

The British Breast Cancer Epidemic: Trends, Patterns, Risk Factors, and Forecasting

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ABSTRACT

The modern breast cancer epidemic continues to spread worldwide. In the UK there is a national registration of newly diagnosed cancers. There is also a consistent national program of breast cancer screening in operation for women throughout the UK. Calculations using this British national data show how the lifetime risk of breast cancer has increased. Forecasts of newly diagnosed cancers published in 2007, using known risk factors to model the rates, accord quite well with what is reported for recent years up to 2014. These encompass both malignant or invasive cancers and in situ cancers of the breast. The modeling for the forecasts used as explanatory variables fertility rates and rates for induced abortions. Acknowledging these variables as risk factors can also help explain the remarkable social gradient of female breast cancer. Acknowledgment of the importance of these risk factors is needed to open the way for breast cancer prevention.

Increased Incidence of Female Breast Cancer

Increased incidence of female breast cancer has been apparent in the modern epoch since registration of breast cancer started. In England this commenced in 1971. Throughout the UK, the numbers of new cases of female breast cancer reported to the cancer registries have continued to increase. The UK total of new malignant cases exceeded 50,000 in 2012, and reached 54,828 in 2014. Breast cancer screening started in the 1980s. This increased detection of female “malignant” breast cancers (ICD10-C50). Screening is also especially efficient at

detecting carcinomas in situ of the breast (ICD10-D05) that are more easily seen in X-rays. In 1980 the number of new malignant cancers was 21,241 and this increased to 46,085 in 2014 for England. With the extended age range for screening and further development of the technology of modern screening in operation, in situ cancers are a larger proportion of new cancers detected in more recent years. The number of in situ cancers increased from 1,715 in 1994 to 7,245 in 2014 for England and Wales. Although the in situ cancers are not directly life-threatening, they require treatment that is similar to the treatment of the malignant cancers. If forecasts of breast cancer incidence in future years are to be useful to plan treatment facilities, the in situ cancers need to be counted.

The modern increase in breast cancer incidence is most apparent in women older than 50. The increase in ages 45 and younger is comparatively small. Screening was focused initially on age groups 50 to 65, then extended to age 70, and most recently to ages 47 and 75. Extension of screening to a wider age range, and use of new digital machines that are more efficient, have led to the in situ tumors becoming an increasing proportion of cancers of the breast reported. In 2002 these totalled 3,732 compared to 41,355 malignants, or 8.3% of the total. In 2013, the in situ tumors numbered 7,263, which was 12.0% of the total. In 2014, the numbers were, respectively, 7,869 and 54,828 so that the in situs were 12.6% of the total. Screening alone cannot account for the continued rise in rates of new cases. When screening has been in force for several years, further increased incidence is not attributable to any introduction of screening. Indeed, it seems women do not

Table 1: Number of New Cases of Malignant and In Situ Cancers Reported to the Cancer Registry in England, Wales, Scotland, and Northern Ireland.

	Malignant Breast Cancers							
	2002	2004	2006	2008	2010	2012	2013	2014
England	34,319	36,939	38,004	39,681	41,259	42,489	44,540	46,085
Wales	2,340	2,380	2,461	2,639	2,647	2,471	2,913	2,872
Scotland	3,742	4,007	4,168	4,336	4,521	4,648	4,686	4,578
N. Ireland	954	1,135	988	1,174	1,215	1,302	1,297	1,293
	In Situ Breast Cancers							
	2002	2004	2006	2008	2010	2012	2013	2014
England	3,152	3,621	4,395	4,795	4,816	5,500	6,324	6,824
Wales	175	201	265	316	315	293	373	421
Scotland	320	356	442	453	458	468	405	462
N. Ireland	85	93	111	133	159	133	161	162

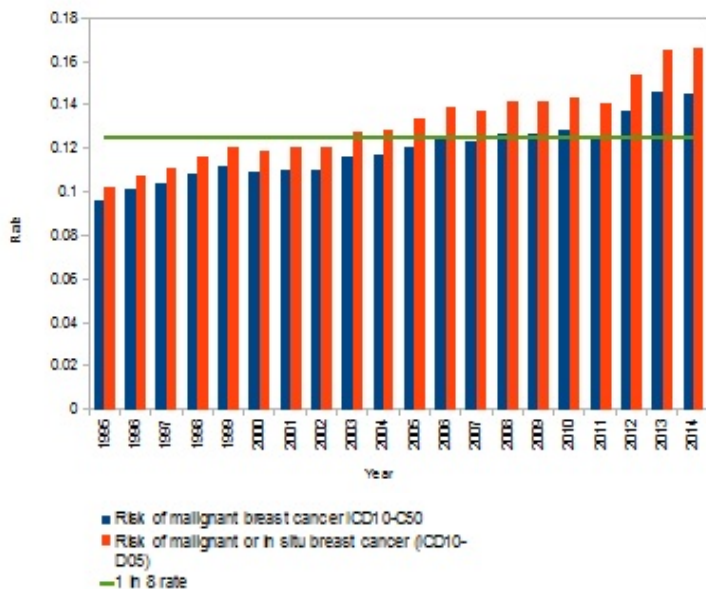


Figure 1: Lifetime Risk of Female Breast Cancer in England 1995-2014.

Source: Calculated by authors from Office for National Statistics (ONS) cancer registry annual breast cancer data with rates for quinquennial age groups and English Life Tables (female lives) to allow for mortality.

enjoy being screened and there is a likelihood of diminished response when women already screened are invited in at a later age for further examination.

The chance of a woman experiencing breast cancer in her lifetime has also increased, so that it is now rather more than the one in eight chance that is widely quoted. Figure 1 shows how the lifetime risk of breast cancer is now around one in seven if only malignant cancers are counted, and around one in six if the total risk of malignant or in situ cancer is considered. These

estimates have been calculated using the annual published incidence data and rates from the National Cancer Registration Service (NCRS) for age groups and using English Life Tables (or ELT) (females) to allow for mortality. ELT 15 was used for the year 1995. ELT 16 was used for years 1996-2005, and ELT 17 was used for the years 2006-2014. The green line in Figure 1 shows how the one-in-eight ratio applied approximately between the years 2000-2007. After 2012 with the extended range of screening, this is now an underestimate. More women with the experience of abortion and use of hormonal contraceptives have entered the age group now being screened.

Figure 2 shows how the rates of malignant breast cancers have increased for the quinquennial age groups of women. The introduction of screening is apparent in the late 1980s with the increased incidence apparent in age groups 50+.

The further extension of screening is also evident after 2000, and again most recently for the age groups 70+ after 2012.

Reproductive and Hormonal Risk Factors

The reproductive and hormonal risk factors known to affect breast cancer include fertility (number of children) and breastfeeding, which are protective; age at first birth, in which a lower age is protective and a higher age conducive; and induced abortion, which is conducive to breast cancer as is childlessness. Also conducive to cancer is the use of hormonal contraceptives and hormone replacement therapy (HRT).

The protective factors are widely acknowledged. A younger age at the birth of her first child reduces a woman's risk of developing cancer of the breast as do further full term pregnancies and longer breastfeeding of each of her infants. But childlessness, as long ago observed in nuns, is conducive

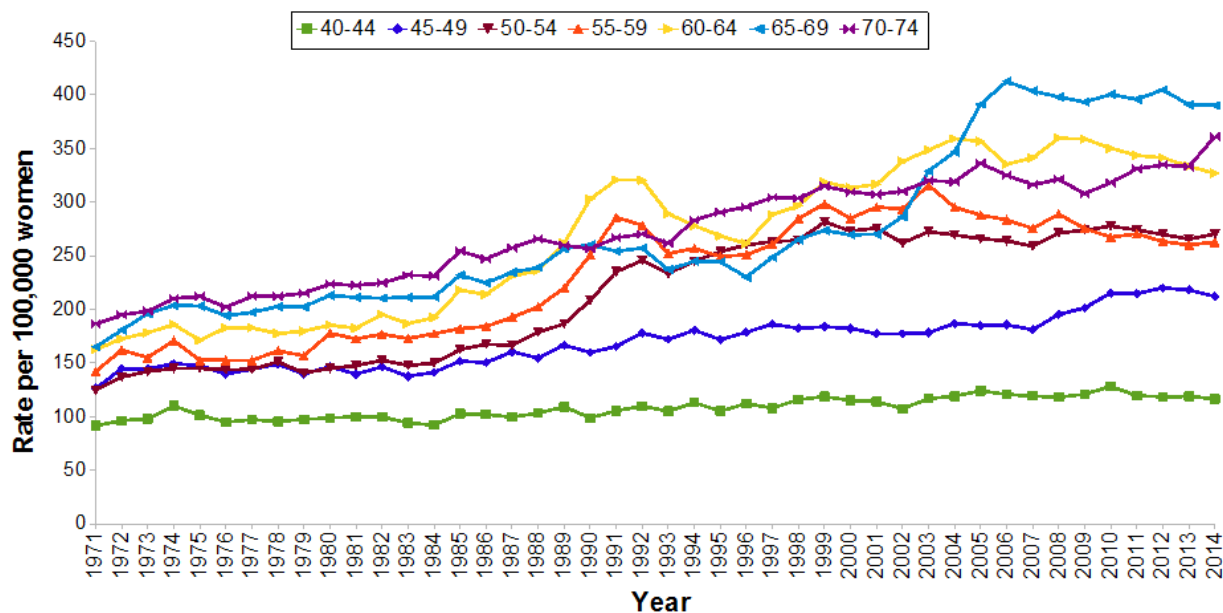


Figure 2. Increasing Cancer Rates for Women of Various Ages
Screening was introduced in the late 1980s and expanded after 2000.
Source: Breast cancer rates as published by ONS.

to development of breast cancer. But childlessness, as long ago observed in nuns, is also acknowledged as conducive to development of breast cancer. Although still contested, there is significant literature that demonstrates that induced abortion, particularly of a woman's first pregnancy, as well as hormonal contraceptives and HRT, also raise the risk of developing breast cancer.²

In the UK there are additional reasons why health authorities and the medical professions take a defensive stance and do not acknowledge the long-term effects of hormonal contraceptives or any of the cancer-inducing effects of legally induced abortions. Each prescription for hormonal contraceptives has a doctor's signature. Every abortion notification form (HSA1), as required by the 1967 Abortion Act, needs two doctors' signatures. In the UK, claims under medical professional liability insurance are largely in the area of obstetrics and gynecology. If women who experience breast cancer could make claims against doctors for prescribing hormonal contraceptives or approving induced abortions, there would be many more claims. For this reason it is understandable that British medical journals are reluctant to publish papers that report a link of breast cancer to induced abortions.

It is also remarkable, notwithstanding the great resources applied to modern cancer research, that the cancer epidemiologists do not make known the additional risks of breast cancer for those women who use hormonal contraceptives. While doctors are now more reluctant to prescribe HRT for reasons of the breast cancer risk, they continue hormonal contraceptives on a mass scale. It seems the medics are relying on studies that report no additional breast cancer 10 years after

a woman has ceased to use hormonal contraceptives. However this risk is quite long-term and not apparent within such a time interval. Breast cancers discovered after age 50 are more reflective of these events in a woman's reproductive history.

National Birth Cohorts: Rates for Breast Cancer and Risk Factors

Using single year-of-age data it is possible to compute cumulated cohort rates for breast cancer within age groups, and cumulated cohort rates for some risk factors. For childlessness and fertility and mean age at first birth, these are published by ONS (Office for National Statistics, England and Wales). For abortion and nulliparous abortion, these have been computed using single year-of-age data as in Abortion Statistics published by the Department of Health for England and Wales and the NHS in Scotland, for Scotland and data on parous and nulliparous abortions kindly supplied by these offices.

In the UK we are fortunate in that we have age-specific data that allows computation for successive cohorts of women of cumulated cohort rates for four known risk factors: fertility, childlessness, mean age at first birth, and legally induced abortion (Figures 3, 4, 5, and 6). Regrettably, we do not have single year-of-age data for the prescribed treatments (hormonal contraceptives and HRT.)

Figure 3 shows the cohort rates over the modern epoch for completed cohort fertility and breast cancer within ages 50-54. The high negative correlation accords with the known protective effect of child-bearing.

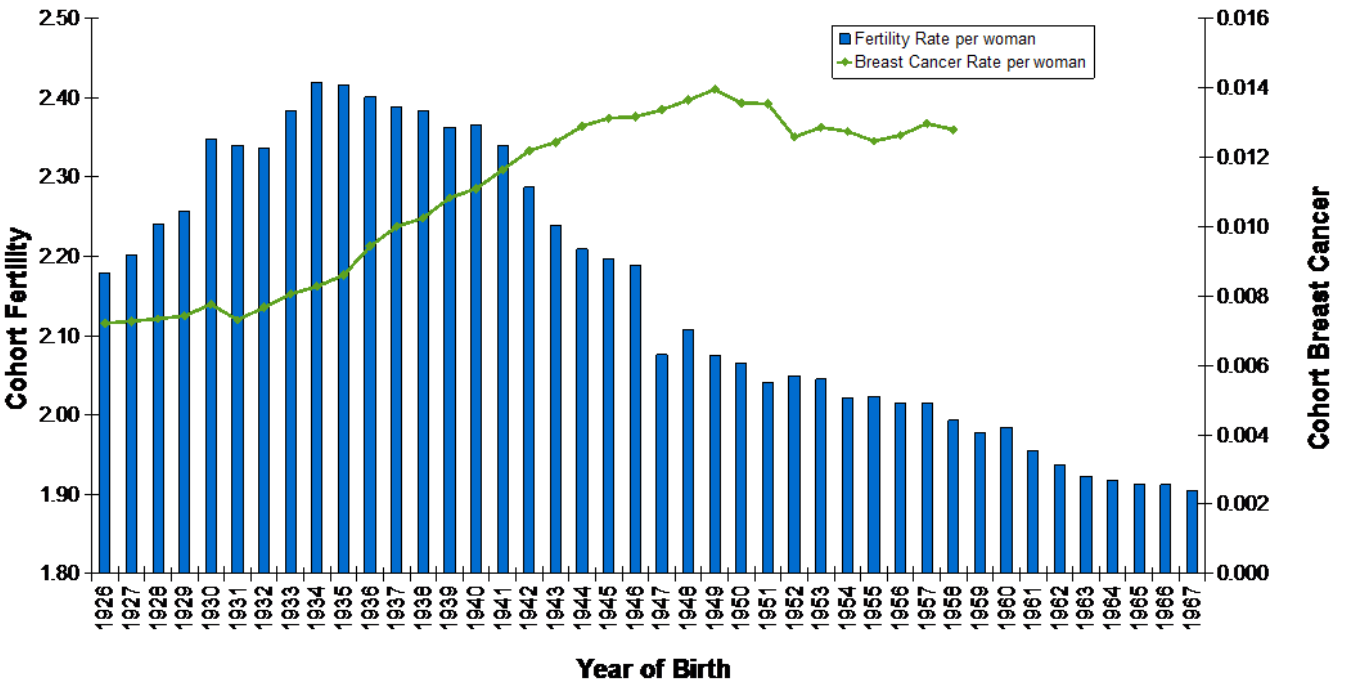


Figure 3. Cohort Fertility Rates and Breast Cancer Rates
Source: Fertility rates as published by ONS; breast cancer rates derived by authors from ONS cancer data

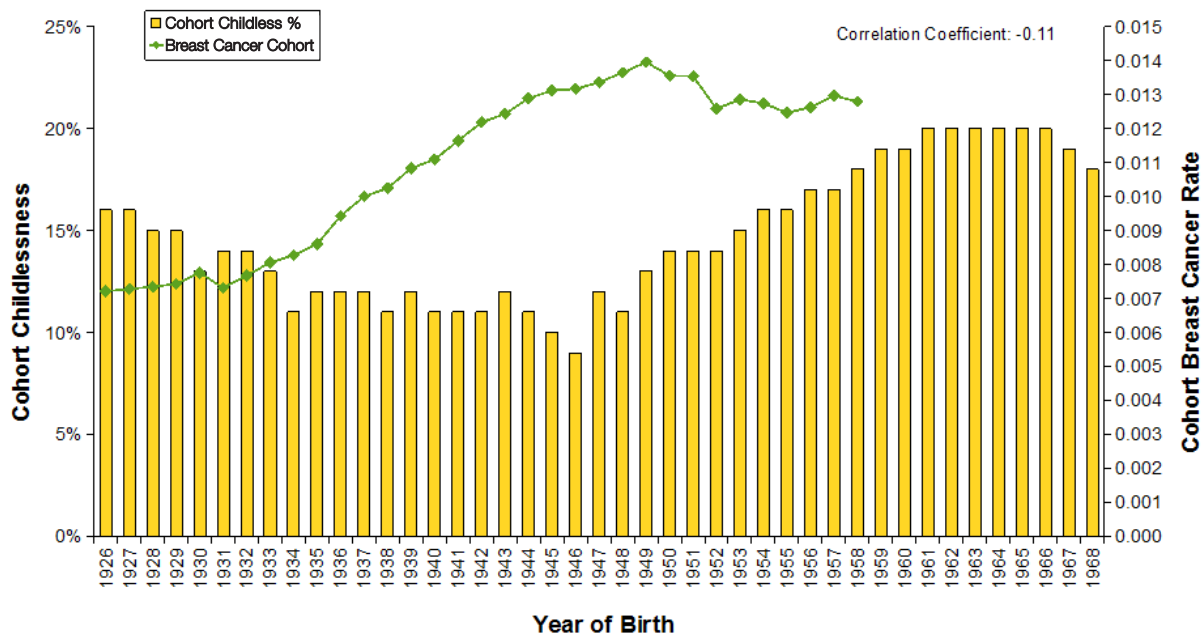


Figure 4. Cohort Rates of Childlessness and Breast Cancer Rates in Women Aged 50-54
Source: Childlessness rates from ONS; breast cancer rates derived by authors from ONS cancer data.

Figure 4 shows the cumulated cohort rates for childlessness and breast cancer within ages 50-54. The small negative correlation (-0.11) is anomalous and can be regarded as the result of a small chance variation. It does indicate that this variable is not a useful predictor of British trends.

Figure 5 shows the cohort rates for mean age at first birth and breast cancer within ages 50-54. The high negative correlation is a strange anomaly. The age at which women give birth has increased considerably among the most recent cohorts of women. The effects of interaction could be more

important than any main effect directly attributable to age at first birth. Upper-class and upwardly mobile women who use hormonal contraceptives to postpone the age at which they first give birth could thereby incur additional risks of breast cancer, and this may help explain the social gradient of breast cancer. Nulliparous (first pregnancy) abortions are also thought to be more conducive to breast cancer than parous abortions, when women are already mothers. It is clear that mean age at first birth in itself is not a useful predictor for breast cancer among British cohorts in the modern epoch.

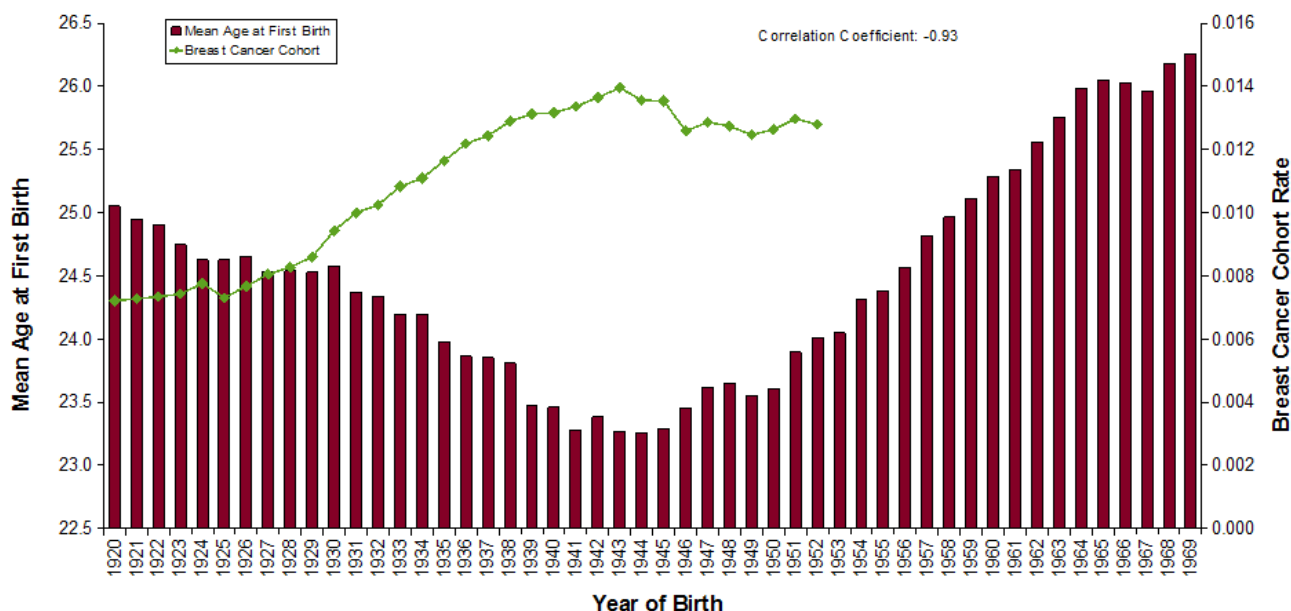


Figure 5. Cohort Rates for Age at First Birth and Breast Cancer Rates in Women Aged 50-54
Source: ONS Mean Age at First Birth; cohort cancer rates derived by authors from ONS cancer data for England and Wales.

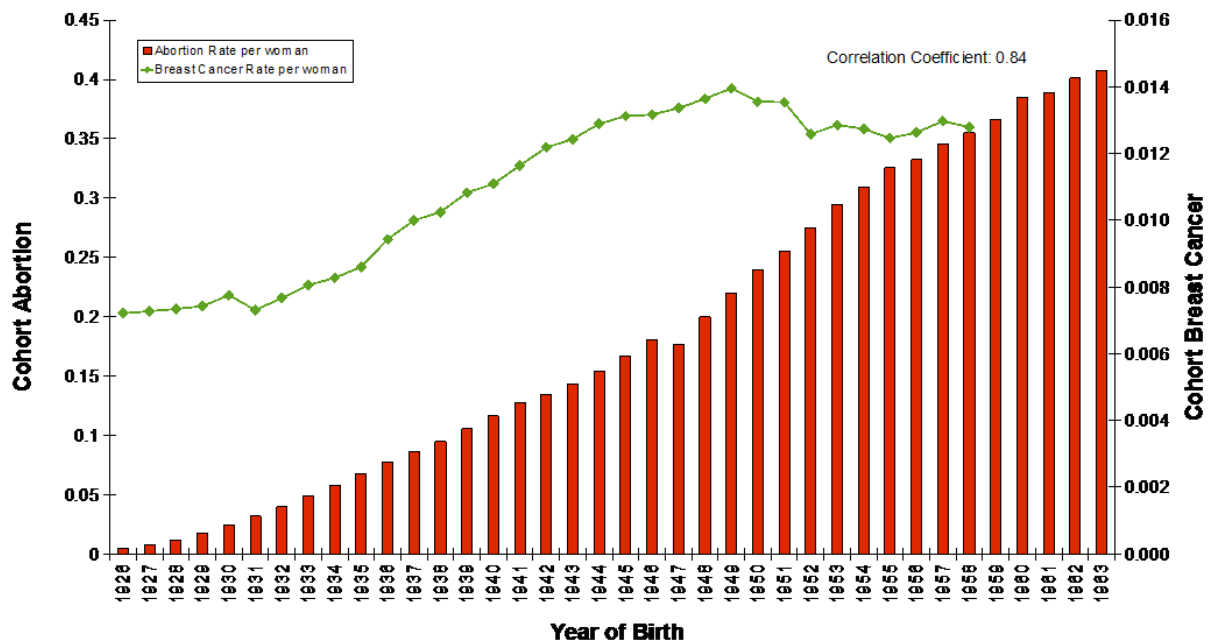


Figure 6. Cumulative Cohort Abortion Rate and Breast Cancer Rates for Cancers Discovered between Ages 50 and 54
Source: Derived by authors from ONS cancer data and Abortion Statistics for England and Wales.

Figure 6 shows the cumulated cohort abortion rates and breast cancer rates for cancers discovered within ages 50-54. The high positive correlation accords with this being a risk factor. It also seems to reflect the advent of hormonal contraception that arrived concurrently. When women were first having large numbers of legally induced abortions, their contemporaries were also starting to make extensive use of hormonal contraceptives.

Trends in Fertility and Abortion Rates

Figure 7 shows how total fertility rates (as published by ONS for England and Wales), and total abortion rates (calculated in the same way as total fertility rates), have progressed since the 1960s. As apparent in the graph, the birth rate fell below replacement level in the 1970s and remains even now below replacement level, notwithstanding some recovery.

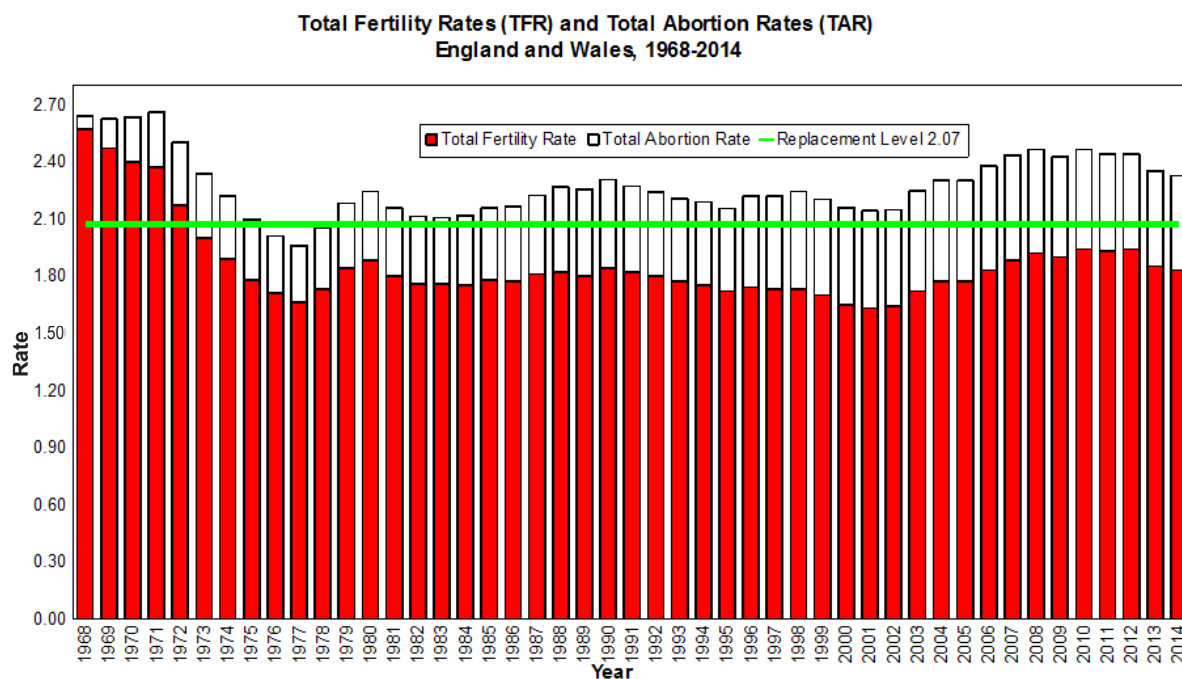


Figure 7. Total Fertility and Abortion Rates for England and Wales, 1968-2014

Source: Fertility rates as published by ONS and abortion rates derived by authors from abortion statistics published by the Department of Health and ONS mid year population estimates.

The cohorts of women born around 1950 were the first cohorts to experience large numbers of legally induced abortions and make extensive use of hormonal contraceptives in the 1970s. The birth rate decline in the 1970s shown in Figure 7 illustrates the considerable impact of these factors. These cohorts of women have now entered the age range in which they are most likely to have breast cancer.

In combination, the hormonal contraceptives and legally induced abortions can interact. The abortion leaves the breast cells in a state of interrupted development whereby they are disposed to become cancerous, and the estrogen in the hormonal contraceptives develops the incipient cancers. It is also known that estrogen can initiate new cancers by itself, and the effects of an abortion can amplify this.

Modeling and Forecasting Breast Cancer

From consideration of the cumulated cohort correlations, it is apparent that fertility and abortion could be useful explanatory variables in a linear regression model in which the breast cancer incidence rate is the response variable. Such a model was fitted and used to estimate future breast cancer incidence from a base year of 2004, with the resulting forecasts published in 2007³. Table 2 shows how these forecasts of breast cancer incidence, both of malignant cancers and in situ cancers, have compared with observed cancers in 2010 in England and Wales, Scotland and Northern Ireland.

Table 2: Number of New Cases of Malignant and In Situ Cancers Reported to the Cancer Registry in England, Wales, Scotland, and Northern Ireland.

	Female Breast Cancers 2010						
	Forecast			Observed			Observed /Expected
	Malignant	In Situ	Total	Malignant	In Situ	Total	%
England & Wales	45,529	4,373	49,902	43,906	5,131	49,037	98.3
Scotland	4,482	392	4,874	4,521	458	4,979	102.2
N. Ireland	1,256	99	1,355	1,215	159	1,374	101.4

	Female Breast Cancers 2013						
	Forecast			Observed			Observed /Expected
	Malignant	In Situ	Total	Malignant	In Situ	Total	%
England & Wales	49,105	4,794	53,899	47,453	6,697	54,150	100.5
Scotland	4,828	427	5,255	4,686	405	5,091	96.9
N. Ireland	1,332	106	1,438	1,297	161	1,458	101.4

	Female Breast Cancers 2014						
	Forecast			Observed			Observed /Expected
	Malignant	In Situ	Total	Malignant	In Situ	Total	%
England & Wales	50,585	4,934	55,519	48,957	7,245	56,202	101.2
Scotland	4,943	438	5,381	4,578	462	5,040	93.6
N. Ireland	1,357	109	1,466	1,293	162	1,455	99.2

	UK Female Breast Cancers 2010, 2013 & 2014						
	Forecast			Observed			Observed /Expected
	Malignant	In Situ	Total	Malignant	In Situ	Total	%
2010	51,267	4,864	56,131	49,642	5,748	55,390	98.7
2013	55,265	5,327	60,592	53,436	7,263	60,699	100.2
2014	56,885	5,481	62,366	54,828	7,869	62,697	100.5

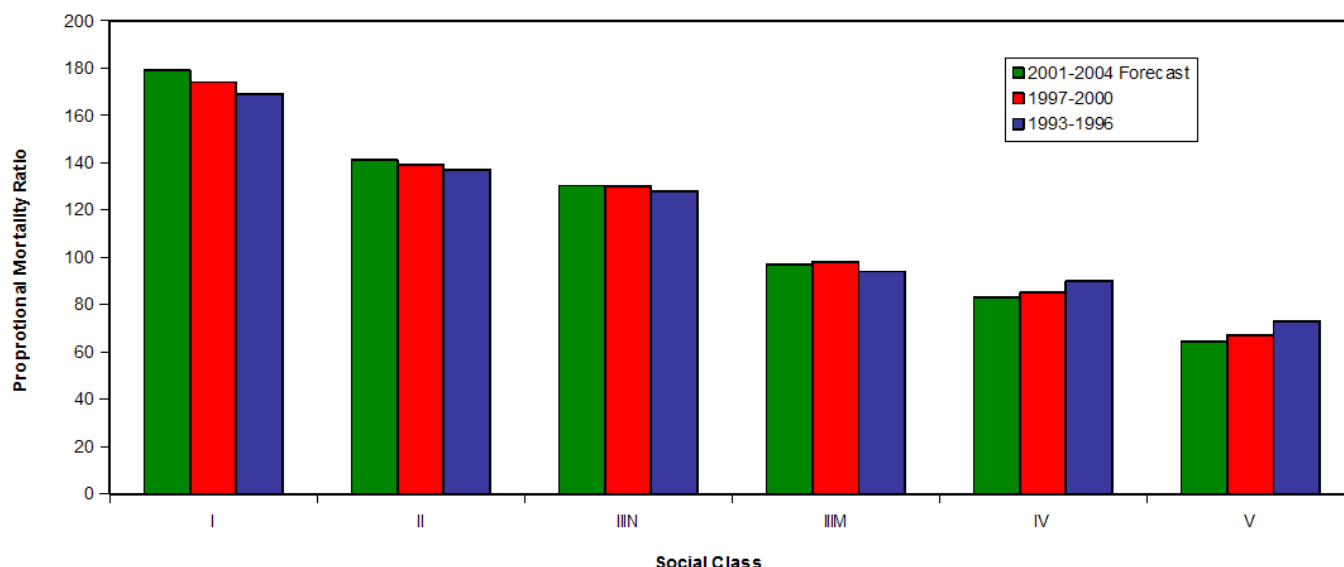


Figure 8. Gradient for Breast Cancer Mortality by Social Class in England and Wales, from Higher Status to Lower
Source: Health Statistics Quarterly, winter 2003, ONS.

Social Gradient of Female Breast Cancer

There is a remarkable social gradient for female breast cancer, which is unlike other cancers. Women in the higher socio-economic groups have more breast cancer and less of the other cancers than lower-class women who are more deprived. We have published gradients for England and Wales, Scotland and Northern Ireland by the national offices.

The Health Statistics Quarterly 2003 showed the social gradient for female breast cancer mortality in England and Wales by the registrar general social classes for the 1990s. This was a steep social gradient, especially as it referred to mortality rather than incidence. Higher-class women, who are usually better educated, are quicker to have their cancers diagnosed and to seek treatment. The response to invitation for screening is higher among less-deprived women. The social gradient for breast cancer mortality is usually less than for incidence.

It is regrettable that there has not been an update of this

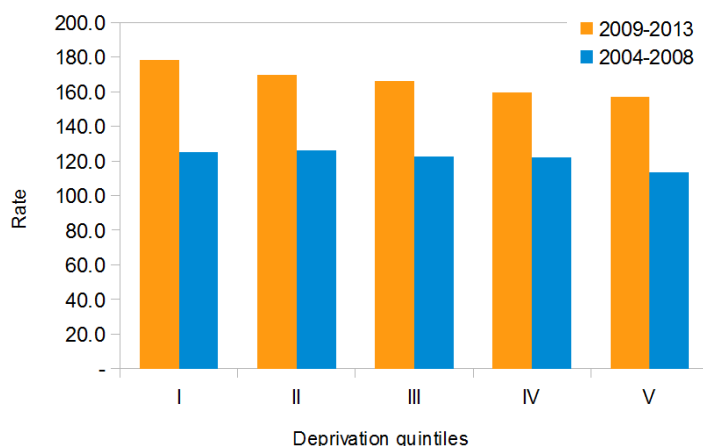


Figure 9. Gradient for Breast Cancer Incidence by Measures of Deprivation in Scotland.
Source: NHS Cancer Registry Scotland.

for more recent years. It is understood that this planned work was cancelled due to financial cutbacks. A forecast was made² projecting a further increase in this gradient, as reproduced in Figure 8, which shows breast cancer mortality for the class compared with the overall average rate for the national population, represented by the 100% mark.

Figure 9 shows a smaller gradient for Scotland, as published by ISD-NHS. This gradient is constructed for social classes defined by deprivation and is not exactly comparable to Figure 8 for England and Wales.

The social gradient for Northern Ireland, as published officially, also using deprivation to define social class, for 2013 as shown in Figure 10 shows only a small gradient.

Figures 9 and 10 show age-standardized incidence per 100,000, rather than proportional mortality.

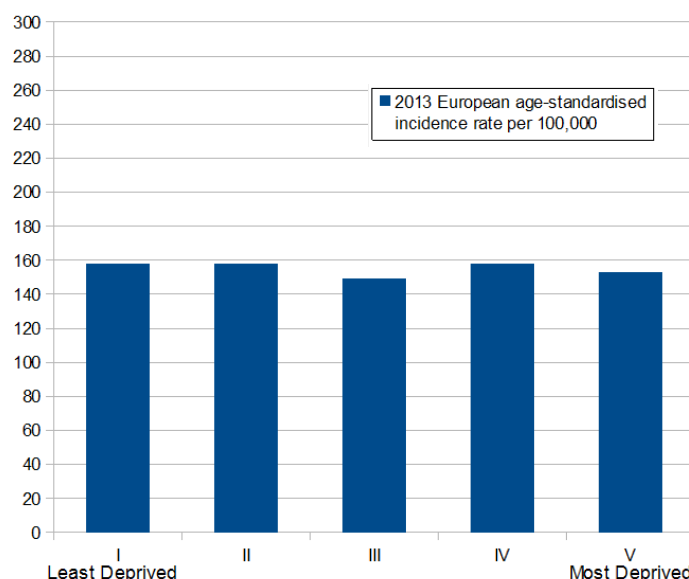


Figure 10. Social Gradient for Breast Cancer. Northern Ireland.
Source: Northern Ireland Cancer Registry

Provision of hormonal contraceptives through the NHS is the same throughout the UK. But the incidence of legally induced abortion has been less in Scotland than in England. And it has been very much less in Northern Ireland, where resident women travel to England for most abortions. This could help to explain the variations in social gradient across these constituent countries in the UK. It might be conjectured that the upper-class and upwardly mobile women in Northern Ireland have had fewer nulliparous abortions and this has contributed to flattening their social gradient for breast cancer.

The social gradient can be explicable in terms of these hormonal and reproductive risk factors. Upper-class women and women who achieve upward social mobility are known to have children later and to make more use of hormonal contraceptives, and when they have pregnancies at a young age, they are more likely to opt for nulliparous abortions. Lower-class single parents, who score highly as to deprivation, often have benefited from the breast cancer protection afforded by their first pregnancy taken to full term at a young age.

Conclusions

The increased scale of the modern epidemic of female breast cancer is reason for concern. The increased lifetime risk of breast cancer is now around 1 in 7 for women if only the malignant cancers are counted and 1 in 6 if the in situ cancers area also counted. The lack of official explanation for the remarkable social gradient of female breast cancer, when such

great resources are available for cancer research, is also a failure of public health education and is consistent with the neglect of breast cancer prevention programs. If fertility and induced abortions are recognised as explanatory variables it is possible to model and forecast breast cancer numbers in future years to enable planning of adequate treatment facilities with some precision.

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