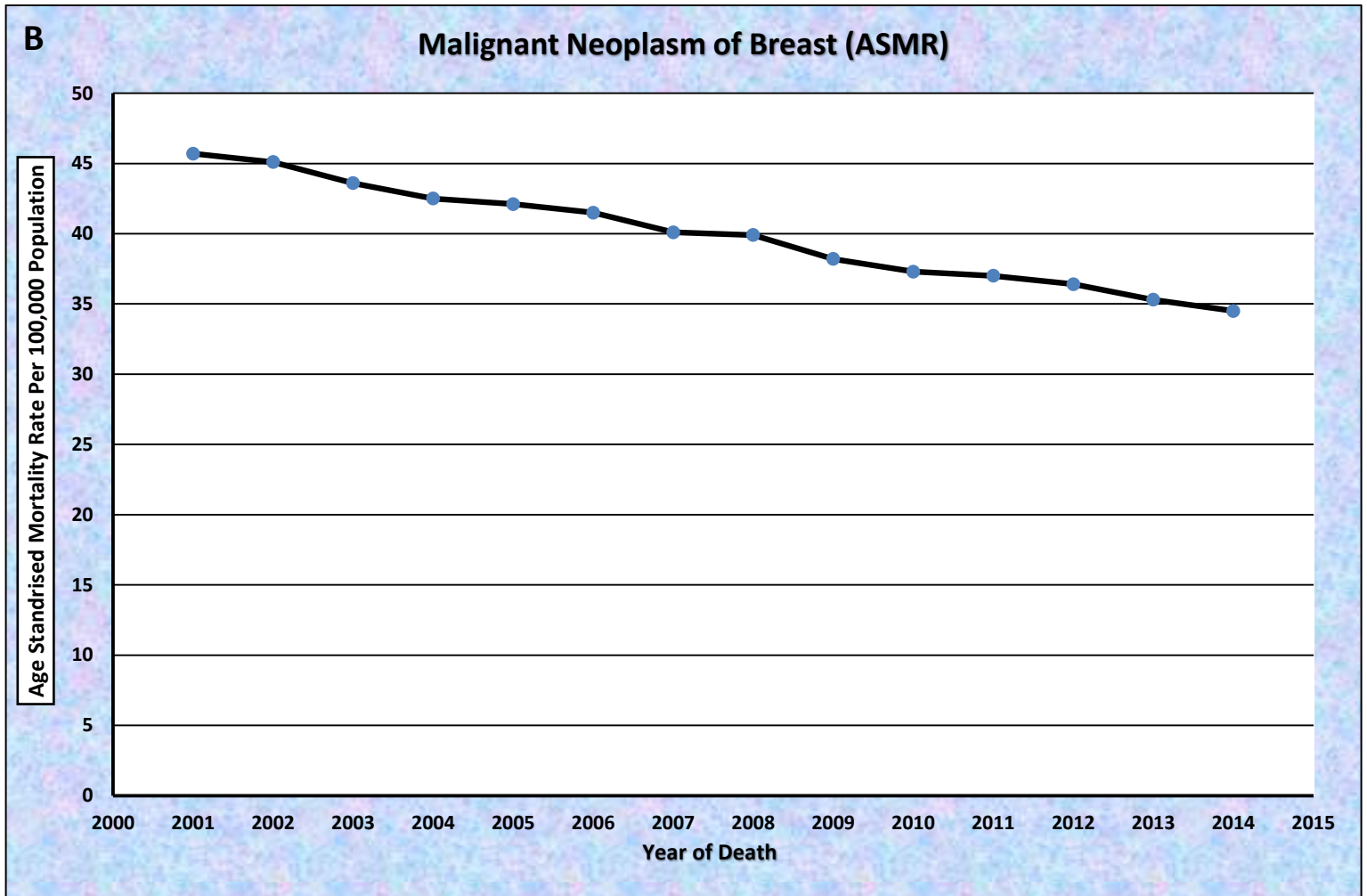
Year of Diagnosis	Malignant neoplasm of breast		Carcinoma in Situ of Breast	
	Number of Deaths	ASMR	Number of Deaths	ASMR
2001	10,857	45.7	1	-
2002	10,802	45.1	0	-
2003	10,502	43.6	0	-
2004	10,289	42.5	0	-
2005	10,304	42.1	1	-
2006	10,243	41.5	2	-
2007	9,984	40.1	0	-
2008	10,067	39.9	0	-
2009	9,752	38.2	0	-
2010	9,637	37.3	0	-
2011	9,701	37.0	1	-
2012	9,698	36.4	1	-
2013	9,545	35.3	0	-
2014	9,497	34.5	0	-
<b>Total</b>	<b>140,878</b>	<b>Mean = 39.9</b>	<b>-</b>	<b>-</b>
<b>Mean</b>	<b>10,063</b>			



**Figure 3: A:** Number of deaths from malignant neoplasm of breast in England from 2000 to 2014.

The ASMR of malignant neoplasm cancer in England was decreased dramatically from 2001 to 2014. It was 45.7 in 2001, and 34.5 in 2014, with an estimated average 39.9 per 100,000 population per year (Figure. 3B).

**Figure 3: A: B: Age standardised mortality rate of malignant neoplasm of breast in England from 2000 to 2014**



**B- Breast carcinoma in situ (Overall number of cases and percentages)**

**B-1 Distribution of cases by region of England**

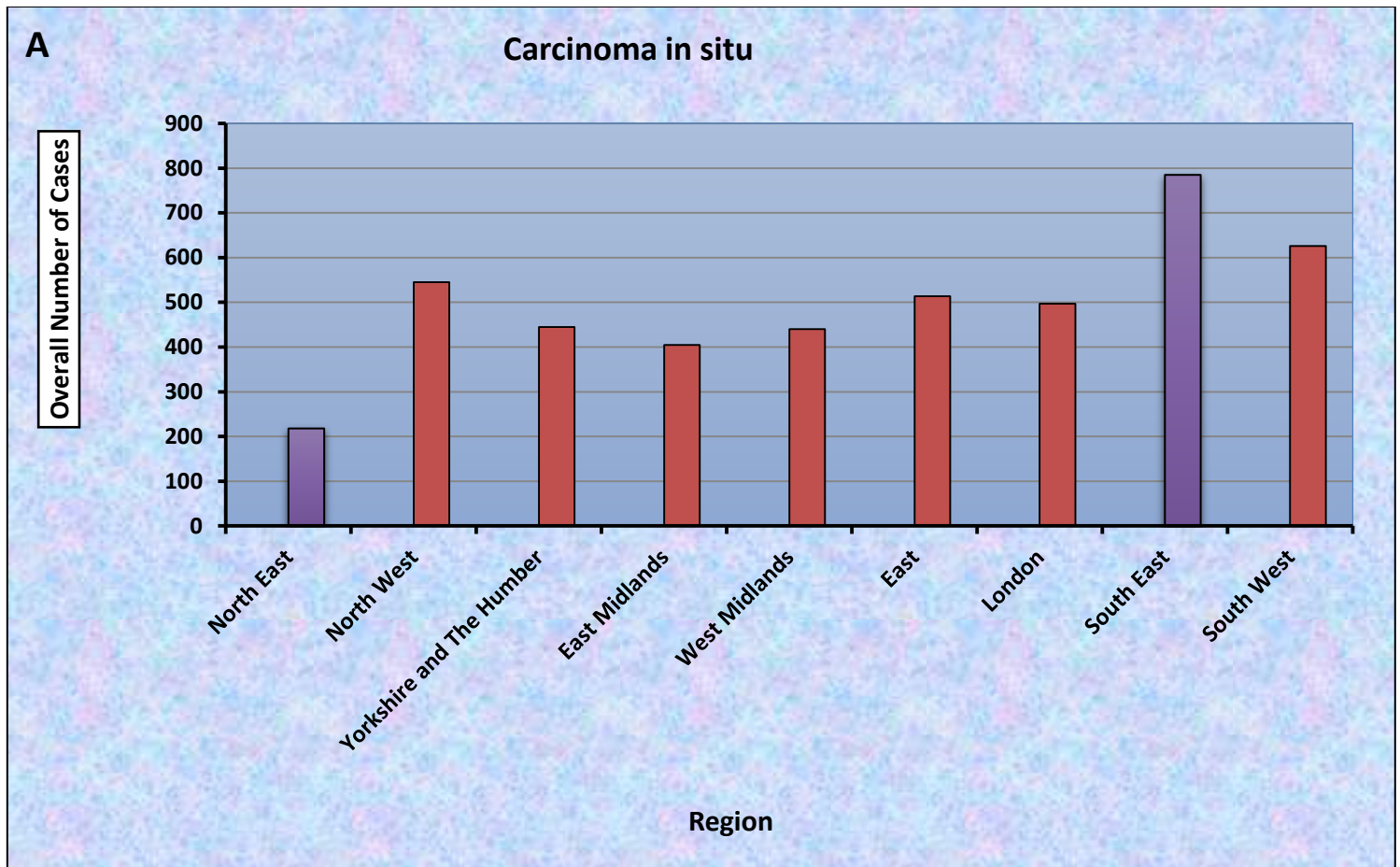
A total of 67,125 breast carcinoma in situ cases were recorded in the National Statistics Office from 2000 to 2014, with an estimated average 4,475 cases per year. The highest overall number

and percentage of breast carcinoma in situ cases (785, 17.5%) was observed in the South East of England, while the lowest overall number and percentage (218, 4.8%) being in the North East of England. The age structures of South East and North East of England are not the same, therefore ASIR should be considered to make a comparison between different populations (**Table 7**) and (**Figure. 4A**).

**Table 7: Overall number of breast carcinoma in situ cases distribution by the regions of England from 2000 to 2014**

Year of Diagnosis	Overall number of breast carcinoma in situ									
	Regions									
	North East	North West	Yorkshire and The Humber	East Midlands	West Midlands	East	London	South East	South West	Total
2000	136	377	328	262	234	389	261	503	385	2,875
2001	127	363	332	268	271	342	354	508	454	3,019
2002	154	374	312	299	313	379	354	542	425	3,152
2003	153	442	365	321	327	436	373	587	431	3,435
2004	206	393	406	344	344	393	312	610	613	3,621
2005	203	454	426	400	393	486	433	751	651	4,197
2006	221	507	450	352	394	514	462	757	738	4,395
2007	232	521	470	395	454	543	449	804	678	4,546
2008	221	476	464	467	450	588	508	901	720	4,795
2009	199	606	445	482	425	552	519	817	664	4,709
2010	236	568	467	451	501	501	583	830	679	4,816
2011	246	649	464	428	553	538	585	851	603	4,917
2012	288	755	521	470	547	611	578	1,039	691	5,500
2013	305	775	625	540	707	708	766	1,058	840	6,324
2014	343	910	596	602	685	734	920	1,215	819	6,824
<b>Total</b>	3,270	8,170	6,671	6,081	6,598	7,714	7,457	11,773	9,391	67,125
<b>Overall</b>	<b>218</b>	<b>545</b>	<b>445</b>	<b>405</b>	<b>440</b>	<b>514</b>	<b>497</b>	<b>785</b>	<b>626</b>	<b>4475</b>
<b>Overall %</b>	<b>4.8</b>	<b>12</b>	<b>10</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>11</b>	<b>17.5</b>	<b>14</b>	<b>100</b>





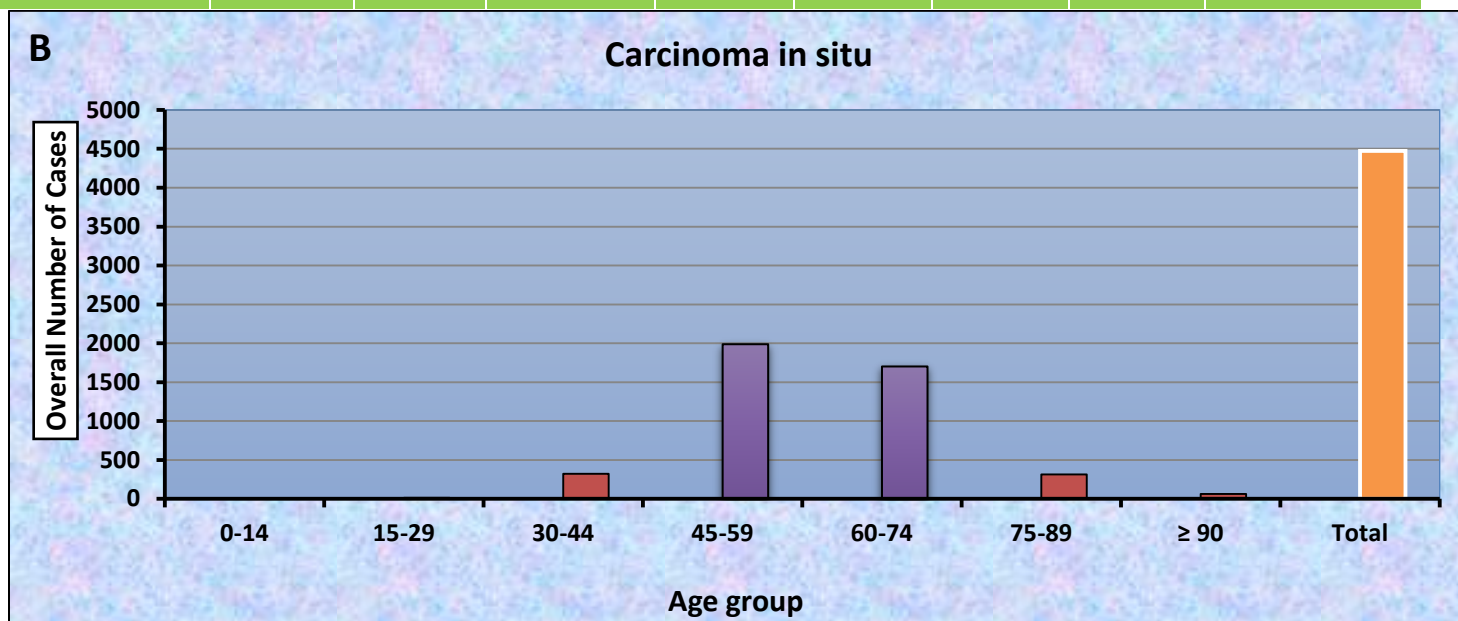
**Figure 4: A:** Overall number of breast carcinoma in situ cases distribution by the regions of England from 2000 to 2014.

### B-2 Distribution of cases by age groups

The overall number and percentage of breast carcinoma in situ cases between 2000 and 2014, stratified by age groups, was calculated from the UK's Office for National Statistics. The age groups that were most affected by breast carcinoma in situ were women aged 45-59 and 60-74, with an estimated average per year (1,989, 1,703) cases representing (44.4%, 38.0%) of the total overall number of breast carcinoma in situ cases. However, the age groups that were least affected by breast carcinoma in situ were women aged 15-29 years, at 0.3%, followed by those older than 90 years, at 1.4% (**Table 8**) and (**Figure. 4B**).

**Table 8:** Overall number of breast carcinoma in situ cases distribution by age groups of women in England from 2000 to 2014

Year of Diagnosis	Overall number of breast carcinoma in situ							Total
	Age groups							
	0-14	15-29	30-44	45-59	60-74	75-89	≥ 90	
2000	0	10	254	1,515	877	182	37	2,875
2001	0	13	241	1,622	910	189	44	3,019
2002	0	7	270	636	996	181	42	3,152
2003	0	8	258	1,742	1,165	222	40	3,435
2004	0	4.0	291	1,758	1,265	243	60	3,621
2005	1	7	292	1,864	1,684	296	53	4,197
2006	0	14	313	2,008	1,706	273	81	4,395
2007	0	13	343	1,883	1,912	292	103	4,546
2008	0	16	386	2,057	1,899	343	94	4,795
2009	1	18	354	2,002	1,917	323	94	4,709
2010	0	21	332	2,059	1,957	355	92	4,816
2011	0	12	339	2,194	1,948	317	107	4,917
2012	0	13	342	2,528	2,160	426	31	5,500
2013	0	19	365	2,897	2,498	508	37	6,324
2014	0	25	436	3,071	2,652	585	55	6,824
<b>Overall</b>	<b>0</b>	<b>13</b>	<b>321</b>	<b>1,989</b>	<b>1,703</b>	<b>316</b>	<b>65</b>	<b>4,475</b>
<b>Overall %</b>	<b>0</b>	<b>0.3</b>	<b>7.1</b>	<b>44.4</b>	<b>38</b>	<b>7</b>	<b>1.4</b>	<b>100</b>

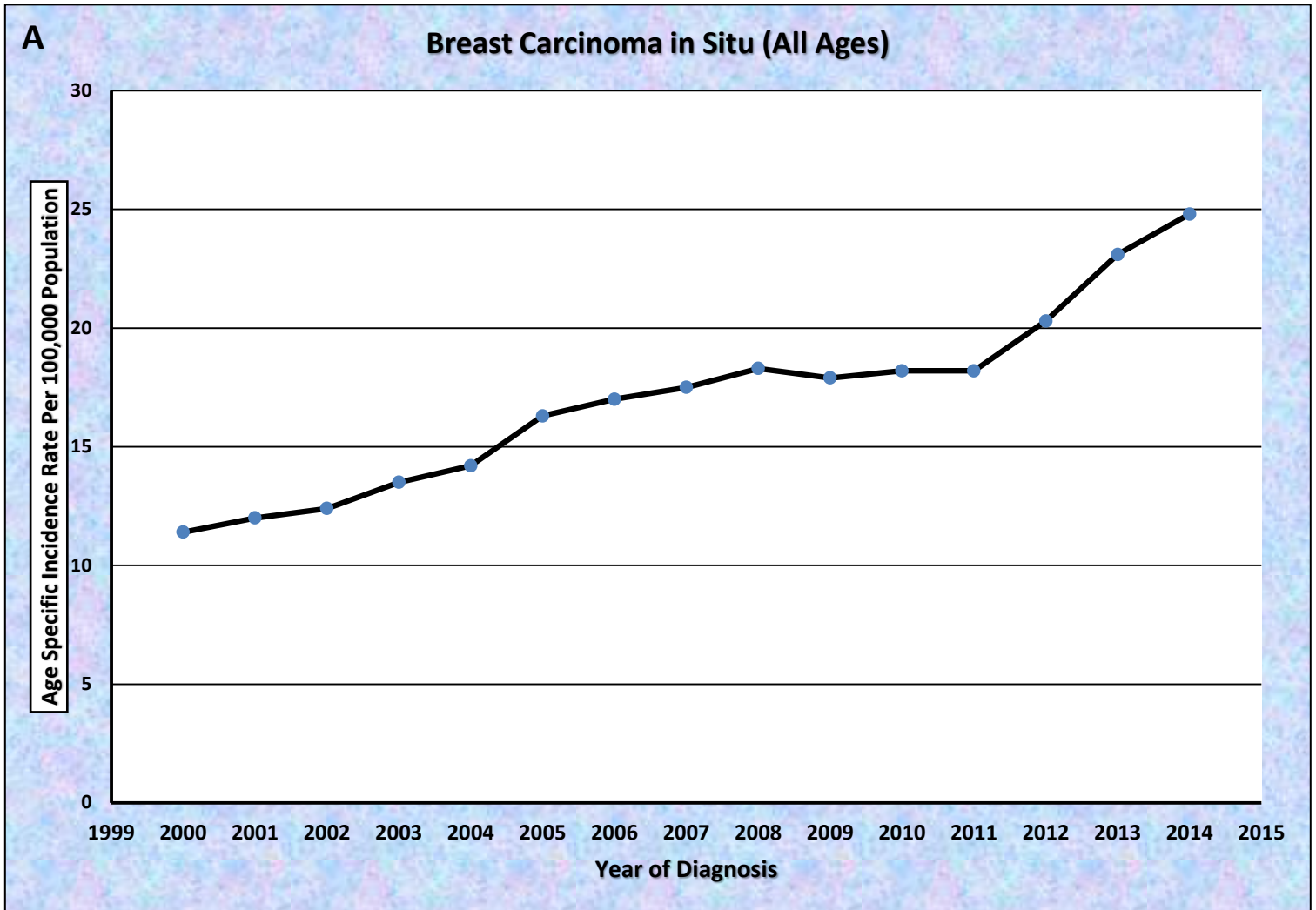


**Figure 4B:** Overall number of breast carcinoma in situ cases distribution by age groups of women in England from 2000 to 2014.

**B-3 Age specific incidence rate of breast carcinoma in situ**

The age specific incidence rate of breast carcinoma in situ adjusted by year of diagnosis from 2000 to 2014 per 100,000 population indicate a steady increase of the disease in England (Figure. 5A).

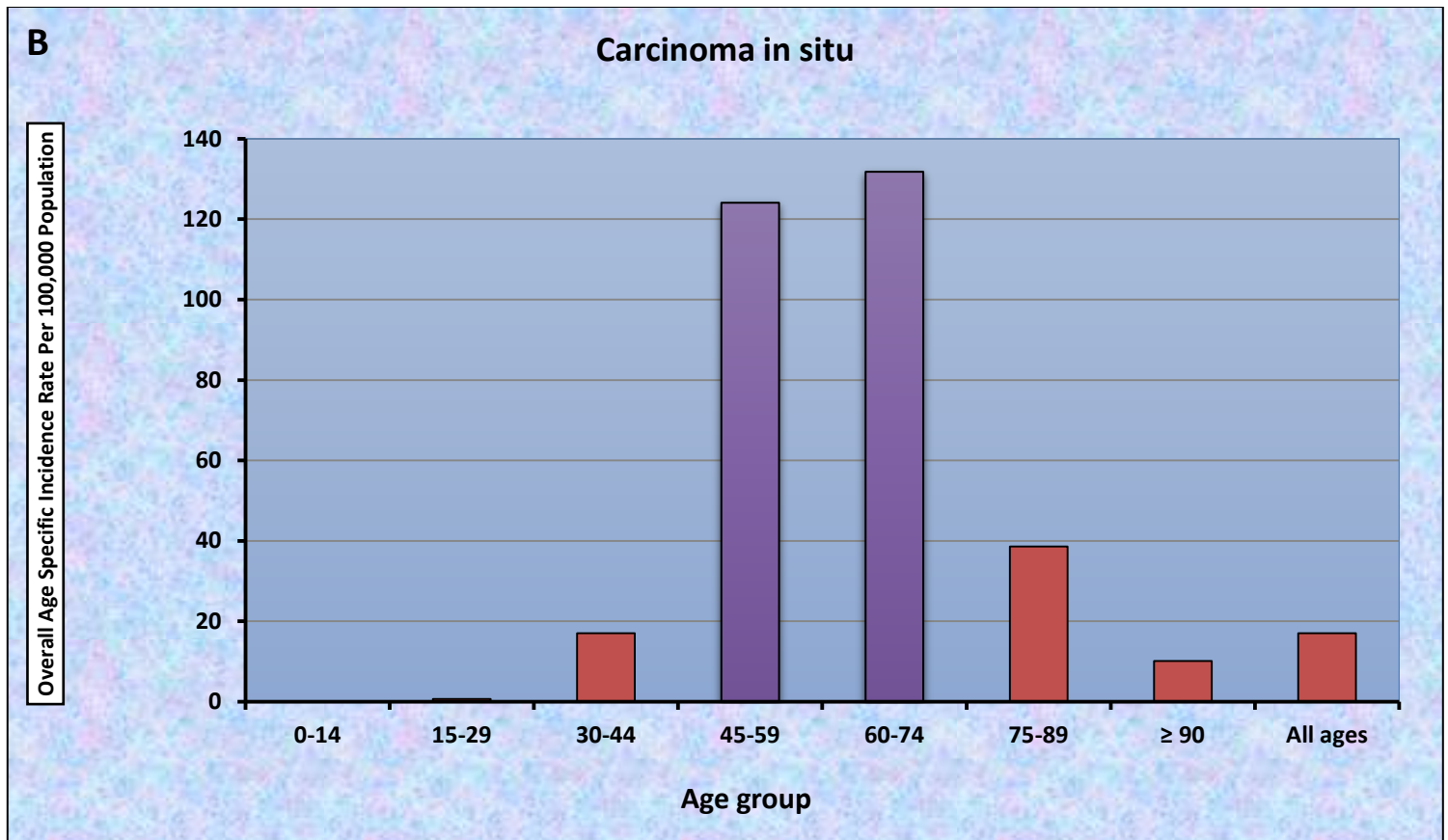
**Figure 5: A:** The age specific incidence rate of breast carcinoma in situ in England from 2000 to 2014



The overall age specific incidence rate of breast carcinoma in situ from 2000 to 2014 was calculated, with an estimated average 17.0 per 100,000 population per year. The highest overall age specific incidence rates of breast carcinoma in situ were observed in the age groups 60-74 and 45-59, with an average (131.8, SD=34.7 and 124.1, SD=20.7). In addition, a Kruskal-Wallis test showed that there was a significant difference in age specific incidence rates between the different age groups,  $\chi^2(6) = 99.931$ ,  $p = 0.001$ . However, the lowest overall age specific incidence rates were documented in women aged 15-29, at (0.7, SD=0.2), followed by those older than 90 years, at (10.1, SD=3.2) (Table 9) and (Figure. 5B).

**Table 9: Overall age specific incidence rate of breast carcinoma in situ in England from 2000 to 2014**

Year of Diagnosis	age specific incidence rate of breast carcinoma in situ							
	Age groups							
	0-14	15-29	30-44	45-59	60-74	75-89	≥ 90	All ages
2000	0	0.6	14.0	97.8	75.1	21.3	5.4	11.4
2001	0	0.8	13.2	103.3	78.5	22.1	6.4	12.0
2002	0	0.5	14.4	104.3	85.7	21.2	6.1	12.4
2003	0	0.5	13.6	109.1	99.5	25.7	6.0	13.5
2004	0	0.3	15.1	110	106.5	28	9.0	14.2
2005	0.1	0.5	15.1	116	140.3	34.9	7.6	16.3
2006	0	0.9	16.1	124.1	140.5	32.3	11.1	17.0
2007	0	0.8	17.7	117.3	152.3	35	13.6	17.5
2008	0	0.9	20	127.7	146	41	12.1	18.3
2009	0	0.9	18.4	122.3	144	39	11.9	17.9
2010	0	1.0	17.7	124	144	42.5	11.4	18.2
2011	0	0.5	17.9	129.0	142.6	37.3	13.3	18.2
2012	0	0.6	18.2	144.4	156.4	57.4	9.8	20.3
2013	0	0.9	19.8	162.3	177.7	65.0	11.5	23.1
2014	0	1.2	23.8	169.3	187.7	76.1	16.4	24.8
<b>Mean</b>	<b>0.0</b>	<b>0.7</b>	<b>17.0</b>	<b>124.1</b>	<b>131.8</b>	<b>38.6</b>	<b>10.1</b>	<b>17.0</b>
<b>Std. Deviation</b>	<b>0.0</b>	<b>0.2</b>	<b>2.9</b>	<b>20.7</b>	<b>34.7</b>	<b>16.2</b>	<b>3.2</b>	



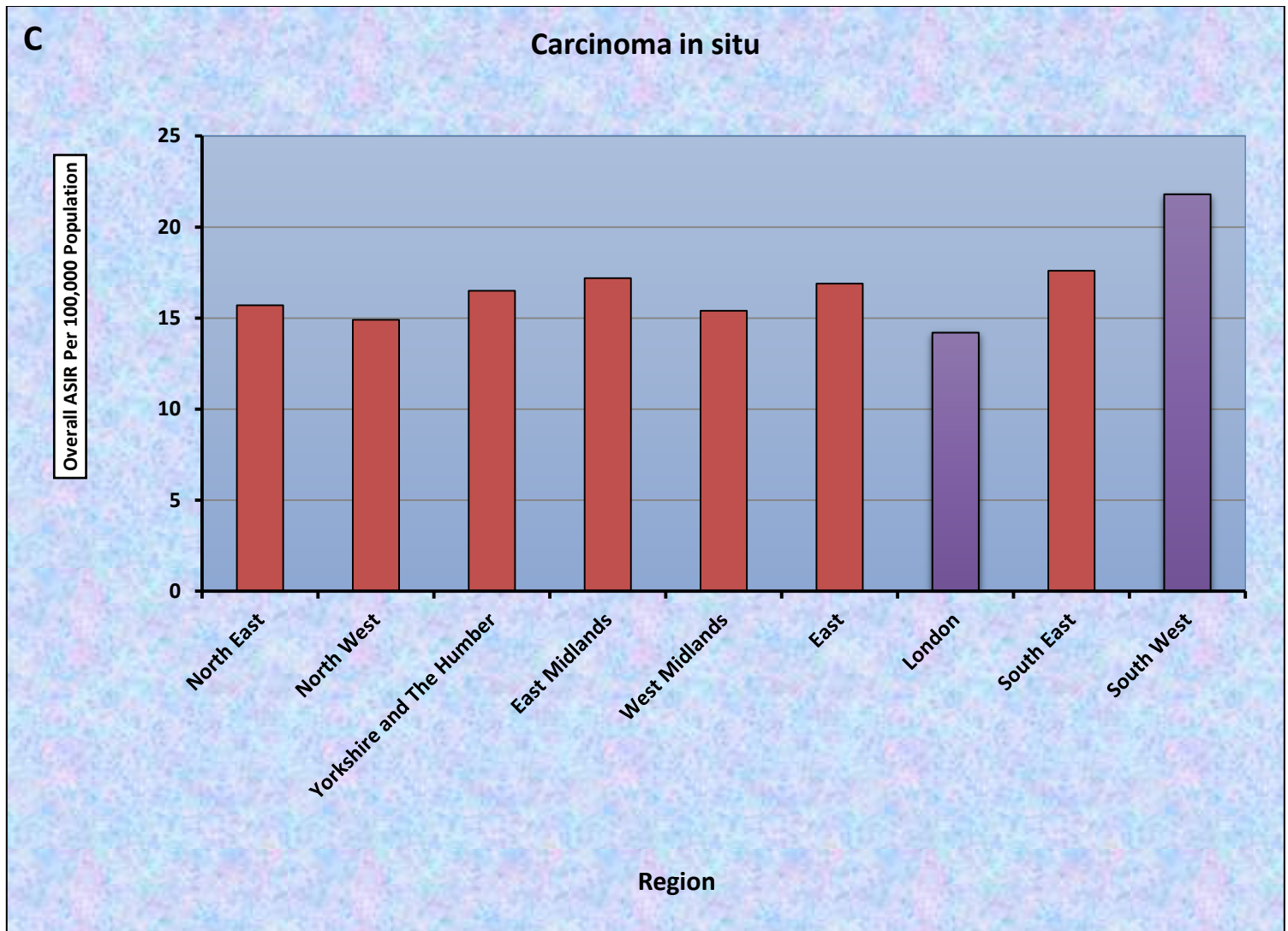
**Figure 5B:** Overall age specific incidence rate of breast carcinoma in situ in England from 2000 to 2014.

#### **B-4 Age standardised incidence rate of breast carcinoma in situ in England**

The overall ASIR of breast carcinoma in situ cases by regions of England, from 2000 to 2014 per 100,000 population was calculated from the UK's Office for National Statistics. The highest overall ASIR of breast carcinoma in situ were observed in South West of England, with an estimated average (21.8, SD=4.2), the overall ASIR of this region were significantly higher compared to other different parts of England,  $\chi^2(8) = 28.527$ ,  $p = 0.001$ . Alternatively, London was the lowest overall ASIR of breast carcinoma in situ in England, with estimated average (14.2, SD=5.6) (Table 10) and (Figure. 5C).

**Table 10: Overall age standardised incidence rate of breast carcinoma in situ in England from 2000 to 2014**

Year of Diagnosis	age standardised incidence rate of breast carcinoma in situ								
	Regions								
	North East	North West	Yorkshire and The Humber	East Midlands	West Midlands	East	London	South East	South West
2000	10.5	10.9	12.9	12.4	8.7	14.2	7.1	12.3	15.3
2001	9.8	10.4	13	12.6	10.1	12.4	9.5	12.4	17.9
2002	11.8	10.7	12.2	13.9	11.6	13.7	9.5	13.2	16.7
2003	11.7	12.7	14.2	14.9	12.1	15.7	10.0	14.2	16.8
2004	15.8	11.2	15.7	15.8	12.7	14.1	8.3	14.7	23.8
2005	15.5	13.0	16.4	18.2	14.4	17.1	11.5	18.0	25.0
2006	15.7	13.3	16.1	14.2	13.2	16.2	13.7	16.2	24.3
2007	15.7	13.7	16.3	15.5	14.9	17.0	13.1	16.8	21.7
2008	15.1	12.1	16.5	18.6	14.9	18.0	14.3	18.7	22.5
2009	13	15.5	15.3	18.7	13.8	16.4	14.7	17	20.4
2010	15.4	14.1	15.8	17.3	15.9	14.9	16.3	16.9	20.8
2011	16.0	15.9	15.5	16.0	17.7	15.5	15.9	17.1	18.6
2012	21.7	21.9	20.4	20.8	20.3	20.9	18.0	24.3	24.6
2013	22.6	22.2	24.2	23.7	26.0	23.8	23.5	24.3	29.6
2014	25.3	25.9	22.9	25.7	24.9	24.2	27.7	27.5	28.3
Mean	15.7	14.9	16.5	17.2	15.4	16.9	14.2	17.6	21.8
Std. Deviation	4.4	4.7	3.4	3.8	4.9	3.5	5.6	4.5	4.2
Median	5.5	13.3	15.8	16.0	14.4	16.2	13.7	16.9	21.7



**Figure 5C:** Overall age standardised incidence rate of breast carcinoma in situ in England from 2000 to 2014.

#### 4. Discussion

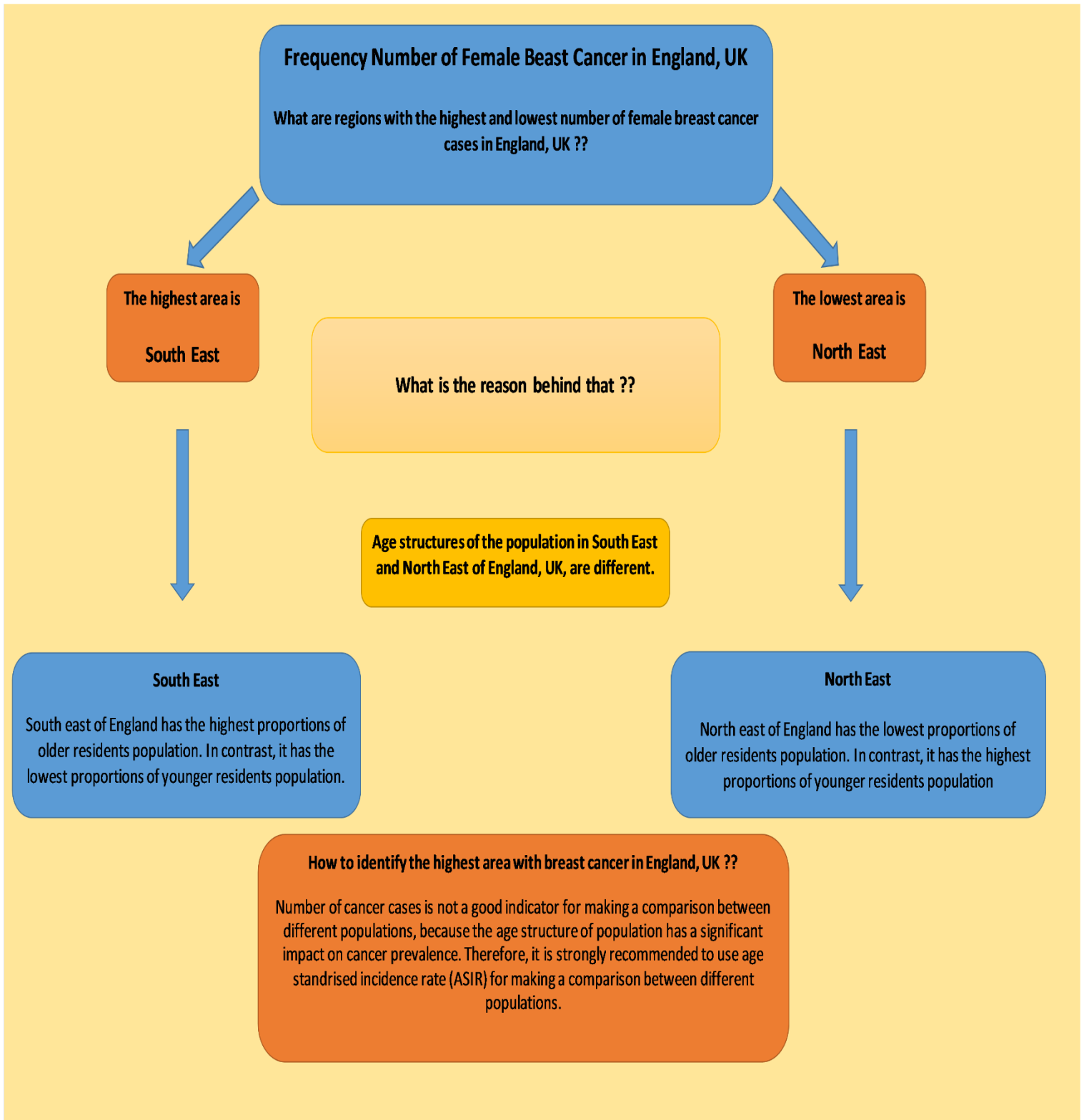
The pattern of female breast cancer among women should be monitored and updated for all geographic areas of England. The descriptive epidemiology of female breast cancer in England explores very important data about female breast cancer trend, approving the significance of the disease in entire population. The results of this research are based on the data recorded in the

UK's National Statistics Office, indicating that breast cancer is a major health problem among women in England, UK. In this study, we focused on the incidence and mortality trend of both malignant neoplasm cancer and breast carcinoma in situ, occurring in England during the year 2000 to 2014.

In this study, we have observed that the highest overall number and percentage of malignant neoplasm cancer cases was in South East of England, while the lowest overall number and percentage being in North East of England. Actually, focusing on the frequency number of cases in different population is very important point should be considered by breast cancer researchers, because the number of cancer cases is not a good indicator for making a comparison between two or more populations with different age structures, therefore, standardisation process in epidemiology was confirmed by epidemiological experts to fix the age structures of population.<sup>10</sup> However, in South East of England, the highest proportions of population are older residents, while in North East of England, the lowest proportions of population being older residents **(Figure. 6).**<sup>9</sup>

The age specific incidence rates adjusted by year of diagnosis indicate a slightly increase of malignant neoplasm cancer and carcinoma in situ in England. We have observed that malignant neoplasm cancer more commonly among older women aged 60-74 and 75-89 years, while carcinoma in situ are more frequently occurring in women aged 60-74 and 45-59. Alternatively, younger women aged 15-29 and 30-44 years, were less frequently contracting of malignant neoplasm cancer and carcinoma in situ.



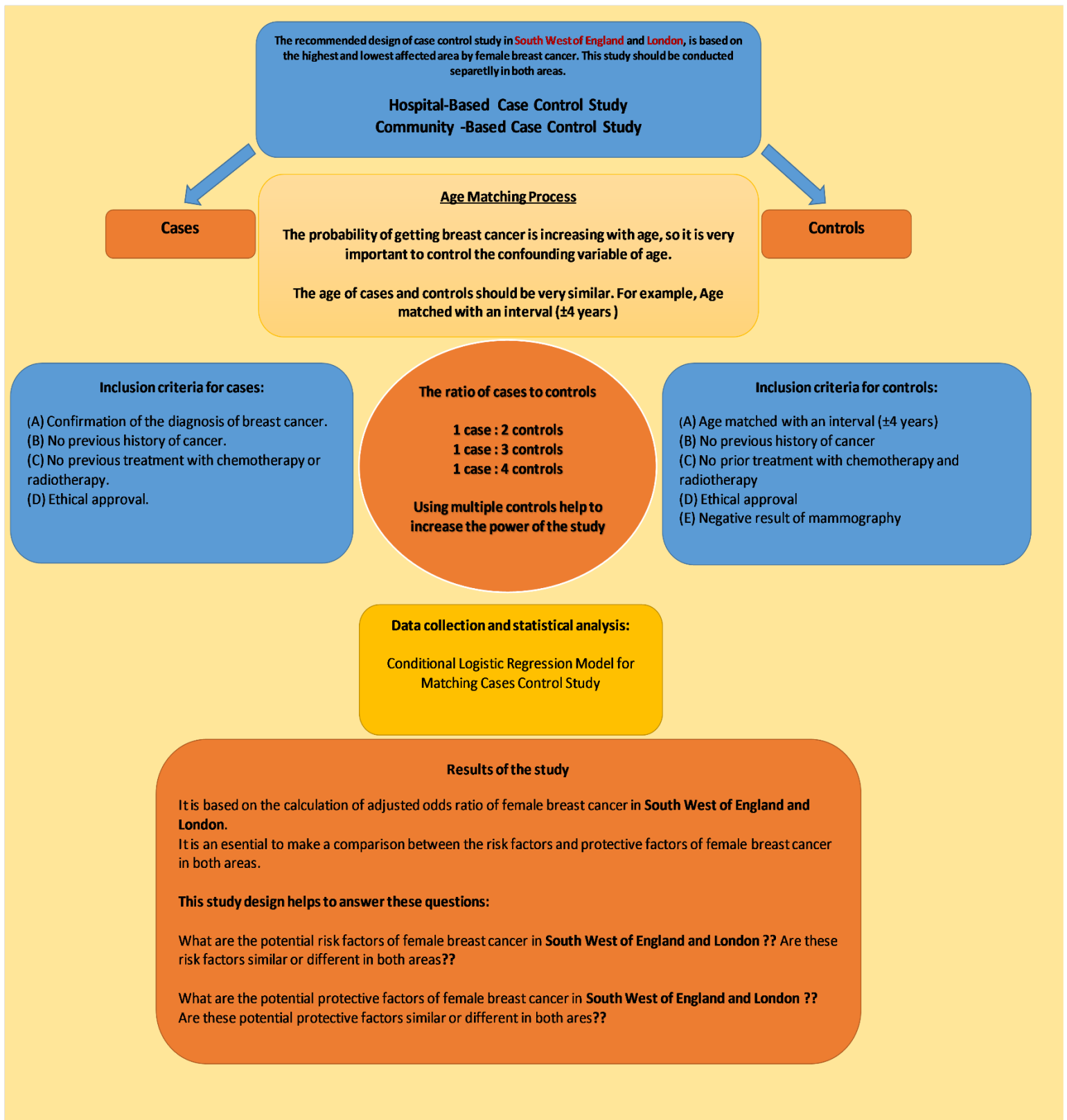


**Figure 6:** The impact of age structures of population on the number of female breast cancer cases in England, UK.

The findings of this study indicate that the South West of England had the highest overall ASIRs of both malignant neoplasm of breast and carcinoma in situ, compared to other regions of England, during the year 2000 to 2014. Alternatively, the region of London recorded the lowest values in the average ASIRs of malignant neoplasm cancer and breast carcinoma in situ. Therefore, the best geographical areas in England are South West and London, for conducting analytical epidemiological studies, identifying the potential risk factors and protective factors of female breast cancer.

The recommended design in **(Figure. 7)** for a case control study that can be conducted in South West of England and London should be based on the highest and lowest affected areas by female breast cancer. However, this design of study helps to make a comparison between the risk factors and protective factors of female breast cancer in both South West of England and London.

Finally, the differences in the ASIR between 2000 and 2014 were calculated from the data of the UK's National Statistics Office. The highest and lowest differences in the ASIR of malignant neoplasm of breast were only observed in the South West of England and London. Therefore, the likely explanation for these differences in rates suggest that the region of London is affected more by malignant neoplasm of breast in the last years from the period 2012 to 2014, however, the expert researchers of breast cancer in London may investigate the reasons of a sharp increasing of ASIR of breast cancer from 2012 to 2014 compared to the year 2000 to 2011. The number of deaths and ASMR of malignant neoplasm cancer in England was decreased dramatically from 2001 to 2014, most likely due to early detection of cancer and avoid the potential risk factors by implementing evidence based prevention strategies.



**Figure 7:** The recommended design of epidemiological study that can be conducted in South West of England and London, confirming the potential risk and protective factors of female breast cancer in England, UK.

## 5. Conclusion

Our study revealed that the South West of England had the highest overall ASIRs of malignant neoplasm of breast and carcinoma in situ. In contrast, London was the lowest overall ASIRs of malignant neoplasm of breast and carcinoma in situ. As mentioned earlier, the region of London documented the greatest differences in the ASIR of malignant neoplasm of breast in England, UK from 2012 to 2014. Older women in England were the highest affected by malignant neoplasm of breast. The number of deaths and ASMR of malignant neoplasm cancer in England was decreased dramatically from 2001 to 2014. However, further analytical epidemiological studies should be conducted in the South West of England and London, determining the potential risk factors and protective factors of breast cancer.

## Acknowledgements

The authors declare that they have no Acknowledgements for other persons.

## Conflict of Interest

The authors declare that they have no conflict of interest.

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