National Cancer Registry Ireland

CANCER INEQUALITIES IN IRELAND BY DEPRIVATION 2004-2018

A NATIONAL CANCER REGISTRY IRELAND REPORT

THE NATIONAL CANCER REGISTRY

www.ncri.ie

About the National Cancer Registry

The National Cancer Registry was established by the Minister for Health in 1991. It has been collecting comprehensive cancer information for the population of the Republic of Ireland since 1994. This information is used in research into the causes of cancer, in education and information programmes, and in the planning and management of cancer services to deliver the best cancer care to the whole population.

The mission of the National Cancer Registry of Ireland (NCRI) is to capture data and communicate information on cancer patients nationally to support the improvement of cancer outcomes in Ireland.

We collect information from all hospitals in Ireland on the number of persons diagnosed with cancer and the types of cancer they have. We also follow up the numbers dying from their cancer or from other causes. All the patient's personal and private details are removed before summaries of this information are made available to public and health professionals through our annual cancer report and other reports on our website.

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Abbreviations	
CI	Confidence Interval
CSO	Central Statistics Office
DSRR	Directly age-standardised rate ratio (for comparison of age-standardised rates)
EASR	European age-standardised rate (rates standardised to 1976 European Standard Population in this report)
ED	Electoral division
ESP	European Standard Population
EU	European Union
HR	Hazard ratio
HSE	Health Service Executive
IARC	International Agency for Research on Cancer
ICD-10	International Statistical Classification of Diseases and Related Health Problems (10th edition)
ICD-O-3	The International Classification of Diseases for Oncology
KPI	Key Performance indicator
NCCP	National Cancer Control Programme
NCRI	National Cancer Registry Ireland
NHL	Non-Hodgkin lymphoma
NMSC	Non-melanoma skin cancer
SES	Socioeconomic status
UK	United Kingdom
US	United States

Foreword

This report focusses on inequalities and measures differences in cancer incidence, survival and stage between populations living in the most and least deprived areas in Ireland for the diagnosis period 2014-2018. It follows on from an earlier report published in 2016, and provides updated statistics on cancer inequalities and, for the first time, looks at trends across time in such disparities across a range of cancers in Ireland.

There is now a large body of evidence describing how socioeconomic factors such as employment status, income level, education, age, sex, ethnicity, gender, or disability status play a major role in determining the health of individuals and their communities. It is a global experience, regardless of the income of the country, that those living in poverty have a higher risk of illness and death. Such health inequalities between social groups have been described as 'avoidable, unfair and systematic differences in health between different groups of people' (The King's Fund 2022).

Deprivation impacts on cancer incidence, stage at diagnosis and outcomes, as it does with other diseases. Our report documents a 7% higher risk for men and a 5% higher risk for women of developing cancer overall for people living in more deprived areas compared with those living in more affluent areas. It reports differences in the types of cancers diagnosed between those living in the most and least deprived areas, with a higher incidence of stomach, lung and cervical cancer in people living in the most deprived areas, but a higher incidence of breast, prostate, melanoma and non-melanoma skin cancers in those living in the least deprived areas.

People living in the most deprived areas had a higher risk of late-stage presentation for breast and prostate cancers than those living in the least deprived areas. No disparities in stage of presentation were found for lung or colorectal cancers when comparing the least and most deprived groups.

Overall, patients with cancer living in the most deprived areas experienced lower five-year survival rates compared with those in the least deprived areas. Those in the most deprived areas had, on average, a 43% higher mortality risk within five years after diagnosis with cancer compared with those in the least deprived areas, or a 28% higher mortality risk after adjustment for cancer type. Many individual cancer types also showed poorer survival in the most deprived areas.

Our review of trends in inequalities found very few differences between the patterns that were seen in 2004-2008 and 2009-2013 and those observed in 2014-2018. This report also examines international data with respect to inequalities in order to give further context to the Irish data.

Although some cancer inequalities in Ireland (notably for overall incidence) appear to be lower than those experienced internationally, we have seen no improvement over time. A range of potential factors contribute to such disparities, including differences in general health, exposure to particular risk factors, health-seeking behaviour

(influencing early detection), access to healthcare, or other factors that may be linked to socioeconomic or geographic factors. Disentangling these factors and their relative importance is far from straightforward, and achieving progress requires action across a range of public policy areas that tackle the root causes of such inequalities – income, education, employment, and living conditions.

Professor Deirdre Murray
Director,
National Cancer Registry

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Report at a glance

Who are we, and what do we do?

The National Cancer Registry of Ireland (NCRI) works on behalf of the Department of Health and collects information from all hospitals in Ireland on the number of persons diagnosed with cancer and the types of cancer they have.

NCRI also follows up the numbers of people dying from their cancer or from other causes. Patient personal and private details are removed before summaries of this information are made available to the public and health professionals through our annual cancer report and other reports on our website (www.ncri.ie)

How are the numbers reported?

Collecting and checking all of this information is performed by a combination of manual and electronic processes. Our staff collect cancer diagnosis information and then use an agreed system of coding (The International Classification of Diseases) to group the cancers into different types.

After a process of collating diverse information from Irish hospitals and validating the accuracy, cancer reports are published following analysis of de-identified data.

What is in this report?

This report assesses differences in incidence, survival and stage for cancer patients by deprivation in Ireland for the periods 2004-2008, 2009-2013 and 2014-2018. Regional deprivation comparisons are based on an index which uses three dimensions of relative affluence/deprivation including demographics, social class and employment factors. Deprivation is assigned to the population according to the area in which they live, and therefore is not assigned at an individual level. The population is divided into five fractions (quintiles) sorted by deprivation index

What is the purpose of this report?

At a population level, socioeconomic factors such as household income, employment and education can have significant impacts on health. Those from wealthier, more privileged communities tend to have longer life expectancies and lower health burdens, including cancer. This is termed cancer inequality, a comparison of the difference in health outcomes between those who have most with those who have least in our society (the most and least deprived). Monitoring cancer inequalities is important. In this report, we measure differences between the most and least deprived quintiles of the population with respect to the occurrence of cancer and survival after diagnosis with cancer. This allows us to identify vulnerable groups

category, and findings are reported by deprivation quintile.

Findings are presented for:

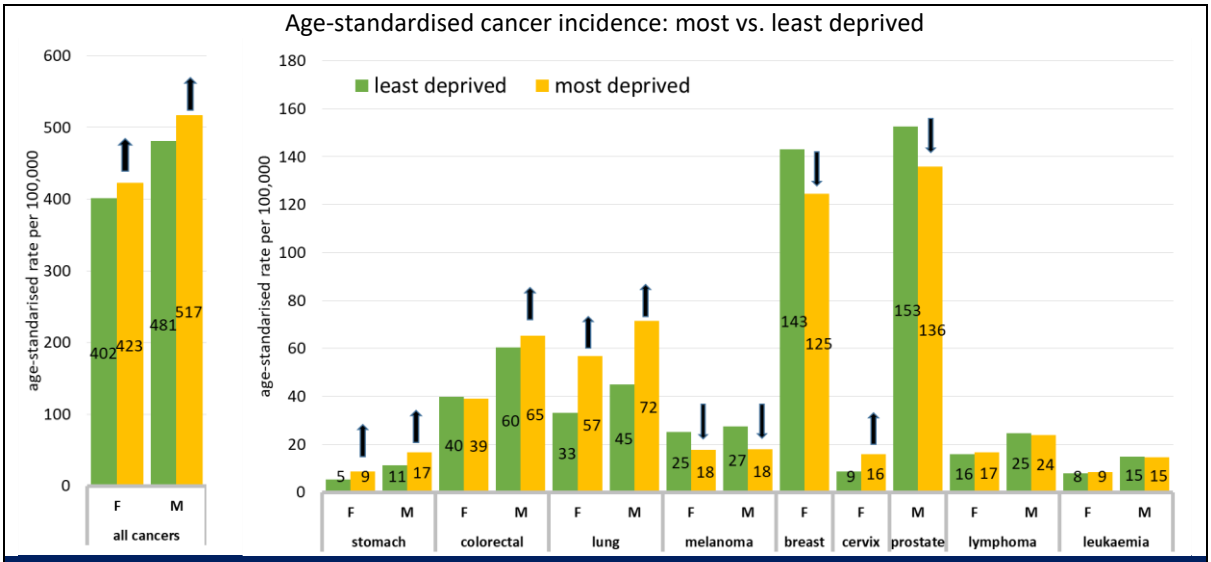
- Cancer overall (excluding non-melanoma skin cancer)
- Ten cancers for incidence
- Nine cancers for survival
- Four cancers for stage

that may benefit from targeted interventions.
This report does not identify the reasons behind differences between the most and least deprived quintiles of the population. However, the findings here may assist with further research into the causes.

What was found?

Incidence

- Both males and females in the most deprived quintile have a significantly higher incidence rate of cancer compared with those in the least deprived quintile (7% higher in males and 5% higher in females).
- There is a higher cancer incidence in more deprived populations for stomach and lung cancer in males and females and cervical cancer in females.
- The opposite trend was observed in breast and prostate cancer, melanoma and non-melanoma skin cancer (NMSC), with the more affluent population showing higher incidence.
- This data is summarised in Figure 1.
- There was no significant narrowing or widening of incidence disparities for males and females over time for cancer as a whole (excluding NMSC), or for eight of the ten individual cancers examined in this report. Of the other two cancers, only NMSC showed evidence of a clear trend over time, involving an apparent widening of incidence disparities (between higher rates in the least deprived and lower rates in the most deprived quintile).

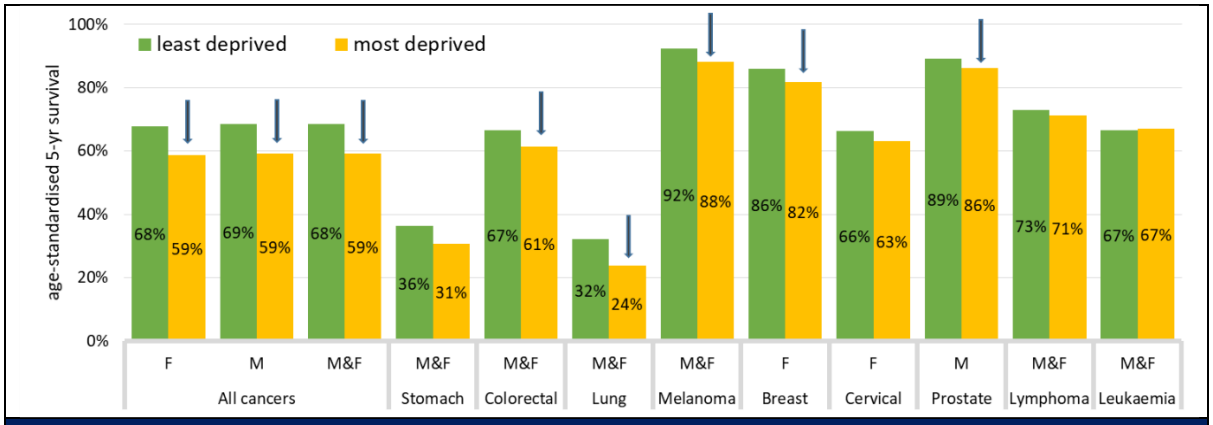


Summary Figure 1.
Age-standardised cancer incidence, Ireland, 2014-2018: comparison between the most and the least deprived quintiles.
Arrows indicate direction of difference and significance at the 95% confidence level.

What was found?

Five-year survival

- The most deprived quintile of the population in 2014-2018 had significantly poorer five-year survival (mortality hazard 28% higher than the least deprived quintile) for cancer as a whole, with similar findings for the two earlier periods.
- Five-year survival was poorer for the most deprived quintile of the population compared with the least deprived quintile for colorectal, lung, melanoma, breast and prostate cancers for the most recent period 2014-2018 and (with the exception of melanoma) for the two earlier periods.
- There was no significant narrowing or widening of survival disparities over time.
- This data is summarised in Figure 2.

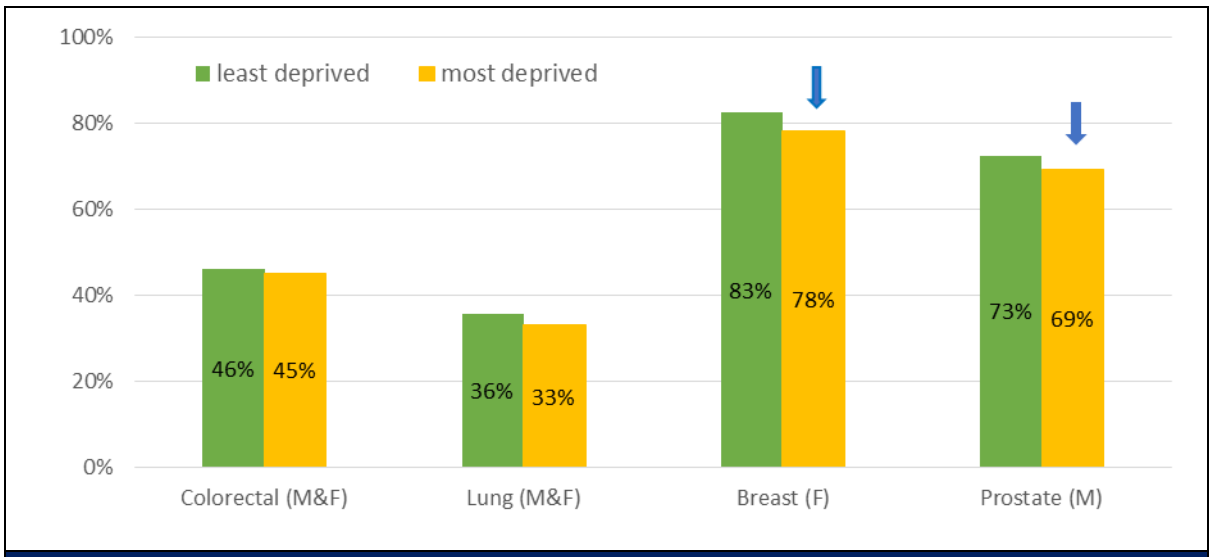


Summary Figure 2. Age-standardised cancer five-year survival, Ireland, 2014-2018: comparison between the most and the least deprived quintiles. Arrows indicate direction of difference and significance at the 95% confidence level (adjusted for age and sex).

What was found?

Stage at presentation

- Of the four cancers examined for stage, people in the most deprived quintile had a higher risk of later stage at presentation for breast and prostate cancer, compared with those in the least deprived quintile.
- This data is summarised in Figure 3.



Summary Figure 3. Percentage of patients presenting at stages I or II (early stage), Ireland, 2014-2018: comparison between the most and the least deprived quintiles. Arrows indicate direction of difference and significance at the 95% confidence level (adjusted for age and sex).

Glossary

95% CI	95% confidence interval
*	Statistically significant at P<0.05 level (i.e. there is a less than one in twenty probability that the difference seen is due to chance).
Adjustment	In the context of statistical modelling: adjustment or allowance for variation of particular factors between comparison groups – e.g. if differences exist in age structures of people between geographical locations, a model comparing survival between geographical locations, adjusted for age, would, in effect, assess differences in survival as they would be if the age-composition in each geographical location were the same. Multiple factors can be adjusted for simultaneously in a model (based on certain simplifying assumptions).
Age-standardisation	Age-standardisation of a cancer incidence rate, for example, involves calculation of incidence for each age-group, then weighting the age-specific incidence rates to a 'standard' weighting, such as the (notional) 1976 European Standard Population, so that rates are not influenced by differences in age-structure between different populations.
Cancer	For this report, only invasive/malignant cases (ICD-O-3 behaviour 3) are included, i.e. in situ carcinomas, tumours of uncertain behaviour and benign tumours are excluded. Non-melanoma skin cancers (NMSC) are excluded from the "all cancer" figures presented here, although included separately for incidence. Note that the "all cancer" findings presented in this report includes all other invasive cancers, i.e. not just the main cancer types for which separate findings are also presented.
Deprivation	Social or socioeconomic deprivation, often represented by a proxy variable or index that incorporates measures such as unemployment, overcrowding and other relevant variables. This report uses the Pobal Haase-Pratschke 2006, 2011 and 2016 indices of deprivation at electoral division (ED) level, i.e. an area-based measure of deprivation incorporating information from the national Census in that year; this is assigned to populations and patients based on their place of residence and therefore is not assigned not at an individual level.
Incidence	Numbers and rates (usually expressed per 100,000 persons per year) of newly-diagnosed disease. In this report, incidence refers to cancers diagnosed during the years 2004-2008, 2009-2013 and 2014-2018 and incidence is quoted separately for each sex.
Leukaemia	In this report 'Leukaemia' refers to any of the following ICD10 diagnoses: C91 (lymphoid), C92 (myeloid), C93 (monocytic), C94 (other specified), C95 (unspecified) leukaemia (chronic or acute).
Lymphoma	In this report, lymphoma refers to any of the following ICD10 diagnoses: C81 (Hodgkin), C82 (follicular non-Hodgkin), C83 (diffuse non-Hodgkin), C84 (peripheral and cutaneous T-cell), C85 (other unspecified non-Hodgkin lymphoma).

Melanoma	In this report refers to malignant melanoma of the skin (ICD-O-3, C43), excluding in situ melanomas.
Screening	Testing for the presence of a specific disease, e.g. breast cancer, in an otherwise healthy or asymptomatic patient (but possibly targeting groups, e.g. particular age-groups, where risk of the disease of interest is higher or where available screening methods are more appropriate).
Significant	Used in the sense of "statistically significant" unless otherwise noted; statistically significant at $P<0.05$ level (i.e. there is less than one in twenty probability that the difference seen is due to chance, although bias or confounding by factors that are unmeasured or inadequately allowed for cannot be ruled out). Note that lack of statistical significance does not exclude there being a "real" difference and may simply reflect small sample sizes.
Stage	Cancer stage as defined using TNM 7th-edition criteria, for this report, based on the combination of T category (primary tumour), N category (regional nodal extension) and M (distant metastasis). Presented as early stage (stages I or II) and late stage (stages III or IV), excluding unknown stage.
Survival	In this report, cause-specific five-year survival is used, i.e. based on an end-point of death attributed to the cancer of interest; patients who die of other causes are included in follow-up but censored at the point of death.
TNM	Tumour, node, metastasis (staging): TNM 7th-edition criteria used in this report.

Introduction

There are many aspects of our lives that impact on our health. These factors are termed 'the determinants of health'. They include individual lifestyle, community and socioeconomic factors. Some of these factors are beyond our control, such as one's age or sex, but other factors are deemed to be modifiable. Modifiable factors include environmental factors (such as exposure to smoke), social factors (such as living and working conditions) and access to health services.

It is well documented that inequalities that are experienced by people in terms of their social or socioeconomic status can impact their health. This is called the social gradient and was most notably outlined in the Whitehall study of British civil servants in 1967 (Marmot et al., 1984). In this study, an inverse association was demonstrated between social class and mortality from a wide range of diseases, with those in lower social classes found to have three times the mortality for certain diseases compared with those in higher social classes. Since this study, many studies have demonstrated the effects of socioeconomic status on health outcomes (Farrell et al., 2008; Foster et al., 2018; Kraftman et al., 2021).

Social inequalities affect the cancer continuum (Pérez et al., n.d.). Systematic differences arise that cause differences in exposure to risk factors, access to screening services and timely treatment and ultimately disparities in chances of survival once diagnosed with cancer. People from disadvantaged backgrounds are known to experience a higher incidence of and mortality from cancer (Arık et al., 2021; Feller et al., 2017). There are many reasons for this including that risk factors which increase the risk of cancer, such as smoking and alcohol, are more prevalent in disadvantaged communities (Payne et al., 2022). Other reasons are inequalities in terms of access to health care including the ability to pay for transport to hospital care visits and the ability to access care in a timely manner (Lawler et al., 2021). Deprivation results in a disparity between populations in relation to awareness of symptoms and access to screening programmes, timely diagnosis and treatment (*National Cancer Strategy 2017 - 2026*, 2017; NCCP, 2022). As a result, inequalities affect the entire cancer continuum from prevention to treatment and quality of life (Pérez et al., n.d.).

Disparities in cancer incidence and survival due to socioeconomic status were published in a comprehensive report by the International Agency for Research on Cancer (IARC) in 1997 (Kogevinas & Porta, 1997). This report highlighted, through the use of available epidemiological studies, the association between socioeconomic status (SES) and cancer incidence and survival. A more recent systematic review, based on population-based cancer registry data (Mihor et al., 2020), noted that adults with lower SES typically have a higher incidence of lung, head and neck, stomach and cervical cancer, whereas those with a higher SES have an increased risk of thyroid, breast, prostate and skin cancer.

Although beyond the scope of this report, the root causes of these inequalities need to be addressed. A recent study in Ireland addressed the barriers faced by people with a cancer diagnosis across the cancer continuum (*TASC Publications*, 2018). Findings of that report demonstrated that financial stress during cancer treatment is experienced by the most vulnerable in society including parents of young children, older people on pensions and those on low incomes. A 'postcode lottery' with less services in deprived areas was also posited as

a barrier when service provision was addressed. All of these factors point to the need to address socioeconomic barriers in terms of the cancer continuum.

It is estimated that 40% of cancers that occur in Europe are preventable (*A Cancer Plan for Europe*, n.d.). Estimates for Ireland have been calculated at 29%, although this has been noted to be a conservative figure (National Cancer Registry Ireland, 2020). These cancers can be prevented by robust primary prevention strategies, screening and reducing inequalities in access to health care. Monitoring cancer inequalities due to deprivation is important. In doing so, specific groups can be identified as vulnerable and in need of targeted interventions in relation to cancer overall as well as individual cancers (Singh et al., 2011). Temporal analyses of cancer inequalities play a part in monitoring progress of cancer control interventions such as screening and cancer treatment. In Europe, the need for monitoring inequalities has been recognised and there is an increased focus on inequalities with the establishment of the European Cancer Inequalities Registry in 2021 (*European Cancer Inequalities Registry | European Cancer Inequalities Registry*, 2022), an initiative of the Europe's Beating Cancer Plan and the European Cancer Pulse (European Cancer Organisation, 2022).

One of the overarching aims of Ireland's National Cancer Strategy 2017-2026 is to improve incidence and survival rates from cancer in Ireland (*National Cancer Strategy 2017 - 2026*, 2017). To monitor incidence and survival, the strategy sets out key performance indicators (KPIs) to monitor the impact of cancer control policies in Ireland. Reducing inequalities is at the heart of the Strategy and three KPIs set out to monitor disparities in cancer due to inequalities within the country and between European Union (EU) member states. Looking at age-standardised cancer incidence, the target is to reduce inequalities in incidence of all cancers (excluding NMSC) to no greater than 3% (in relative terms) between those in the most deprived and least deprived quintiles of the population by 2026. The target for five-year survival for all cancers combined (excluding NMSC), colorectal, lung and breast cancer is also no greater than 3% (but in absolute terms) between those in the most deprived and least deprived quintiles of the population by 2026. The National Cancer Strategy also sets out a 2026 KPI target for Ireland being in the top quartile in all EU member states with regard to overall cancer five-year survival.

This is the second major report produced by the NCRI regarding cancer inequalities in Ireland. The first report was published in 2016 and examined cancer inequalities during 2008-2012 (Walsh et al. 2016). In the current report, analyses are updated to 2014-2018 for ten major cancer types in adults (stomach, colorectal, lung, breast, cervical and prostate cancers, melanoma, lymphoma, leukaemia and non-melanoma skin cancers (NMSC)), and also all cancers combined (excluding NMSC). Among these, the impact of deprivation on incidence for all ten cancer types (and cancer as a whole) is addressed, as well as the impact of deprivation on five-year survival (except for NMSC, excluded due to low mortality). The impact of deprivation on stage at presentation is also examined for the four most common types of cancer (other than NMSC) diagnosed in Ireland, namely breast, lung, colorectal and prostate cancer. It is worth noting that, in this report, 'deprivation' is assigned at an area level (according to area of residence) and is not assigned at an individual level. Therefore, within the deprivation quintiles, there may exist people with differing affluence levels.

This report also aims to report on possible changes over time in incidence or survival disparity between socioeconomic groups, where they exist. A previous report by the NCRI found little evidence of any decrease in survival disparities between socioeconomic groups for breast cancer in Ireland (Walsh et al., 2014). In this report, we explore whether disparities between the least deprived and most deprived quintiles in incidence or survival have varied across three diagnosis periods (2004-2008, 2009-2013 and 2014-2018). This may assist in assessment of the impact of interventions and whether the National Cancer Strategy targets are on track to be met.

Methods and patient characteristics

Deprivation

Cancer patients were assigned, on the basis of addresses of residence geocoded to electoral division (ED) level, to deprivation quintiles derived from the Pobal Haase-Pratschke index of deprivation at ED level for 2006, 2011 and 2016 (Haase & Pratschke, 2017). This index is a proxy variable for relative affluence and deprivation. Scores on this index are based on information collected by the Central Statistics Office at household level in the relevant national Census. Analyses for the most recent diagnosis period examined, 2014-2018, compare cancer incidence, five-year survival and stage across deprivation quintiles based on the 2016 index. Equivalent, new analyses of incidence and survival for two earlier periods, 2004-2008 and 2009-2013, are also included, using the indices for 2006 and 2011, respectively. Data is provided up to 2018 as each period in this report covers five years centred on the censuses in 2006, 2011 and 2016.

The Pobal index (2016) is based on the combination of three dimensions of relative affluence and deprivation:

1. Demographic Profile, with the following components:
   - percentage increase in population over the previous five years;
   - percentage of population aged under 15 or over 64 years of age;
   - percentage of population with a primary school education only;
   - percentage of population with a third level education;
   - percentage of households with children aged under 15 years and headed by a single parent.
   - the mean number of persons per room.
2. Social Class Composition, with the following components:
   - percentage of population with a primary school education only;
   - percentage of population with a third-level education;
   - percentage of households headed by professionals or managerial and technical employee including farmers with 100 acres or more;
   - percentage of households headed by semi-skilled or unskilled manual workers, including farmers with less than 30 acres;
   - mean number of persons per room.
3. Labour Market Situation, with the following components:
   - percentage of households with children aged under 15 years and headed by a single parent;
   - male unemployment rate;
   - female unemployment rate.

For the purposes of this report, and for each index separately (2006, 2011, 2016), population quintiles of deprivation were assigned (at ED level) by sorting the EDs from least deprived to most deprived (using detailed index values), then splitting all EDs into five groups of equal population size, using populations of all ages (and both sexes) combined for the year concerned. This assignment of cases to quintiles was done for practical reasons, to ensure

that each deprivation category had broadly comparable numerators and denominators and to avoid having too many categories.

In theory, if cancer risk were equal across the quintiles and if the age-breakdown of populations across quintiles were similar, each quintile would hold 20% of cancer cases. However, if cancer incidence is influenced by deprivation, case numbers will be less-evenly distributed across quintiles. Age-variation between quintiles will also influence the distribution of cancer cases across the quintiles. In the diagnosis period 2014-2018, the most deprived quintile held a higher proportion of all incident cancer cases (23%) than the least deprived quintile (20%), unadjusted for age (Table m.2). By individual cancer type, the distribution of cases across the deprivation quintiles varied in magnitude and direction. For example, there were proportionately fewer patients diagnosed with melanoma, but proportionately more lung cancer patients, in the most deprived quintile compared with the least deprived quintile (Table m.2).

In total, for the period 2014-2018, 93% of patients with cancer were assigned to a specific deprivation quintile (Table m.2). This included some cases that could only be assigned to an adjacent group of up to four EDs, provided such EDs all fell within the same deprivation quintile. Cancer cases where the address details available were insufficient for assignment to an ED or adjacent EDs were excluded (see under *Incidence rates* below for details of compensatory adjustments made to incidence rate calculations). The geographic distribution of EDs by deprivation quintile in 2016 is mapped in Figure m.1.

In reporting findings in relation to deprivation, the main emphasis has been placed on comparisons of the most deprived quintile with the least deprived quintile. For the most recent period (2014-2018), reference is also made in the text to any significant differences between intermediate quintiles and the least deprived quintile.

Incidence rates

All incidence rates are presented as age-standardised rates, standardised to the 1976 European Standard Population (ESP), and formal comparisons between population groups are based on directly age-standardised rate ratios (DSRRs) (Jensen et al. 1991). Age-standardised incidence rates (and comparisons of rates) are reported separately by sex, because of differences, often substantial, in rates between males and females. Rates are provided for diagnosis periods 2004-2008, 2009-2013 and 2014-2018. The population denominators used for each deprivation quintile were based on the census population data, by age and sex, for component EDs at the midpoint of each diagnosis period.

It should be noted that the population standard used in this report differs from that (the 2013 ESP) used in the main body of the most recent NCRI annual statistical report (NCRI 2022). The 1976 ESP has been retained here for consistency with the previous NCRI report on cancer inequality (Walsh et al. 2016), which provided a basis for the National Cancer Strategy target for reducing survival inequalities related to deprivation. Further NCRI analyses will examine the possible implications for measurement of incidence disparities of changing to the newer standard (which is more heavily weighted towards older populations – though currently the 1976 ESP provides a closer fit than the 2013 ESP to the Irish population).

Standard IARC/IACR multiple primary rules (World Health Organization 2013) were applied before incidence analyses, and for incidence-reporting purposes some patients contributed more than one cancer case (where if the combination of site and morphology differed sufficiently from other cancers in the same patient).

All populations at risk were assigned to a specific electoral division, thus deprivation quintile could be assigned (with the exception of EDs not assigned a Pobal index value in the source index data). However, not all cases could be assigned to a specific ED (or to a small group of EDs with the same deprivation). To allow calculation of meaningful rates (cases per 100,000 per year), the populations at risk in each category (deprivation quintiles 1-5) were therefore adjusted downwards by a proportion equivalent to the proportion of cases that were of "unknown" deprivation (on an age-specific basis, separately within each diagnosis period). This approach also ensured that appropriate 95% confidence intervals were calculated (because the numbers of cases were not modified/adjusted upwards).

Possible interactions between diagnosis period and the influence of deprivation on incidence were formally tested by comparison of incidence rate ratios (for the most versus least deprived quintile) between the 2014-2018 period and each of the previous periods examined (2004-2008 and 2009-2013) (Altman 2003). This allowed assessment of whether deprivation-related disparities in incidence varied significantly between periods, i.e. whether there was good evidence of either narrowing or widening of incidence disparities over time.

Cause specific five-year survival

Cause-specific five-year survival is the outcome used in this report i.e. deaths attributed to the cancer of interest (or to a cancer of unknown site or of an adjacent site), using a combination of rules defined by the Scottish Cancer Intelligence Unit (2000) and by the United States (US) Surveillance, Epidemiology and End Results (SEER) cancer registry (https://seer.cancer.gov/causespecific/). For survival-reporting purposes in this report, only the first significant invasive cancer (other than NMSC) in a given patient was included (based on diagnosis years 1994-2018 as a whole).

Deaths occurring up to 31 December 2019 were included, based on comprehensive matching of cancer cases to death certificates collated at national level. Five-year age-standardised survival estimates are presented for the three diagnosis periods (2004-2008, 2009-2013 and 2014-2018). Estimates are based on 'adult' patients, age-range 15-99 at diagnosis, as widely used in cancer registry practice. The age-groups and age-specific weights used for age-standardisation were those defined by Corazziari et al. 2004 (15-44, 45-54, 55-64, 65-74, 75-99 or, for prostate cancer, 15-54, …, 85-99, with weights specific to the cancer types involved) (Corazziari et al., 2004).

Formal testing of the influence of deprivation on cause-specific five-year survival was based on Cox modelling, adjusted for sex and stratified by age. For all cancers combined (excluding NMSC), a fuller model adjusted for cancer type (based on three-digit ICD10 code) was also run. For colorectal, lung, breast and prostate cancers, models further adjusted for (stratified

by) stage were also run, based on a breakdown by stages I, II, II, IV, unknown, or non-applicable. Stratification rather than adjustment for age and stage was done to allow for non-proportional hazards. The age-groups used for stratification of models were as defined for age-standardisation above. All models were truncated at five years post-diagnosis (i.e. any patients whose deaths occurred more than five years post-diagnosis were censored at five years), to ensure that models for different diagnosis periods could be compared directly.

As also done for incidence, interactions between diagnosis period and the influence of deprivation on survival were formally tested (Altman 2003) by comparison of mortality hazard ratios (for the most versus least deprived quintiles) between the 2014-2018 period and each of the previous periods examined (2004-2008 and 2009-2013). This allowed assessment of whether there was good evidence of either narrowing or widening of survival disparities over time.

Stage at presentation

For colorectal, lung, breast and prostate cancers diagnosed during 2014-2018, stage was assigned based on TNM 7th-edition staging rules (Sobin et al. 2009), and results are presented on the breakdown by stage I or II (combined as 'early stage') v. III or IV (late stage). Cases with unknown stage were excluded from these stage analyses (but included in survival models adjusted for stage, as noted under *Cause-specific five-year survival* above). The stage information used here assumes that, in the absence of any explicit statement of regional nodal (N-category) or distant metastatic (M-category) spread, unknown or unstated regional and distant metastatic status can be interpreted as N0 and M0, respectively. Survival analyses based on NCRI data indicate that this assumption is broadly correct, although it may be less safe an assumption for older patients if investigations for regional or distant spread are less thorough.

Patient characteristics

Table m.1 presents a summary of patients' age and sex by deprivation status; and Table m.2 a tabulation of case numbers by deprivation status and cancer type.

Patients from the most deprived group during 2014-2018 tended to be slightly older (median age 68 years), compared with the least deprived group (67 years), but this largely reflected the pattern for female patients (67 v. 65 years) (Table m.1). Of the individual cancer types examined, six (colorectal, non-melanoma skin, female breast, and cervical cancer, lymphoma and leukaemia) showed a similar pattern of higher age in the most deprived group, with the opposite pattern for stomach and lung cancers. All differences were by one or two years only, and no difference was evident for melanoma skin cancers.

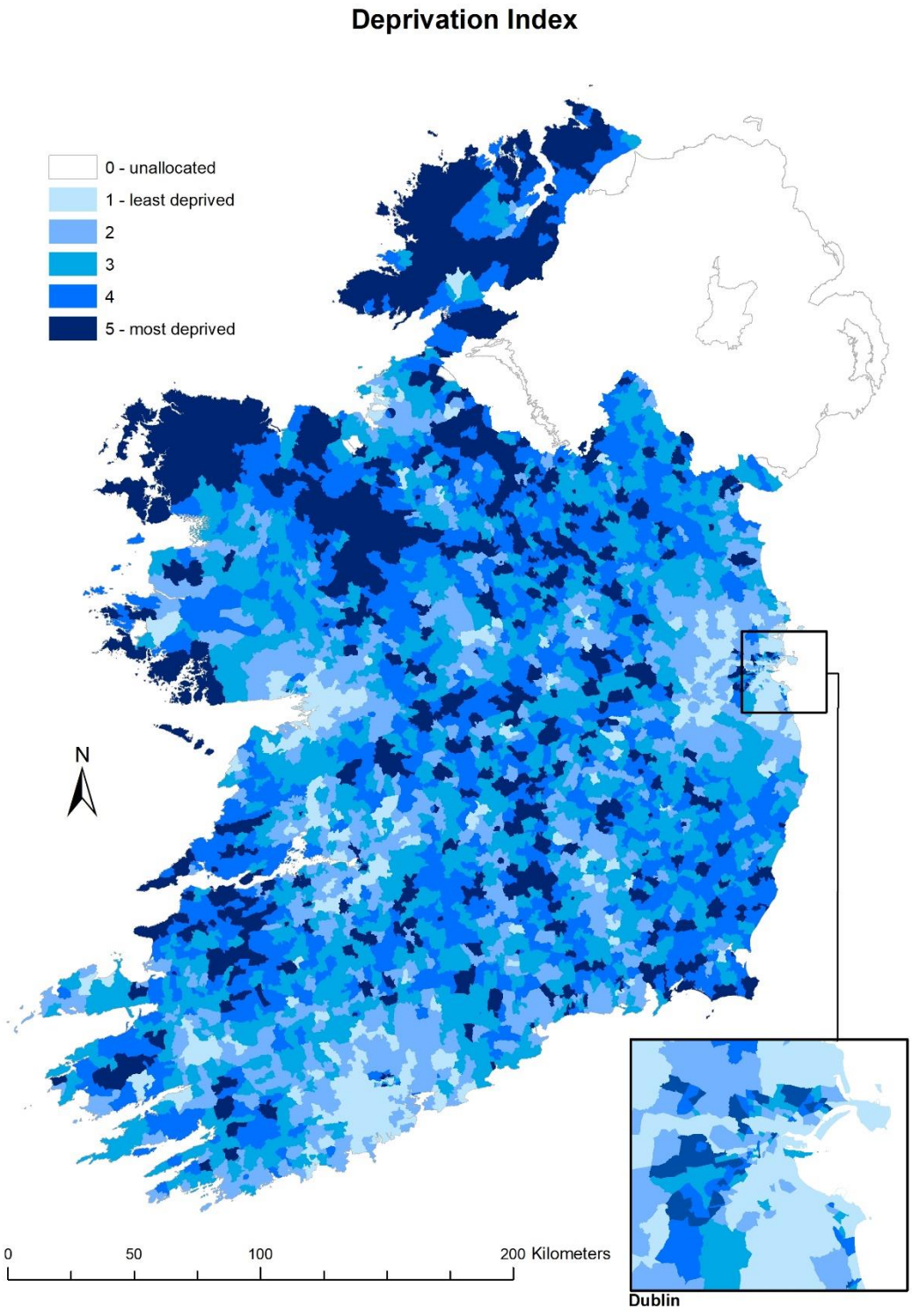


Figure m.1. Geographic distribution of electoral divisions (EDs) by deprivation, based on the Pobal Haase-Pratschke deprivation index (ED version) for 2016, divided into quintiles based on 2016 populations by ED. For some sparsely populated EDs (shown in white), the deprivation index could not be allocated as the ED codes used for geocoding of cancer cases were not sufficiently detailed to allow matching to the Pobal data.

Table m.1 Age and sex of cancer patients in Ireland, 2014-2018, by cancer type and deprivation status (Pobal 2016 ED deprivation index). Note: fuller adjustment for age-group is used in some analyses later in this report, but basic summary figures are given here.

Cancer (ICD-10 code)		Deprivation quintile (1 = least, 5 = most deprived)						
		1	**2**	**3**	**4**	**5**	**X**	**All**
All cancers excluding NMSC	Median age	67	66	67	67	68	67	67
(C00-C43, C45-C96)	% male	50.9	52.7	53.7	54.4	53.6	53.2	53.1
All (male)	Median age	68	67	68	68	68	68	68
All (female)	Median age	65	63	65	66	67	65	65
Stomach (C16)	Median age	72	69	71	71	71	75	71
	% male	63.2	63.8	63.7	66.1	63.3	64.7	64.1
Colorectal (C18-C20)	Median age	70	68	69	70	71	70	70
	% male	55.0	58.3	57.9	60.2	59.8	60.3	58.5
Lung (C34)	Median age	72	71	71	70	70	71	71
	% male	52.5	53.2	55.4	55.6	53.1	59.0	54.3
Melanoma skin (C43)	Median age	65	62	64	65	65	65	64
	% male	48.8	46.8	48.5	50.0	49.7	46.4	48.4
Non-melanoma skin (C44)	Median age	70	70	71	71	73	71	71
	% male	55.4	57.6	58.1	58.2	57.2	59.1	57.6
Female breast (C50)	Median age	59	56	59	60	61	60	59
Cervical (C53)	Median age	43	44	43	44.5	44	44	44
Prostate (C61)	Median age	67	66	67	66	67	67	67
Lymphoma (C81-C85)	Median age	65	65	67	66	66	64	66
	% male	57.3	57.5	52.6	55.3	56.3	60.1	56.2
Leukaemia (C91-C95)	Median age	67	65	68	67.5	69	63	67
	% male	60.6	64.2	62.4	62.1	61.0	62.5	62.1

Table m.2 Breakdown of invasive cancer cases diagnosed in Ireland, 2014-2018, by cancer type and deprivation status (Pobal 2016 ED deprivation index).

		Case numbers by deprivation quintile 1 = least, 5 = most deprived, X = unknown							Row % by deprivation quintile (excluding unknown deprivation)				
		1	2	3	4	5	X	All	1	2	3	4	5
All cancers excluding NMSC	Total	20,704	17,652	20,394	21,213	24,467	9,468	113,898	20%	17%	20%	20%	23%
Stomach	Total	418	417	562	558	709	167	2,831	16%	16%	21%	21%	27%
Colorectal	Total	2,433	2,010	2,345	2,572	2,861	978	13,199	20%	16%	19%	21%	23%
Lung	Total	1,923	1,779	2,213	2,553	3,556	919	12,943	16%	15%	18%	21%	30%
Melanoma skin	Total	1,271	1,023	1,023	960	922	377	5,576	24%	20%	20%	18%	18%
Non-melanoma skin	Total	13,368	9,030	9,797	9,470	9,886	3,583	55,134	26%	18%	19%	18%	19%
Female breast	Total	3,371	2,646	2,789	2,837	3,068	1,558	16,254	23%	18%	19%	19%	21%
Cervical	Total	220	214	252	296	369	74	1,425	16%	16%	19%	22%	27%
Prostate	Total	3,253	2,868	3,332	3,327	3,443	1,555	17,778	20%	18%	21%	21%	21%
Lymphoma	Total	940	769	891	844	1,007	451	4,902	21%	17%	20%	19%	23%
Leukaemia	Total	510	450	479	514	575	355	2,883	20%	18%	19%	20%	23%

1 All invasive cancers (excluding non-melanoma skin cancer)

Key points

Incidence

- Males in the most deprived population quintile had a significantly higher age-standardised incidence rate of all invasive cancer (excluding NMSC) (7% higher) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). A similar pattern was observed in males in the most deprived population quintile compared with the least deprived quintiles in 2004-2008 (4% higher rate) and 2009-2013 (4% higher rate).
- Females in the most deprived quintile had a significantly higher age-standardised incidence rate of all invasive cancer (excluding NMSC) (5% higher) in the diagnosis period 2014-2018 and a 4% higher risk in 2009-2013.
- No significant narrowing or widening in disparities in incidence was seen, for cancer as a whole, in males or females over the three diagnosis periods.

Five-year survival

- Patients diagnosed with invasive cancer (excluding NMSC) from the most deprived quintile showed significantly poorer five-year survival (age/sex-adjusted mortality risk 43% higher, or 28% higher after further adjustment for cancer type) relative to the least deprived quintile, in the most recent diagnosis period, 2014-2018.
- Disparities in five-year survival between the most and least deprived quintiles were also significant for patients diagnosed during 2004-2008 and 2009-2013 (24% higher mortality risk from cancer in the most deprived quintile, in both periods)
- There was no significant narrowing or widening of deprivation-related disparity in five-year survival over the three diagnosis periods.

1.1 All cancer: incidence

Variation by deprivation quintile

Age-standardised incidence rates of all invasive cancer (excluding NMSC) in 2014-2018 ranged 456-517 cases per 100,000 males and 376-423 cases per 100,000 females and across the five deprivation quintiles (Figure 1.1.1). Rates during 2004-2008 ranged 460-514 cases per 100,000 males and 358-390 cases per 100,000 females, and rates during 2009-2013 ranged 476-527 cases per 100,000 males and 377-413 cases per 100,000 females across the five quintiles.

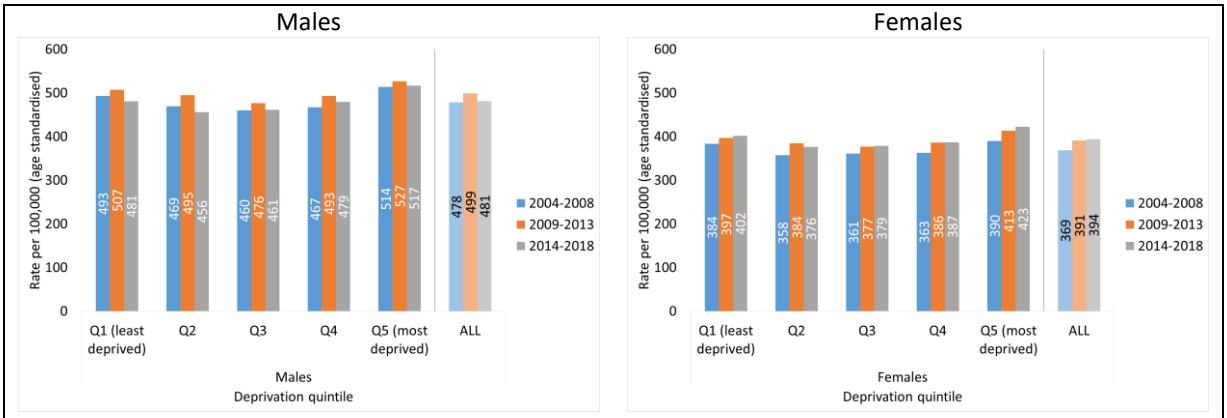


Figure 1.1.1 Incidence rate of all cancer (excluding NMSC) per 100,000, by deprivation quintile (Q1-5) and diagnosis period

In the most recent period (2014-2018), there was a significant difference in rates of all invasive cancer between the most and least deprived quintiles for males: directly standardised rate ratio (DSRR) 1.07 (95% CI 1.05-1.10) (Figure 1.1.2), i.e. males in the most deprived quintile had a 7% higher rate of all invasive cancer (excluding NMSC) compared with those in the least deprived quintile. There was also a significant difference between quintiles 2 and 3 and the least deprived quintile: DSRR 0.95 (95% CI 0.92-0.98) and DSRR 0.96 (95% CI 0.93-0.99) respectively, i.e. a 5% lower rate in quintile 2 and a 4% lower rate in quintile 3 compared with quintile 5 (least deprived).

In females, there was also a significant difference in rates between the most and least deprived quintiles: DSRR 1.05 (95% CI 1.02-1.08) in the most recent period (2014-2018), i.e. females in the most deprived quintile had a 5% higher rate of all invasive cancer (excluding NMSC) compared with those in the least deprived quintile. There was also a significant difference between quintiles 2, 3 and 4 and the least deprived quintile: DSRR 0.94 (95% CI 0.91-0.97), 0.94 (95% CI 0.92-0.97) and 0.96 (95% CI 0.94-0.99) respectively, i.e. a 6% lower rate in quintiles 2 and 3 and a 4% lower rate in quintile 4 compared with quintile 5 (least deprived) (Figure 1.1.2).

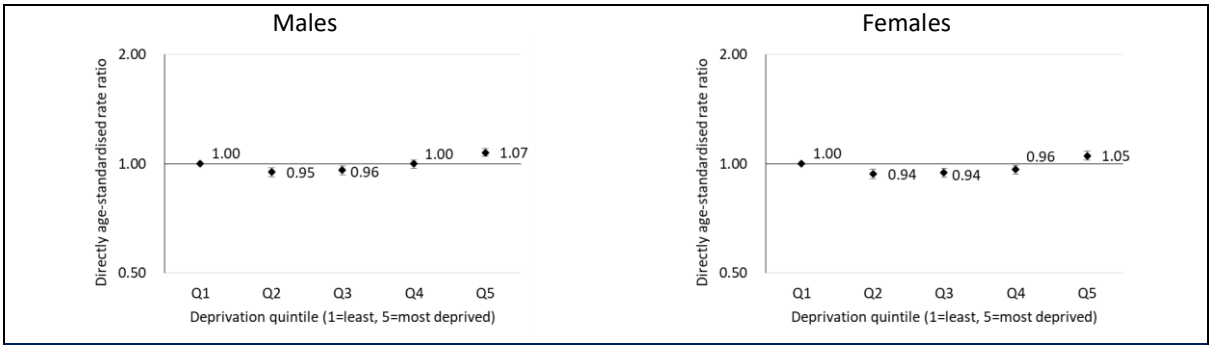


Figure 1.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for all invasive cancer (excluding NMSC) by deprivation quintile, 2014-2018

Incidence rate ratios of all invasive cancer (excluding NMSC) between the most and least deprived quintiles are shown for each diagnosis period in Figure 1.1.3. There was a significant difference in rate of all invasive cancers between those in the most and least deprived quintiles for males in the diagnosis periods 2004-2008 (DSRR 1.04, 95% CI 1.01-1.07), 2009-2013 (DSRR 1.04 95% CI 1.01-1.07) and 2014-2018 (DSRR 1.07 95% CI 1.05-1.10). In females, there was a significant difference in rate of all invasive cancers between those in the most and least deprived quintiles for the diagnosis periods 2009-2013 (DSRR 1.04, 95% CI 1.01-1.07) and 2014-2018 (DSRR 1.05, 95% CI 1.02-1.08) but not for 2004-2008 (DSRR 1.02, 95% CI 0.98-1.05).

On formal significance testing, there was no significant narrowing or widening over time in incidence disparities between the least and the most deprived quintiles in males or females.

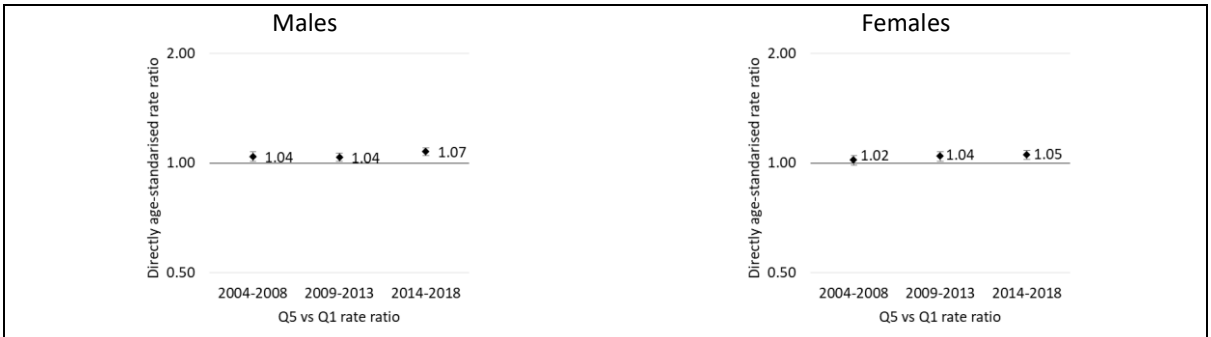


Figure 1.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for all invasive cancer (excluding NMSC) for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods

1.2 All cancer: cause-specific five-year survival

Variation by deprivation

For patients diagnosed during 2014-2018, age-standardised estimates of five-year survival for males and females combined ranged 59-68% across the five deprivation quintiles (Figure 1.2.1). For the two earlier diagnosis periods, five-year survival ranged 53-62% in 2004-2008 and 57-65% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged lower in the most deprived compared with the least deprived quintile (see also Figure 1.2.2), and a broadly similar pattern was seen for the earlier periods (Figure 1.2.1).

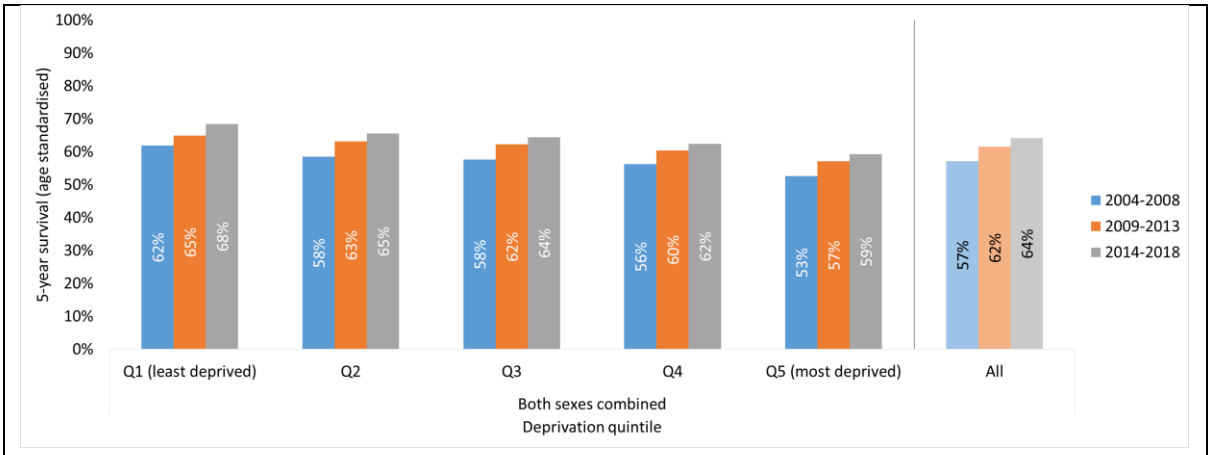


Figure 1.2.1 Cause-specific five-year survival of all invasive cancer (excluding NMSC) patients (males and females combined) by deprivation quintile and diagnosis period

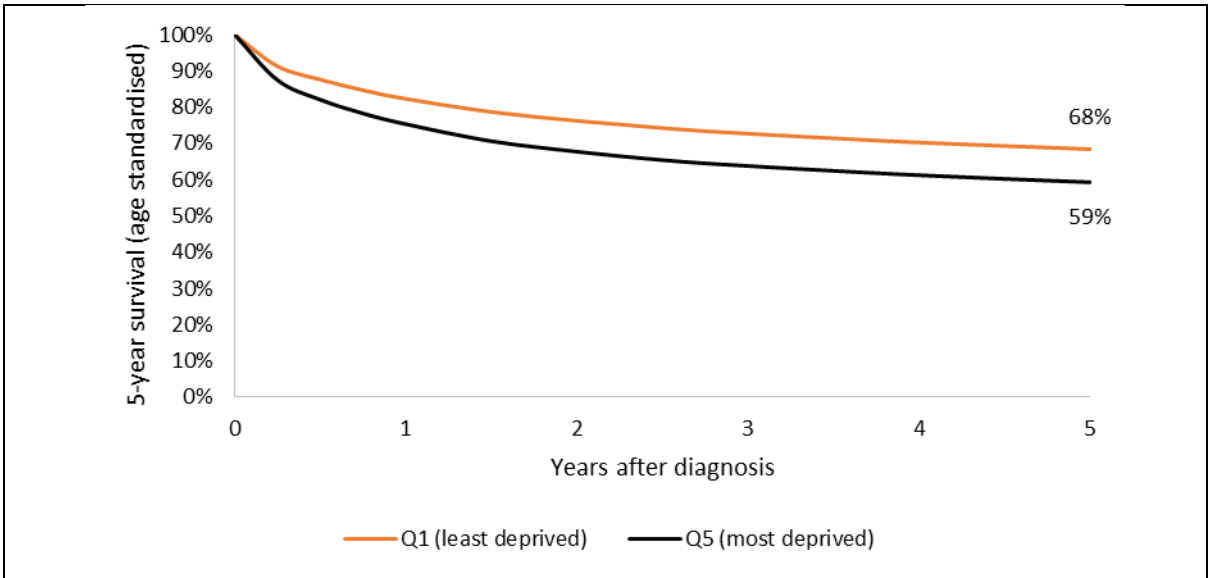


Figure 1.2.2 Cause-specific five-year survival curve for all invasive cancer (excluding NMSC) patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling confirmed significantly higher mortality for the most deprived versus least deprived quintile: age/sex-adjusted hazard ratio (HR) 1.43 (95% CI 1.38-1.49), or, following further adjustment for cancer type, HR 1.28 (95%

CI 1.23-1.33) (Figure 1.2.3A). This represents an estimated 43% higher risk (after adjustment for age and sex only) or a 28% higher risk (adjusted for age, sex and cancer type) of death from cancer, within five years of cancer diagnosis, among patients in the most deprived quintile. Mortality was also significantly higher for intermediate deprivation quintiles 2, 3 and 4 compared with the least deprived quintile: HR 1.13 (95% CI 1.09-1.18), 1.16 (95% CI 1.11-1.20) and 1.19 (95% CI 1.15-1.24), respectively, adjusted for age, sex and cancer type.

Five-year survival was also significantly poorer among patients from the most deprived compared with the least deprived quintile in the two earlier diagnosis periods, 2004-2008 (HR 1.24, 95% CI 1.20-1.29) and 2009-2013 (HR 1.24, 95% CI 1.19-1.28), adjusted for age, sex and cancer type (Figure 1.2.3B).

Comparison of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods (formal testing for heterogeneity of effect) indicated no significant narrowing or widening in the degree of survival disparity over time.

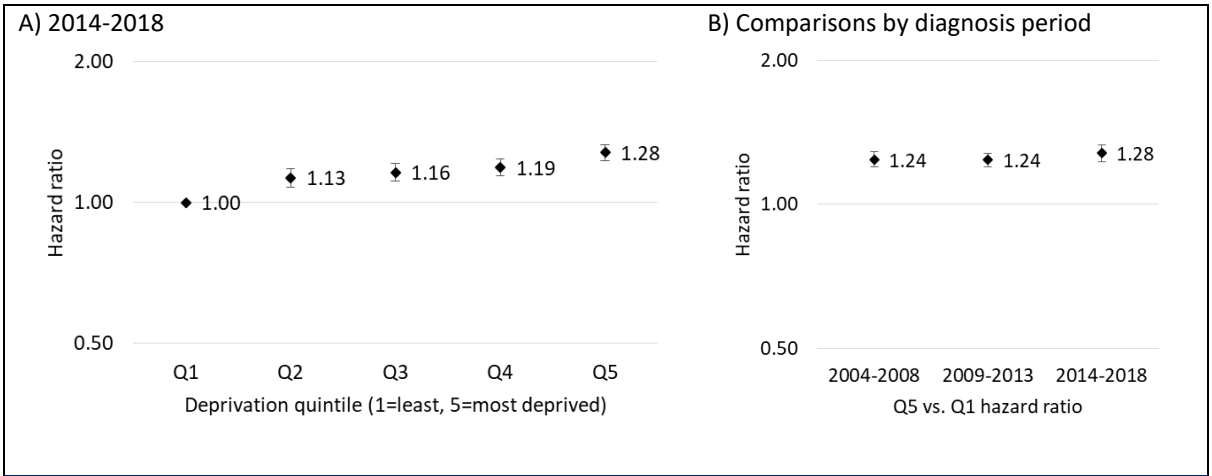


Figure 1.2.3 Mortality hazard ratios by deprivation quintile for all invasive cancer (excluding NMSC), based on cause-specific five-year survival:
A) model adjusted for age, sex and cancer type, 2014-2018
B) Q5 vs Q1 hazard ratio from equivalent model for three diagnosis periods

2 Stomach cancer

Key points

Incidence

- Males in the most deprived population quintile had a significantly higher age-standardised incidence rate of stomach cancer (48% higher) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences in incidence were also seen in both earlier periods (40% higher in 2004-2008 and 24% higher in 2009-2013).
- In females, the most deprived population quintile also had a significantly higher incidence rate of stomach cancer (63% higher) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences were again seen in incidence between the most and least deprived quintiles in the two earlier periods (36% higher in 2004-2008 and 39% higher in 2009-2013).
- Despite apparent variation over time in the strength of deprivation-related patterns, no significant narrowing or widening in incidence disparities over time was confirmed in male or females.

Five-year survival

- There was no significant difference in five-year survival between patients with stomach cancer from the most deprived and the least deprived quintile in the most recent diagnosis period (2014-2018).
- However, disparity in five-year survival between the most and least deprived quintiles was significant for patients diagnosed during 2004-2008 and 2009-2013 (relative mortality risk, adjusted for age and sex, 30% and 27% higher, respectively).
- There was no significant narrowing or widening of deprivation-related survival disparity over the three diagnosis periods.

2.1 Stomach cancer: incidence

Variation by deprivation quintile

Age-standardised rates of stomach cancer in 2014-2018 ranged 11-17 cases per 100,000 males and 5-9 cases per 100,000 females across the five deprivation quintiles (Figure 2.1.1). Rates during 2004-2008 ranged 14-19 cases per 100,000 males and 6-9 cases per 100,000 females, and rates during 2009-2013 ranged 14-18 cases per 100,000 males and 6-9 cases per 100,000 females across the five quintiles.

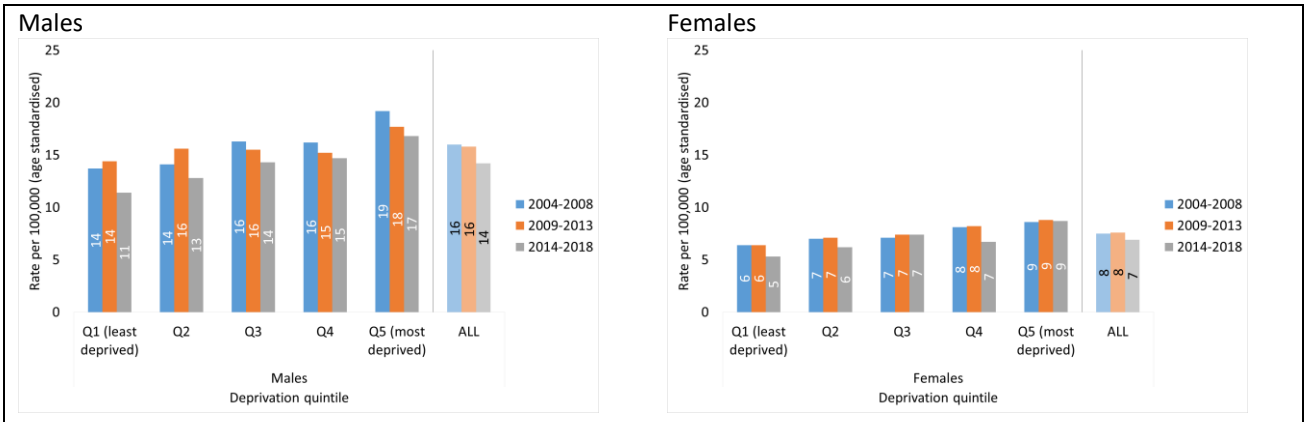


Figure 2.1.1 Incidence rate of stomach cancer per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was a significant difference in rates between the most and least deprived quintiles for males: DSRR 1.48 (95% CI 1.27-1.72) (Figure 2.1.2), i.e. males in the most deprived quintile had a 48% higher rate of stomach cancer compared with those in the least deprived quintile. There was also a significant difference between both quintile 3 and 4 and the least deprived quintile: DSRR 1.26 (95% CI 1.07-1.47) and 1.30 (95% CI 1.11-1.52) respectively, i.e. a 26% higher rate in quintile 3 and a 30% higher rate in quintile 4 compared with the least deprived quintile.

In females, there was also a significant difference in rates in the most recent period between the most and least deprived quintiles: DSRR 1.63 (95% CI 1.33-2.01), i.e. females in the most deprived quintile had a 63% higher rate of stomach cancer compared with those in the least deprived quintile (Figure 2.1.2). There was also a significant difference between both quintile 3 and 4 and the least deprived quintile: DSRR 1.41 (95% CI 1.13-1.74) and 1.26 (95% CI 1.01-1.57) respectively, i.e. a 41% higher rate in quintile 3 and a 26% higher rate in quintile 4.

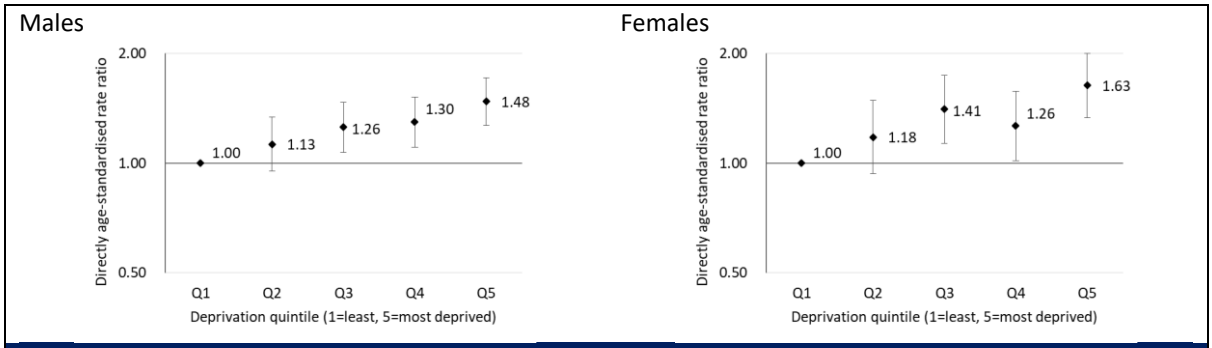


Figure 2.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for stomach cancer by deprivation quintiles, 2014-2018

Incidence rate ratios of stomach cancer between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in (Figure 2.1.3). In males, incidence rates of stomach cancer were higher in the most deprived quintile compared with the least deprived quintile in all three periods (DSRR 1.40, 95% CI 1.18-1.65 for 2004-2008, 1.24 95% CI 1.06-1.44 for 2009-2013 and 1.48 95% CI 1.27-1.72 for 2-14-2018). In females, rates of stomach cancer were higher in the most deprived quintile across the three diagnosis periods also (DSRR 1.36, 95% CI 1.09-1.70 for 2004-2008, 1.39, 95% CI 1.13-1.70 for 2008-2013 and 1.63, 95% CI 1.33-2.01 for 1014-2018).

There was no significant narrowing or widening in incidence disparities over time between the least and the most deprived quintiles for either males or females, reflecting wide confidence intervals around the estimates for specific periods.

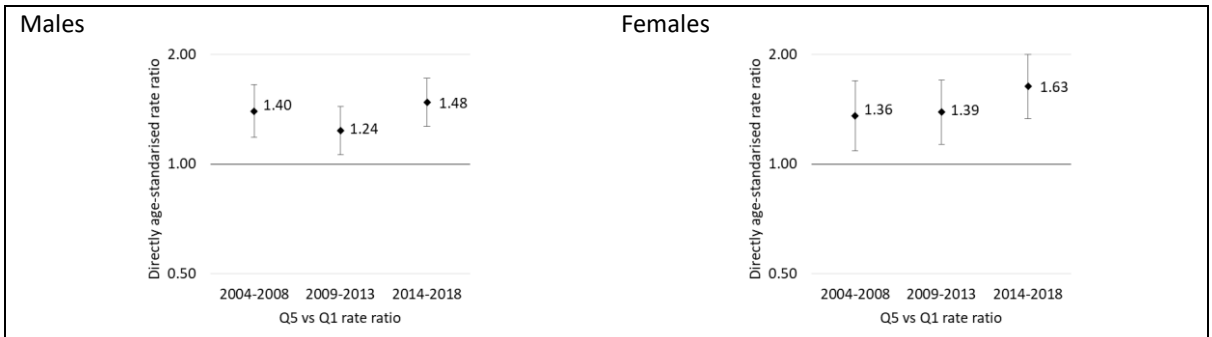


Figure 2.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for stomach cancer for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods

2.2 Stomach cancer: cause-specific five-year survival

Variation by deprivation

For stomach cancer patients diagnosed during 2014-2018, age-standardised estimates of five-year survival for males and females combined ranged 28-36% across the five deprivation quintiles (Figure 2.2.1). For the two earlier diagnosis periods, five-year survival ranged 21-29% in 2004-2008 and 25-31% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged lower in the most deprived compared with the least deprived quintile, but the difference was not statistically significant for this period (see also Figure 2.2.2). A broadly similar pattern was seen for the earlier periods (Figure 2.2.1).

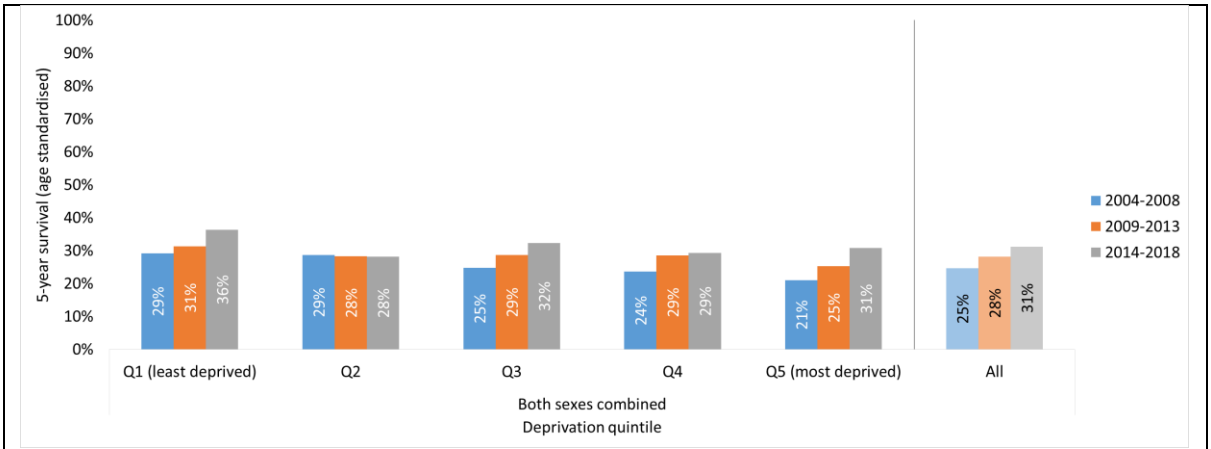


Figure 2.2.1 Cause-specific five-year survival of stomach cancer patients (males and females combined) by deprivation quintile and diagnosis period

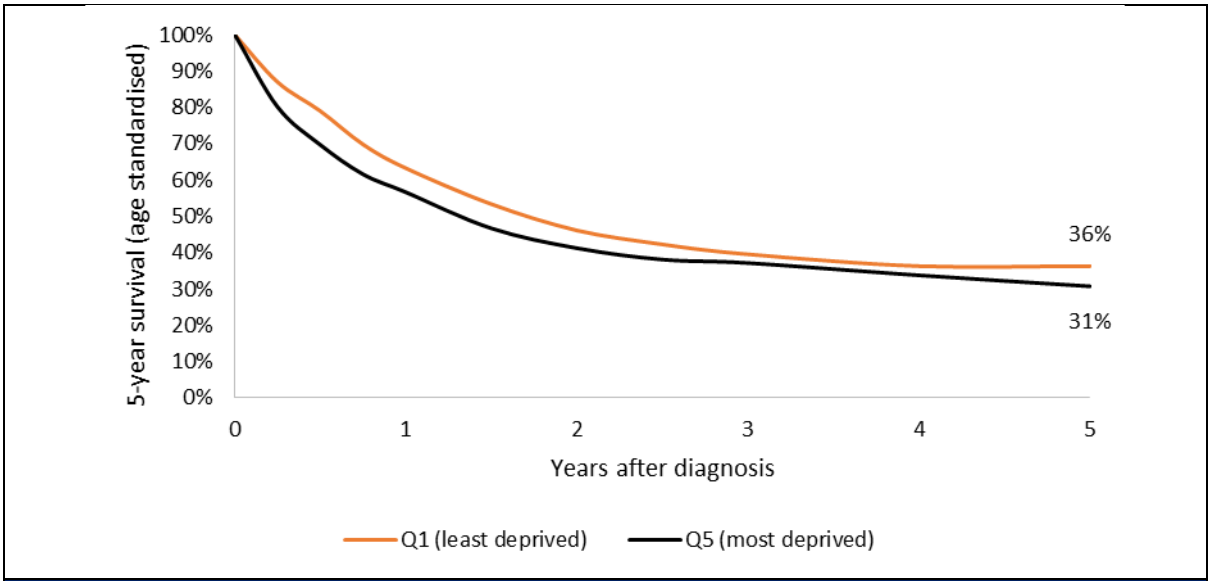


Figure 2.2.2 Cause-specific five-year survival curve for stomach cancer patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling did not confirm significantly higher mortality for patients from the most deprived versus least deprived quintile (Figure 2.2.3A).

Mortality was significantly higher for deprivation quintile 2 compared with the least deprived quintile (Q1): HR 1.26 (95% CI 1.05-1.52).

Five-year survival was significantly poorer among patients from the most deprived compared with the least deprived quintile in 2004-2008 (HR 1.30, 95% CI 1.10-1.54) and 2009-2013 (HR 1.27, 95% CI 1.09-1.48) (Figure 2.2.3B).

While there was some indication of a narrowing of survival disparity over time, comparisons of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods did not reach statistical significance.

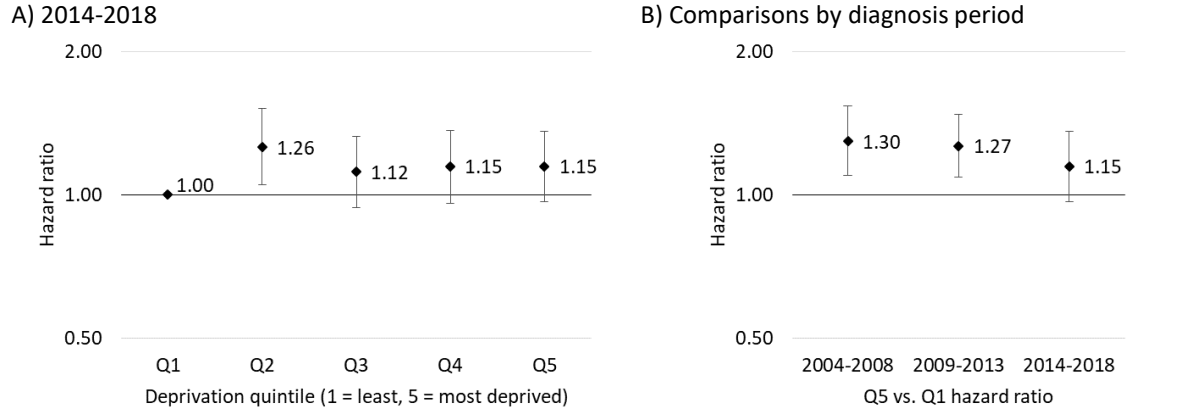


Figure 2.2.3 Mortality hazard ratios by deprivation quintile for stomach cancer, based on five-year cause-specific survival: A) age-and sex-adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

3 Colorectal cancer

Key points

Incidence

- Males in the most deprived population quintile had a significantly higher age-standardised incidence rate of colorectal cancer (8% higher) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). No significant differences were seen in incidence between the most and least deprived quintiles in earlier periods (2004-2008 and 2009-2013).
- In females, there were no significant differences in the incidence rate of colorectal cancer between the most and least deprived quintiles in any of the three periods examined.
- No significant narrowing or widening of disparities in incidence was seen in males or females over the three diagnosis periods.

Five-year survival

- Patient with colorectal cancer from the most deprived quintile showed significantly poorer five-year survival (relative mortality risk 29% higher, age/sex-adjusted) relative to the least deprived quintile, in the most recent diagnosis period (2014-2018).
- Disparities in five-year survival between the most and least deprived quintiles were also significant for patients diagnosed with colorectal cancer during 2004-2008 and 2009-2013 (mortality risk 19% and 25% higher in the most deprived quintile, respectively).
- There was no significant narrowing or widening of deprivation-related survival disparity over the three diagnosis periods.

Stage

- The risk of being diagnosed with a late-stage (stage III/IV) colorectal cancer did not differ between the least and most deprived quintiles in 2014-2018.

3.1 Colorectal cancer: incidence

Variation by deprivation quintile

Age-standardised rates of colorectal cancer in 2014-2018 ranged 56-65 cases per 100,000 males and 36-40 cases per 100,000 females across the five deprivation quintiles (Figure 3.1.1.). Rates during 2004-2008 ranged 64-71 cases per 100,000 males and 39-46 cases per 100,000 females, and rates during 2009-2013 ranged 62-70 cases per 100,000 males and 39-41 cases per 100,000 females across the five quintiles.

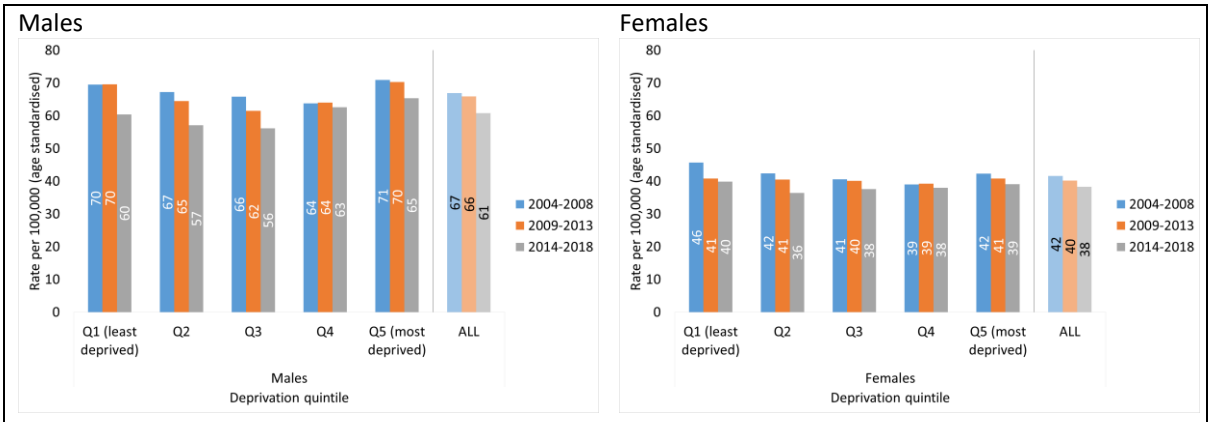


Figure 3.1.1 Incidence rate of colorectal cancer per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was a significant difference in colorectal cancer incidence rates between the most and least deprived quintiles for males: DSRR 1.08 (95% CI 1.01-1.16) (Figure 3.1.2), i.e. males in the most deprived quintile had an 8% higher rate of colorectal cancer compared with those in the least deprived quintile.

In females, in the most recent period (2014-2018), there was no significant difference in colorectal cancer incidence rates between the most and least deprived quintiles: DSRR 0.98 (95% CI 0.90-1.07) (Figure 3.1.2).

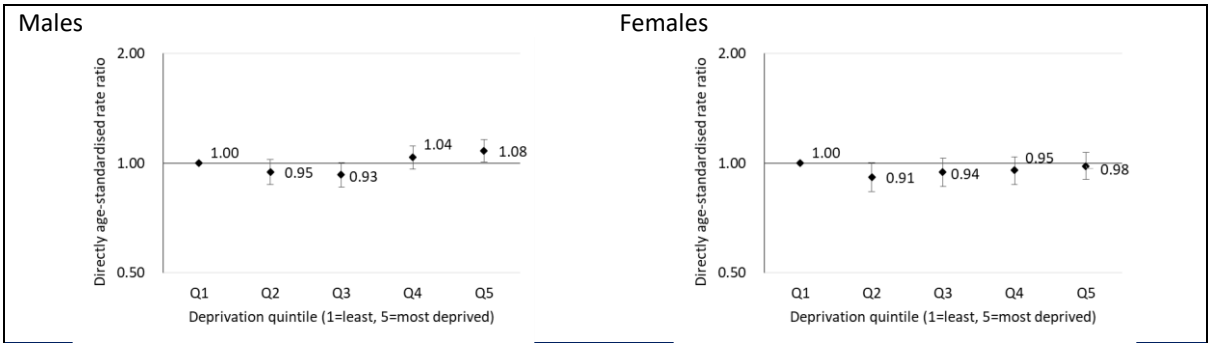


Figure 3.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for colorectal cancer by deprivation quintiles, 2014-2018

Incidence rate ratios of colorectal cancer between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in Figure 3.1.3. In males, there was a significant difference in incidence between the most and deprived quintiles in the most recent diagnosis period only, with no significant difference in the two earlier periods. In females, there were no significant differences in incidence of colorectal cancer between the most and least deprived quintiles for all three diagnosis periods (Figure 3.1.3).

There was no significant narrowing or widening in colorectal incidence disparities over time between the least and the most deprived quintiles in either males or females.

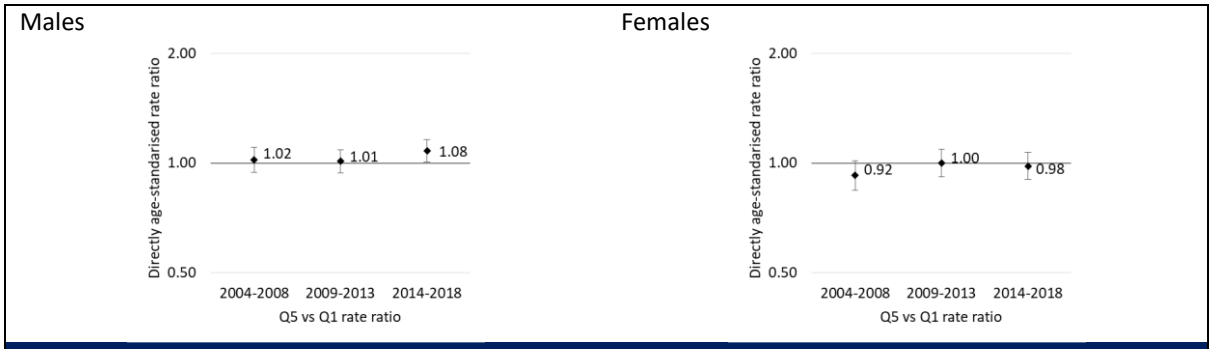


Figure 3.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for colorectal cancer for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods

3.2 Colorectal cancer: cause-specific five-year survival

Variation by deprivation

For patients diagnosed with colorectal cancer during 2014-2018, age-standardised estimates of five-year survival for males and females combined ranged 61-67% across the five deprivation quintiles (Figure 3.2.1). For the two earlier diagnosis periods, five-year survival ranged 54-61% in 2004-2008 and 57-64% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged lower in the most deprived compared with the least deprived quintile (see also Figure 3.2.2), and a broadly similar pattern was seen for the earlier periods (Figure 3.2.1).

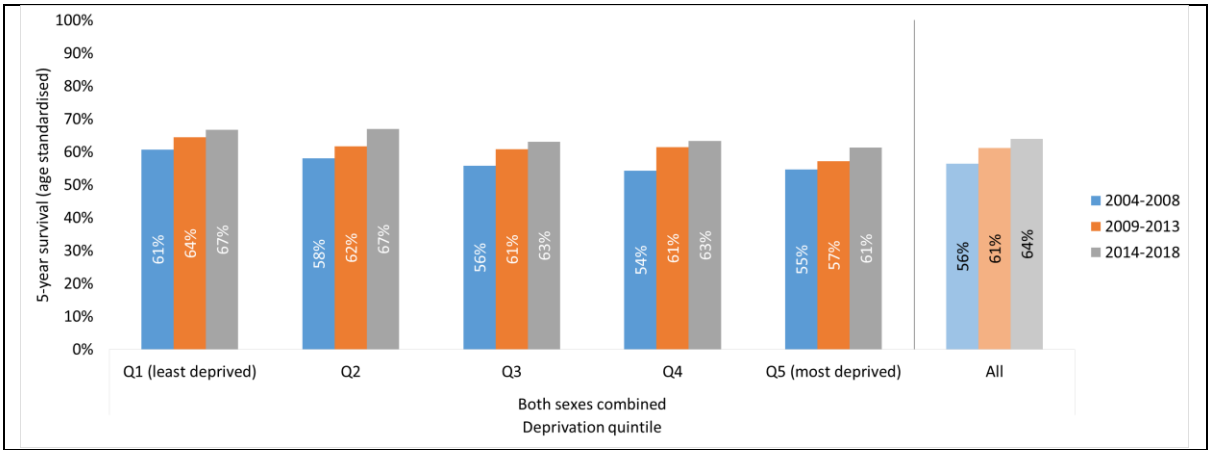


Figure 3.2.1 Cause-specific five-year survival of colorectal cancer patients (males and females combined) by deprivation quintile and diagnosis period

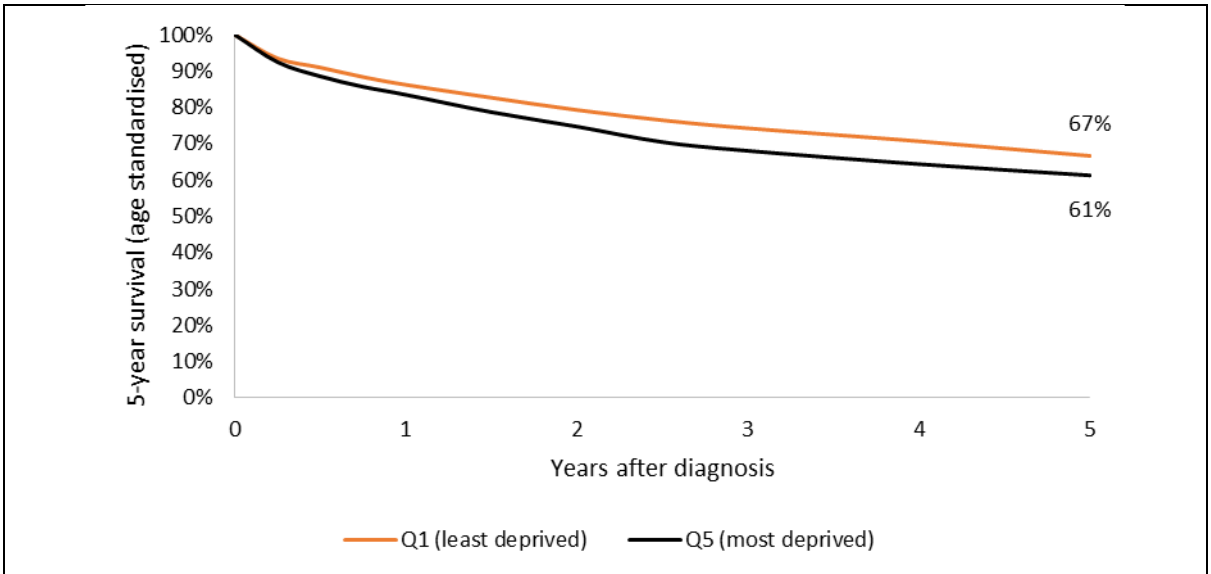


Figure 3.2.2 Cause-specific five-year survival curve for colorectal cancer patients: comparison of least and most deprived quintiles (Q1 and Q5), 2014-2018

For the most recent period, 2014-2018, Cox modelling confirmed higher mortality due to colorectal cancer for the most deprived versus least deprived quintile: age/sex-adjusted hazard ratio (HR) 1.29 (95% CI 1.15-1.43) (Figure 3.2.3A), i.e. a 29% higher risk of death within five years of diagnosis for patients from the most deprived quintile. The mortality risk was

also significantly higher for intermediate deprivation quintiles 3 and 4 compared with the least deprived quintile: HR 1.23 (95% CI 1.10-1.38) and 1.18 (95% CI 1.06-1.33), respectively.

Five-year survival was also significantly poorer among patients with colorectal cancer in the most deprived compared with the least deprived quintile in two earlier diagnosis periods, 2004-2008 (HR 1.19, 95% CI 1.08-1.32) and 2009-2013 (HR 1.25, 95% CI 1.13-1.37) (Figure 3.2.3B).

Comparison of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods indicated no significant narrowing or widening of the degree of survival disparity over time.

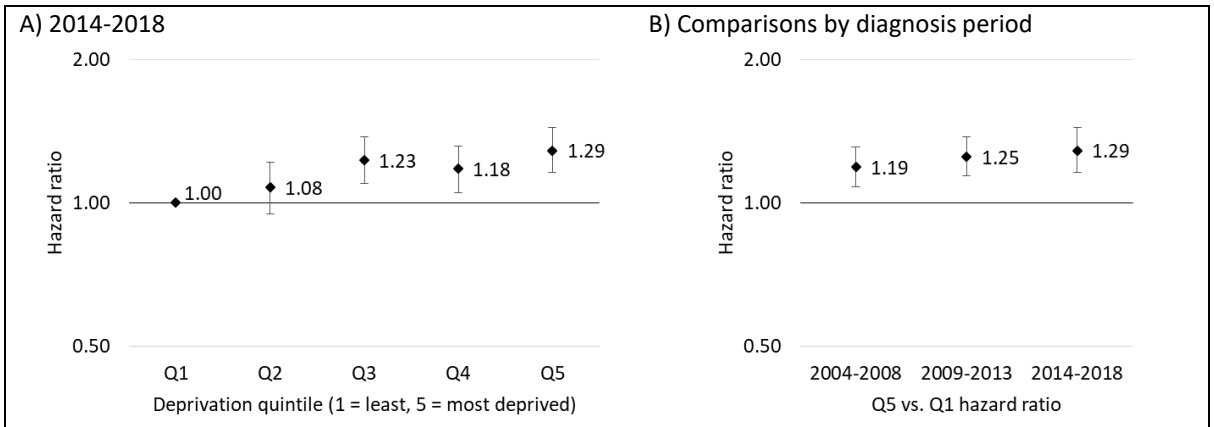


Figure 3.2.3 Mortality hazard ratios by deprivation quintile for colorectal cancer, based on five-year cause-specific survival: A) age-and sex-adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

Further adjustment, for cancer stage at diagnosis, had only a minor effect on hazard ratios comparing the most deprived with the least deprived quintile: age/sex/stage-adjusted HR 1.22 (95% 1.11-1.35) for 2004-2008, 1.21 (95% CI 1.10-1.33) for 2009-2013 and 1.27 (95% CI 1.13-1.41) for 2014-2018 (not graphed).

3.3 Colorectal cancer: stage (2014-2018)

Variation by deprivation

Stage at diagnosis was grouped as early stage (stage I/II) or late stage (stage III/IV), excluding unstaged cases, based on TNM 7th-edition staging criteria applied to cases diagnosed during 2014-2018.

The stage breakdown of colorectal cancer cases in males and females combined ranged 42-46% for early stage and 54-58% for late stage across the five deprivation quintiles in 2014-2018 (Figure 3.3.1). In proportional terms, the relative risk of being diagnosed with late-stage colorectal cancer (adjusted for age and sex) did not differ significantly between the most and least deprived quintiles (RR 1.03, 95% CI 0.97-1.08).

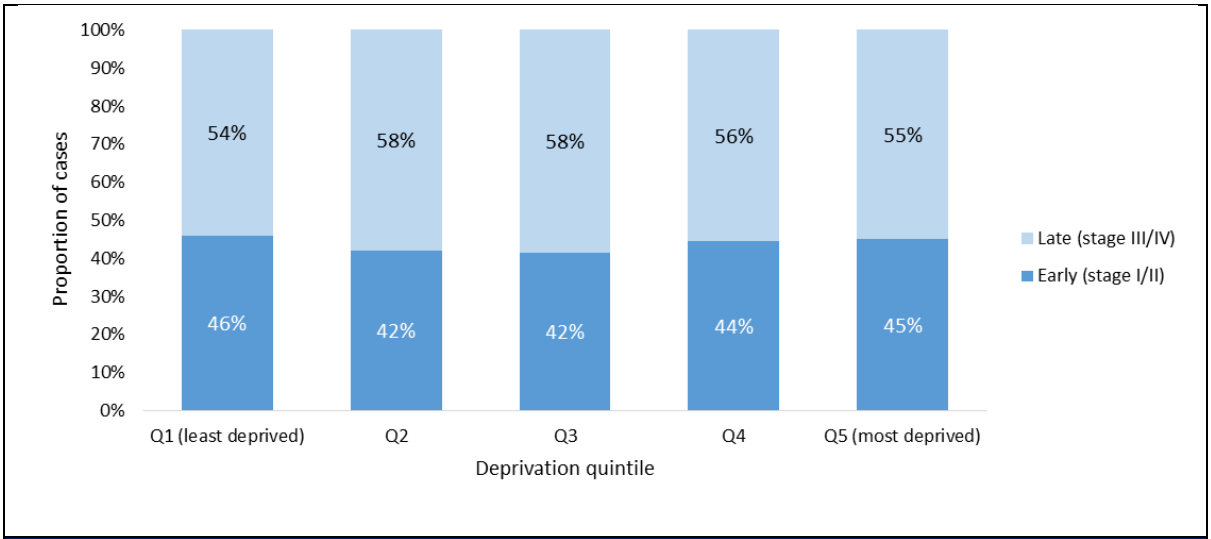


Figure 3.3.1 Stage at diagnosis for colorectal cancer patients by deprivation quintile, 2014-2018

4 Lung cancer

Key points

Incidence

- Males in the most deprived population quintile had a significantly higher age-standardised incidence rate of lung cancer (59% higher) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences were also seen in incidence between the most and least deprived quintiles in earlier periods (55% higher risk in 2004-2008 and 48% higher risk in 2009-2013).
- Likewise, females in the most deprived population quintile had a significantly higher age-standardised incidence rate of lung cancer (71% higher) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences were also seen in incidence between the most and least deprived quintiles in earlier periods (56% higher risk in 2004-2008 and 55% higher risk in 2009-2013).
- No significant narrowing or widening of disparities in incidence was seen in males or females over the three diagnosis periods.

Five-year survival

- Patients with lung cancer from the most deprived quintile showed significantly poorer five-year survival (age/sex-adjusted mortality risk 20% higher) relative to the least deprived quintile, in the most recent diagnosis period (2014-2018).
- Disparities in five-year survival between the most and least deprived quintiles were also significant for patients diagnosed during 2004-2008 and 2009-2013 (age/sex-adjusted mortality risk 18% higher in the most deprived quintile for both periods).
- There was no significant narrowing or widening of deprivation-related survival disparity over the three diagnosis periods.

Stage

- The risk of being diagnosed with a late stage (stage III/IV) lung cancer did not differ between the least and most deprived quintiles in 2014-2018.

4.1 Lung cancer: incidence

Variation by deprivation quintile

Age-standardised rates of lung cancer in 2014-2018 ranged 45-72 cases per 100,000 males and 33-57 cases per 100,000 females across the five deprivation quintiles (Figure 4.1.1). Rates during 2004-2008 ranged 51-79 cases per 100,000 males and 29-49 cases per 100,000 females, and rates during 2009-2013 ranged 52-77 cases per 100,000 males and 33-52 cases per 100,000 females across the five quintiles.

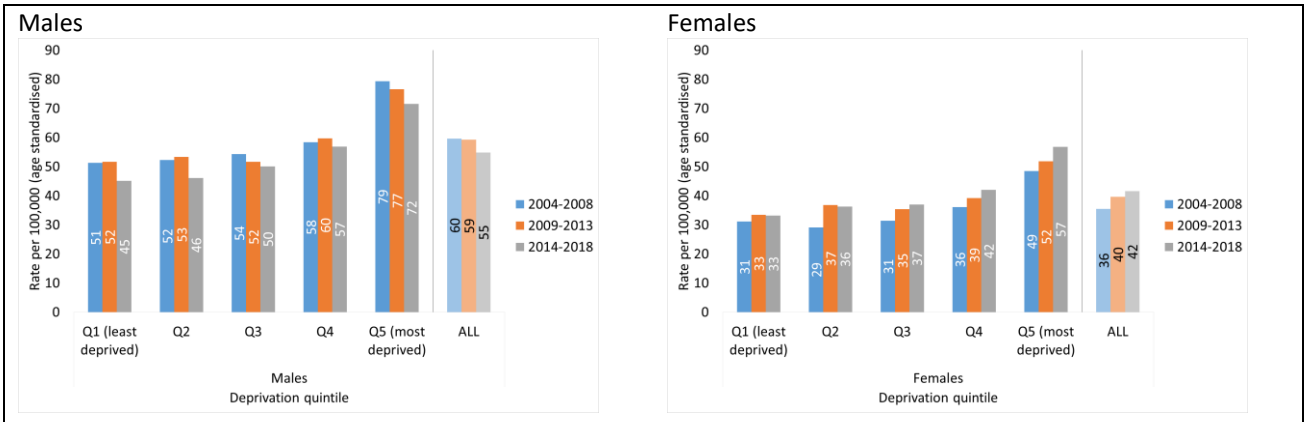


Figure 4.1.1 Incidence rate of lung cancer per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was a significant difference in rates between the most and the least deprived quintiles for males: DSRR 1.59 (95% CI 1.47-1.71) (Figure 4.1.2), i.e. males in the most deprived quintile had a 59% higher rate of lung cancer compared with those in the least deprived quintile. There was also a significant difference between both quintiles 3 and 4 and the least deprived quintile: DSRR Q3 1.11 (95% CI 1.02-1.21), Q4 1.26 (95% CI 1.16-1.37), i.e. an 11% higher rate in quintile 3 and a 26% higher rate in quintile 4 compared with the least deprived quintile.

In females, there was also a significant difference in rates in the most recent period between the most and least deprived quintiles: DSRR 1.71 (95% CI 1.58-1.86) (Figure 4.1.2). There was also a significant difference between both quintiles 3 and 4 and the least deprived quintile: DSRR for Q3 1.11 (95% CI 1.02-1.22), for Q4 1.27 (95% CI 1.16-1.38).

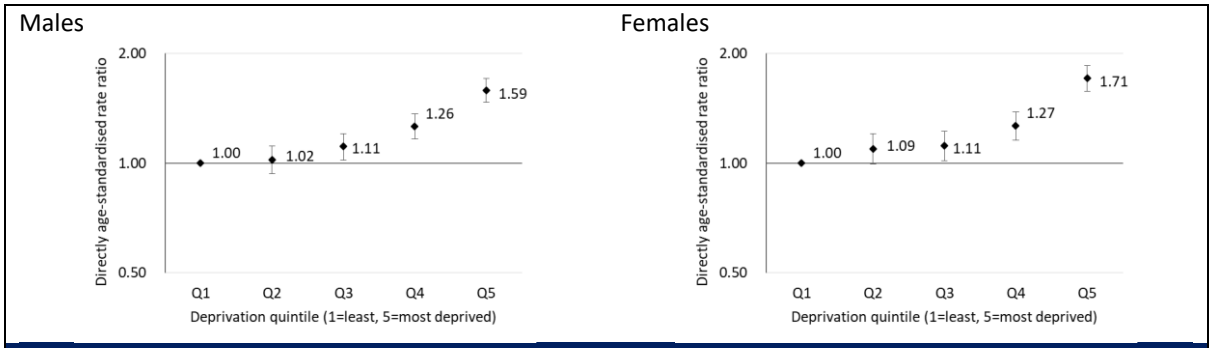


Figure 4.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for lung cancer by sex and deprivation quintile, 2014-2018

Incidence rate ratios of lung cancer between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in Figure 4.1.3. In males, significantly higher incidence rates of lung cancer were observed in the most deprived quintile compared with the least deprived quintile in all three periods (DSRR 1.55 95% CI 1.42-1.68 for 2004-2008, 1.48 95% CI 1.37-1.60 for 2009-2013 and 1.59, 95% CI 1.47-1.71 for 2014-2018).

Females had significantly higher incidence rates also in the most deprived quintile compared with the least deprived quintile also in each period (DSRR 1.56, 95% CI 1.41-1.72 for 2004-2008, 1.55 95% CI 1.42-1.69 for 2009-2013 and 1.71 95% CI 1.58-1.86 for 2014-2018).

There was no significant narrowing or widening of incidence disparities over time between the least and the most deprived quintiles in either males or females.

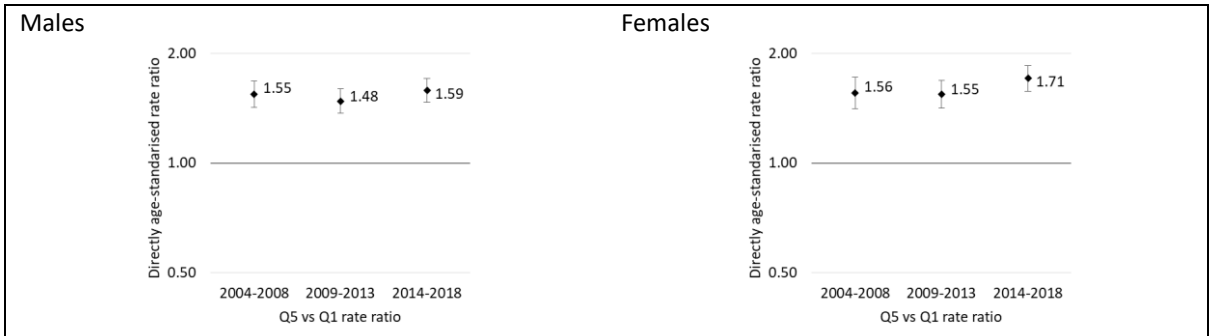


Figure 4.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for lung cancer for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods by sex

4.2 Lung cancer: cause-specific five-year survival

Variation by deprivation

For patients diagnosed during 2014-2018, age-standardised estimates of five-year survival for males and females combined ranged 21-32% across the five deprivation quintiles (Figure 4.2.1). For the two earlier diagnosis periods, five-year survival ranged 12-17% in 2004-2008 and 17-23% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged lower in the most deprived compared with the least deprived quintile (see also Figure 4.2.2), and a broadly similar pattern was seen for the earlier periods (Figure 4.2.1).

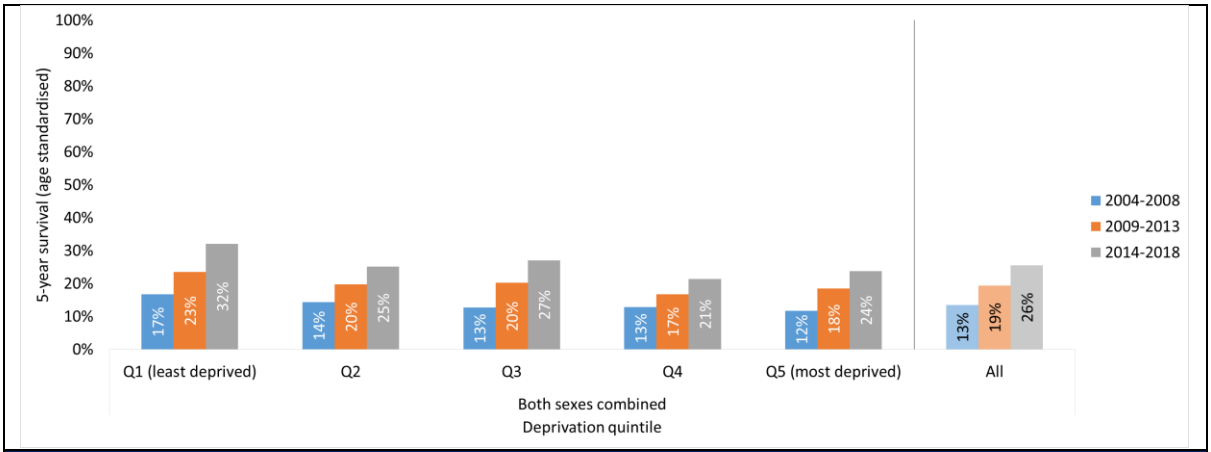


Figure 4.2.1 Cause-specific five-year survival of lung cancer patients (males and females combined) by deprivation quintile and diagnosis period

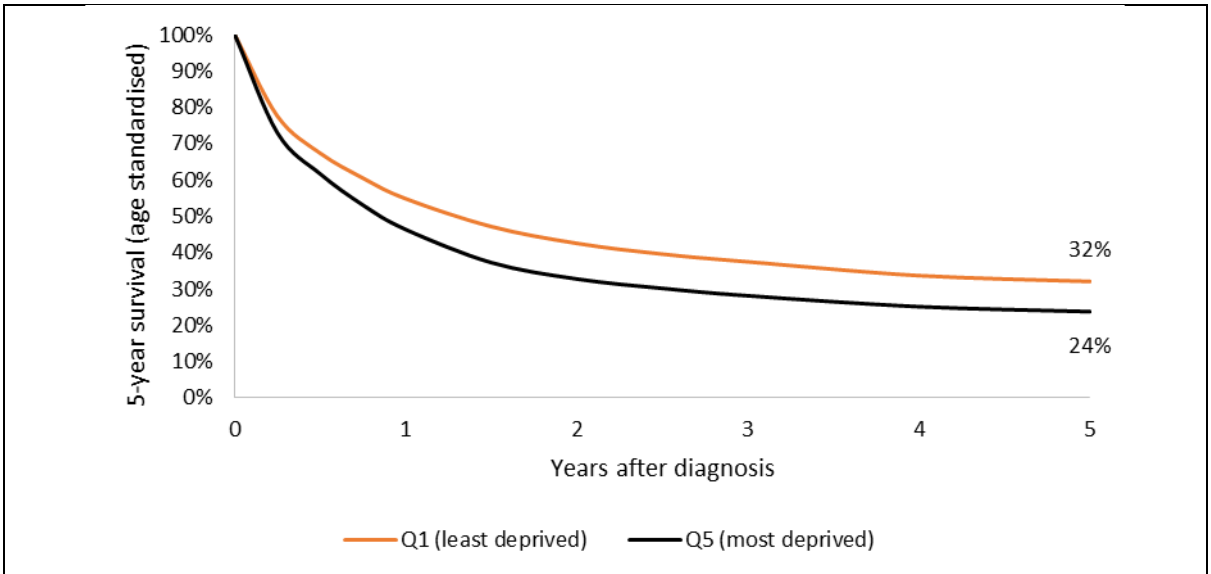


Figure 4.2.2 Cause-specific five-year survival curve for lung cancer patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling confirmed higher mortality for the most deprived versus least deprived quintile: age/sex-adjusted hazard ratio (HR) 1.20 (95% CI 1.11-1.30) (Figure 4.2.3A), i.e. a 20% higher risk of death among lung cancer patients in the most deprived quintile compared with the least deprived quintile. Mortality risk was also significantly higher for intermediate deprivation quintiles 2, 3 and 4 compared with the least deprived quintile: HR 1.11 (95% CI 1.02-1.21), 1.12 (95% CI 1.03-1.22) and 1.19 (95% CI 1.10-1.29), respectively.

Five-year survival was also significantly poorer among patients from the most deprived compared with the least deprived quintile in two earlier diagnosis periods, 2004-2008 (HR 1.18, 95% CI 1.09-1.27) and 2009-2013 (HR 1.18, 95% CI 1.09-1.26) (Figure 4.2.3B).

Comparison of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods indicated no significant narrowing or widening of the degree of survival disparity over time.

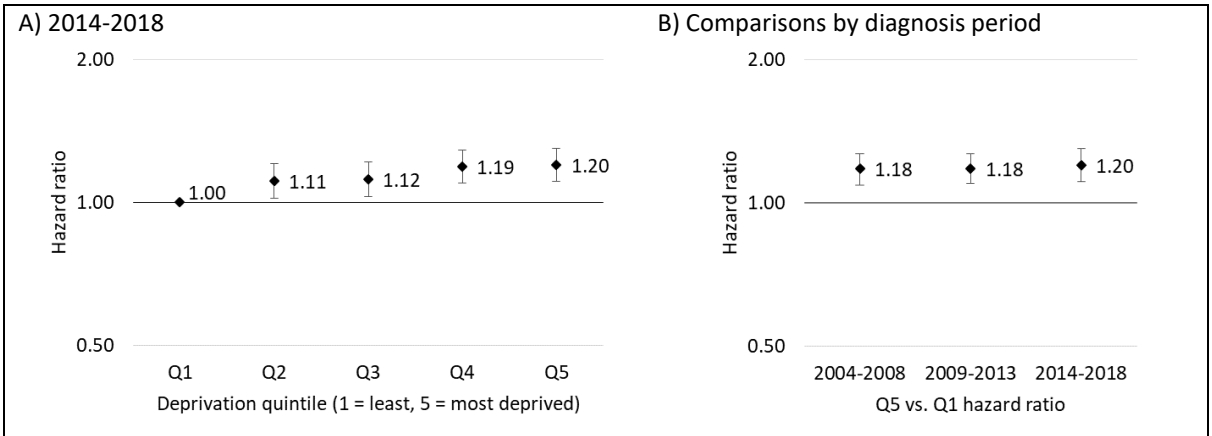


Figure 4.2.3 Mortality hazard ratios by deprivation quintile for lung cancer, based on five-year cause-specific survival: A) age-and sex-adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

Further adjustment, for cancer stage at diagnosis, had little effect on hazard ratios comparing the most deprived with the least deprived quintile: age/sex/stage-adjusted HR 1.18 (95% 1.10-1.28) for 2004-2008, 1.22 (95% CI 1.14-1.32) for 2009-2013 and 1.19 (95% CI 1.11-1.29) for 2014-2018 (not graphed).

4.3 Lung cancer: stage (2014-2018)

Variation by deprivation

Stage at diagnosis was grouped as early stage (stage I/II) or late stage (stage III/IV), excluding unstaged cases, based on TNM 7th-edition staging criteria applied to cases diagnosed during 2014-2018.

The stage breakdown of lung cancer cases in males and females combined ranged 32-36% for early stage and 64-68% for late stage across the five deprivation quintiles in 2014-2018 (Figure 4.3.1). In proportional terms, the relative risk of being diagnosed with late-stage lung cancer (adjusted for age and sex) did not differ significantly between the most and least deprived quintiles (RR 1.04, 95% CI 1.00-1.09).

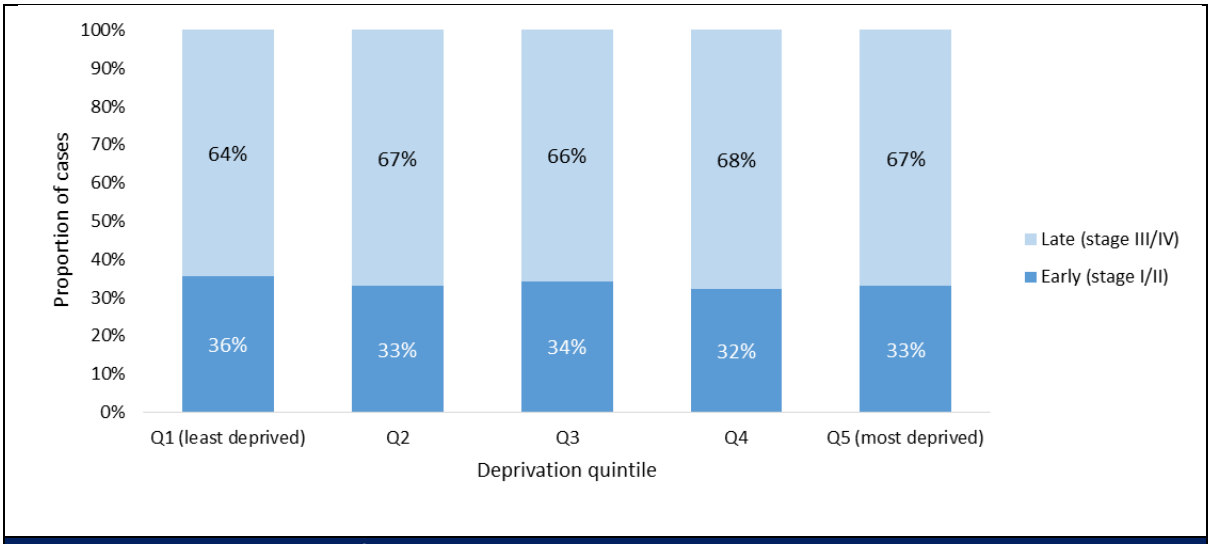


Figure 4.3.1 Stage at diagnosis for lung cancer patients by deprivation quintile, 2014-2018

5 Melanoma of skin

Key points

Incidence

- Males in the most deprived population quintile had a significantly lower age-standardised incidence rate of melanoma (34% lower) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences were also seen between the most and deprived quintiles in earlier periods (37% lower in 2004-2008 and 33% lower in 2009-2013).
- Females in the most deprived population quintile likewise had a significantly lower age-standardised incidence rate of melanoma (30% lower) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences were also seen between the most and deprived quintiles in earlier periods (26% lower in 2004-2008 and 26% lower in 2009-2013).
- No significant narrowing or widening of incidence disparities over time across the three diagnosis periods was seen in males or females.

Five-year survival

- Patients with melanoma from the most deprived quintile showed significantly poorer five-year survival (age/sex-adjusted mortality risk 67% higher) relative to the least deprived quintile, in the most recent diagnosis period (2014-2018).
- Disparities in five-year survival between the most and least deprived quintiles were also significant for patients diagnosed in 2009-2013 (mortality risk 37% higher in the most deprived quintile).
- There was no significant narrowing or widening of survival disparities over the three diagnosis periods.

5.1 Melanoma of skin: incidence

Variation by deprivation quintile

Age-standardised rates of melanoma in 2014-2018 ranged 18-27 cases per 100,000 males and 18-25 cases per 100,000 females across the five deprivation quintiles (Figure 5.1.1). Rates during 2004-2008 ranged 13-20 cases per 100,000 males and 15-20 cases per 100,000 females, and rates during 2009-2013 ranged 15-23 cases per 100,000 males and 18-24 cases per 100,000 females across the five quintiles.

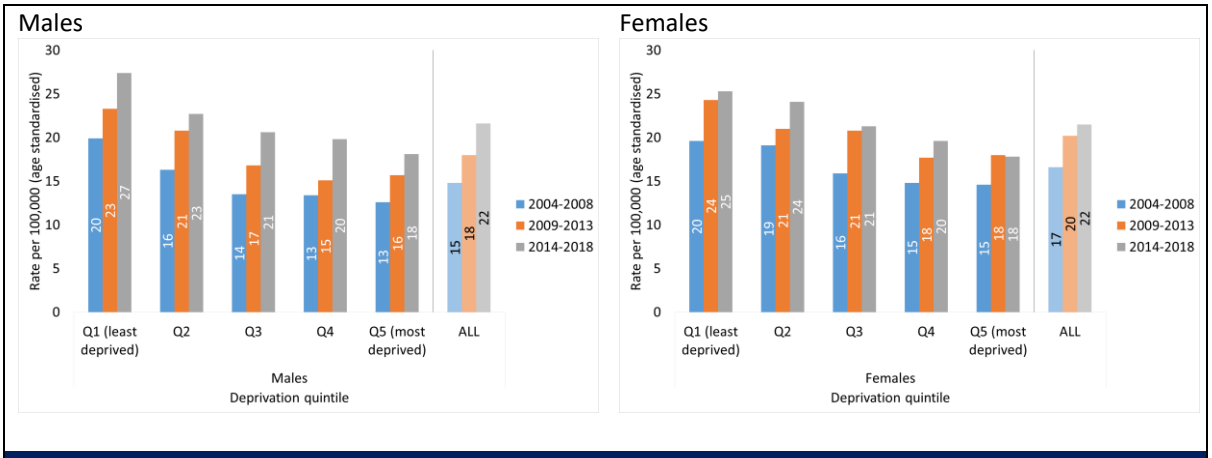


Figure 5.1.1 Incidence rate of melanoma per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was a significant difference in incidence rates between the most and least deprived quintiles for males: DSRR 0.66 (95% CI 0.59-0.75) (Figure 5.1.2), i.e. males in the most deprived quintile had a 34% lower rate of melanoma compared with those in the least deprived quintile. There were also significant differences between quintile 2, 3 and 4 and the least deprived quintile: DSRR 0.83 (95% CI 0.74-0.94), 0.75 (95% CI 0.67-0.85) and 0.73 (95% CI 0.64-0.82) respectively i.e. quintiles 2, 3 and 4 had 17%, 25% and 27% lower rates, respectively, compared with the least deprived quintile.

In females also, incidence rates were significantly lower in the most deprived compared with the least deprived quintile in the most recent period (2014-2018): DSRR 0.70 (95% CI 0.62-0.79) (Figure 5.1.2). Quintiles 3 and 4 also had significantly lower rates than the least deprived quintile: DSRR 0.84 (95% CI 0.75-0.95) and DSRR 0.77 (95% CI 0.69-0.87) respectively i.e. 16% and 23% lower rates compared with the least deprived quintile.

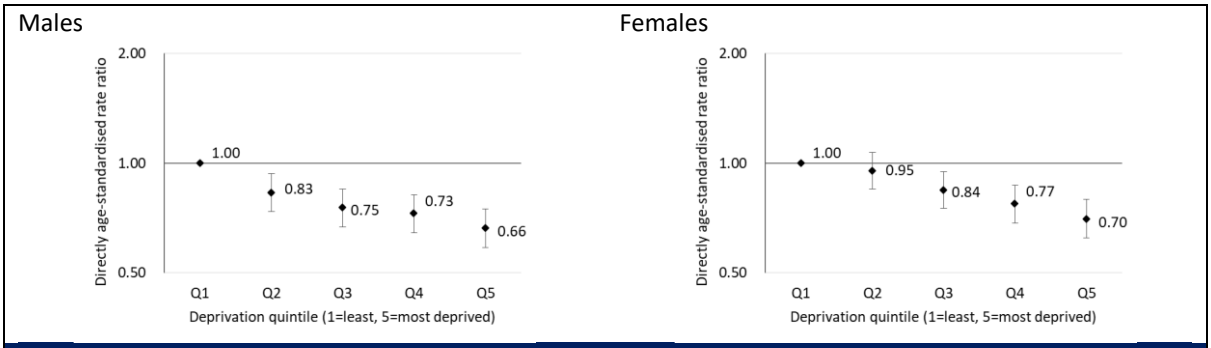


Figure 5.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for melanoma by deprivation quintiles, 2014-2018

Incidence rate ratios of melanoma between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in Figure 5.1.3. In males, there was a significant difference in incidence rate between those in the most deprived and least deprived quintiles, with those in the most deprived quintile having a lower incidence in all three diagnosis periods: DSRR 0.63 (95% CI 0.53-0.75) for 2004-2008, 0.67 (95% CI 0.58 -0.78) for 2009-2013 and 0.66 (95% CI 0.59-0.75).

Females also had significantly lower incidence rates of melanoma in the most deprived compared with the least deprived quintiles in all three diagnosis periods: DSRR 0.74 (95% CI 0.64-0.87) for 2004-2008, 0.74 (95% CI 0.65-0.85) for 2009-2013 and 0.70 (95% CI 0.62-0.79) for 2014-2018.

There was no significant narrowing or widening of disparities over time between the least and the most deprived quintiles for either males or females.

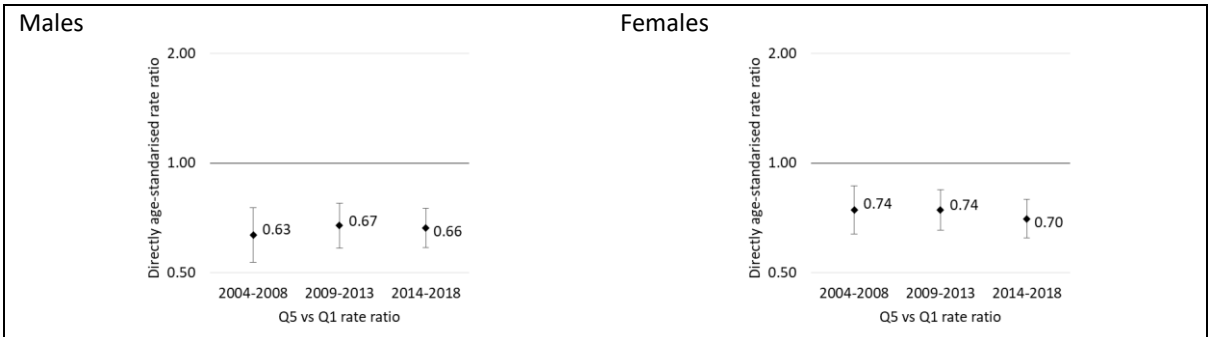


Figure 5.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for melanoma for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods

5.2 Melanoma of skin: cause-specific five-year survival

Variation by deprivation

For patients diagnosed during 2014-2018, age-standardised estimates of five-year survival for males and females combined ranged 88-93% across the five deprivation quintiles (Figure 5.2.1). For the two earlier diagnosis periods, five-year survival ranged 82-87% in 2004-2008 and 86-90% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged lower in the most deprived compared with the least deprived quintile (see also Figure 5.2.2), and a broadly similar pattern was seen for 2004-2008 and 2009-2013 (Figure 5.2.1), although for 2004-2008 this was not statistically significant (see below).

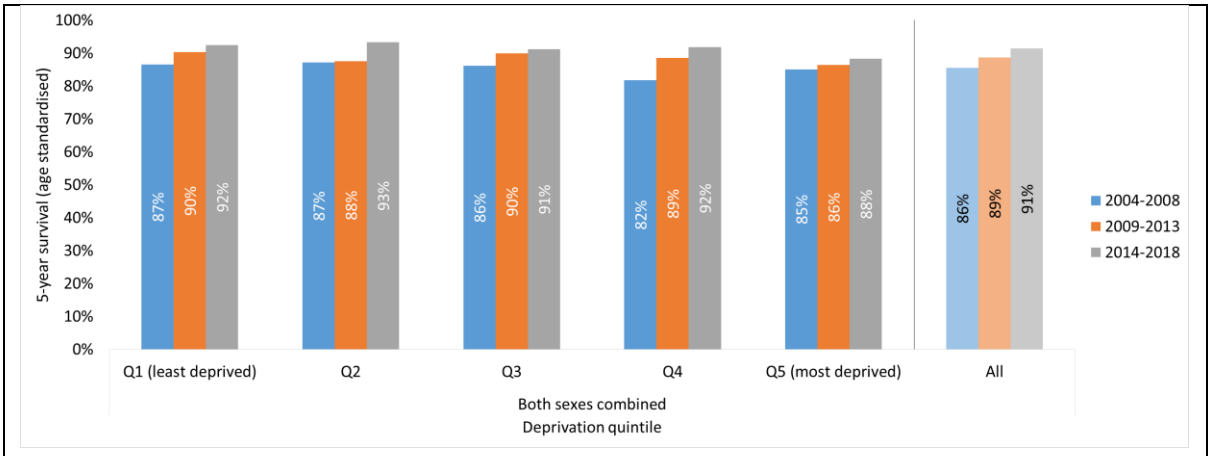


Figure 5.2.1 Cause-specific five-year survival of melanoma patients (males and females combined) by deprivation quintile and diagnosis period

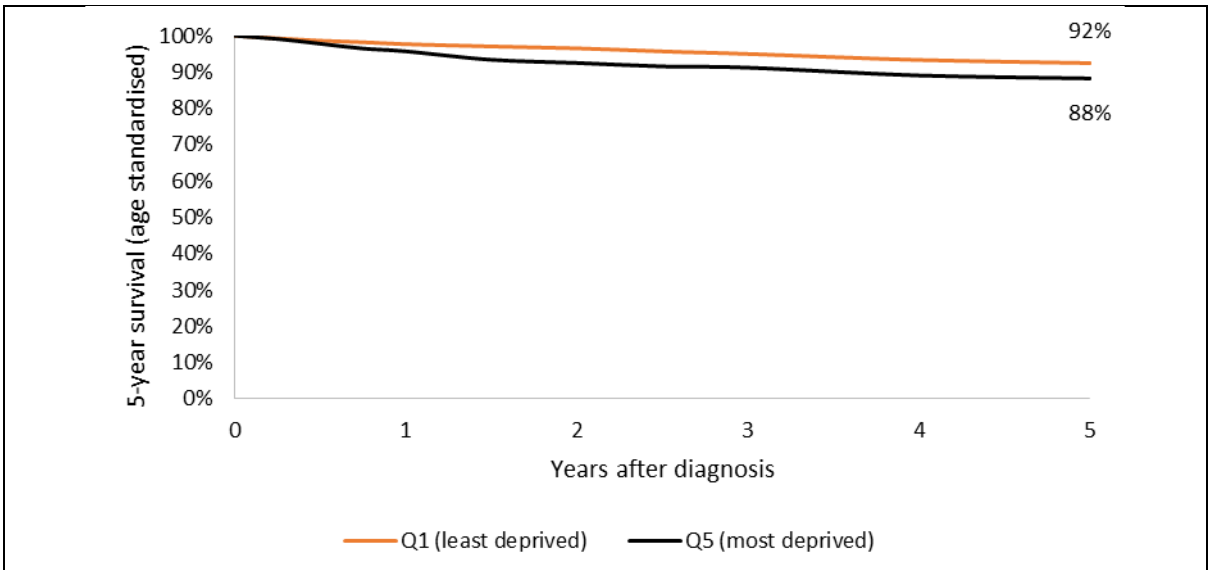


Figure 5.2.2 Cause-specific five-year survival curve for melanoma patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling confirmed higher mortality for the most deprived versus least deprived quintile: age/sex-adjusted hazard ratio (HR) 1.67 (95% CI

1.22-2.27) (Figure 5.2.3A), i.e. a 67% higher risk of death among patients in the most deprived quintile.

Five-year survival was also significantly poorer among patients from the most deprived compared with the least deprived quintile in 2009-2013 (HR 1.37, 95% CI 1.04-1.82), but not in 2004-2008 (Figure 5.2.3B).

However, while there appears to be stepwise widening in survival disparity over time, comparison of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods did not confirm a statistically significant change in the degree of disparity over time.

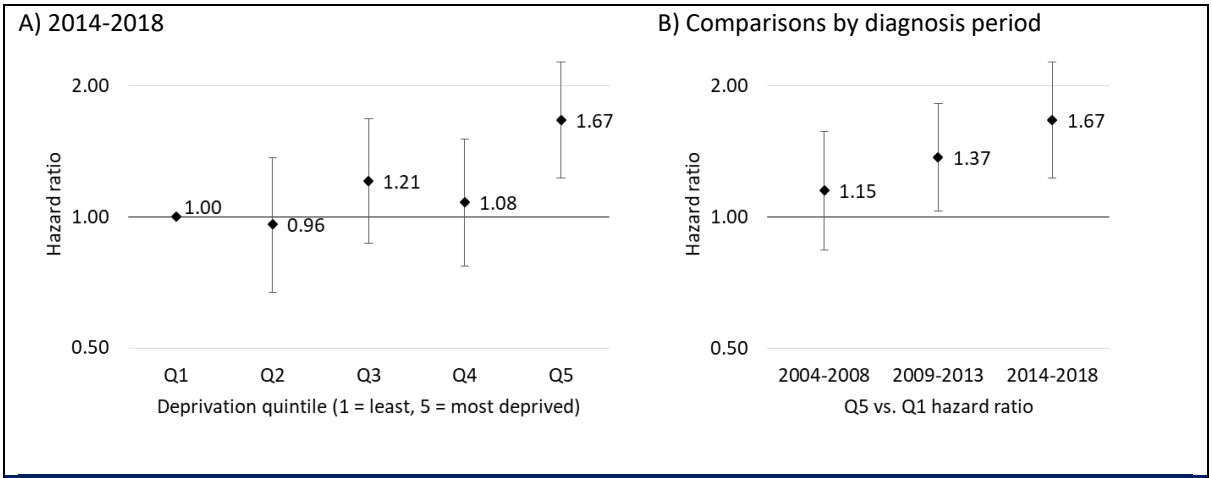


Figure 5.2.3 Mortality hazard ratios by deprivation quintile for melanoma, based on five-year cause-specific survival: A) age-and sex-adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

6 Female breast cancer

Key points

Incidence

- Females in the most deprived population quintile had a significantly lower age-standardised incidence rate of breast cancer (13% lower) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences were also seen between the most and least deprived quintiles in earlier periods (14% lower in 2004-2008 and 11% lower in 2009-2013).
- No significant narrowing or widening of disparities in incidence of breast cancer was seen over the three diagnosis periods.

Five-year survival

- Patients with breast cancer from the most deprived quintile showed significantly poorer five-year survival (age-adjusted mortality risk 41% higher) relative to the least deprived quintile, in the most recent diagnosis period (2014-2018).
- Disparities in five-year survival between the most and least deprived quintiles were also significant for patients diagnosed during 2004-2008 and 2009-2013 (mortality risk 63% and 33% higher in the most deprived quintile, respectively).
- There was no significant narrowing or widening of disparities in survival over the three diagnosis periods.

Stage

- The risk of being diagnosed with late stage (stage III/IV) breast cancer was significantly higher (24% higher) in the most deprived compared with the least deprived quintile in 2014-2018.

6.1 Breast cancer: incidence

Variation by deprivation quintile

Age-standardised rates of female breast cancer in 2014-2018 ranged 118-143 cases per 100,000 females across the five deprivation quintiles (Figure 6.1.1). Rates during 2004-2008 ranged 113-131 cases per 100,000 females, and rates during 2009-2013 ranged 121-136 cases per 100,000 females across the five quintiles.

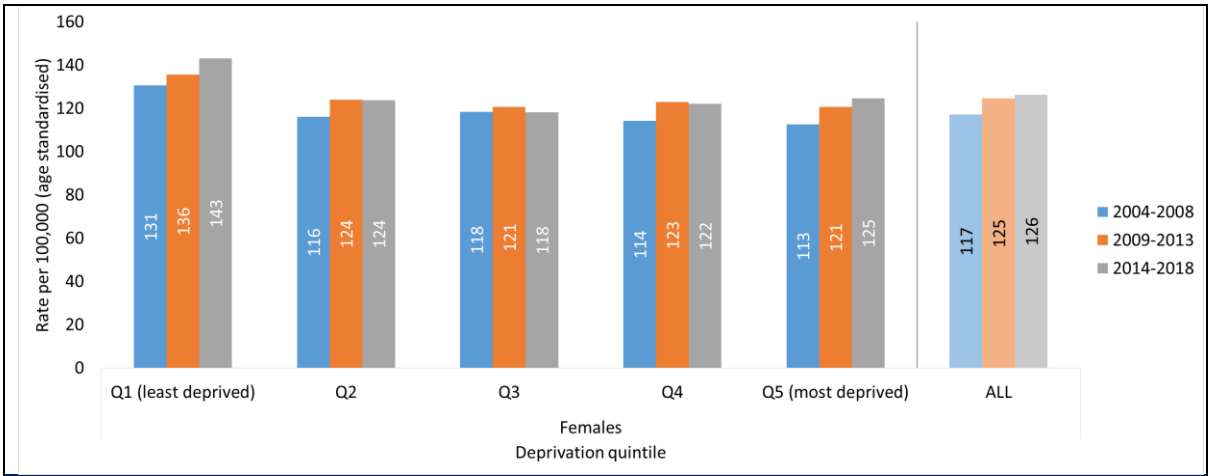


Figure 6.1.1 Incidence rate of female breast cancer per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was a significant difference in incidence rates between the least deprived quintile (Q1) and all other quintiles: DSRR Q2 0.87 (95% CI 0.82- 0.91), Q3 0.83 (95% CI 0.79- 0.87), Q4 0.85 (95% CI 0.81- 0.90), Q5 0.87 (95% CI 0.83- 0.92) (Figure 6.1.2), i.e. females in quintiles 2-5 had between 13% and 17% lower rates of breast cancer compared with those in the least deprived quintile.

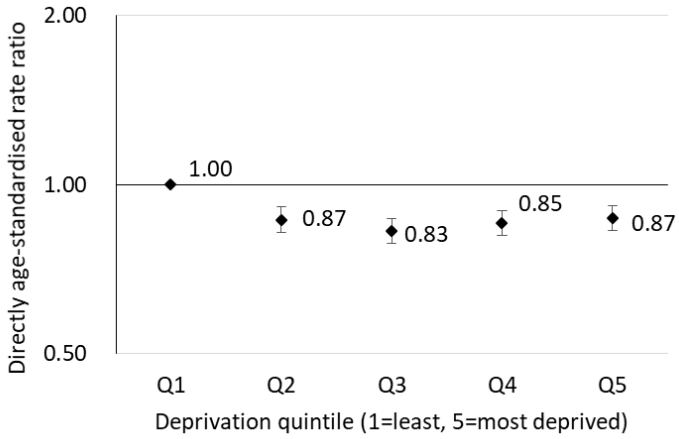


Figure 6.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for female breast cancer by deprivation quintiles, 2014-2018

Incidence rate ratios of female breast cancer between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in Figure 6.1.3. There was a significant difference in incidence of breast cancer between the most and least deprived quintiles, with populations in the most deprived quintile having a lower incidence for all

diagnosis periods: DSRR 0.86 (95% CI 0.81-0.92) for 2004-2008 (14% lower), 0.89 (95% CI 0.84-0.94) for 2009-2013 (11% lower) and 0.87 (95% CI 0.83-0.92) for 2014-2018 (13% lower).

There was no significant narrowing or widening of incidence disparities over time between the least and the most deprived quintiles.

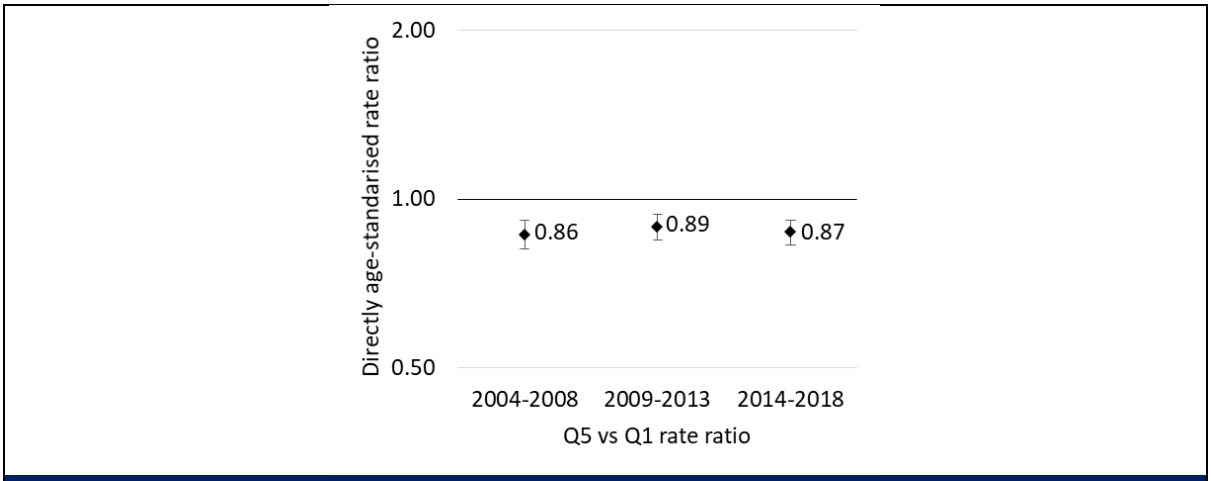


Figure 6.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for female breast cancer for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods

6.2 Breast cancer: cause-specific five-year survival

Variation by deprivation

For female patients diagnosed during 2014-2018, age-standardised estimates of five-year survival ranged 82-87% across the five deprivation quintiles (Figure 6.2.1). For the two earlier diagnosis periods, five-year survival ranged 75-83% in 2004-2008 and 80-84% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged lower in the most deprived compared with the least deprived quintile (see also Figure 6.2.2), and a broadly similar pattern was seen for the earlier periods (Figure 6.2.1).

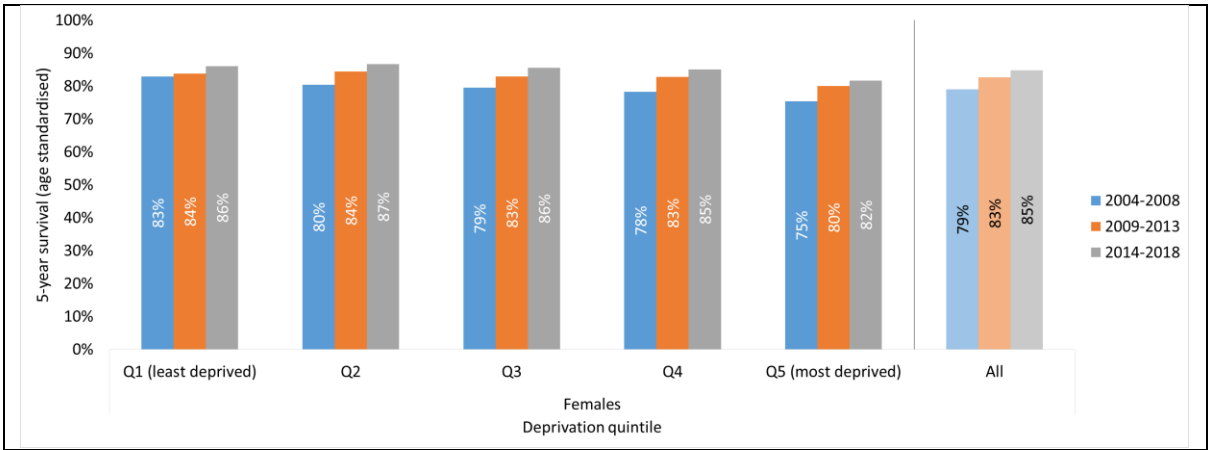


Figure 6.2.1 Cause-specific five-year survival of female breast cancer patients by deprivation quintile and diagnosis period

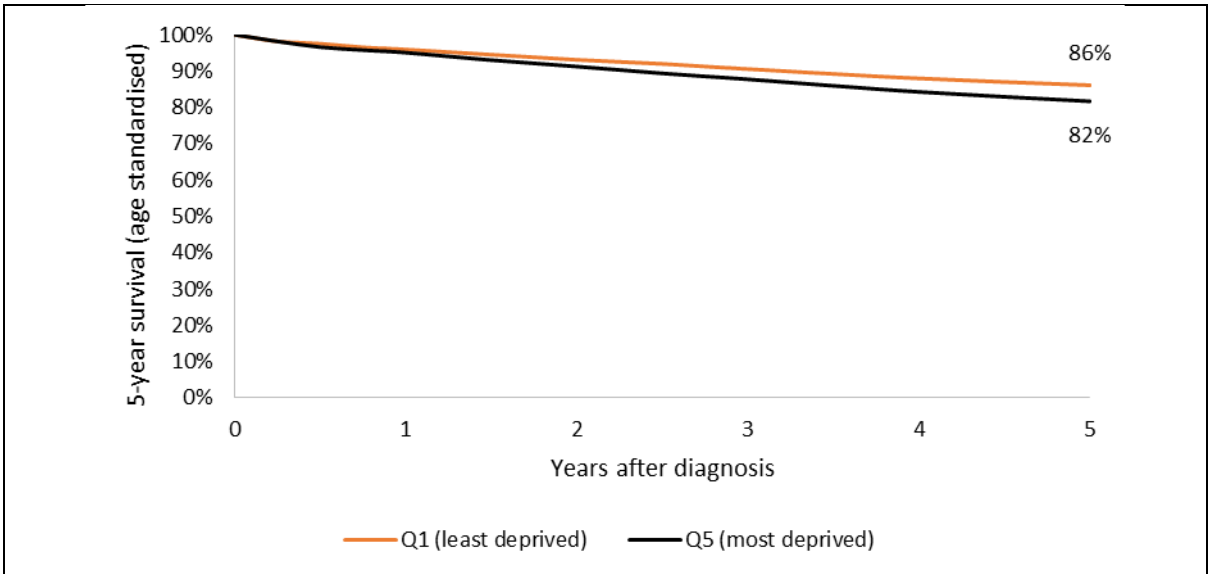


Figure 6.2.2 Cause-specific five-year survival curve for female breast cancer patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling confirmed higher mortality for the most deprived versus least deprived quintile: age-adjusted hazard ratio (HR) 1.41 (95% CI 1.19-1.68) (Figure 6.2.3A), i.e. a 41% higher risk of death within 5 years of cancer diagnosis

among patients in the most deprived quintile compared with those in the least deprived quintile.

Five-year survival was also significantly poorer among patients from the most deprived compared with the least deprived quintile in the two earlier diagnosis periods, 2004-2008 (HR 1.63, 95% CI 1.41-1.90) and 2009-2013 (HR 1.33, 95% CI 1.15-1.53) (Figure 6.2.3B).

Comparison of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods indicated no significant narrowing or widening in the degree of survival disparity over time.

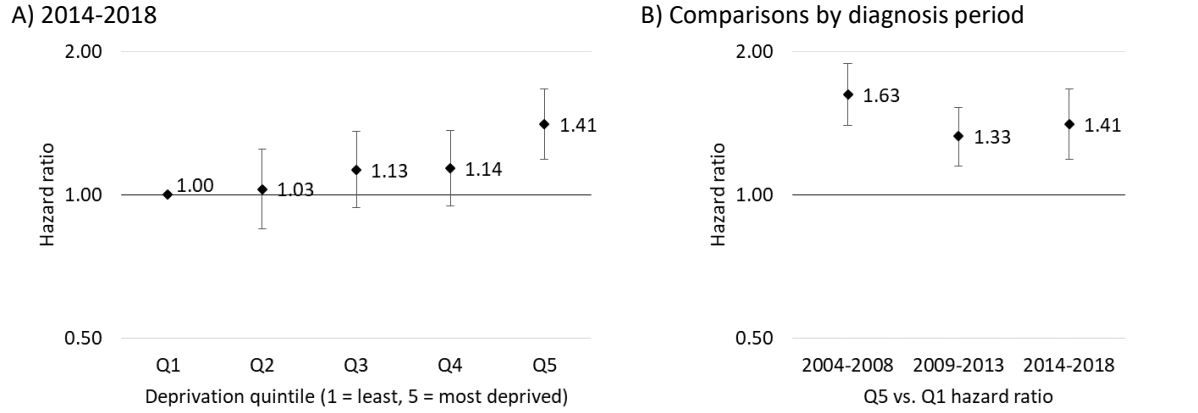


Figure 6.2.3 Mortality hazard ratios by deprivation quintile for female breast cancer, based on five-year cause-specific survival: A) age-adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

Further adjustment, for stage, attenuated, to a small or moderate degree (depending on period), the hazard ratios comparing the most deprived with the least deprived quintile: age/sex/stage-adjusted HR 1.54 (95% 1.33-1.79) for 2004-2008, 1.22 (95% CI 1.06-1.41) for 2009-2013 and 1.26 (95% CI 1.06-1.50) for 2014-2018 (not graphed).

6.3 Breast cancer: stage (2014-2018)

Variation by deprivation

Stage at diagnosis was grouped as early stage (stage I/II) or late stage (stage III/IV), excluding unstaged cases, based on TNM 7th-edition staging criteria applied to cases diagnosed during 2014-2018.

The stage breakdown of female breast cancer cases ranged 78-83% for early stage and 17-22% for late stage across the five deprivation quintiles in 2014-2018 (Figure 6.3.1). In proportional terms, the relative risk of being diagnosed with late-stage breast cancer (adjusted for age) was significantly higher in patients from the most compared with the least deprived quintiles (RR 1.24, 95% CI 1.12-1.37).

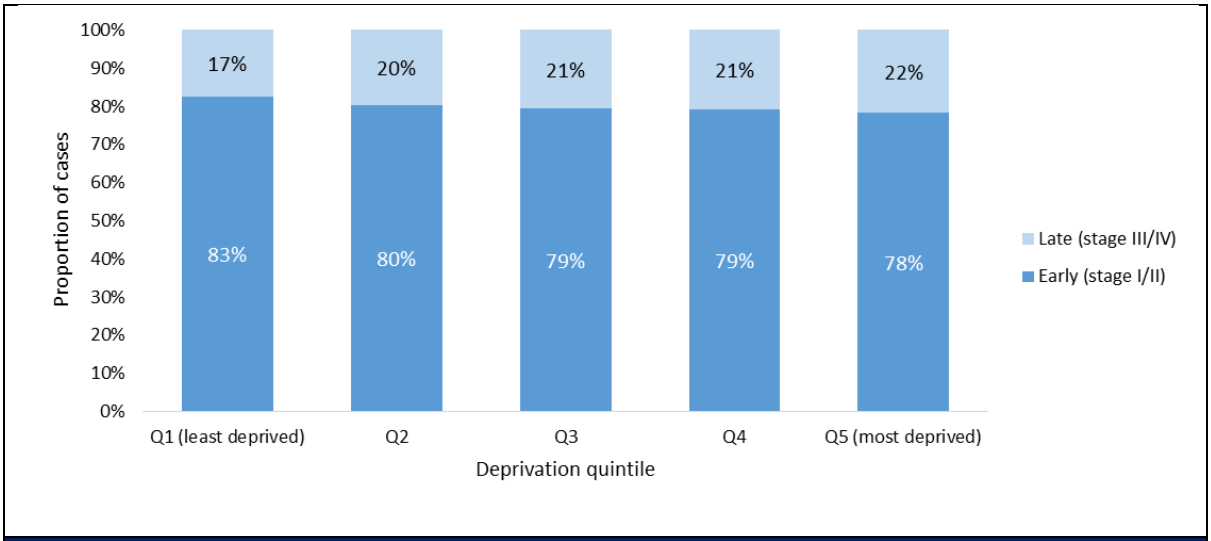


Figure 6.3.1 Stage at diagnosis for female breast cancer patients by deprivation quintile, 2014-2018

7 Cervical cancer

Key points

Incidence

- Females in the most deprived population quintile had a significantly higher age-standardised incidence rate of cervical cancer (84% higher) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences were also seen between the most and least deprived quintiles in earlier periods (99% higher in 2004-2008 and 93% higher in 2009-2013) – i.e., in all three periods, rates were almost twice as high in populations from the most deprived compared with the least deprived quintile.
- No significant narrowing or widening in disparities in incidence was seen over the three diagnosis periods.

Five-year survival

- Patients with cervical cancer in the most deprived quintile did not show significantly poorer five-year survival relative to the least deprived quintile, in the most recent diagnosis period (2014-2018).
- Patients in the most deprived quintile showed significantly poorer five-year survival (relative mortality risk 49% higher, age/sex-adjusted) relative to the least deprived quintile in 2009-2013 but there was no difference for the earlier period 2004-2008.
- There was no significant narrowing or widening of survival disparities over the three diagnosis periods.

7.1 Cervical cancer: incidence

Variation by deprivation quintile

Age-standardised rates of cervical cancer in 2014-2018 ranged 9-16 cases per 100,000 females across the five deprivation quintiles (Figure 7.1.1). Rates during 2004-2008 ranged 9-17 cases per 100,000 females, and rates during 2009-2013 ranged 11-20 cases per 100,000 females across the five quintiles.

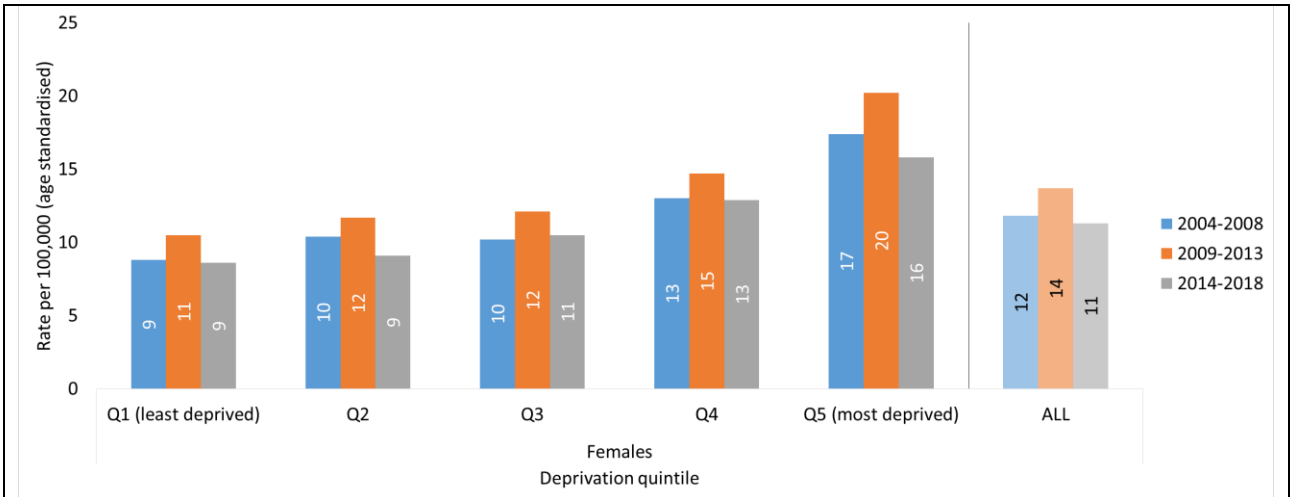


Figure 7.1.1 Incidence rate of cervical cancer per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was a significant difference in rates between the most and least deprived quintiles: DSRR 1.84 (95% CI 1.55-2.17) (Figure 7.1.2), i.e. females in the most deprived quintile had an 84% higher rate of cervical cancer compared with those in the least deprived quintile. There was also a significant difference between quintile 3 and 4 and the least deprived quintile: DSRR 1.22 (95% CI 1.02-1.47) and DSRR 1.49 (95% CI 1.25-1.78) respectively, i.e. a 22% and 49% higher rate in quintiles 3 and 4 respectively compared with the least deprived quintile.

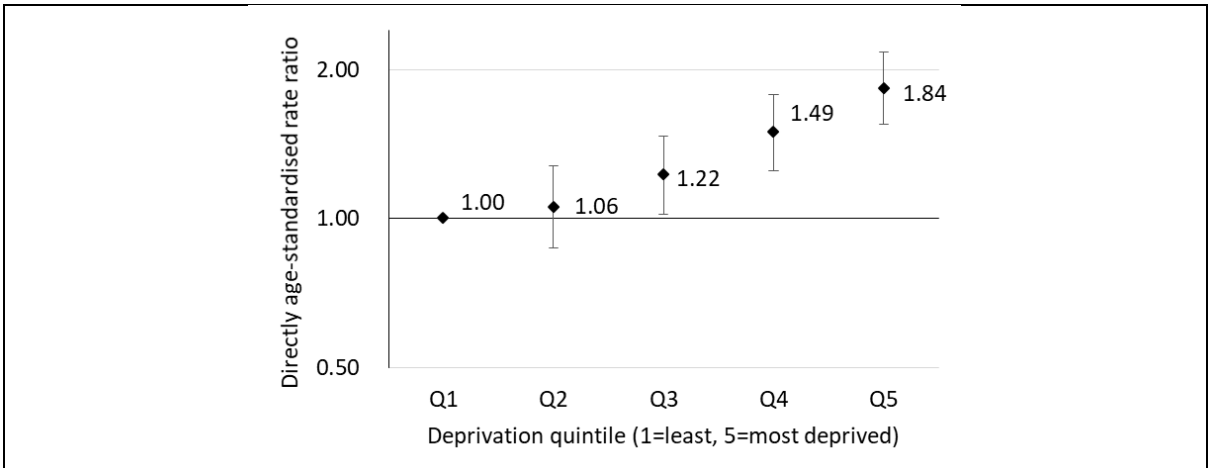


Figure 7.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for cervical cancer by deprivation quintiles, 2014-2018

Incidence rate ratios of cervical cancer between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in Figure 7.1.3. A higher

incidence of cervical cancer was observed in the most deprived compared with the least deprived quintile across all three diagnosis periods: DSRR 1.99 (95% CI 1.66-2.38) for 2004-2008, 1.93 (95% CI 1.65-2.25) for 2009-2013 and 1.84 (95% CI 1.55-2.17) for 2014-2018.

There was no significant narrowing or widening of incidence disparities over time between the least and the most deprived quintiles.

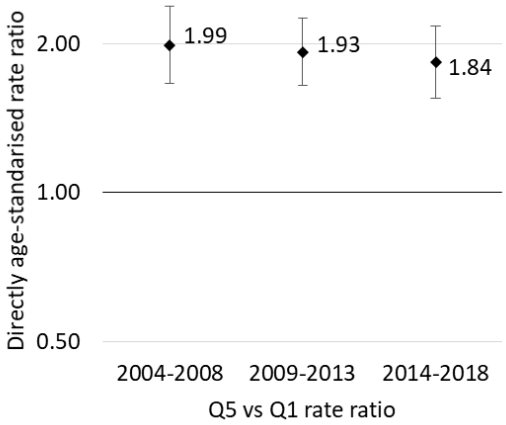


Figure 7.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for cervical cancer for most and least (Q5 vs Q1) deprived quintiles for the three diagnosis periods

7.2 Cervical cancer: cause-specific five-year survival

Variation by deprivation

For patients diagnosed during 2014-2018, age-standardised estimates of five-year survival ranged 62-71% across the five deprivation quintiles (Figure 7.2.1). For the two earlier diagnosis periods, five-year survival ranged 58-65% in 2004-2008 and 59-69% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged lower in the most deprived compared with the least deprived quintile (see also Figure 7.2.2), with a broadly similar pattern seen for 2009-2013 (Figure 7.2.1), though the pattern for 2014-2018 was not statistically significant (see below).

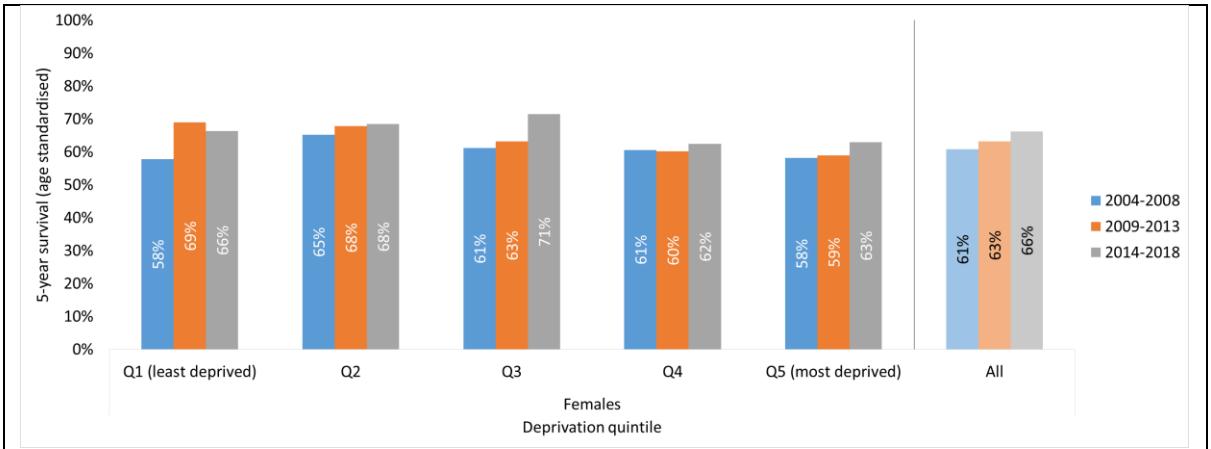


Figure 7.2.1 Cause-specific five-year survival of cervical cancer patients by deprivation quintile and diagnosis period

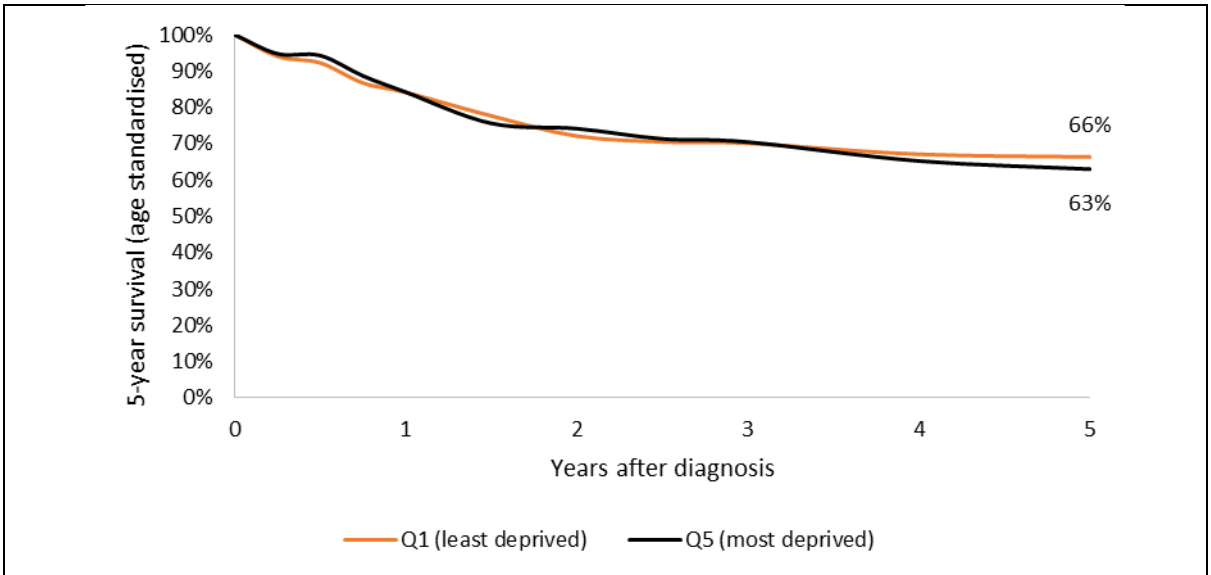


Figure 7.2.2 Cause-specific five-year survival curve for cervical cancer patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling showed no significant difference in age-adjusted mortality for the most deprived versus least deprived quintiles (Figure 7.2.3A).

There was a significant difference in mortality for patients from the most deprived compared with the least deprived quintile in the 2009-2013 diagnosis period (HR 1.49, 95%CI 1.07-2.09) but not for 2004-2008 (Figure 7.2.3B).

Comparison of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods indicated no significant narrowing or widening in the degree of survival disparity over time.

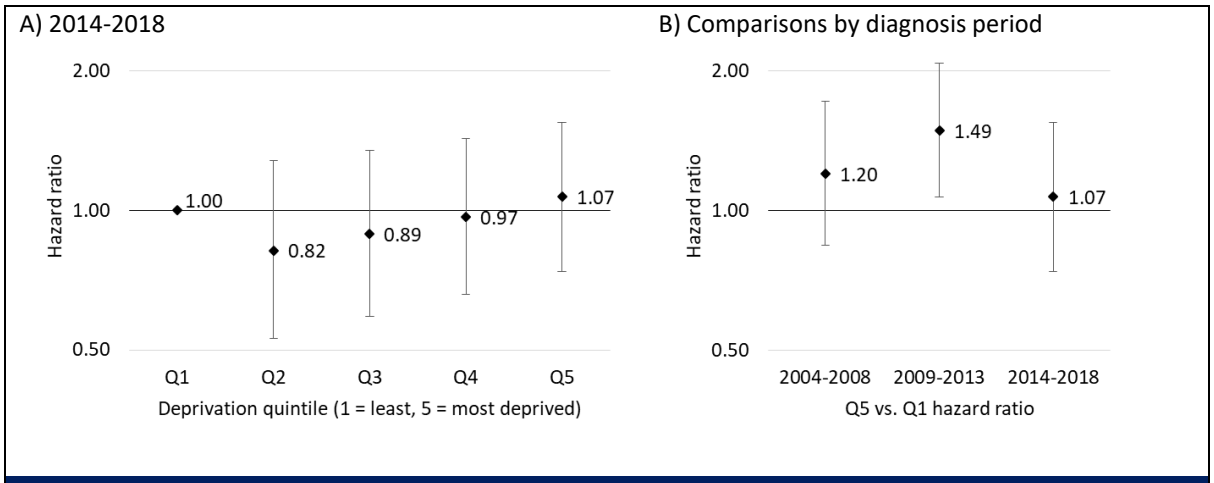


Figure 7.2.3 Mortality hazard ratios by deprivation quintile for cervical cancer, based on five-year cause-specific survival: A) age-adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

8 Prostate cancer

Key points

Incidence

- Males in the most deprived population quintile had a significantly lower age-standardised incidence rate of prostate cancer (11% lower) compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018). Significant differences were also seen between the most and least deprived quintiles in earlier periods (12% lower in 2004-2008 and 9% lower in 2009-2013).
- No significant variation narrowing or widening of incidence disparities was seen in incidence of prostate cancer over the three diagnosis periods.

Five-year survival

- Patients with prostate cancer from the most deprived quintile showed significantly poorer five-year survival (age-adjusted mortality risk 62% higher) relative to the least deprived quintile, in the most recent diagnosis period (2014-2018).
- Disparities in five-year survival between the most and least deprived quintiles were also significant for patients diagnosed during 2004-2008 and 2009-2013 (age-adjusted mortality risk 26% and 28% higher in the most deprived quintile, respectively).
- There was no significant narrowing or widening of survival disparities over the three diagnosis periods.

Stage

- The risk of being diagnosed with a late stage (stage III/IV) prostate cancer was significantly higher in the most compared with the least deprived quintile in 2014-2018 (12% higher).

8.1 Prostate cancer: incidence

Variation by deprivation quintile

Age-standardised incidence rates of prostate cancer in 2014-2018 ranged 136-153 cases per 100,000 males across the five deprivation quintiles (Figure 8.1.1). Rates during 2004-2008 ranged 137-156 cases per 100,000 males, and rates during 2009-2013 ranged 152-166 cases per 100,000 males across the five quintiles.

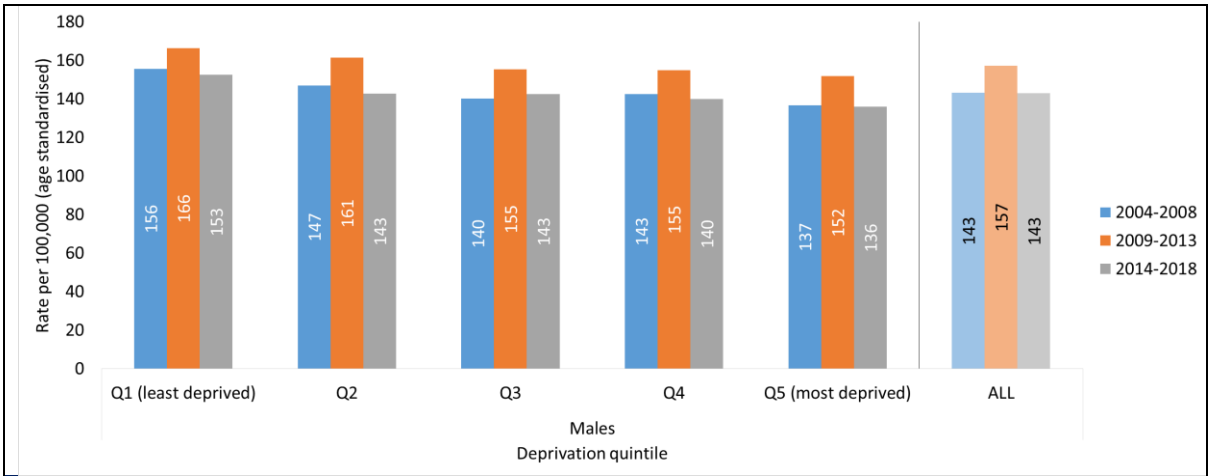


Figure 8.1.1 Incidence rate of prostate cancer per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was a significant difference in incidence rates between the most and least deprived quintiles for males: DSRR 0.89 (95% CI 0.85-0.94) (Figure 8.1.2), i.e. males in the most deprived quintile had a 11% lower rate of prostate cancer compared with those in the least deprived quintile. There was also a significant difference between quintiles 2, 3 and 4 and the least deprived quintile: DSRR 0.94 (95% CI 0.89-0.98), DSRR 0.93 (95% CI 0.89-0.98), and DSRR 0.92 (95% CI 0.87-0.96) respectively, i.e. rates in the most deprived quintiles 2, 3 and 4 were 6%, 7% and 8% lower than in the least deprived quintile, respectively.

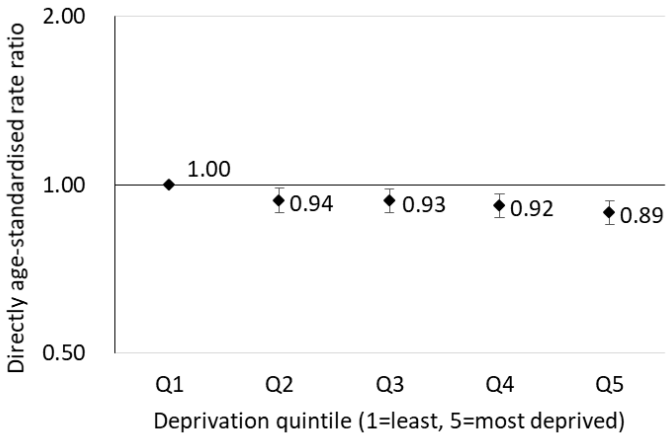


Figure 8.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for prostate cancer by deprivation quintiles, 2014-2018

Incidence rate ratios of prostate cancer between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in Figure 8.1.3. There

was a significantly lower risk of prostate cancer in those in the most deprived quintile compared with the least deprived quintile for all three diagnosis periods: DSRR 0.88 (95%CI 0.83-0.93) for 2004-2008 (12% lower), DSRR 0.91 (95% CI 0.87-0.96) for 2009-2013 (9% lower) and DSRR 0.89 (95% CI 0.85-0.94) for 2014-2018 (11% lower).

There was no significant narrowing or widening of incidence disparities over time between the least and the most deprived quintiles.

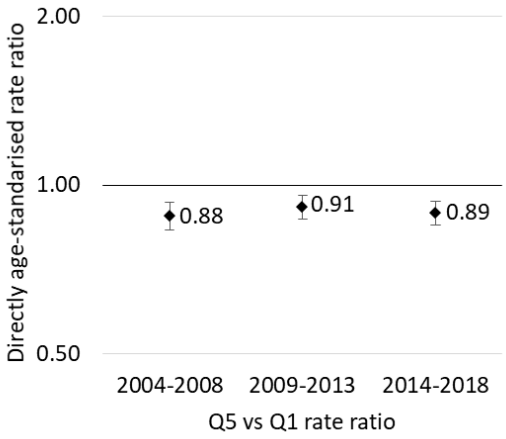


Figure 8.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for prostate cancer for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods

8.2 Prostate cancer: cause-specific five-year survival

Variation by deprivation

For patients diagnosed during 2014-2018, age-standardised estimates of five-year survival ranged 86-89% across the five deprivation quintiles (Figure 8.2.1). For the two earlier diagnosis periods, five-year survival ranged 85-87% in 2004-2008 and 87-89% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged lower in the most deprived compared with the least deprived quintile (see also Figure 8.2.2), and a broadly similar pattern was seen for the earlier periods (Figure 8.2.1).

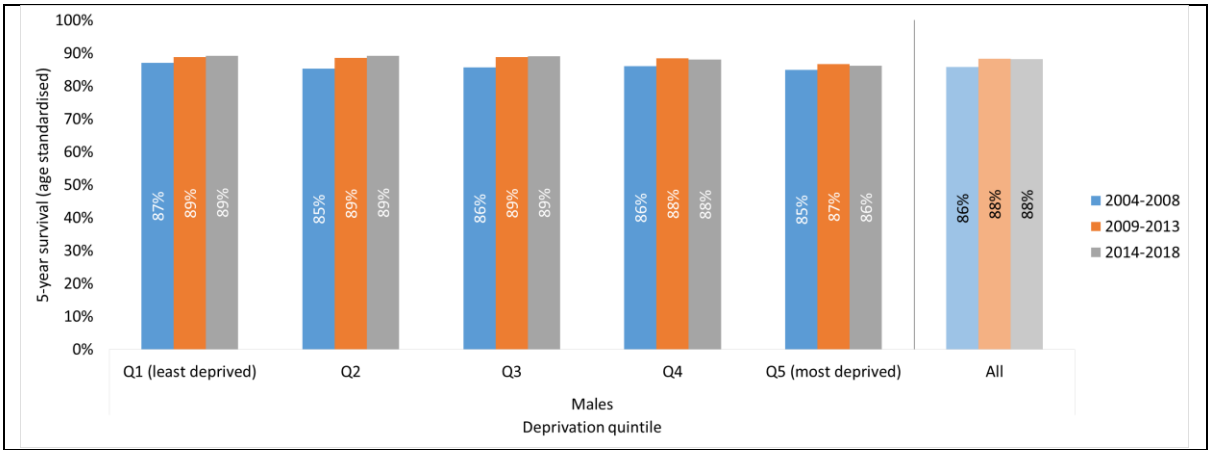


Figure 8.2.1 Cause-specific five-year survival of prostate cancer patients by deprivation quintile and diagnosis period

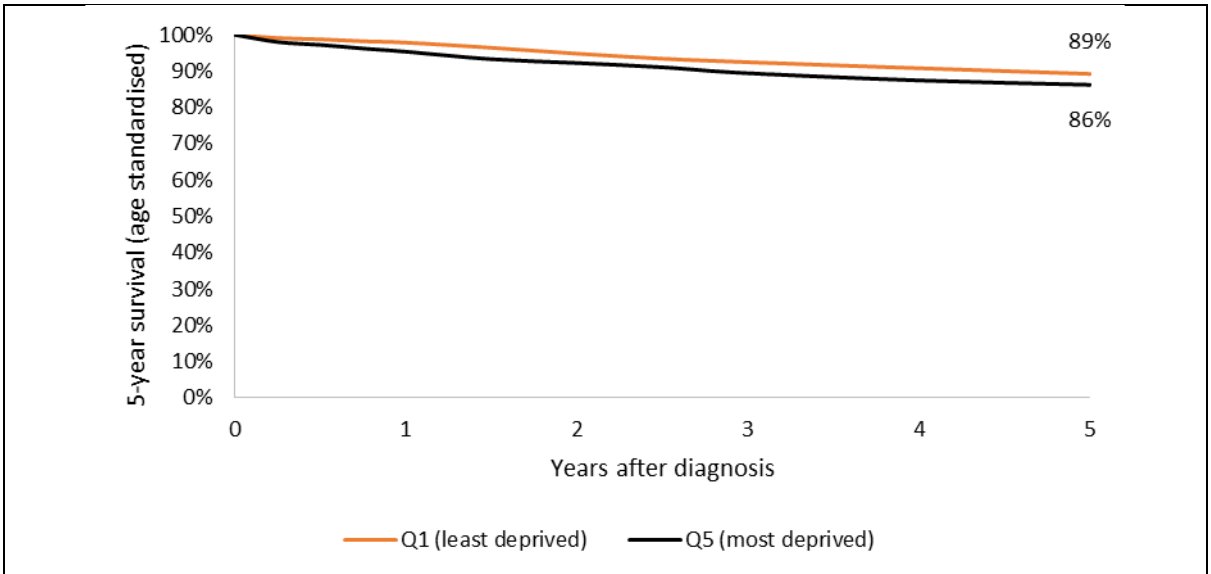


Figure 8.2.2 Cause-specific survival curve for prostate cancer patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling confirmed higher mortality for the most deprived versus least deprived quintile: age-adjusted hazard ratio (HR) 1.62 (95% CI 1.32-1.98) (Figure 8.2.3A), i.e. a 62% higher risk of death among patients in the most deprived

quintile. Mortality was also significantly higher for intermediate deprivation quintile 4 compared with the least deprived quintile: HR 1.29 (95% CI 1.04-1.60).

Five-year survival was also significantly poorer among patients from the most deprived compared with the least deprived quintile in two earlier diagnosis periods, 2004-2008 (HR 1.26, 95% CI 1.06-1.49) and 2009-2013 (HR 1.28, 95% CI 1.08-1.52) (Figure 8.2.3B).

While the survival disparity appear to be wider in the most recent period (Figure 8.2.3B), this did not reach statistical significance.

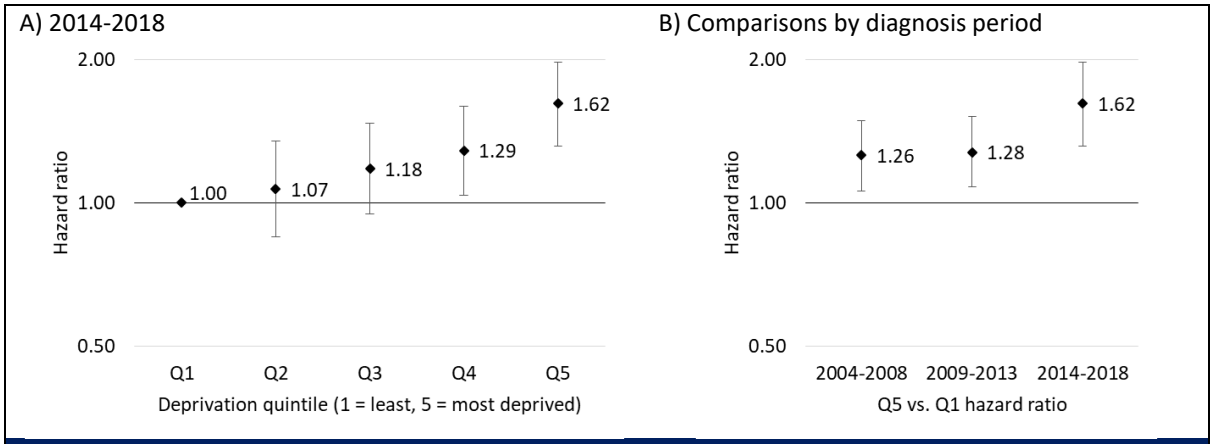


Figure 8.2.3 Mortality hazard ratios by deprivation quintile for prostate cancer, based on five-year cause-specific survival: A) age adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

Further adjustment, for cancer stage at diagnosis, moderately reduced hazard ratios comparing the most deprived with the least deprived quintile for the earlier two periods (age/stage-adjusted HR 1.16 [95% CI 0.98-1.38] for 2004-2008, 1.16 [95% CI 0.98-1.38] for 2009-2013, both no longer statistically significant), but had little or no effect for 2014-2018 (HR 1.64 [95% CI 1.34-2.01]) (not graphed).

8.3 Prostate cancer: stage (2014-2018)

Variation by deprivation

Stage at diagnosis was grouped as early stage (stage I/II) or late stage (stage III/IV), excluding unstaged cases, based on TNM 7th-edition staging criteria applied to cases diagnosed during 2014-2018.

The stage breakdown of prostate cancers ranged 69-73% for early stage and 27-31% for late stage across the five deprivation quintiles in 2014-2018 (Figure 8.3.1). In proportional terms, the relative risk of being diagnosed with a late-stage prostate cancer (adjusted for age) was significantly higher in the most compared with least deprived quintile (RR 1.12, 95% CI 1.03-1.21).

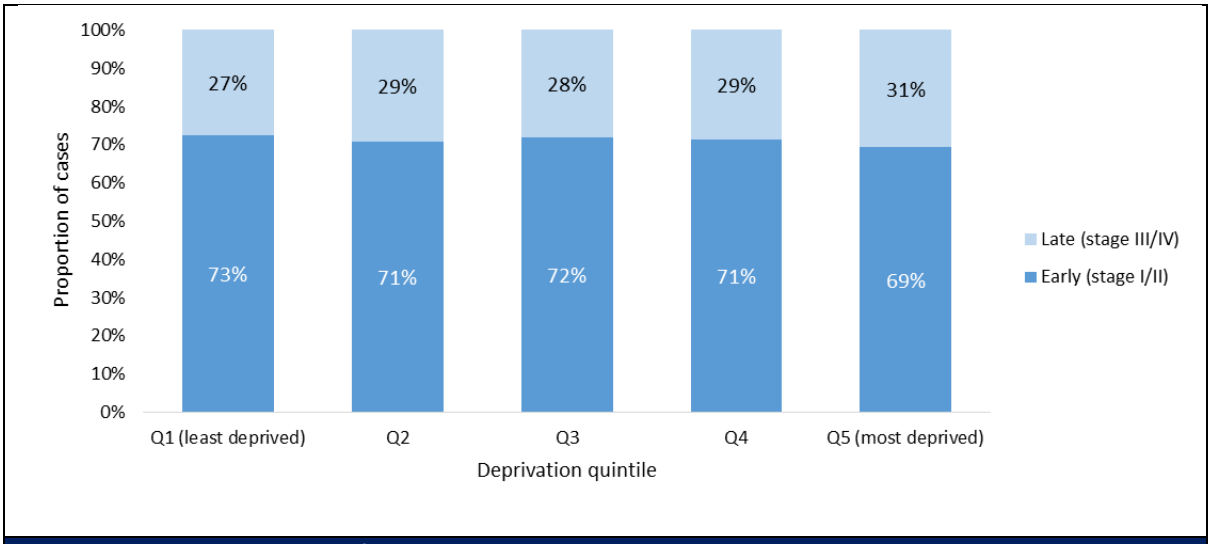


Figure 8.3.1 Stage at diagnosis for prostate cancer patients by deprivation quintile, 2014-2018

9 Lymphoma

Note: Figures here include Hodgkin and non-Hodgkin lymphomas (ICD-10 code C81 and C82-85, respectively).

Key points

Incidence

- Neither males nor females in the most deprived population quintile had significantly different incidence rates of lymphoma compared with those in the least deprived quintile, in the most recent diagnosis period (2014-2018) or in earlier periods (2004-2008 and 2009-2013).
- No significant narrowing or widening of disparities in incidence of lymphoma was seen in males or females over the three diagnosis periods.

Five-year survival

- Patients with lymphoma from the most deprived quintile did not show significantly different five-year survival relative to the least deprived quintile, in the most recent diagnosis period (2014-2018).
- However, disparities in five-year survival between the most and least deprived quintiles were significant for patients diagnosed during 2004-2008 and 2009-2013 (mortality risk 24% and 23% higher in the most deprived quintile, respectively).
- There was no significant narrowing or widening of survival disparities over the three diagnosis periods.

9.1 Lymphoma: incidence

Variation by deprivation quintile

Age-standardised rates of lymphoma in 2014-2018 ranged 20-25 cases per 100,000 males and 15-17 cases per 100,000 females across the five deprivation quintiles (Figure 9.1.1). Rates during 2004-2008 ranged 19-20 cases per 100,000 males and 14-16 cases per 100,000 females, and rates during 2009-2013 ranged 20-22 cases per 100,000 males and 15-18 cases per 100,000 females across the five quintiles.

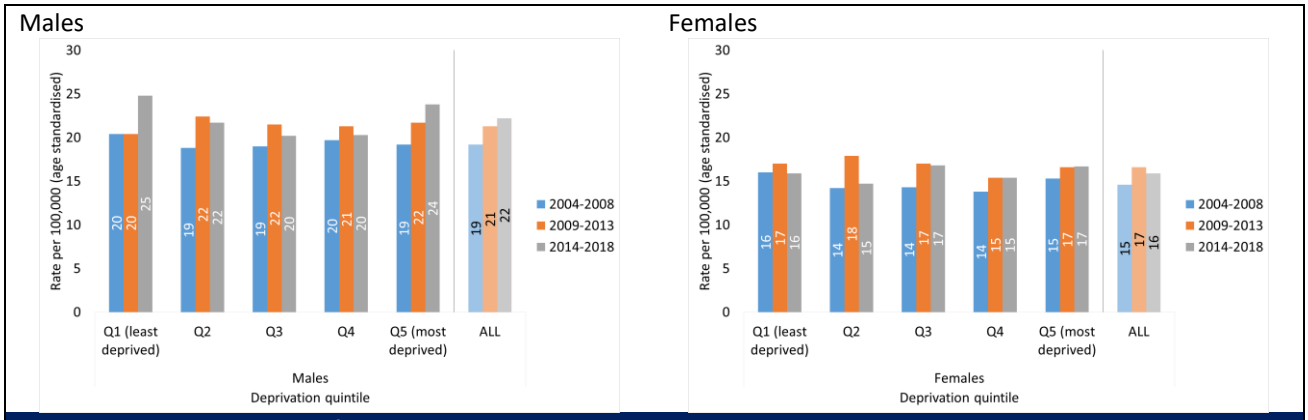


Figure 9.1.1 Incidence rate of lymphoma per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was no difference in incidence rates between the most and least deprived quintiles for either sex (Figure 9.1.2). There was a significant difference in males between quintiles 2, 3 and 4 and the least deprived quintile: DSRR 0.88 (95% CI 0.77-0.99), DSRR 0.82 (95% CI 0.72-0.92) and DSRR 0.82 (95% CI 0.72-0.93) respectively, i.e. rates for quintiles 2, 3 and 4 were 12%, 18% and 18% lower than the least deprived quintile, respectively.

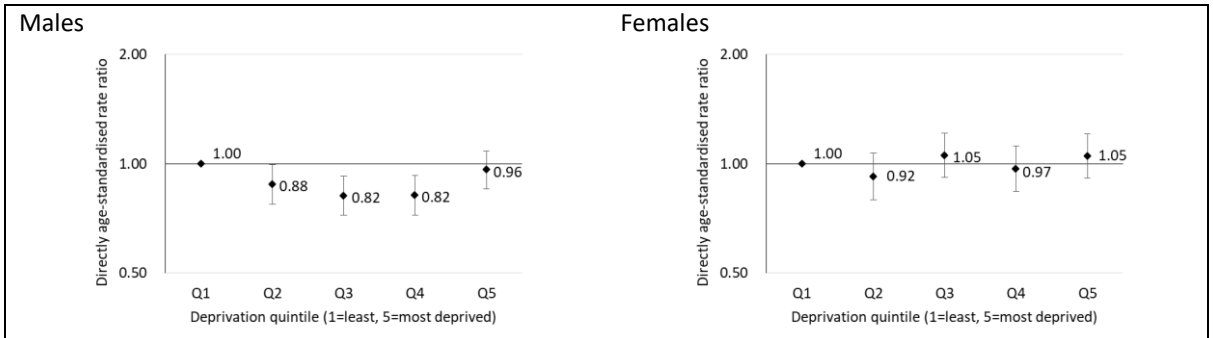
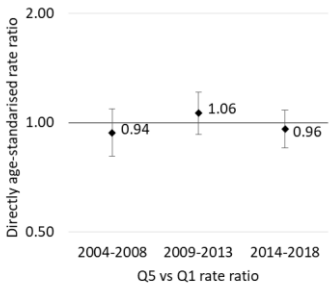


Figure 9.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for lymphoma by sex and deprivation quintiles, 2014-2018

Incidence rate ratios of lymphoma between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in Figure 9.1.3. There was no significant difference between the most and least deprived quintiles for any of the three diagnosis periods for either sex.

No significant narrowing or widening of incidence disparities was seen over time between the least and the most deprived quintiles for males or females.

Males



Females

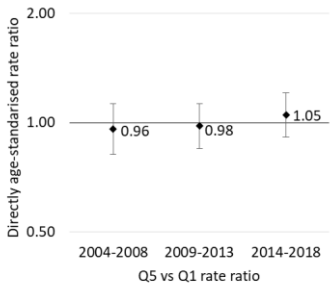


Figure 9.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for lymphoma for most and least (Q5 vs Q1) deprived quintiles by for three diagnosis periods

9.2 Lymphoma: cause-specific five-year survival

Variation by deprivation

For patients diagnosed during 2014-2018, age-standardised estimates of five-year survival for males and females combined ranged 70-73% across the five deprivation quintiles (Figure 9.2.1). For the two earlier diagnosis periods, five-year survival ranged 61-66% in 2004-2008 and 64-70% in 2009-2013 across the deprivation quintiles.

In the most recent period, 2014-2018, five-year survival averaged slightly lower (but not significantly lower) in the most deprived compared with the least deprived quintile (see also Figure 9.2.2), and a broadly similar pattern was seen for the earlier periods (Figure 9.2.1).

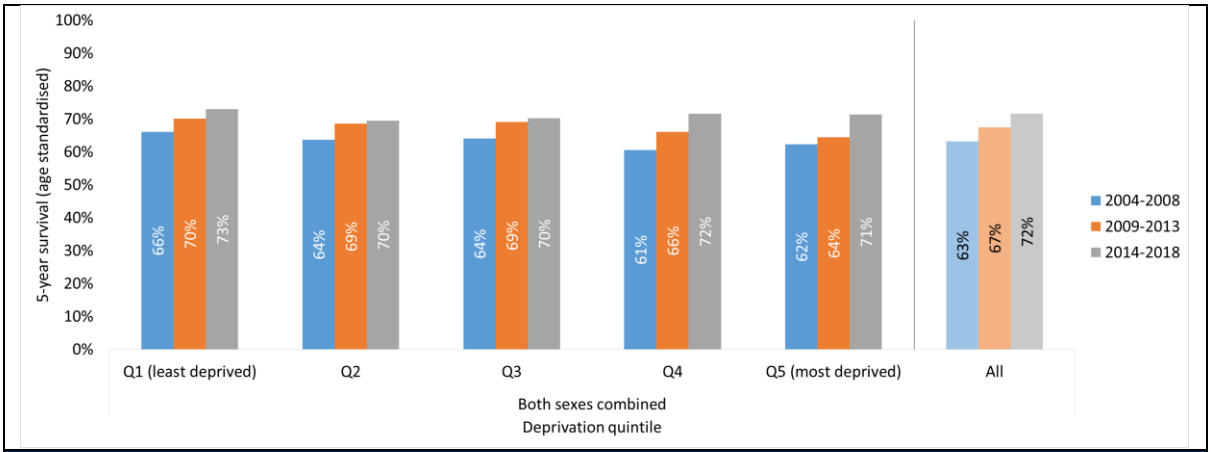


Figure 9.2.1 Cause-specific five-year survival of lymphoma patients (males and females combined) by deprivation quintile and diagnosis period

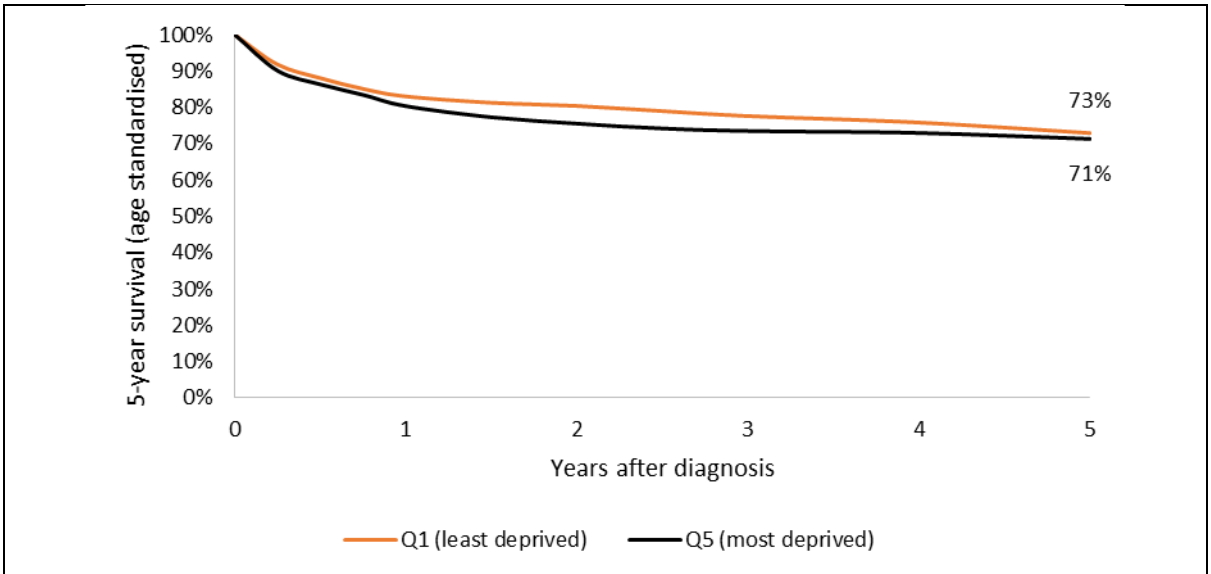


Figure 9.2.2 Cause-specific five-year survival curve for lymphoma patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling found no significant difference in mortality for the most deprived versus the least deprived quintile (Figure 9.2.3A).

Five-year survival was found to be significantly poorer among patients from the most deprived compared with the least deprived quintile in 2009-2013 (HR 1.23, 95% CI 1.01-1.50) and 2004-2008 (HR 1.24, 95% CI 1.01-1.54) (Figure 9.2.3B).

However, comparison of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods indicated no significant narrowing or widening over time in the degree of disparity.

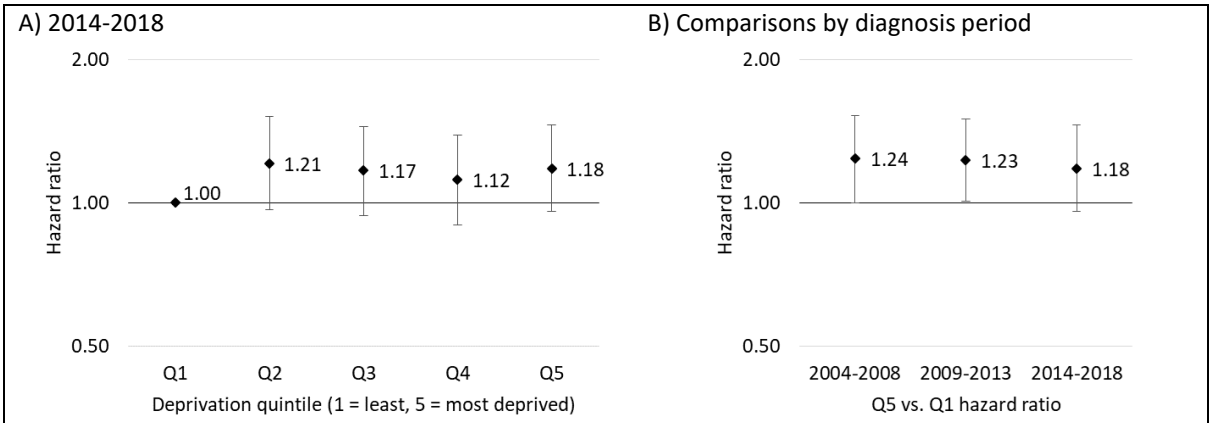


Figure 9.2.3 Mortality hazard ratios by deprivation quintile for lymphoma, based on five-year cause-specific survival: A) age-and sex-adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

10 Leukaemia

Key points

Incidence

- There was no significant difference in the age-standardised incidence rate of leukaemia in males between the most and least deprived quintiles in the most recent diagnosis period (2014-2018) and in 2004-2008. Males in the most deprived quintile had a significantly lower incidence rate compared with those in the least deprived quintile in 2009-2013 (18% lower).
- Similarly, in females, there was no significant difference in incidence rate between the most and least deprived quintiles in the most recent period and in 2004-2008. However, females in the most deprived quintile had a significantly lower age-standardised rate of leukaemia compared with those in the least deprived quintile in 2009-2013 (20% lower).
- In males, there was a significant difference in incidence disparity between the most and least deprived quintiles between 2004-2008 and 2009-2013 and in females between 2009-2013 and 2014-2018, but there was no consistent pattern over the three periods.

Five-year survival

- There was no difference in five-year survival of patients with leukaemia between those from the most and least deprived quintiles across any of the three diagnosis periods.
- There was no significant narrowing or widening of survival disparities over the three diagnosis periods.

10.1 Leukaemia: incidence

Variation by deprivation quintile

Age-standardised rates of leukaemia in 2014-2018 ranged 13-15 cases per 100,000 males and 7-9 cases per 100,000 females across the five deprivation quintiles (Figure 10.1.1). Rates during 2004-2008 ranged 16-18 cases per 100,000 males and 8-10 cases per 100,000 females, and rates during 2009-2013 ranged 14-17 cases per 100,000 males and 8-10 cases per 100,000 females across the five quintiles.

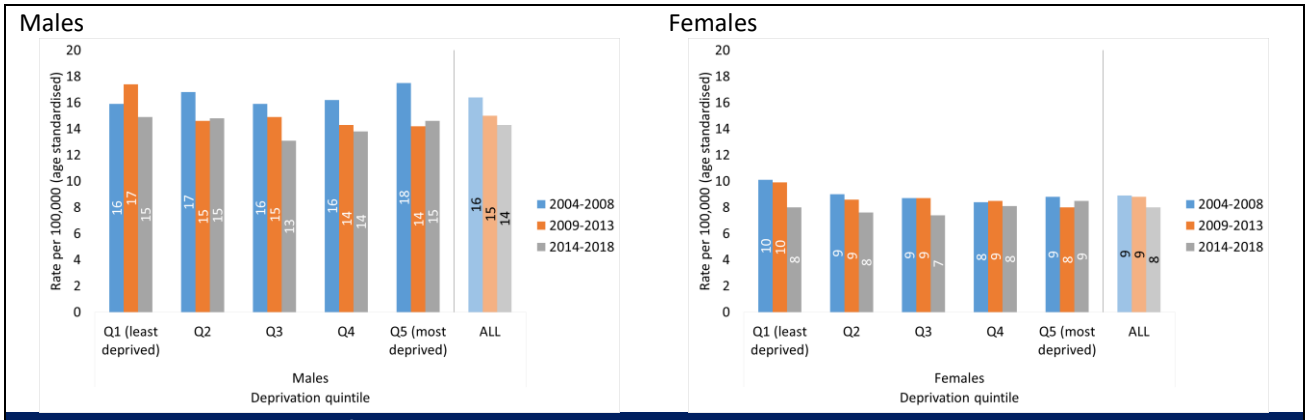


Figure 10.1.1 Incidence rate of leukaemia per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was no significant difference in incidence rates between the most and least deprived quintiles for males or females (Figure 10.1.2).

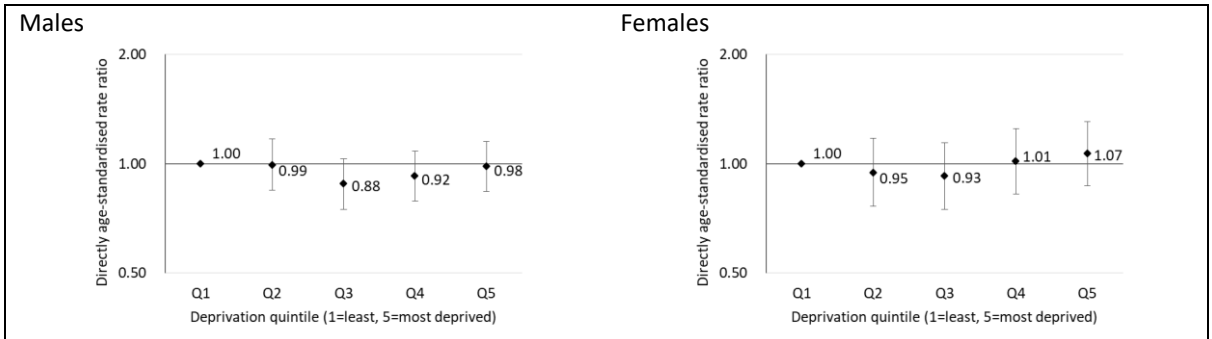
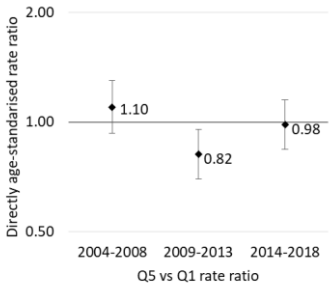


Figure 10.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for leukaemia by deprivation quintiles, 2014-2018

Incidence rate ratios of leukaemia between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are compared in Figure 10.1.3. Significant disparity was seen for both males and females in 2009-2013 only (lower rate in the most deprived quintile compared with the least deprived quintile): DSRR 0.82 (95% CI 0.70-0.95) and DSRR 0.80 (95% CI 0.66-0.88), respectively.

Disparities in incidence rates between the most and the least deprived quintiles in males differed significantly between 2004-2008 (DSRR 1.10, 95% CI 0.93-1.30) and 2009-2013 (DSRR 0.82, 95% CI 0.70-0.95), $p<0.05$ for difference. In females, disparities in incidence rates between the most and the least deprived quintiles differed significantly between 2009-2013 (DSRR 0.80, 95% CI 0.66-0.98) and 2014-2018 (DSRR 1.07, 95% CI 0.87-1.31), $p<0.05$ for difference.

Males



Females

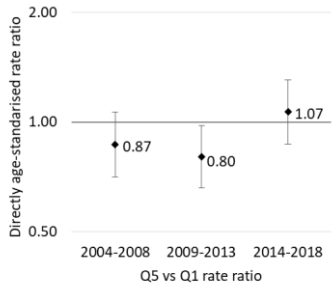


Figure 10.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for leukaemia for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods

10.2 Leukaemia: cause-specific five-year survival

Variation by deprivation

For patients diagnosed during 2014-2018, age-standardised estimates of five-year survival for males and females combined ranged 67-71% across the five deprivation quintiles (Figure 10.2.1). For the two earlier diagnosis periods, five-year survival ranged 60-67% in 2004-2008 and 63-69% in 2009-2013 across the deprivation quintiles.

In all three diagnosis periods, average five-year survival among leukaemia patients was very similar in the most deprived compared with the least deprived quintile.

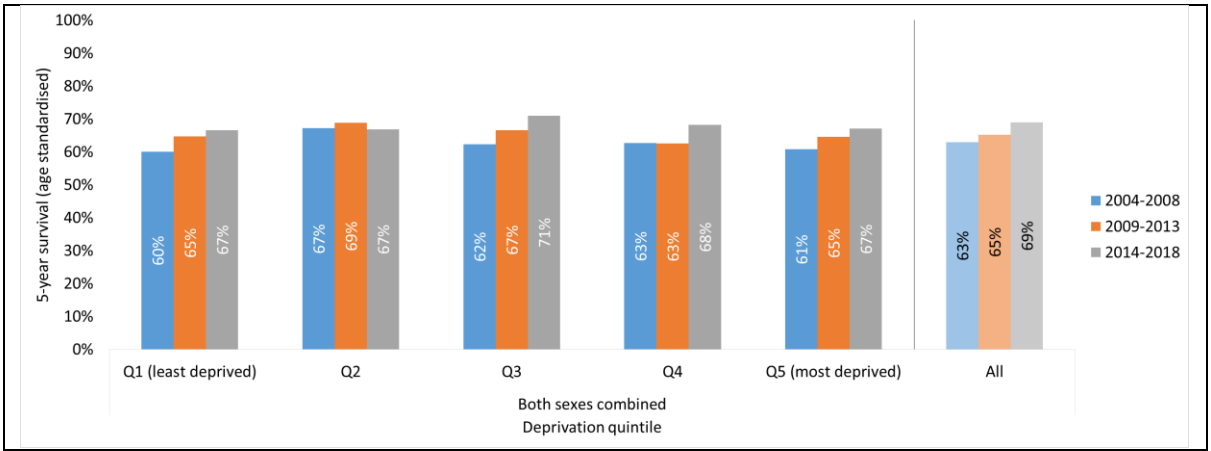


Figure 10.2.1 Cause-specific five-year survival of leukaemia patients (males and females combined) by deprivation quintile and diagnosis period

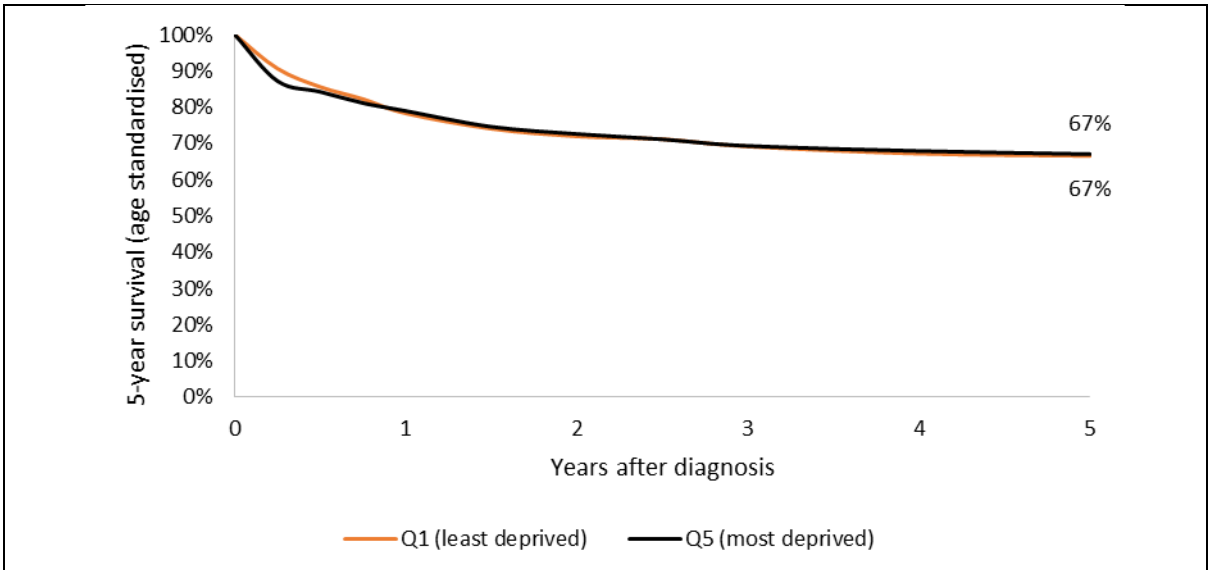


Figure 10.2.2 Cause-specific five-year survival curve for leukaemia patients: comparison of least and most deprived quintiles, 2014-2018

For the most recent period, 2014-2018, Cox modelling found no significant difference in mortality for the most deprived versus least deprived quintile: age/sex-adjusted hazard ratio (HR) 0.99 (95% CI 0.77-1.27) (Figure 10.2.3A).

Five-year survival likewise did not differ significantly between patients from the most deprived and the least deprived quintile in the earlier diagnosis periods (Figure 10.2.3B).

Comparison of the hazard ratios of the most to least deprived quintiles across the three diagnosis periods indicated no significant narrowing or widening in the degree of survival disparity over time.

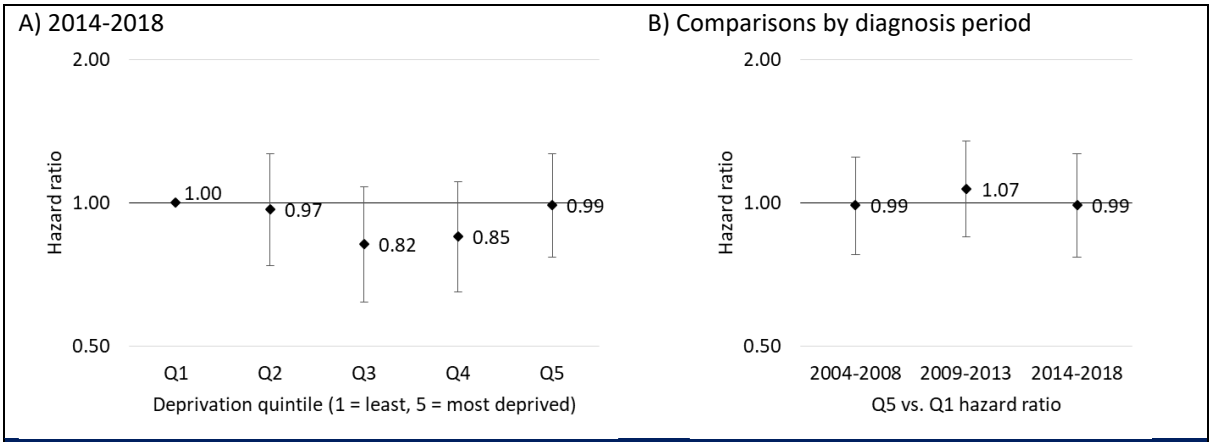


Figure 10.2.3 Mortality hazard ratios by deprivation quintile for leukaemia, based on five-year cause-specific survival: A) age-and sex-adjusted model 2014-2018 and B) Q5 vs Q1 hazard ratio for three diagnosis periods

11 Non-melanoma skin cancer

Note: Survival is not examined for NMSC, as five-year cause-specific survival would generally exceed 99%. NMSC is not included in the analyses of incidence and survival in the "all cancers" section earlier.

Key points

Incidence

- Males in the most deprived population quintile had a significantly lower age-standardised incidence rate of NMSC (36% lower) compared with those in the least deprived quintile in the most recent diagnosis period (2014-2018). Differences were also seen between the most and least deprived quintiles in earlier periods (28% lower in 2004-2008 and 32% lower in 2009-2013).
- Females in the most deprived population quintile had a significantly lower age-standardised incidence rate of NMSC (37% lower) compared with those in the least deprived quintile in the most recent diagnosis period (2014-2018). Differences were also seen between the most and least deprived quintiles in earlier periods (28% lower in 2004-2008 and 36% lower in 2009-2013).
- There was a significant widening of deprivation-related disparities for males in the most and least deprived quintiles between 2004-2008 and 2014-2018 and between 2009-2013 and 2014-2018 for males.
- In females, there was a significant widening of deprivation-related disparities between the most and least deprived quintiles between 2004-2008 and 2009-2013 and between 2004-2008 and 2014-2018.

11.1 Non-melanoma skin cancer: incidence

Variation by deprivation quintile

Age-standardised rates of NMSC in 2014-2018 ranged 211-328 cases per 100,000 males and 138-221 cases per 100,000 females across the five deprivation quintiles (Figure 11.1.1). Rates during 2004-2008 ranged 180-252 cases per 100,000 males and 121-180 cases per 100,000 females, and rates during 2009-2013 ranged 199-308 cases per 100,000 males and 137-213 cases per 100,000 females across the five quintiles.

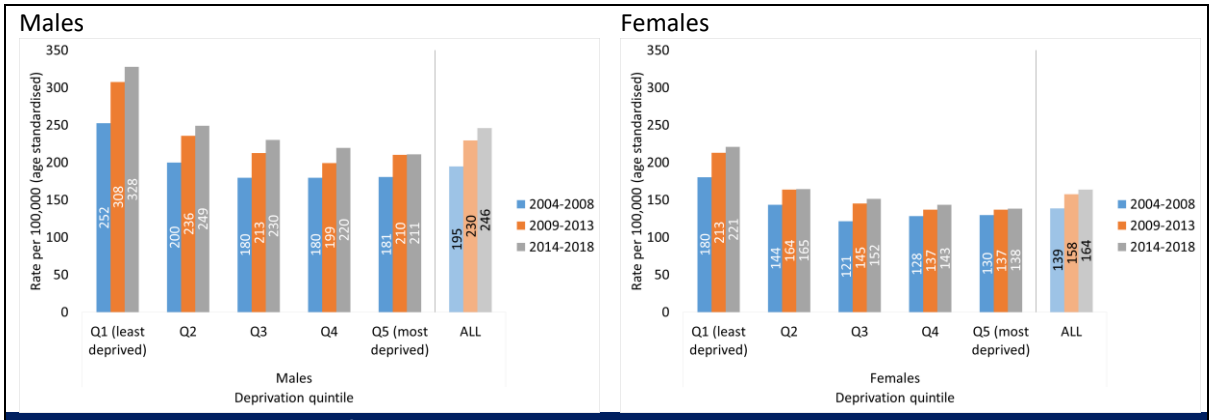


Figure 11.1.1 Incidence rate of NMSC per 100,000, by deprivation quintile and diagnosis period

In the most recent period (2014-2018), there was a significant difference in rates between the most and least deprived quintiles for males: DSRR 0.64 (95% CI 0.62-0.67) (Figure 11.1.2), i.e. males in the most deprived quintile had a 36% lower rate of NMSC compared with those in the least deprived quintile. There were also significant differences between quintiles 2, 3 and 4 and the least deprived quintile: DSRR 0.76 (95% CI 0.73-0.79), DSRR 0.70 (95% CI 0.68-0.73) and DSRR 0.67 (95% CI 0.65-0.69) respectively, i.e. between 24% and 33% lower rates than the least deprived quintile.

In females, there was a significantly lower rate in the most deprived compared with the least deprived quintile: DSRR 0.63 (95% CI 0.60-0.65) (Figure 11.1.2), and for quintiles 2, 3 and 4: DSRR 0.75 (95% CI 0.72-0.78), 0.69 (95% CI 0.66-0.71) and 0.65 (95% CI0.62-0.68), respectively.

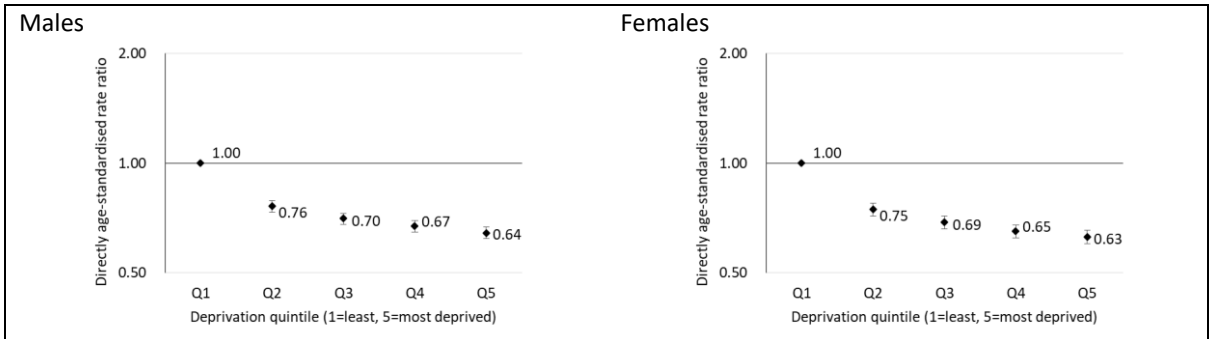


Figure 11.1.2 Age-standardised incidence rate ratios and 95% confidence intervals for NMSC by deprivation quintiles, 2014-2018

Incidence rate ratios of NMSC between the most and least deprived quintiles for each of the periods 2004-2008, 2009-2013 and 2014-2018 are shown in Figure 11.1.3. Disparities in incidence rates of NMSC for males in the most and least deprived quintiles widened significantly between the periods 2004-2008 (DSRR 0.72, 95% CI 0.68-0.75, p<0.001) and 2014-2018 (DSRR 0.64, 95% CI 0.62-0.67), and between 2009-2013 (DSRR 0.68, 95% CI 0.66-0.71, p<0.05) and 2014-2018, p<0.05 for differences. There was no significant change in disparities in males in the most and least deprived quintiles between 2004-2008 and 2009-2013.

In females, disparities in incidence of NMSC between the least and the most deprived quintiles widened significantly between 2004-2008 (DSRR 0.72 95% CI 0.68-0.76) and 2009-2013 (DSRR 0.64 95% CI 0.62-0.67), and between 2004-2008 and 2014-2018 (DSRR 0.63 95% CI 0.60-0.65), p<0.05 for differences. There was no significant change in incidence disparities in females between 2009-2013 and 2014-2018.

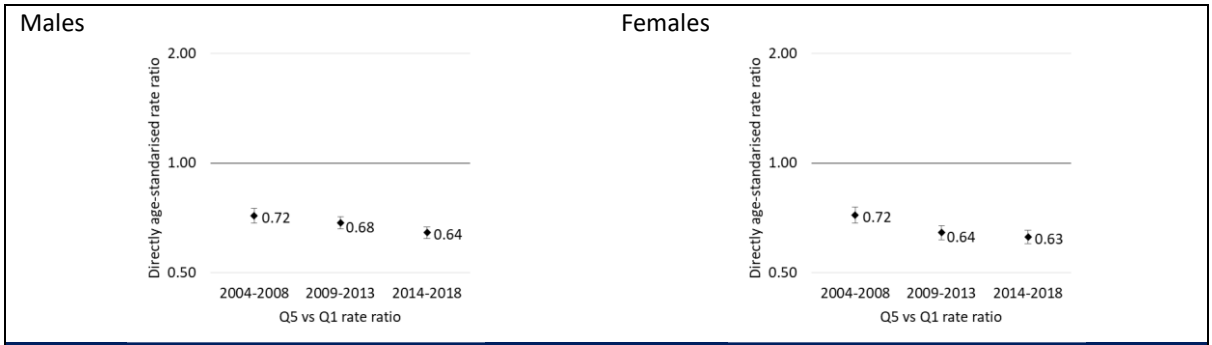


Figure 11.1.3 Age-standardised incidence rate ratios and 95% confidence intervals for NMSC for most and least (Q5 vs Q1) deprived quintiles for three diagnosis periods

Discussion

This report has assessed inequalities, by deprivation, in incidence and survival for cancer patients in Ireland for three diagnosis periods (2004-2008, 2009-2013 and 2014-2018) and in stage for 2014-2018. This is the first report to present a time series in relation to inequalities by deprivation for cancer, overall and for specific cancers, in Ireland.

Incidence

The incidence of overall invasive cancer (excluding NMSC) was 7% higher for males and 5% higher for females in the most deprived quintile of the population, compared with the least deprived quintile for both females and males in the most recent period 2014-2018. In males, incidence of overall cancer was higher for the most deprived quintile compared with the least deprived quintile for the two earlier periods, but there was no significant change in incidence disparity between the most and least deprived quintiles over time. In females, overall incidence in cancer was higher for the most deprived quintile compared with the least deprived quintile for 2009-2013 but not for 2004-2008. However, as seen for males, there was no significant variation in disparities in overall cancer incidence in females over the three diagnosis periods.

Of the individual cancers examined, stomach, lung and cervical cancer demonstrated a clear pattern of populations in the most deprived quintile having a higher incidence compared with those in the least deprived quintile, for each of the diagnosis periods. In the most recent period, incidence in the most deprived quintile was 48% and 59% higher in males for stomach and lung cancer respectively and 63%, 71% and 84% higher in females for stomach, lung and cervical cancer respectively, compared with the least deprived quintile. There was no significant narrowing or widening in this disparity over the three periods for any of these three cancers.

A different pattern was observed in melanoma, NMSCs, breast and prostate cancers, with a lower incidence of cancer observed in both males and females in the most deprived quintile compared with the least deprived quintiles. During 2014-2018, rates were 34%, 36% and 11% lower for melanoma, NMSC and prostate cancer respectively in males and 30%, 37% and 13% lower for melanoma, NMSC and breast cancer respectively in females, compared with the least deprived quintile. Over the three periods, there were no change in incidence disparity observed between the most and least deprived quintiles for melanoma, breast cancer or prostate cancer. However, there was a widening over time in the disparity in incidence of NMSC in both males and females between the most and least deprived quintiles, with a significantly wider disparity in 2009-2013 compared with 2004-2008 and in 2014-2018 compared with 2004-2008.

Among haematological cancers, there was a significant difference in incidence of leukaemia between those in the most and least deprived quintiles for the diagnosis period 2009-2013 only, with males and females in the most deprived quintile having a lower incidence. There was no consistent narrowing or widening of incidence disparities in either leukaemia or lymphoma for both males and females over the three periods examined.

A recent cancer statistics report for England reported significant differences in overall cancer incidence in both males and females in the least compared with the most deprived quintiles of the population (*Cancer Registration Statistics, England*, 2017). Age-standardised overall cancer incidence in males was 16% higher in the most deprived quintile compared with the least deprived quintile. For females, overall cancer incidence was 20% higher in the most deprived compared with the least deprived quintiles. Even more strikingly, a report on deprivation and cancer inequalities in Scotland noted overall cancer incidence rates 33% higher in the most deprived compared with the least deprived quintile (Cancer Research UK, 2022). In our study, the difference was substantially less (rates 7% higher for males and 5% higher for females in the most deprived compared with the least deprived quintiles during 2014-2018).

It is notable, however, that incidence rates in Ireland for all cancers combined show a shallow 'U'-shaped pattern in relation to deprivation, with the lowest rates in intermediate deprivation quintiles. This pattern is evident for both sexes and for all three periods examined, and reflects variation by cancer type in the 'direction' of incidence disparities. Some other reports using cancer registry data demonstrate a more step-like progression of inequalities from most deprived to least deprived in terms of incidence, for example in Scotland (Cancer Research UK, 2022). It may be that the 'balance' between cancers associated with higher deprivation and those with lower deprivation is different in Ireland, unless factors related to the derivation of deprivation indices in different countries may also be contributing.

A recent review of cancer incidence in Europe addressed the effect of socioeconomic inequality on incidence (Mihor et al., 2020). This study examined literature published between 2000 and 2019, using cancer registry data and reporting on relative risks. Lower socioeconomic status was associated with increased risk of stomach, lung and cervical cancer, as was demonstrated in our report. In relation to the incidence of stomach cancer, they found that recent European registry data demonstrated 1.5 times (range from 1.1 to 2) increased risk of stomach cancer for males and females with a lower socioeconomic status. This is in keeping with our finding that males and females in the most deprived quintile had stomach cancer rates 1.2 to 1.6 times higher than in the least deprived quintile across the three periods examined. For lung cancer, the majority of studies examined in this review supported our finding that lung cancer is associated with increased deprivation, although the disparities were higher in *Mihor et al.* compared with our study. For cervical cancer, there was evidence in *Mihor et al.* of a strong association between deprivation and incidence of cervical cancer, similar to our study. *Mihor et al.* also demonstrated an 'opposite' effect of deprivation with respect to melanoma, NMSC, breast and prostate cancers as was the case in our study, with an association between higher SES and higher incidence of each of these cancers. Similar to our study, evidence in *Mihor et al.* found only limited evidence of disparities in haematological cancers between populations of higher and lower socioeconomic status.

A study in the US by Singh & Jemal (2017) examined disparities in cancer mortality, incidence and survival using three national data sources including the SEER cancer registry database. The authors observed similar patterns for age-standardised male lung cancer rates and age-standardised cervical cancer rates, with incidence rates significantly higher in the most deprived populations. While the US findings for prostate cancer were broadly similar to those

for Ireland, with populations from the least deprived quintile having a higher rate compared with the most deprived quintile, the rate disparity in the US during 1988-1992 was about twice as high as in our study. Similarly, females in the least deprived quintile in the US had a higher incidence of breast cancer compared with those from the most deprived quintile, again with a higher level of disparity (at least twice as high) compared with Ireland.

Survival

In our report, age-standardised five-year cause-specific survival was examined, for males and females combined, for nine cancer types (excluding NMSC) as well as overall cancer (excluding NMSC). There was evidence of poorer cause-specific five-year survival in the most deprived quintile of the population compared with the least deprived quintile for eight of the nine cancers examined (not for leukaemia) in the most recent period 2014-2018. However, in stomach, cervical cancer and lymphoma, this did not reach statistical significance. For the remaining cancers, the difference in mortality risk between the most and least deprived quintiles ranged from 20% (for lung cancer) to 67% (for melanoma) in 2014-2018. For all cancers combined, there was a 43% higher mortality risk (adjusted for age and sex) or a 28% higher mortality risk (adjusted for age, sex and cancer type) for patients in the most deprived quintile compared with those in the least deprived quintile in 2014-2018. There was no significant change in disparities in five-year survival between the most and least deprived quintiles for cancer as a whole or for any of individual cancers examined over the three periods.

A recent study in the United Kingdom (UK) examined cancer survival by deprivation between 2015 and 2019 and followed up in 2020 (Public Health England, 2022). They found that the age-standardised net survival for overall cancers was higher for both males and females in the least deprived quintile compared with the most deprived quintile, which was consistent with our study (Public Health England, 2022; Woods et al., 2009). A further study, using German cancer registry data on 25 cancers from 1998 to 2014, examined socioeconomic inequalities in cancer survival (Finke et al., 2021). Although Finke *et al.* (2021) measured relative survival, patterns were similar to our findings, with a lower survival seen for those in the most deprived quintile compared with the least deprived for 17 of the 25 cancer sites. In our study, survival was significantly poorer for overall cancer and in five of the nine invasive cancers examined in the most recent period 2014-2018, namely colorectal, lung, breast and prostate cancers and melanoma. This pattern was observed also in the German study for these cancers in 2012-2014. However, the German study found a significant disparity in survival between the most and least deprived quintiles for non-Hodgkin lymphoma (NHL) but not Hodgkin lymphoma. Though we did not examine lymphoma survival by subtype, our study found no difference between the most and least deprived quintiles for lymphoma overall in the most recent period 2014-2018. Singh & Jemal (2017) examined five-year survival in the US population according to deciles (Singh & Jemal, 2017). For overall cancer, colorectal, prostate and female breast cancer, those in the most deprived decile had a poorer five-year survival compared with those in the least deprived decile, evident also at quintile scale, and is consistent with Irish findings.

Stage

This report examined stage for the most recent period for the four most common cancers in males and females combined (these cancers accounting for over 50% of deaths in Ireland due to cancer each year), namely colorectal, lung, prostate and breast cancer (National Cancer Registry Ireland, 2021).

For colorectal and lung cancer, the relative risk of being diagnosed with a late-stage cancer did not differ significantly between the most and the least deprived quintile. In contrast to our study, previous international studies have demonstrated significant socioeconomic disparities by stage for these cancers, with more deprived populations presenting with later disease (Coleman et al., 2011) (Li et al., 2017).

The relative risk of being diagnosed with a late-stage breast cancer was significantly higher (21%) in the most deprived compared with the least deprived quintile in 2014-2018. A previous study using NCRI data from 1999-2008, showed a significantly higher risk of being diagnosed with late-stage breast cancer in the most deprived quintile (Walsh et al., 2014). The latter study noted that stage at presentation appeared to account for disparities in survival between these quintiles more substantially than other factors examined. In the present report, survival analyses adjusted for stage suggested that stage accounted for a small to moderate degree of the survival disparities seen, depending on the period examined. The conclusion that late stage at presentation contributes to disparities in survival is supported by studies of cancer registry databases internationally (Coleman et al., 2011).

A similar picture was seen in our report for prostate cancer, where those in the most deprived quintile had an 11% higher risk of being diagnosed with late-stage disease compared with those in the least deprived quintile, and stage appeared to contribute to a moderate degree to the survival disparities seen. A Finnish study conducted on males from the Finnish Randomized Study of Screening for Prostate Cancer from 1996 to 2011, examined stage at presentation in relation to income, education status and home ownership, factors that cause disparities in socioeconomic status. Stage was divided into low risk, moderate risk, high risk and advanced prostate cancer (T4+ or any T with N1 or M1). In the control arm of the study, where screening was not performed, incidence of advanced prostate cancer was significantly higher for those with primary education compared with those with secondary or tertiary education and for those with the lowest income compared with those with moderate to high income. These findings were in keeping with our findings.

Limitations

In particular, it should be noted that a measure or index of ‘deprivation’ has been assigned at the level of the electoral district (ED) and not at the individual level. There are 3,440 EDs in the Republic of Ireland, probably few of which could be considered homogenous with respect to deprivation. Therefore, the assignment of an ED to a deprivation category will not necessarily provide a good descriptor at an individual level to residents or patients within that ED. This must be taken into consideration when interpreting the findings of this report. It may be possible at a future date to examine disparities in cancer at a ‘small area’ level, of which there are 18,488 (representing between 65-90 households in each) in the Republic of Ireland.

This may reduce the risk of unsafe conclusions being drawn based on 'ecological fallacy' which can occur as a result of an area-based measure being assumed to apply, for analysis purposes, at an individual level. However, measuring inequalities at the ED level most likely underestimates the effect of deprivation. Therefore, the significant findings in this report are likely reflective of the strength of the effect of deprivation on cancer incidence, five-year survival and stage at presentation for the cancers involved.

When possible reasons for the patterns demonstrated in this report are being considered, it is important that the potential contributions of both area-level and personal-level factors are taken into account. Area-level factors include access to services, pollution and social isolation, while individual level factors include lifestyle choices, such as diet and exercise. As deprivation is assigned, in this report, at an area level and not at an individual level, a combination of these factors are likely to have contributed to the patterns of disparity seen.

Causes of cancer inequalities

While identification or quantification of the role of various factors in producing the patterns seen in this report are beyond the scope of this report, it is worth noting a number of factors likely to be involved. The 'modifiable' risk factors with the biggest impact on cancer incidence in Ireland (as well as internationally) are smoking and obesity, as previously set out by the NCRI (National Cancer Registry Ireland, 2020). The Healthy Ireland 2019 report (the most recent survey to report on deprivation using the index described in this report) demonstrated that rates of smoking are higher in the most deprived areas of residence compared with the least deprived areas of residence (24% versus 14%). The proportion of people who are overweight or obese is higher in the most deprived compared with the least deprived areas (65% versus 55% respectively). It is likely that the higher proportion of these risk factors in the most deprived areas accounts to some degree for the increased incidence of cancers such as lung and stomach cancer.

There are many reasons why cancer inequalities exist though the cancer continuum. Prevention and early diagnosis are influenced by health-seeking behaviours, such as participation in screening services, including BreastCheck, CervicalCheck and BowelScreen, and awareness of symptoms and subsequent presentation at GP services. For example, it has been shown that uptake of screening services is poor among those living in more deprived areas across Europe (Smith et al., 2019). This may contribute, in part, to our finding of higher incidence of breast cancer in those from the least deprived areas, though other factors correlated with higher socioeconomic status also contribute. Lower levels of health awareness (in terms of screening or other aspects) may also contribute to the poorer survival in patients with breast cancer from the most deprived areas, by reducing the likelihood of diagnosis at an earlier, more readily treatable stage.

A range of system or other factors may contribute to cancer inequalities, including: access to health services in terms of proximity; availability of affordable transport to health services; access to early diagnostics and treatment; language and cultural barriers; disparities in health education; affordability of cancer care as a whole (including loss of income); and access to post-treatment survivorship programmes, and to palliative care services for patients at the end of life. This list is not exhaustive. Therefore, when considering the large number of factors

at play, it will require a whole-system approach to tackling the root causes of these inequalities over a projected time in order to see a narrowing of cancer inequalities between the most and least deprived populations in Ireland, a key objective of the National Cancer Strategy.

Conclusion

The findings of this report contribute to international findings on deprivation-related cancer inequalities, as well as supporting cancer prevention and treatment services in planning and targeting their interventions. The National Cancer Strategy for Ireland has a key focus on narrowing the disparity between socioeconomic groups in relation to incidence and survival, with specific targets for 2026. The findings in this report update our previous work with data presented to 2018. Overall, there is strong evidence of inequality with a higher cancer incidence in the most deprived quintile compared with the least deprived quintile for cancer as a whole (excluding NMSC), and for stomach, lung and cervical cancer across the three periods, with no evidence of a narrowing gap over time in this disparity in both males and females. Conversely, we have also demonstrated the higher incidence rate for the least deprived quintiles in terms of melanoma, NMSC, breast and prostate cancer, again with no evidence of a narrowing in disparity between the two groups over the three periods. In fact, in NMSC in males and females there is evidence of a widening gap, with those in the least deprived quintile having a higher incidence. Patients with cancer in the most deprived quintile have significantly poorer five-year survival compared with those in the least deprived quintile for cancer as a whole and for five of the nine specific cancers examined, in the most recent period. There was no narrowing of survival disparity between the most and least deprived quintiles across the three periods in these cancers.

In conclusion, these data highlight the impact of deprivation on cancer inequalities and need to be considered in the context of ensuring optimal outcomes for cancer patients regardless of their socio-economic status.

Acknowledgements

The authors wish to acknowledge the NCRI staff and their dedication to collecting, maintaining and ensuring the quality of the data that is available as part of the cancer registry, including Neil McCluskey for geocoding and mapping input. This high quality data allows us to demonstrate the cancer inequalities that exist in this report. This will inform policy makers in their continued efforts to narrow the gap in cancer inequalities experienced by the most and least deprived communities.

This work uses data provided by patients and collected by the health service as part of their care and support.

Results are also based on analysis of strictly controlled Research Microdata Files provided by the Central Statistics Office (CSO), who provided access to death certificate and population data. The CSO does not take any responsibility for the views expressed or the outputs generated from this research.

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