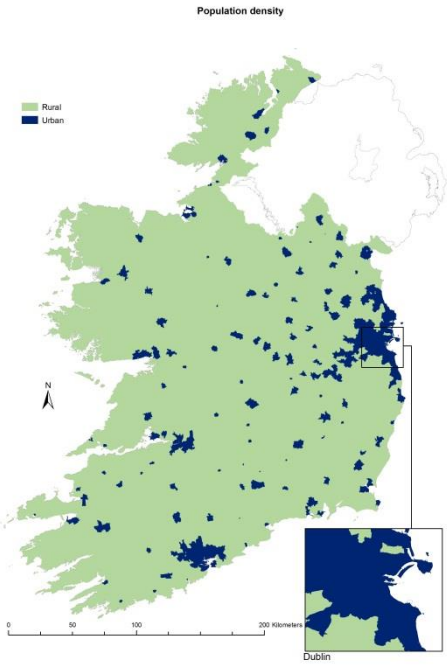
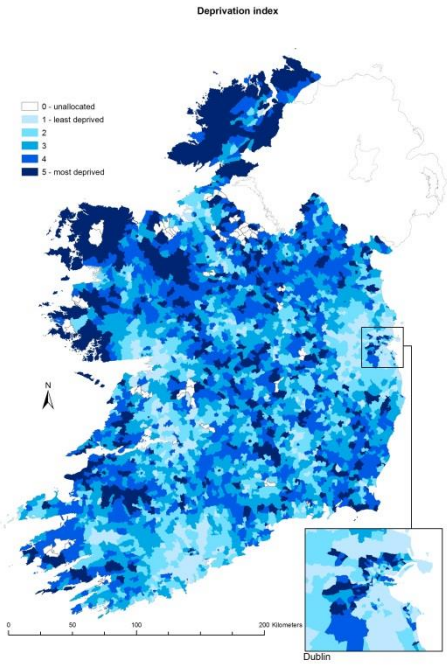
Cancer inequalities in Ireland by deprivation, urban/rural status and age: a National Cancer Registry report





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Cancer inequalities in Ireland by deprivation, urban/rural status and age: a National Cancer Registry report

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CONTENTS

KEY FINDINGS

This report assesses inequalities by urban/rural status, social/socioeconomic deprivation, and age in incidence, survival, stage, treatment and comorbidity for cancer patients in Ireland during the years 2008-2012. Findings are presented for invasive cancer as a whole and for nine major cancer types – stomach, colorectal, lung, female breast, cervical and prostate cancers, melanoma of skin, lymphoma and leukaemia.

Strong patterns of inequality by deprivation and age are documented for most of the measures examined, and the influence of age is particularly striking. These patterns were often applicable across a range of cancer types, although the patterns shown by different cancers could differ markedly or, for some cancers, the evidence was less strong. Variation by urban/rural status was less pronounced but some differences in deprivation effect were evident between urban and rural cases.

Particularly notable (and statistically significant) findings included:

- *By urban/rural status*:
  - Higher cancer incidence in urban than in rural populations, overall (invasive cancers as a whole) and for six of the nine specific cancer types examined in further detail: stomach, lung, male colorectal, female breast and cervical cancers, and melanoma.
  - A tendency towards lower proportions of patients treated in urban compared with rural populations.

- *By deprivation status*:
  - Higher incidence of cancer in more deprived populations, overall and for stomach, lung and cervical cancers, but the opposite trend (lower incidence in more deprived populations) for breast cancer and melanoma.
  - Opposite patterns of incidence in relation to deprivation for urban and rural prostate cancer and male leukaemia patients (higher incidence in more deprived rural areas, but lower incidence in more deprived urban areas) and stronger patterns of increasing incidence with increased deprivation for lung cancer and male colorectal cancer.
  - Lower survival of cancer patients from more deprived populations, overall and for six cancer types: stomach, colorectal, lung, breast and prostate cancers, and lymphoma.
  - Lower proportions of early-stage or higher proportions of later-stage cancers among more deprived populations for stomach, breast and prostate cancers and melanoma.
  - Lower proportions of patients surgically treated in more deprived populations, overall and for stomach, colorectal, lung, breast and prostate cancers.
  - Higher prevalence of comorbidities (other serious health conditions) in cancer patients from more deprived populations, overall and for lung and breast cancers and lymphoma.

- *By age:*
  - Markedly higher incidence in the oldest patients, overall and for most major cancers, but weaker trends by age for breast and prostate cancers and the opposite pattern for cervical cancer.
  - Markedly poorer cancer-specific survival among the oldest patients, overall and for all nine major cancers,
  - Older patients for some cancers (notably melanoma, breast, cervical and prostate cancers) tended to present at more advanced stage, but the opposite pattern was seen for colorectal and lung cancers, which appeared to present at less advanced stage in the elderly.
  - Substantially lower proportions of the oldest patients having active treatment for their cancer, overall and for all nine major cancers, with the exception of hormonal therapy for breast and prostate cancers (higher use in the elderly).
  - Substantially higher prevalence of comorbidities among the oldest cancer patients, for all nine major cancers.

A fuller summary of results is given below, including visual representations of inequalities by urban/rural status, deprivation and age in *Summary Tables 1-3*. The latter tables are scaled to allow direct comparison between different factors influencing inequality and between different cancers, and highlight in particular the magnitude and scope of inequalities by age.

Summary Table 1. Influence of **urban status** on cancer in Ireland, 2008-2012: urban v rural patients

Urban status	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
All cancers ex NMSC	M↑ F↑	↓M↓ F=			R↓ C↓ H↓	↑M↑ F↑
Stomach cancer	M↑ F↑	=	=	III↑ IV=	R↓ TSC=	=
Colorectal cancer	M↑	=	=	=	S↓ C↓ TR=	=
Lung cancer	M↑ F↑	↑	I↑ II=	III↓ IV=	=	=
Melanoma of skin	M↑ F↑	↑	=	IV↓ III=	T↓ C↓ SR=	=
Female breast cancer	↑	=	I↑ II=	III↓ IV=	C↓ H↓ TSR=	=
Cervical cancer	↑	=	=	=	C↑ TSR=	=
Prostate cancer	=	↓	=	IV↑ III=	T↓S↑R↓H↓	=
Lymphoma	=	=	=	=	S↑ TSRC=	=
Leukaemia	=	=			R↑ TC=	↓

Summary Table 2. Influence of **deprivation** on cancer in Ireland, 2008-2012: most deprived v least deprived patients

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
All cancers ex NMSC	M↑ F↑	↓M↓ F↓			S↓ H↑ TRC=	↑M↑ F↑
Stomach cancer	M↑ F↑	↓	=	IV↑ III=	S↓ TRC=	↑
Colorectal cancer	=	↓	=	IV↑ III=	T↓ S↓ RC=	=
Lung cancer	M↑ F↑	↓	II↑ I=	=	T↓ S↓ RC=	↑
Melanoma of skin	M↓ F↓	↓	II↑ I=	III↑ IV↓	R↑ C↑ TS=	↓
Female breast cancer	↓	↓	I↓ II=	IV↑ III=	S↓ H↑ TRC=	↑
Cervical cancer	↑	↓	=	III↑ IV=	C↑ TSR=	↑
Prostate cancer	=	↓	I↓ II↓	III↑ IV↑	T↑ S↓ R↑ C↑ H↑	↑
Lymphoma	=	↓	II↑ I=	=	R↑ TSC=	↑
Leukaemia	M↓ F=	↓			T↑ R↑ C↑	↑

Summary Table 3. Influence of **older age** on cancer in Ireland, 2008-2012: age 75+ v 45-54 (85+ v 55-64 for prostate)

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
All cancers ex NMSC	M↑ F↑	↓M↓F↓			T↓S↓R↓C↓H↑	↑M↑F↑
Stomach cancer	M↑ F↑	↓	I↑ II↓	III↓ IV↓	T↓S↓R↓C↓	↑
Colorectal cancer	M↑ F↑	↓	I↓ II↑	III↓ IV↓	T↓S↓R↓C↓	↑
Lung cancer	M↑ F↑	↓	I↑ II↑	III↓ IV↓	T↓S↓R↓C↓	↑
Melanoma of skin	M↑ F↑	↓	I↓II↑	III↑ IV↑	T↓S↓C↓R=	↑
Female breast cancer	↑	↓	I↓ II↓	III↑ IV↑	T↓S↓R↓C↓H↑	↑
Cervical cancer	↓	↓	I↓II↑	III↓ IV↑	T↓S↓C↓R=	↑
Prostate cancer	↑	↓	I↓ II↓	III↓ IV↑	T↓S↓R↓H↑C=	↑
Lymphoma	M↑ F↑	↓	I↓ II↓	III= IV=	T↓S↓C↓R=	↑
Leukaemia	M↑ F↑	↓			T↓R↓C↓	↑

Footnote/Key to Summary Tables 1-3: See overleaf.

Footnote to Summary Tables 1-3:

[a] Age-standardised incidence rate; M = males, F = females. [b] Age/sex-adjusted survival within 5 years of diagnosis. [c] Age/sex-adjusted stage proportions I = stage I, II = stage II. [d] III = stage III, IV = stage IV. [e] Age/sex/casemix-adjusted proportion of patients having tumour-directed treatment, T = any treatment, S = surgery, R = radiotherapy, C = chemotherapy / immunotherapy, H = hormone therapy. [f] Age/sex-adjusted proportion of patients with other significant health conditions.

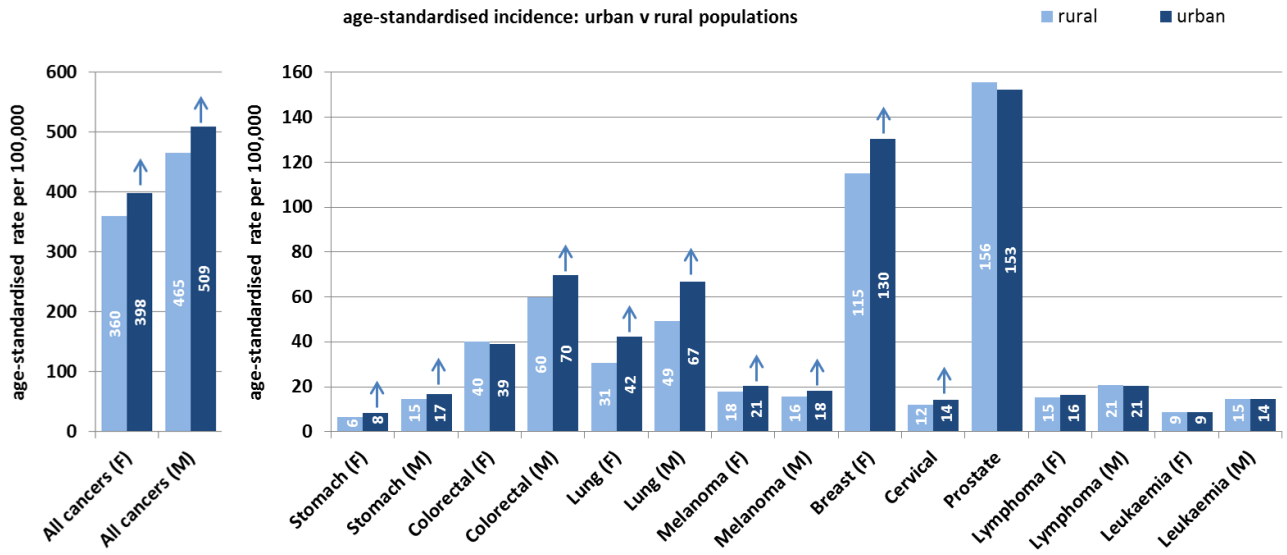
↑ significantly higher: relative risk or rate ratio <1.1↑, ≥1.1↑, ≥1.5↑, ≥2.0↑, ≥5.0↑ or ≥10.0↑ (or, for survival, mortality hazard significantly lower: hazard ratio >0.9, ≤0.9, ≤0.67, ≤0.5, ≤0.2 or ≤0.1 but shown as upward arrow).

↓ significantly lower: relative risk or rate ratio >0.9↓, ≤0.9↓, ≤0.67↓, ≤0.5↓, ≤0.2↓ or ≤0.1↓ (or, for survival, mortality hazard significantly lower: hazard ratio <1.1, ≥1.1, ≥1.5, ≥2.0, ≥5.0 or ≥10.0 but shown as downward arrow).

↑ non-significantly higher (but ratio ≥1.1), ↓ = non-significantly lower (but ratio ≤0.9) i.e. apparent difference not statistically significant at P<0.05 level.
= no significant difference (& <10% relative difference).

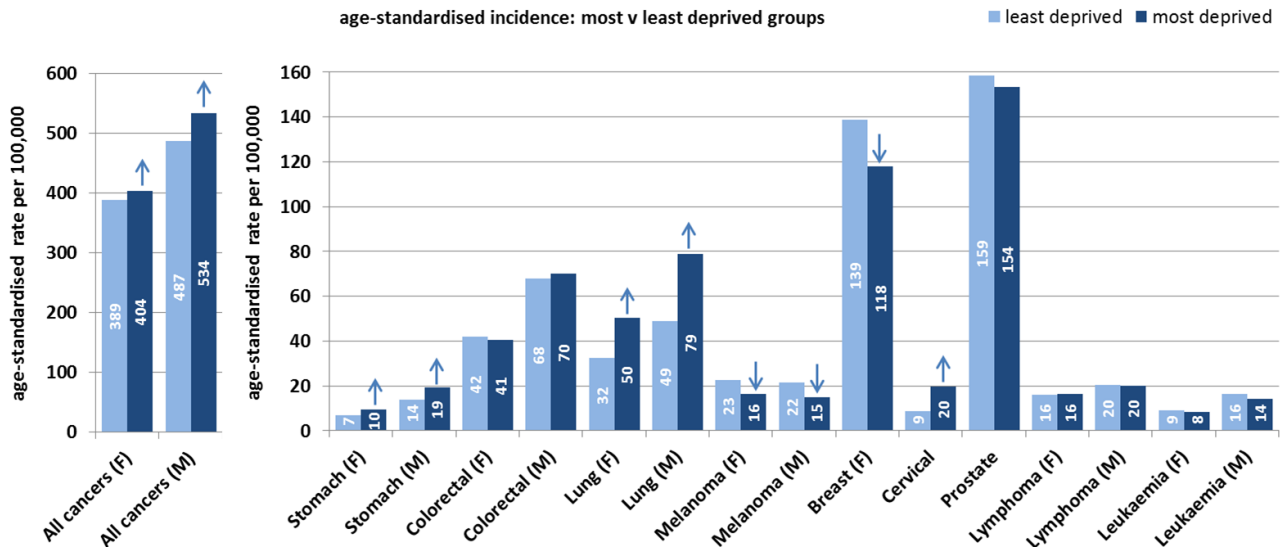
Incidence

By urban/rural status: Age-standardised incidence for six of the cancer types examined (stomach, lung, melanoma, male colorectal, female breast and cervical), and for cancer as a whole, was significantly higher among urban populations (defined on the basis of average population density ≥1 person/hectare) than among rural populations. For these cancers, urban rates were 13-38% higher, most notably for lung cancer (36-38% higher). For all cancers combined, urban rates were 10% (95% confidence interval 8-12%) higher for males and 11% (95% CI 8-12%) higher for females. For prostate cancer, lymphoma, leukaemia and female colorectal cancer there was no significant variation between urban and rural populations.



Summary Figure 1 Age-standardised cancer incidence, Ireland, 2008-2012: comparison between urban and rural populations. Arrows indicate significant differences. Note different scale for all-cancer graph.

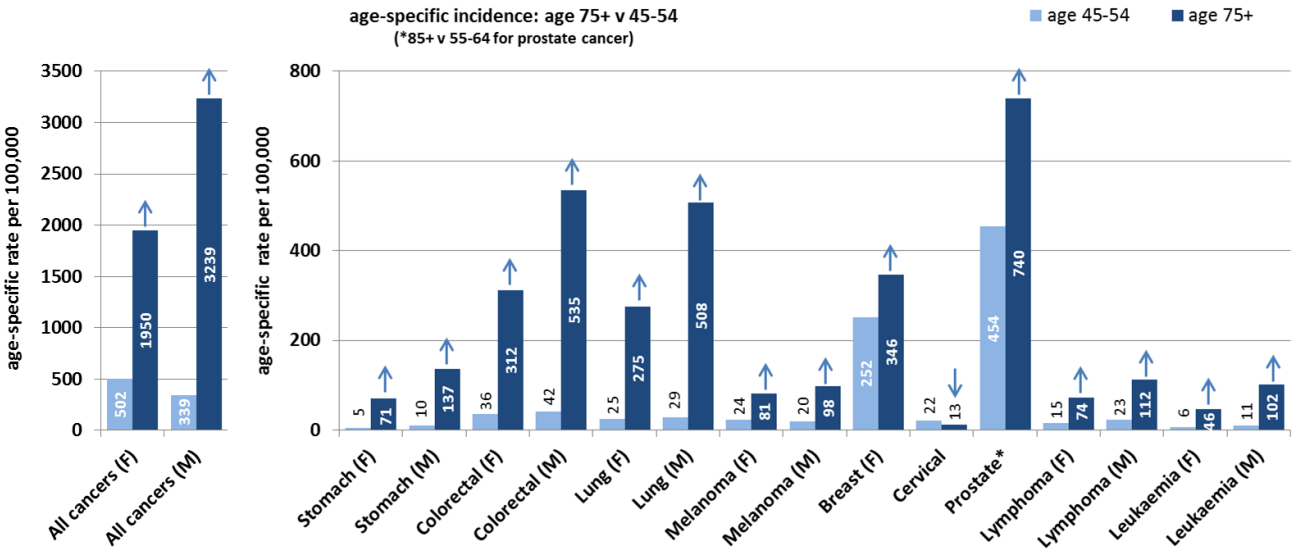
By deprivation: Overall cancer incidence was slightly but significantly higher in the most deprived 20% of the population, by about 10% (95% confidence interval 6-13%) for males and 4% (95% CI 1-7%) for females, having adjusted for age. Of the individual cancers examined, cervical, lung and stomach cancers showed strong patterns of increasing incidence with increasing deprivation, with age-standardised rates about 120%, 60% and 40% higher, respectively, in the most deprived compared with the least deprived fifth of the Irish population. Breast cancer and melanoma showed the opposite pattern, i.e. decreasing incidence with increasing deprivation, with age-standardised rates about 15% lower and 30% lower, respectively, in the most deprived populations. No clear patterns of incidence by deprivation were evident for colorectal or prostate cancers, lymphoma or leukaemia.



Summary Figure 2 Age-standardised cancer incidence, Ireland, 2008-2012: comparison between the most and the least deprived 20% of the population. Arrows indicate significant differences. Note different scale for all-cancer graph.

Interaction between deprivation and urban/rural status: For lung cancer and male colorectal cancer, urban populations showed a significantly stronger pattern of higher incidence in more deprived areas than seen in rural populations. For prostate cancer and male leukaemia, urban and rural populations showed opposite (and significantly different) patterns of deprivation influence on incidence, i.e. higher incidence in more deprived rural areas but lower incidence in more deprived urban areas. Otherwise, the pattern of deprivation influence on incidence was broadly similar for urban and rural populations.

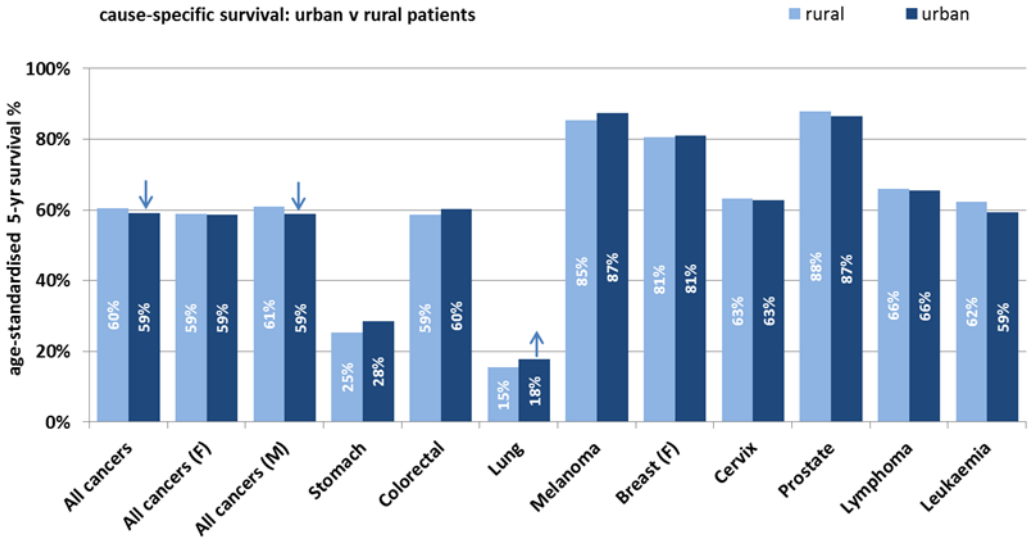
By age: Cancer as a whole and almost all of the specific cancer types examined showed significantly higher incidence rates at older ages, based on comparisons between age-groups 75+ and 45-54 (or 85+ and 55-64 for prostate cancer). Overall incidence rates were about ten times higher for males and four times higher for females in the oldest group (compared with 45-54). For eight of the nine specific cancers examined, male rates were 1.6-15 times higher and female rates 1.4-13 times higher in the oldest group. The biggest differences (more than 10-fold) were seen for stomach cancer, lung cancer and male colorectal cancer. For breast and prostate cancers the difference was relatively modest (1.4-fold and 1.6-fold differences, respectively). Only cervical cancer showed a pattern of significantly lower rates (42% lower) in the oldest group.



Summary Figure 3 Age-specific cancer incidence, Ireland, 2008-2012: age 75+ and 45-54 groups (or 85+ and 55-64 for prostate cancer). Arrows indicate significant differences. Note different scale for all-cancer graph.

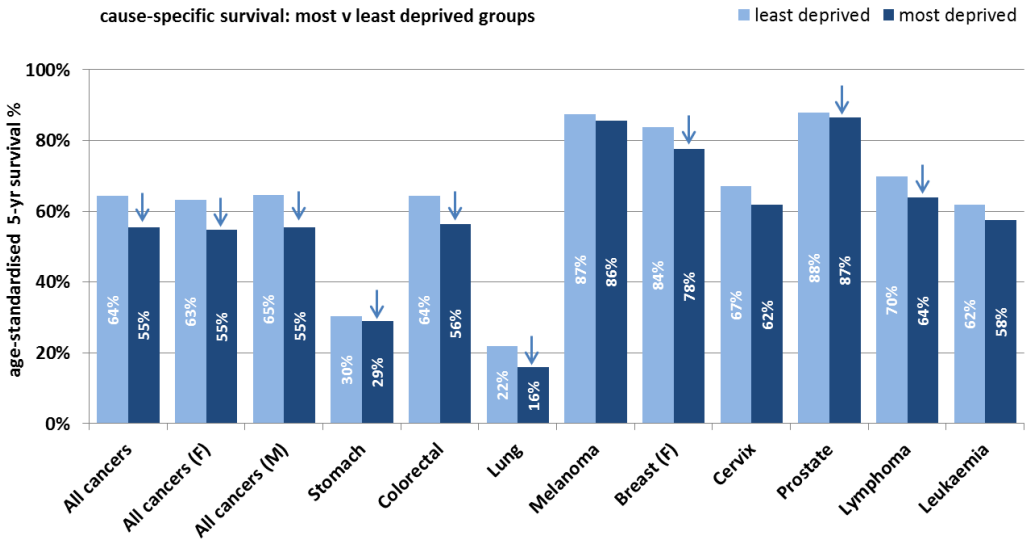
Survival

By urban/rural status: For all cancers combined, age-standardised survival was slightly but significantly lower among urban than among rural patients: mortality risk about 4% (95% confidence interval 2-7%) higher overall, 8% (95% CI 4-11%) higher for males but no significant difference for females. However, these differences were no longer significant after adjustment for casemix (cancer type), which is also influenced by urban/rural status (e.g. lung cancer make up a higher proportion of cancers in urban patients). Lung cancer survival was significantly higher in urban patients (mortality risk about 6% lower than for rural patients), but there was no difference after adjustment for stage. Otherwise urban status did not significantly influence survival for the specific cancers examined.



Summary Figure 4 Age-standardised cancer survival, Ireland, 2008-2012: comparison between urban and rural populations. Arrows indicate significant differences (after adjustment for age and sex).

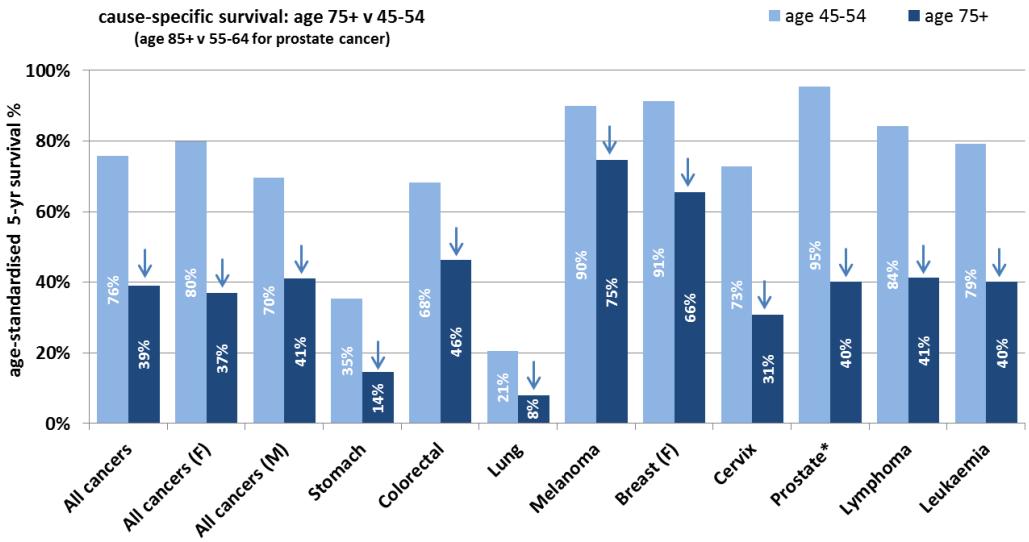
By deprivation: For all nine cancer types examined, and for cancers as a whole, there was evidence of poorer cancer-specific survival in patients from the most deprived compared with the least deprived areas. This was not statistically significant for melanoma, cervical cancer or leukaemia, but for the other cancers examined the age/sex-adjusted mortality risk among cancer patients was between 19% and 54% higher among patients from the most deprived areas. The greatest inequality seen was for breast cancer, the lowest for stomach cancer and melanoma. For all cancers combined, the mortality risk was 39% (95% confidence interval 34-45%) higher in the most deprived compared with the least deprived areas, having adjusted for age and sex, or 27% (95% CI 22-32%) higher if further adjusted for the cancer types involved (i.e. casemix may explain about a third of the survival variation by deprivation). Models adjusted for stage suggested that stage accounted for between one-fifth and two-fifths of the deprivation-related variation in survival for breast, cervical and prostate cancers but none of the variation for colorectal or lung cancers or lymphoma.



Summary Figure 5 Age-standardised cancer survival, Ireland, 2008-2012: comparison between the most and the least deprived 20% of the population. Arrows indicate significant differences (adjusted for age and sex).

Interaction between deprivation and urban/rural status: For cancer as a whole and for male colorectal cancer, patients from urban areas showed a significantly stronger pattern of poorer survival in the most deprived areas. For other cancer types the influence of deprivation on survival was broadly similar (or differences could not be statistically confirmed) between urban and rural patients.

By age: A very striking decline in average survival with increasing age was seen for all cancer types examined, even though cancer-specific survival was the outcome (thus mortality risk from non-cancer causes, which increase rapidly with age, was excluded). Overall, patients aged 75+ years were about four (3.8) times more likely to die from their cancer than patients aged 45-54, or about three (2.9) times more likely if adjustment is made for cancer type. For females, the disparity in survival by age was particularly high (mortality risk 5.2 times higher in the oldest group, compared with 2.6 times for the oldest males). For specific cancer types, survival disparities between ages 75+ and 45-54 ranged from about a two-fold difference (for stomach, colorectal and lung cancers) to a five-/six-fold difference or more (for breast and prostate cancers and lymphoma). Models adjusted for age suggested that stage differences by age accounted for a substantial proportion (perhaps 30-70%) of the age-related variation in survival for some cancers (breast, cervical, prostate, melanoma) but not for others (stomach, colorectal, lung cancers, lymphoma).

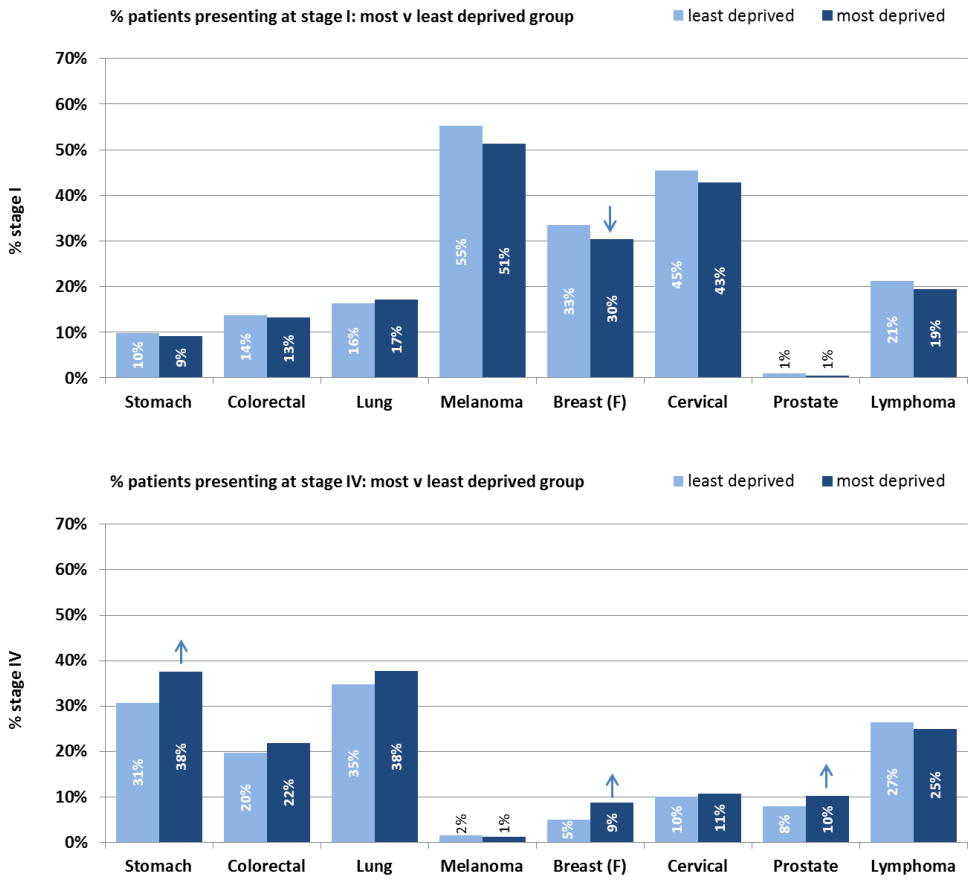


Summary Figure 6 Age-specific cancer survival, Ireland, 2008-2012: comparison between age 75+ and 45-54 groups (or 85+ and 55-64 for prostate cancer). Arrows indicate significant differences (adjusted for sex where relevant).

Stage

By urban/rural status: Urban patients with lung or breast cancer were significantly more likely to present at the least advanced stage (stage I), and less likely to present at an advanced stage (stage III), than rural patients, having adjusted for age and sex. Urban patients with prostate cancer were more likely to present at the most advanced stage (stage IV). For other cancers examined, the stage breakdown of cases did not vary significantly between urban and rural cases.

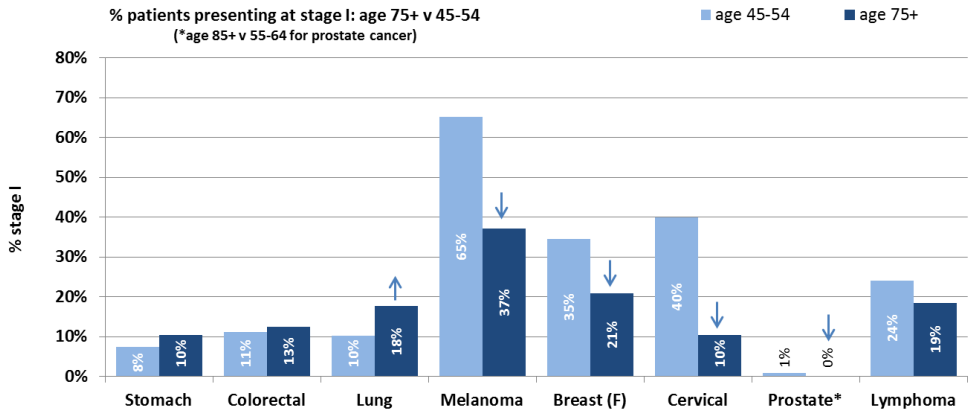
By deprivation: Patients from the most deprived areas were significantly less likely to present at an early stage for breast cancer (stage I) and prostate cancer (stage II), and more likely to present at an advanced stage for breast cancer (stage IV), prostate cancer (stages III and IV), stomach cancer (stage IV) and melanoma of skin (stage III), compared with patients from the least deprived areas. For lymphoma, the most deprived group were significantly less likely to present at stage II. These findings are adjusted for age and sex. See *Summary Figure 7* for stage I and stage IV comparisons.

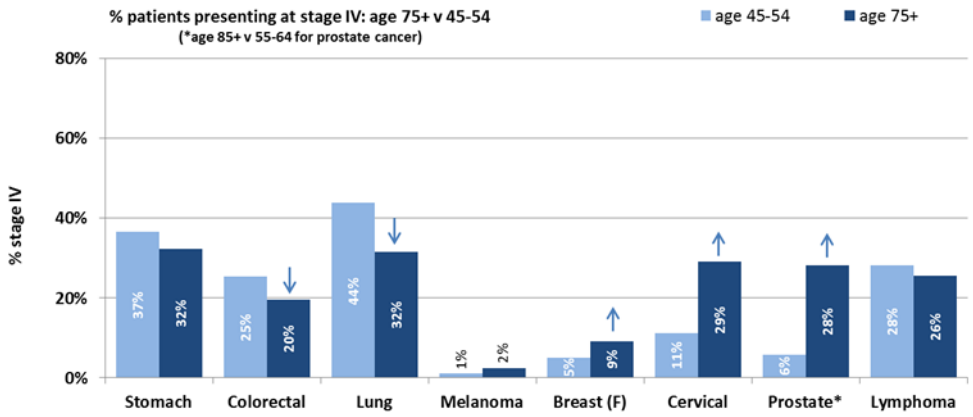


Summary Figure 7 Percentage of patients presenting at stages I and IV, Ireland, 2008-2012: comparison between the most and the least deprived 20% of the population. Arrows indicate significant differences (adjusted for age and sex).

Interaction between deprivation and urban/rural status: Influences of deprivation on the stage breakdown of cases differed significantly between urban and rural patients for stomach cancer (stages I, II and IV), colorectal cancer (stage IV) and lymphoma (stage III).

By age: The influence of age on stage breakdown of cases was striking but was not consistent across cancer types, and two broad patterns were seen. For colorectal and lung cancers, the oldest patients were significantly more likely to present at an earlier stage (stage II colorectal, I lung) and less likely to present at an advanced stage (III and IV for both). In contrast, for melanoma, breast, cervical and prostate cancers, the oldest patients were less likely to present at early stages (stage I melanoma, I and II breast, I cervical, II prostate) and more likely to present at advanced stages (stage III melanoma, III and IV breast, IV cervical and IV prostate). Older patients with stomach cancer were less likely to present at stage II or III, those with lymphoma less likely to present at stage I. See *Summary Figure 8* for stage I & stage IV comparisons.



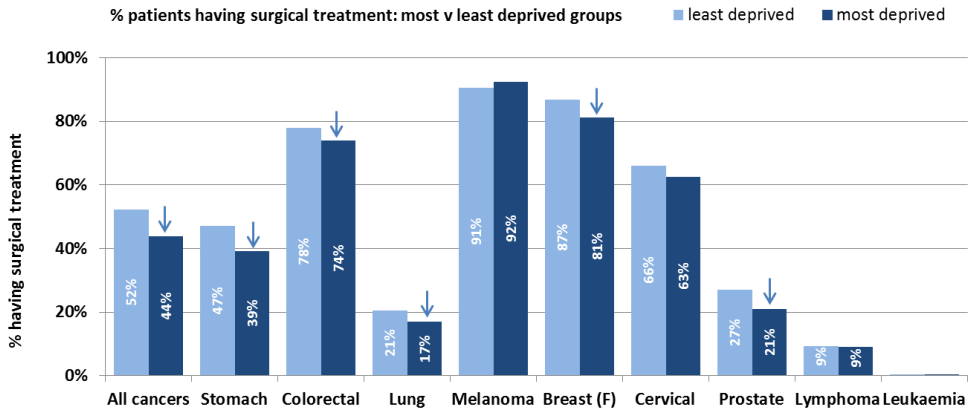


Summary Figure 8 Percentage of patients presenting at stages I and IV, Ireland, 2008-2012: comparison between the most and the least deprived 20% of the population. Arrows indicate significant differences (adjusted for age and sex).

Treatment

By urban/rural status: Urban patients were significantly less likely than rural patients to have any treatment for melanoma (-2% relative) and prostate cancer (-4%); tumour-directed surgery for colorectal cancer (-3%); radiotherapy for any cancer (-4%) and prostate cancer (-9%); chemotherapy/immunotherapy for any cancer (-4%), colorectal cancer (-5%), melanoma (-26%) and breast cancer (-5%); and hormonal treatment for any cancer (-13%), breast cancer (-8%) and prostate cancer (-18%). However, urban patients were more likely to have surgery for prostate cancer (+12%). Analyses for cancer as a whole, colorectal cancer, lymphoma and leukaemia were adjusted for casemix (cancer type).

By deprivation: Patients from the most deprived populations were significantly less likely to have surgery for cancer, overall (-6% relative) and for stomach cancer (-13%), colorectal cancer (-4%), lung cancer (-7%), female breast cancer (-4%) and prostate cancer (-19%), compared with the least deprived group (*Summary Figure 9*); and less likely to have any treatment for colorectal cancer (-4%) and lung cancer (-21%). Patients from the most deprived populations were significantly more likely to have hormonal treatment, overall (+27%) and for breast cancer (+11%) and prostate cancer (+61%); and also any treatment (+8%), radiotherapy (+12%) or chemotherapy (+95%) for prostate cancer.

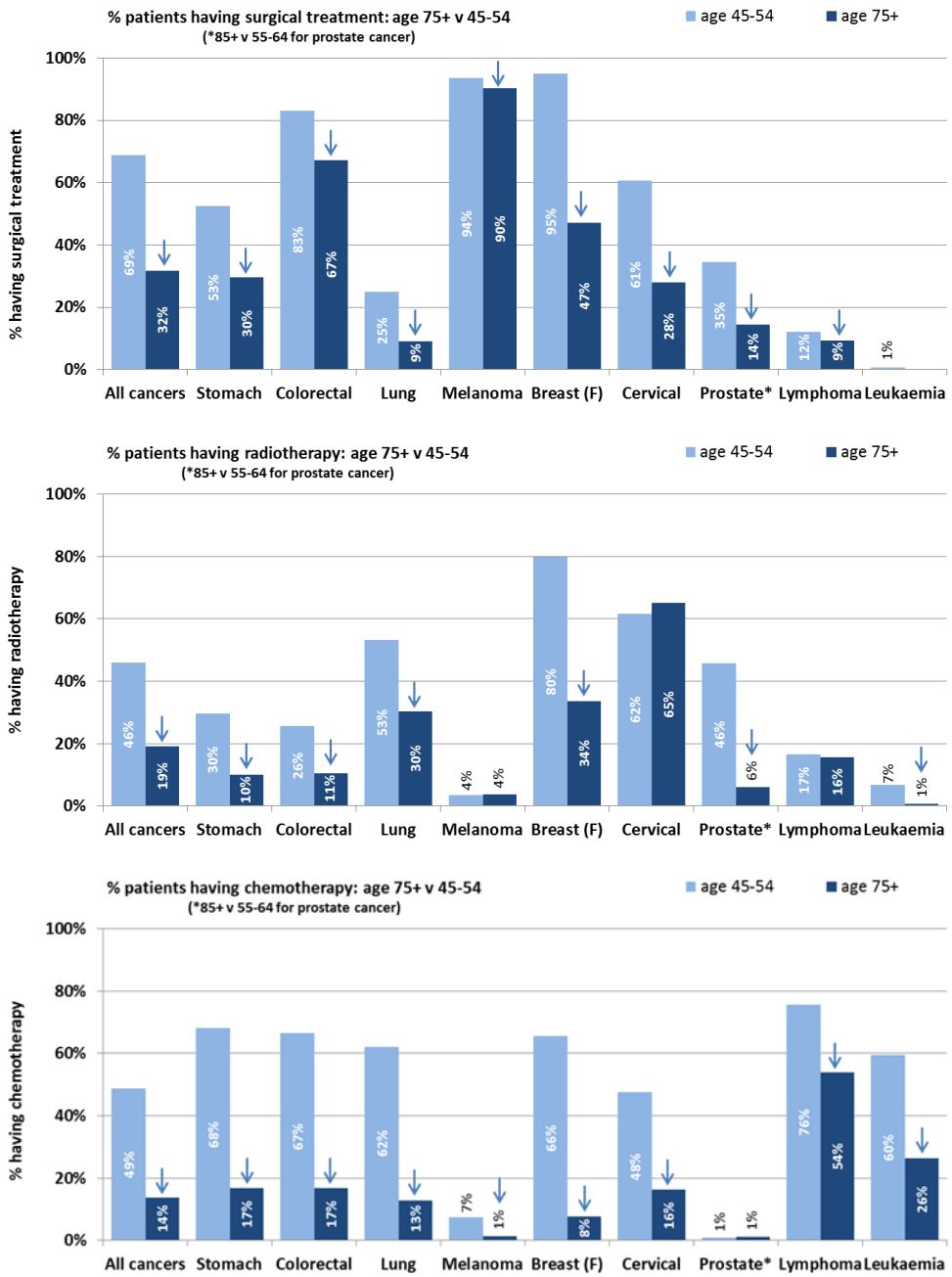


Summary Figure 9 Percentage of patients having tumour-directed surgery within a year of diagnosis, Ireland, 2008-2012: comparison between the most and the least deprived 20% of the population. Arrows indicate significant differences (after adjustment for age and sex).

Interaction between deprivation and urban/rural status: The influence of deprivation on treatment differed significantly between urban and rural patients for chemotherapy in breast cancer patients (stronger effect for rural patients), hormonal therapy in prostate cancer (stronger effect for urban patients), and chemotherapy in leukaemia (stronger effect for rural patients) – in each case, a higher proportion of patients in the most deprived group were treated.

By age: Very marked variation of treatment by age was seen, particularly in the use of chemotherapy, with (in general) a lower proportion of older patients having treatment (with the exception of hormonal treatment) (*Summary Figure 10*). For cancers as a whole, patients aged 75+ years were significantly less likely to have any treatment (-30% in relative terms), surgery (-21%), radiotherapy (-22%) or chemotherapy (-72%) but more likely to have hormonal treatment (+41%) than those aged 45-54. Across nine specific cancer types, use of any treatment was significantly lower in the oldest group for all (ranging from -4% for melanoma to -53% for leukaemia); use of surgery lower for eight cancers (-4% melanoma to -

63% lung cancer); use of radiotherapy lower for six cancers (-43% lung cancer to -91% leukaemia); use of chemotherapy or immunotherapy lower for eight cancers (-31% lymphoma to -88% breast cancer); but use of hormonal treatment higher for the oldest patients with breast cancer (+8%) and prostate cancer (+105%).

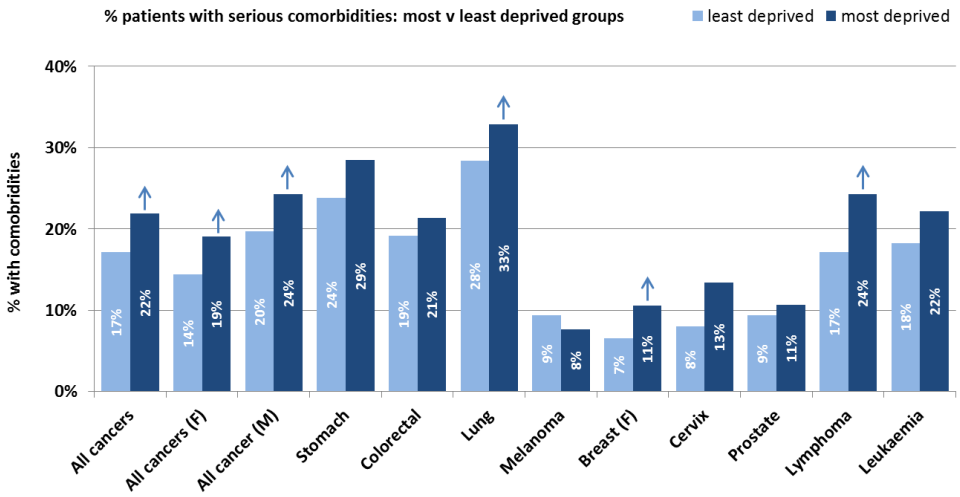


Summary Figure 10 Percentage of patients having tumour-directed surgery, radiotherapy or chemotherapy / immunotherapy within a year of diagnosis, Ireland, 2008-2012: comparison between age 75+ and 45-54 groups (or 85+ and 55-64 for prostate cancer). Arrows indicate significant differences (adjusted for sex where relevant).

Comorbidity

By urban/rural status: Cancer patients (as a whole) from urban areas were slightly but significantly more likely (about 6% more likely having adjusted for age and sex) to have other significant health conditions than those from rural areas, for both males and females. However, variation was not statistically significant for individual cancer types.

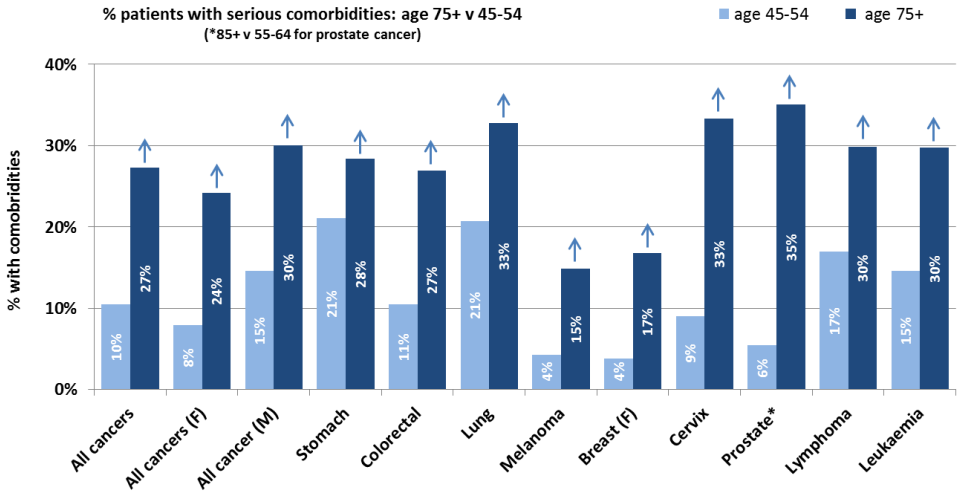
By deprivation: Cancer patients from the most deprived areas were significantly more likely to have serious comorbidities than those from the least deprived areas: about 20% more likely for cancer patients as a whole, or about 15% more likely for lung cancer, 40% more likely for breast cancer and 30% more likely for lymphoma patients (having adjusted for age and sex) (*Summary Figure 11*). Findings were broadly similar (but not statistically significant) for most other cancers examined.



Summary Figure 11 Percentage of cancer patients having serious comorbidities, Ireland, 2008-2012: comparison between the most the least deprived 20% of the population. Arrows indicate significant differences (adjusted for age and sex).

Interaction between deprivation and urban/rural status: For cancer patients as a whole (overall and for males), urban patients showed a significantly stronger pattern of higher levels of comorbidity in the most deprived group than seen for rural patients.

By age: For all cancer types examined, there was a significantly higher prevalence of non-cancer comorbidities in the oldest patients. Overall, cancer patients from the oldest group (75+) were 150% more likely (i.e. 2.5 times as likely) to have serious comorbidities, compared with ages 45-54; or 35%-350% more likely for individual cancers, highest (250-350% more likely) for melanoma, cervical cancer, prostate cancer and breast cancer. Overall, 27% of cancer patients aged 75+ years had known serious comorbidities, based on hospital inpatient data, highest (33%) for cervical and lung cancer patients, lowest (15-17%) for melanoma and breast cancer patients, and higher for males (34%) than for females (24%).



Summary Figure 12 Percentage of cancer patients having serious comorbidities, Ireland, 2008-2012: comparison between age-groups 75+ and 45-54 (85+ / 55-64 for prostate cancer). Arrows indicate significant differences (adjusted for sex where relevant).

Screen-detection status (for breast cancer)

By urban/rural status: In the age-group (50-64) initially targeted by the national breast screening programme (BreastCheck), breast cancers in women from urban populations were slightly (7%) but significantly more likely to have presented through screening than in rural women. The per-population incidence rate of screen-detected breast cancers was also higher (by about 20%) in urban populations, reflecting a combination of higher screen-detected proportion and higher overall incidence of breast cancer in urban populations.

By deprivation: The proportion of breast cancers at ages 50-64 that were screen-detected did not differ significantly by deprivation status, but the rate of screen-detected breast cancer was about 20% lower in the most deprived compared with the least deprived population group. This finding seems to reflect the overall influence of deprivation on breast cancer incidence more strongly than its influence on screening.

INTRODUCTION

It is well established that the incidence of a range of cancer types and survival from cancer can show strong relationships to the social or socioeconomic status of populations and patients (Kogevinas et al. 1996), whether defined on the basis of area-based or individual data. In Ireland, this has been shown for incidence and survival for a range of cancers (e.g. Carsin et al. 2009, NCR/NICR 2011, Walsh et al. 2014), such as higher incidence of lung cancer and poorer survival from breast cancer in more deprived populations. Urban/rural and age-related disparities in incidence, survival or treatment have also been noted by previous National Cancer Registry (NCR) analyses. Mortality rates from cancer and from a range of non-cancer causes in Ireland also show strong relationships to deprivation (Centre for Health Geoinformatics 2015).

In this report, we widen the scope of previous analyses by the National Cancer Registry (NCR) to examine, more comprehensively, the influence of deprivation, and also urban/rural status and age on cancer in Ireland. In particular, we assess how these factors influence cancer incidence, stage, survival and treatment, for nine major cancer types (stomach, colorectal, lung, breast, cervical and prostate cancers, melanoma, lymphoma and leukaemia) and for invasive cancers as a whole. The cancer types we focus on are particularly significant in terms of numbers of cases or there is existing evidence from Ireland or elsewhere of deprivation-related gradients in incidence or survival. We also assess the occurrence of other significant health conditions (comorbidities) among cancer patients, which may help determine their suitability for treatment. For breast cancer, the influence of deprivation on method of presentation, specifically in relation to screening, is also examined.

Because detailed information is not available on the socioeconomic status of individual patients in Ireland, and access to household-level data is restricted, we have used an area-based measure of deprivation, reflecting the average socioeconomic conditions applicable within electoral divisions (EDs). Urban/rural status was also assigned based on the EDs where patients were resident at the time of their cancer diagnosis, using higher population density to define urban status. With the exception of age, we have not explicitly set out to examine inequalities based on other criteria, such as patients' sex or geographic location (except where the latter determines deprivation or urban/rural status). However, all statistical analyses have been adjusted to allow for variations in sex between populations or patient groups.

Our main intention is to document and draw attention to patterns of inequality, where they exist. A fuller exploration or assessment of the mechanisms or intervening factors by which deprivation acts was considered beyond the scope of a report covering the range of cancers and outcomes included here, but some limited discussion is included. However, patterns revealed by this report may be explored in further analyses examining specific cancers.

This report only covers recent years (2008-2012 diagnoses), and does not attempt to assess possible changes in disparities over time. An earlier analysis of breast cancer survival in Ireland in relation to deprivation found little evidence that deprivation-related disparities had improved over time (Walsh et al. 2014), and we hope to explore this further for other cancers in future.

A *glossary* of terms, abbreviations and definitions used in this report is given below, and fuller details of definitions and methodologies are given in the *Methods and patient characteristics* section.

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 the age breakdown of patients differs between urban and rural patients, a model comparing survival between rural and urban cases, adjusted for age, would, in effect, assess differences in survival as they would be if the age-composition of rural and urban cases were the same. Multiple factors can be adjusted for simultaneously in a model (based on certain simplifying assumptions).
Age-standardisation	e.g. age-standardisation of a cancer incidence rate 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 also excluded here. Note that the "all cancer" findings presented in this report does include all other invasive cancers, i.e. not just the nine main cancer types for which separate findings are also presented.
Charlson Index	The Charlson Comorbidity Index is a method of categorising comorbidities of patients, for example using the International Classification of Diseases (ICD) diagnosis codes found in administrative data such as HIPE. Each comorbidity category has an associated weight, based on the adjusted risk of mortality or resource use, and the sum of all the weights results in a single comorbidity score for a patient. A score of zero indicates that no comorbidities were found. The higher the score, the more likely the predicted outcome will result in mortality or higher resource use. For the purposes of this report a patient was defines as having no comorbidities (zero) or at least one (1+).
Chemotherapy	Includes cytotoxic agents e.g. 5-FU, doxorubicin, capecitabine, etc.; targeted monoclonal antibodies e.g. trastuzumab, bevacizumab, etc.; immunotherapy, e.g. IL-2, interferon alpha, etc.; tyrosine kinase inhibitors e.g. imatinib, etc.
Comorbidity	The presence of other significant health conditions in a patient; for this report defined as any non-cancer condition mentioned in hospital in-patient records within a month before (or one year after) the cancer diagnosis, if that condition scored as significant/relevant for the purposes of the Charlson Index.
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 index of deprivation at electoral division (ED) level, i.e. an area-based measure of deprivation incorporating information from the 2006 national Census; this is assigned to populations and patients based on their place of residence.
DSRR	Directly age-standardised rate ratio (for comparison of age-standardised rates).
EASR	European age-standardised rate (standardised to 1976 European Standard Population).
ED	Electoral Division.
Heterogeneity test	In this report, a test comparing the strength (or direction) of the influence of deprivation between different urban and rural populations or patients; can also be referred to as a test for interaction. A p-value <0.05 indicates a significant difference of deprivation influence (strength and sometimes direction) between urban and rural strata
HIPE	Hospital In-patient Enquiry system: administrative data on diagnosis and treatment of patients in public hospitals in Ireland
Hormonal therapy	Treatment given to reduce the effect of sex hormones on tumour growth in cancers of the breast and prostate, e.g. tamoxifen, bicalutamide, leuprorelin, etc.
HR	Hazard ratio (for model-based comparisons of mortality hazard)
ICD-10	International Statistical Classification of Diseases and Related Health Problems (10^{th} edition) (WHO 1992)
ICD-O-3	The International Classification of Diseases for Oncology (ICD-O) is internationally recognized as the definitive classification of neoplasms. The third edition of ICD-O (ICD-O-3) was published in 2000 (Fritz et al. 2000).
Immunotherapy	Cytokines e.g. IL-2, interferon alpha, etc. and targeted monoclonal antibodies e.g. trastuzumab, bevacizumab, etc. (grouped with chemotherapy for analysis purposes in this report).
Incidence	Numbers and rates (usually expressed per 100,000 persons per year) of newly-diagnosed disease. In this report, it refers to cancers diagnosed during the years 2008-2012, 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 and melanomas primary to other sites.
NCR	National Cancer Registry
NMSC	Non-melanoma skin cancer- mainly basal cell and squamous cell carcinomas; these are rarely fatal and for international comparison purposes are usually excluded from the 'all cancer' definition
Radiotherapy	In this report, therapy administered as ionizing radiation (mainly beam-radiation or radioactive implants) within one year of diagnosis, as part of cancer treatment to control or kill malignant cells. Radiation therapy may be

	curative in a number of cancers if the cancer is localized to one area of the body. It may also be used as part of adjuvant therapy, to prevent tumour recurrence after surgery.
RR	Risk ratio, or relative risk (for model-based comparisons of proportions).
Rural	Defined for this report on the basis of average population density within an electoral division: rural = < 1 person per hectare in 2006 .
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. Conversely, given the large number of comparisons made in this report, some "significant" findings may, nevertheless, be chance findings.
Stage	Cancer stage as defined using TNM 5th-edition criteria, based on the combination of T category (primary tumour), N category (regional nodal extension) and M (distant metastasis). Presented as stages I, II, III, IV or unknown.
Survival	In this report, cause-specific survival is used, i.e. with endpoint death attributed to the cancer of interest (or a cancer of unknown or adjacent site); patients who die of other causes are included in follow-up but censored at the point of death.
Surgery	In this report refers to tumour directed surgery, excision, including endoscopic tumour directed surgery, or other tumour destructive treatment (e.g. laser ablation, cauterisation, etc.) undertaken within one year of diagnosis. It excludes diagnostic and palliative surgery (e.g. placement of a stent) and reconstruction.
TNM	Tumour, node, metastasis (staging): TNM 5th-edition criteria used in this report.
Treatment (tumour-directed)	Treatment aimed at, or with the effect of, removing or destroying tumour tissue, or helping to prevent further tumour growth, regardless of whether 'curative' or 'palliative' in intent; excludes purely diagnostic surgery that does not aim to remove the entire tumour.
Urban	Defined for this report on the basis of average population density within an electoral division (ED): urban = ≥ 1 person per hectare in 2006.

METHODS AND PATIENT CHARACTERISTICS

Urban/rural status

Cancer patients' addresses were geocoded, where address details allowed, to a specific electoral division (ED) or, sometimes, to a group of adjacent EDs. Patients were assigned to "urban" or "rural" status on the basis of population density in their EDs of residence in 2006, using Census 2006 data. If a patient could only be geocoded to a group of adjacent EDs, urban/rural status could also be assigned if all EDs in the group were similarly classified. "Urban" EDs were defined as those with a population density of ≥1 person per ha, "rural" as those with a density of <1 person per ha. This is a simplified version of the urban/rural classification used in previous NCR reports or atlases (e.g. Carsin et al. 2009, NCR/NICR 2011).

In total, 92% of cancer cases could be assigned an urban/rural status (*Table m.2*). The geographic distribution of EDs classed as rural or urban is mapped in *Figure m.1*. For calculation of rural and urban incidence rates, age-specific adjustments to the relevant population denominators were made to compensate for the cases that could not be allocated to a specific category.

Deprivation

Cancer patients were assigned, on the basis of addresses geocoded to ED level, to deprivation strata derived on the Pobal Haase-Pratschke 2006 index of deprivation at ED level (Haase & Pratschke 2010). This index is a proxy variable for relative affluence and deprivation. Scores on this index are based on information collected at household level in the 2006 Census.

The index 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
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 headed by semi-skilled or unskilled manual workers, including farmers with less than 30 acres
   - 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, population quintiles of deprivation were assigned (at ED level) by sorting the EDs from least deprived to most deprived (using detailed Haase-Pratschke index values), then splitting all EDs into five groups of equal population size, using 2006 populations of all ages (and both sexes) combined. Thus, in theory, if cancer risk is equal by deprivation, if the age-breakdown of populations across quintiles is similar, and if the population changes are similar across quintiles (from 2006 up to 2012), each quintile should hold 20% of cancer cases during the 2008-2012 period covered by this report. This assignment of cases to quintiles was done for practical reasons, to ensure that each deprivation category had similar numbers of cases and to avoid having too many categories.

In total, 90% of cancer cases could be assigned to a specific deprivation quintile (*Table m.2*). This included some cases that could only be assigned to an adjacent group of EDs, if all EDs fell within the same deprivation quintile. The geographic distribution of EDs by deprivation quintile is mapped in *Figure m.2*. For calculation of deprivation-specific incidence rates, age-specific adjustments to the relevant population denominators were made to compensate for the cases that could not be allocated to a specified urban/rural or deprivation category.

In practice, for the diagnosis period 2008-2012, the most deprived quintile held a higher proportion of all cancer cases (23%) than the least deprived quintile (18%) (*Table m.2*), excluding cases that could not be assigned to a known deprivation quintile. This deviation from an 'even' 20% distribution probably reflects differences in cancer risk, and to a lesser extent differences in age-profile between deprivation quintiles. However, for breast cancer and leukaemia, the distribution of cases across the deprivation quintiles was more even (20-21% in both the least and most deprived strata).

In reporting findings in relation to deprivation, the main emphasis has been placed on comparisons of the most deprived stratum with the least deprived stratum, but reference is also made in the text to any significant differences between intermediate strata and the least deprived stratum.

Possible interactions between urban/rural status and the influence of deprivation were formally tested (Altman 2003) by comparison of the rate ratios, risk ratios and hazard ratios (for the most versus least deprived stratum) between urban and rural populations or patients, to assess whether the deprivation effect was stronger or weaker in urban situations.

Age

For comparison of age-specific incidence, survival and other outcomes or patient/tumour characteristics, five broad age-groups were used: ages 15-44, 45-54, 55-64, 65-74 and 75+ for most cancer types. These are the age-groups recommended by Corazziari et al. (2004) for age-standardisation of survival for most cancers, and widely used by projects such as EUROCARE (De Angelis et al. 2014). For prostate cancer, by convention an adapted version of these age-groups is used (15-54, 55-64, 65-74, 75-84 and 85+) (Corazziari et al. 2004).

By convention, age-standardised survival for adult cancers is generally presented for the age-range 15-99, and survival of patients aged <15 is generally reported separately. In this report, all survival figures (age-specific or age-standardised) relate to diagnoses ages 15-99 only. For most other measures presented in this report (incidence, stage, treatment and comorbidity), overall figures (age-standardised or crude) are based on patients of all ages, but age-specific figures are only presented for ages 15 upwards. This approach is taken, in part, because numbers of childhood cases are much smaller than numbers in the other age-groups, and also because ICD10-based groupings of cancer types is generally inappropriate for childhood cancers

For model-based analyses, age-adjustment is based on the five age-groups from 15-44 to 75+ (or 15-54 to 85+ for prostate cancer) for survival but six age-groups 0-14 to 75+ (or 0-14 to 85+ for prostate cancer) for stage, treatment and comorbidity. Models use age-group 45-54 as the reference group for most cancers, for improved stability of computation of rate ratios, risk ratios and hazard ratios (because case numbers may be quite small in the 15-44 group), and to 'scale' the ratios more manageably for incidence (incidence ratios between the very oldest and youngest groups may be very high). For prostate cancer, the 55-64 group is used as the baseline.

For incidence, calculation of directly age-standardised rates is used, based on 18 age-groups (0-4 to 85+), and comparisons between deprivation strata and between urban and rural populations is based on directly age-standardised rate ratios rather than by modelling (Jensen et al. 1991).

Sex

For cancer incidence, by convention rates are presented separately for males and females, because sex-specific rates for specific cancers (and overall) tend to differ quite markedly between the sexes and because 'age-standardised' figures could be confounded by differences in male/female ratios between populations.

For analyses of survival, stage, treatment and comorbidity, male and female patients have generally been combined, though some breakdowns by sex are also given (mainly for the "all cancer" group). All statistical models have been adjusted for sex, to allow for possible confounding by differences in the sex-ratio of cases between urban/rural, deprivation or age groups. Possible differences in the influence of deprivation, urban/rural status or age between sexes have not been examined in this report, nor have differences in incidence or in other measures/outcomes been formally compared between the sexes.

Incidence rates

All incidence rates are presented as age-standardised rates, standardised to the 1976 European population standard, and formal comparisons between population groups were based on directly age-standardised rate ratios (DSRRs) (Jensen et al. 1991).

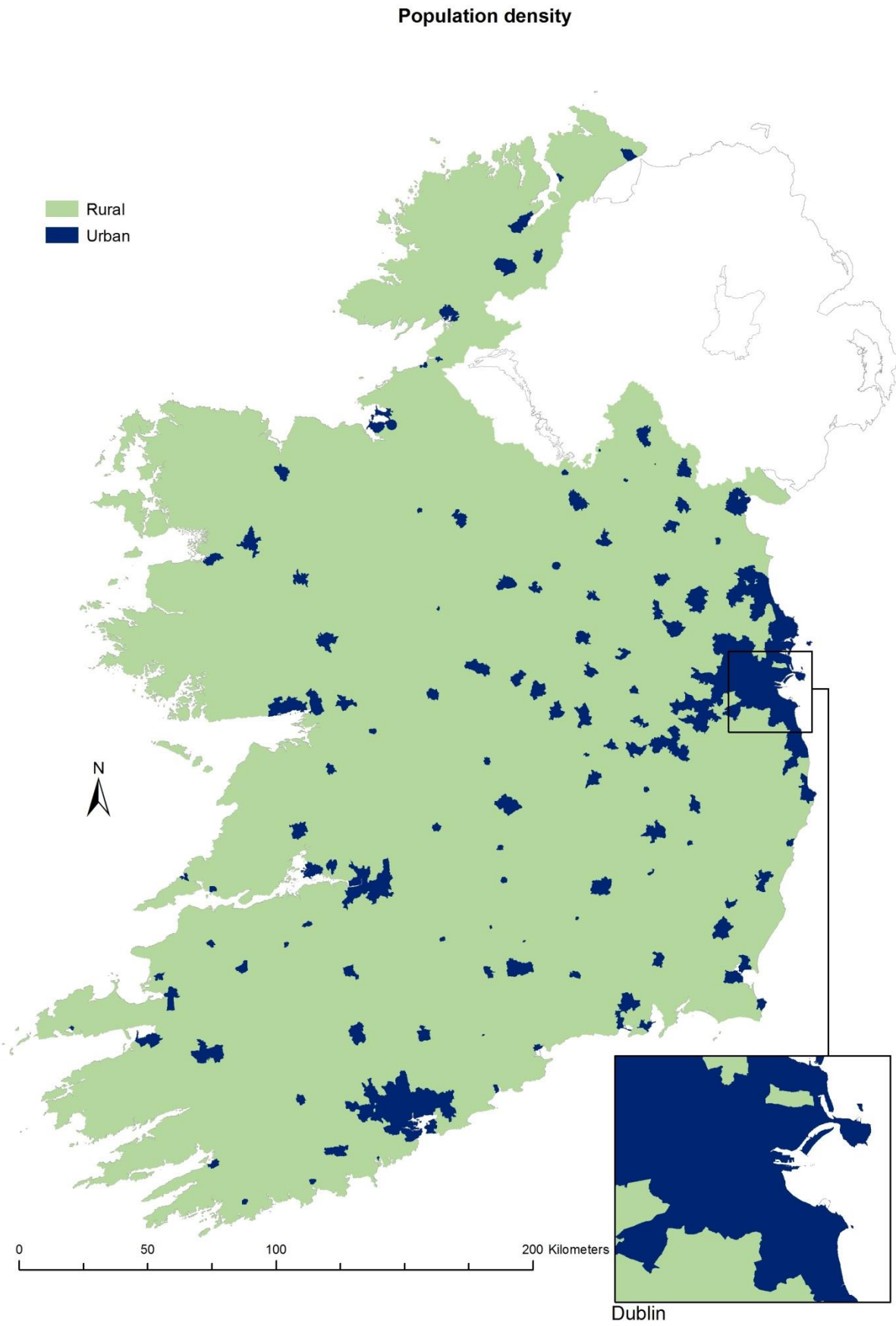


Figure m.1. Geographic distribution of electoral divisions (EDs) classed as "rural" (population density <1 person/ha in 2006) or "urban" (≥1 person/ha).

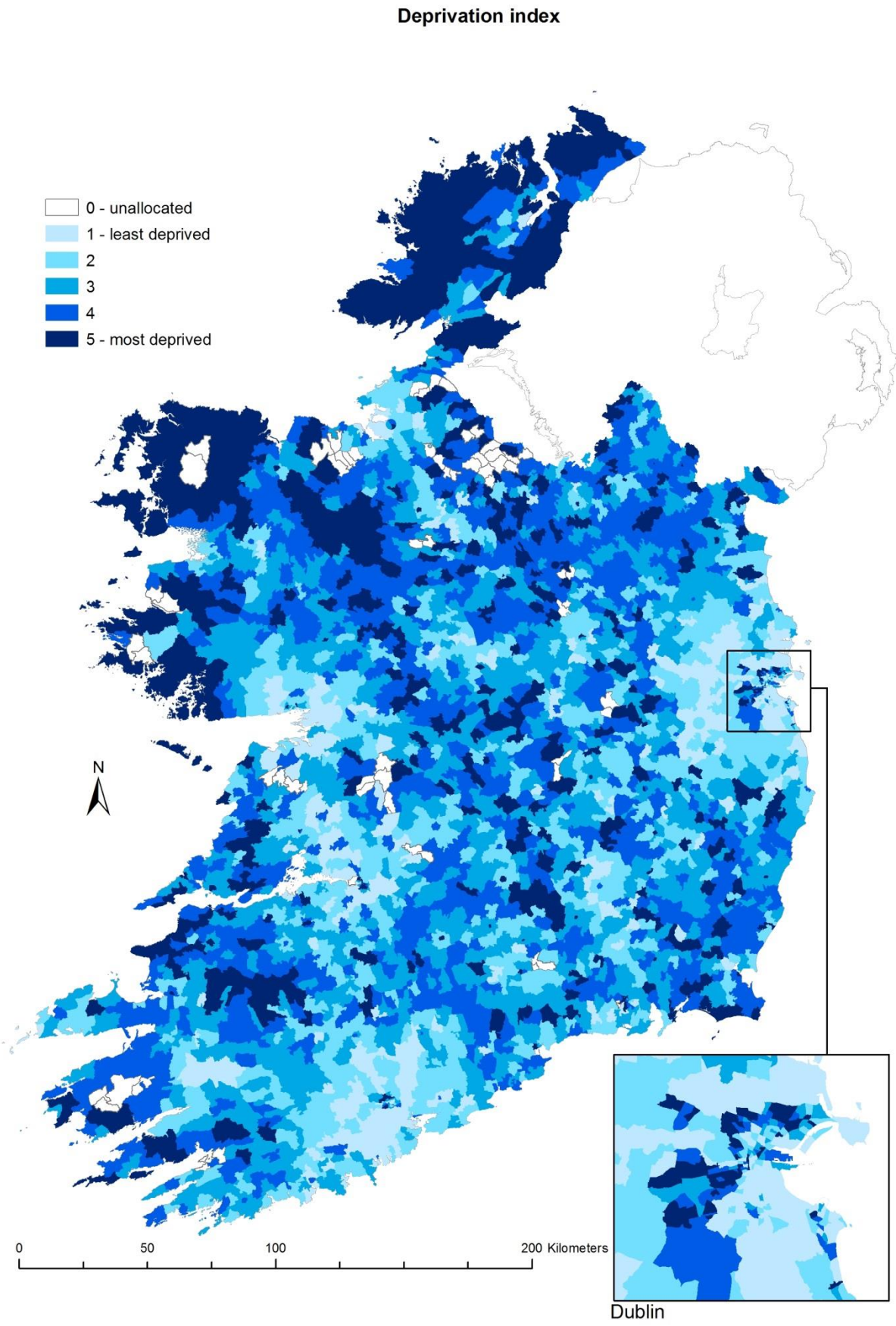


Figure m.2. Geographic distribution of electoral divisions (EDs) by deprivation, based on the Pobal Haase-Pratschke deprivation index (ED version) for 2006, divided into quintiles based on 2006 populations by ED. For some sparsely populated EDs (shown in white), the deprivation index could not be allocated as the ED codes used for geocoding of cancer cases were not sufficiently detailed to allow matching to the Pobal data.

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

Survival

Cause-specific 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 rules defined by the Scottish Cancer Intelligence Unit (2000). Deaths up to 31 December 2013 were included, based on comprehensive matching of cancer cases to death certificates collated at national level. Five-year survival estimates are presented for the 'hybrid period' 2009-2013, taking account of all available follow-up information within those calendar years. The use of this methodology (Brenner & Rachet 2004) allows more robust and up-to-date assessment of survival than would be possible using a traditional 'cohort' approach.

For computational reasons, Cox modelling was done for approximately (but not exactly) the same years, being based on the 2008-2012 cohort (i.e. only those cases diagnosed in those years). Sometimes the pattern of findings from the models appears to show a slight mismatch with the pattern shown by five-year survival endpoints, and in part this may be because the hybrid period estimates include more comprehensive data. However, perhaps more importantly, Cox models compare mortality across follow-up, so patterns may not always be consistent with those shown by fixed survival endpoints – for example, survival differences may be apparent in the first several years of follow-up even if, by five years after diagnosis, cumulative survival of all groups has become more similar. All Cox models were stratified by (rather than adjusted for) age, to allow for non-proportional hazards, and this approach was also taken for models that also incorporated stage.

Stage

Stage was assigned to cases based on TNM 5th edition staging rules (Fleming et al. 1997), and results are presented or adjusted for stages I, II, III, IV and unknown. 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 of NCR data suggests that this assumption is broadly correct, although it may be less safe an assumption for older patients where investigations for regional or distant spread might be less routine..

Further analyses based on the relative proportions of stages I-II combined ('early stage') and stages III-IV combined ('late stage') might help clarify or simplify some of the patterns of stage variation described based on individual stages I-IV.

Tumour-directed treatment

Treatment figures presented and analysed in this report reflect tumour-directed treatments that took place within 12 months after (or 1 month before) the formal date of diagnosis. Findings are presented for overall (any) relevant treatment and for specific modalities: surgery, radiotherapy, chemotherapy / immunotherapy and hormonal therapy. All treatments that, in aim or effect, removed or destroyed substantial amounts of tumour tissue or were likely to help prevent tumour growth or recurrence, were counted.

Diagnostic procedures (e.g. biopsies) were excluded unless they were known to have removed the entire primary tumour. Treatments to relieve symptoms (e.g. stent surgery) were likewise not included unless (as in palliative radiotherapy or chemotherapy) they also had a tumour-directed effect. For some cancer types, 'watchful waiting' and 'active surveillance' may be a common initial treatment plan, and such patients are not included in the definition of tumour-directed treatment used here. Other possible reasons why individual patients may have been classified as having no tumour-directed treatment could include: patient considered unfit, or patient refusing, treatment; cancer stage being too advanced at time of diagnosis; or treatment data in patient records being incomplete or ambiguous.

Comorbidity

For cancer cases that could be linked to HIPE (Hospital In-Patient Enquiry system) data for public hospitals, other health conditions listed within 12 months after (or 1 month before) the date of diagnosis were extracted. This covered approximately 85% of cancer patients, both 'public' patients and any 'private' patients who had at least some of their

treatment or diagnostic investigations in a public hospital. Using this information, matched patients were allocated a Charlson Comorbidity Index (Charlson et al. 1987) using an algorithm based on ICD-10 disease codes (Quan et al. 2005). A Charlson Index score in the range 1-6 was applied if the cancer patients had one or more of the following significant health conditions (excluding their cancer diagnosis) defined: myocardial infarct (score 1), congestive heart failure (1), peripheral vascular disease (1), cerebrovascular disease (1), dementia (1), chronic pulmonary disease (1), connective tissue disease (1), ulcer disease (1), mild liver disease (1), diabetes (1), hemiplegia (2), moderate to severe renal disease (2), diabetes with end organ damage (2), moderate to severe liver disease (3) or AIDS (6). Any matched patients with no relevant conditions mentioned in HIPE were assigned a Charlson Index of 0, and unmatched patients were classified as 'unknown' Charlson Index.

The Charlson Index was originally developed as a method of predicting mortality, but it also widely used to help assess if differences in treatment or survival of cancer patients (e.g. between age-groups) might be explained or influenced by other health conditions. An important caution to note in the present analysis is that not all relevant conditions may have been recorded in HIPE data for the relevant admissions, for example if the condition was not clinically apparent or otherwise known to hospital staff. Thus some patients classified as having a Charlson index of 0 might actually have had a relevant health condition that might have influenced treatment decisions or the patient's ability to tolerate a particular treatment.

To simplify presentation and analysis in this report, Charlson Index scores 1-6 were grouped as "1+". Proportions of patients with a Charlson Index of 1+ (of all patients with a score of 0 or 1+) are compared by deprivation status, urban/rural status, age and sex. This information is provided, in part, as context for interpretation of patterns of treatment and survival, but comorbidity has not formally been incorporated in the models of treatment or survival.

Screen-detection status (breast cancer only)

The national breast screening programme in Ireland (BreastCheck) currently targets and invites women aged 50-64 for mammographic screening. This age-group has therefore been used to assess possible inequalities in screen-detection status by urban/rural and deprivation status. Comparisons between age-groups are not made, but finer ager-groups (50-54, 55-59 and 60-64) are adjusted for in any statistical models. The majority of screen-detected breast cancers in this group are through organised screening, but small numbers of cases in this group may have been coded as presenting through unorganised (ad hoc) screening or through screening of unspecified type; all are counted as 'screen-detected' here.

Modelling and statistical comparisons

The basic summary statistics in this report are presented as rates per population (for incidence), percentages of patients (for survival, treatment and comorbidity) or both (for stage and screen-detection status). Rates are compared using directly age-standardised rate ratios (DSRRs) (Jensen et al. 1991). Survival is compared by Cox regression, adjusted for sex and stratified by age, generating hazard ratios (relative mortality risks); in fuller models, we also adjusted for cancer type, smoking and marital status and stratification by stage. For stage, treatment, comorbidity and screen-detection status, proportions (percentages) are compared using Poisson regression with robust error variance (Zou 2004), adjusted for relevant variables and generating relative risks or risk ratios. (Logistic regression, generating odds ratios, was not used, as odds ratios overstate the magnitude of differences for non-rare events like treatments.)

Models comparing urban and rural categories have not been adjusted for deprivation, and likewise models comparing deprivation strata have not been adjusted for urban/rural status. However, models assessing deprivation influences have been formally compared (Altman 2003) between urban and rural categories to assess whether or not there is significant heterogeneity by urban/rural status.

A final comment on statistical methodology is that, in view of the large number of comparisons between populations or patient groups in this report, inevitably some 'statistically significant' differences will be chance findings when using the standard ($P<0.05$) cut-off for significance. However, it was not considered practical to make further allowance for this.

Patient characteristics

Table m.1 presents a summary of patients' age, sex, smoking status and marital status by deprivation and urban/rural status; *Table m.2* a fuller cross-tabulation of deprivation and urban/rural status by cancer type; and *Table m.3* the geographic distribution of cases included in analyses in this report.

About 25% of patients from the most deprived fifth of the population were smokers at the time of their cancer diagnosis, compared with only 14% of patients from the least deprived group (*Table m.1*). About 19% of all cancer patients were

current smokers, highest for lung cancer (46%) and cervical cancer patients (36%). Patients from the most deprived group also tended to be slightly older (median age 68 years) and less likely to be married at the time of diagnosis (52%), compared with the least deprived group (65 years and 60% married) (*Table m.1*). All individual cancer types examined also showed these deprivation-related patterns in age, smoking status and marital status, to a lesser or greater degree (with the exception of age for lung cancer). In general, urban/rural differences in age, marital status and smoking status were relatively minor.

Age and sex were adjusted for in all statistical comparisons between deprivation and urban/rural categories, to avoid possible confounding by these variables. More detailed models of survival and treatment also adjusted for marital and smoking status, to help assess if these variables played any role in differences by deprivation or urban/rural status.

Of patients resident in areas flagged as least deprived (i.e. the least deprived fifth of the Irish population), 86% of those with known urban/rural status were categorised as urban and only 14% as rural (*Table m.2*). Between 47% and 65% of patients in the other four deprivation strata were categorised as urban (65% in the most deprived group).

Of the four Health Service Executive areas of residence, 28% of all cancer patients lived in the Dublin /North-East area but this area accounted for 52% of all patients from the least deprived fifth of the Irish population and 23% of patients from the most deprived group (*Table m.3*). In contrast, the West area accounted for 25% of all patients but 33% of those from the most deprived group (the highest proportion in any area) and only 12% of those from the least deprived group (the lowest proportion in any area). The South (27% of all patients) held the highest proportion of patients from the intermediate deprivation strata, while the deprivation breakdown of patients from the Dublin / Mid-Leinster area was the most even. The Dublin / North-East area also held the highest proportion (37%) of urban patients, while the West area held the lowest proportion of urban patients (15%) but the highest proportion of rural patients (41%) (*Table m.3*).

Interactions between deprivation urban/rural and geographic (or institutional) factors are potentially quite complex, and apparent influence of deprivation or urban status on cancer could, in part, reflect geographic factors (e.g. relating to access to services). Fuller exploration of this was considered beyond the scope of the current report, but the possibility of such influences should be borne in mind; further analyses by NCR may explore this further.

Table m.1 Age, sex, smoking status and marital status of cancer patients in Ireland, 2008-2012, by cancer type, deprivation status (Pobal 2006 ED deprivation index) and urban/rural status. Note: fuller adjustment for age-group, smoking status and marital status is used in some analyses later in this report, but basic summary figures are given here.

		Deprivation stratum (1 = least, 5 = most deprived)								
		1	**2**	**3**	**4**	**5**	**X**	**All**	**Rural**	**Urban**
All	Median age	65.0	65.0	66.0	67.0	68.0	65.0	66.0	67.0	66.0
	% male	50.9	52.9	54.1	53.9	54.6	53.4	53.4	55.9	51.7
	% current smokers	14.1	16.6	18.9	20.5	25.3	17.1	19.2	17.8	20.2
	% married	60.1	60.1	57.8	56.6	52.3	57.3	57.1	58.6	56.1
All (male)	Median age	67.0	67.0	67.0	68.0	68.0	67.0	67.0	68.0	67.0
	% current smokers	15.0	17.5	19.4	21.4	26.1	17.6	20.1	18.7	21.0
	% married	66.7	65.6	62.5	61.7	57.4	60.2	62.2	61.3	62.8
All (female)	Median age	63.0	63.0	64.0	66.0	67.0	63.0	64.0	65.0	64.0
	% current smokers	13.2	15.5	18.3	19.4	24.5	16.5	18.2	16.6	19.3
	% married	53.2	53.9	52.3	50.6	46.1	53.9	51.3	55.1	48.9
Stomach	Median age	70.0	70.0	72.0	72.0	73.0	73.0	72.0	71.0	72.0
	% male	60.6	62.8	67.3	63.1	62.6	66.2	63.5	67.3	61.1
	% current smokers	13.5	14.2	17.5	17.5	22.5	12.9	17.3	17.5	17.2
	% married	61.1	62.6	58.4	57.0	52.4	56.7	57.5	57.1	57.7
Colorectal	Median age	70.0	69.0	71.0	71.0	71.0	70.0	70.0	70.0	70.0
	% male	56.0	58.4	58.6	58.9	59.1	59.1	58.3	58.6	58.2
	% current smokers	10.7	12.5	13.7	14.4	15.9	10.0	13.3	12.1	14.1
	% married	61.2	62.1	57.0	56.2	53.1	58.0	57.6	58.1	57.3
Lung	Median age	72.0	71.0	71.0	70.0	70.0	71.0	71.0	71.0	70.0
	% male	54.9	58.4	58.0	58.9	58.3	55.1	57.7	60.4	56.2
	% current smokers	38.1	42.3	45.8	48.6	50.9	44.3	46.1	45.0	46.7
	% married	55.3	56.1	52.6	54.2	51.7	54.0	53.6	53.9	53.5
Melanoma skin	Median age	61.0	60.0	62.0	65.0	63.0	62.0	62.0	62.0	62.0
	% male	44.3	41.9	43.0	43.7	45.5	46.7	43.9	46.7	42.2
	% current smokers	5.3	6.6	7.1	10.3	12.2	7.7	8.1	7.0	8.7
	% married	57.1	51.7	59.6	49.4	48.9	52.6	53.4	57.3	51.1
Female breast	Median age	57.0	58.0	58.0	60.0	61.0	58.0	59.0	59.0	59.0
	% current smokers	11.0	13.0	15.0	17.2	22.6	16.3	15.8	14.7	16.4
	% married	63.9	62.7	62.0	59.6	53.4	66.7	61.1	66.2	58.0
Cervical	Median age	43.0	44.0	44.0	45.0	45.0	44.0	44.0	45.0	44.0
	% current smokers	28.3	34.5	32.7	35.8	44.4	27.8	35.6	30.6	38.2
	% married	45.5	47.5	49.3	47.4	40.1	39.7	45.0	48.5	43.1
Prostate	Median age	66.0	66.0	67.0	67.0	67.0	67.0	67.0	67.0	67.0
	% current smokers	8.7	10.2	11.7	12.4	15.6	11.1	11.8	10.9	12.6
	% married	70.1	69.8	67.5	65.7	61.5	64.9	66.5	65.9	67.0
Lymphoma	Median age	62.0	60.0	65.0	65.0	64.0	63.0	63.0	64.0	63.0
	% male	52.6	53.2	54.2	57.6	51.9	56.7	54.2	57.3	52.2
	% current smokers	11.9	14.6	18.5	14.0	19.8	15.3	15.8	16.1	15.6
	% married	56.2	60.0	55.5	55.9	49.4	51.7	54.9	55.6	54.5
Leukaemia	Median age	66.0	66.0	64.0	65.0	68.0	64.0	66.0	66.0	65.0
	% male	60.4	60.1	62.8	60.4	59.2	57.7	60.2	62.2	58.8
	% current smokers	8.0	11.4	11.6	12.8	15.8	8.3	11.5	11.2	11.8
	% married	56.6	53.2	56.4	54.2	50.6	46.2	53.2	52.8	53.5

Table m.2 Breakdown of invasive cancer cases diagnosed in Ireland, 2008-2012, by cancer type, deprivation status (Pobal 2006 ED deprivation index) and urban/rural status.

		Case numbers by deprivation stratum 1 = least, 5 = most deprived, X = unknown							Row % by deprivation stratum (excluding unknown deprivation)					Column % by deprivation stratum (excluding unknown urban/rural status)						
		1	2	3	4	5	X	All	1	2	3	4	5	1	2	3	4	5	X	All
All	Total	15930	16025	17291	18857	20457	9566	98126	18%	18%	20%	21%	23%							
	Rural	2288	6343	9148	9510	7148	1676	36113	6%	18%	25%	26%	20%	14%	40%	53%	50%	35%	80%	40%
	Urban	13599	9632	8069	9335	13299	413	54347	25%	18%	15%	17%	24%	86%	60%	47%	50%	65%	20%	60%
	Unknown	43	50	74	12	10	7477	7666	1%	1%	1%	0%	0%							
Stomach	Total	378	401	452	567	679	210	2687	15%	16%	18%	23%	27%							
	Rural	46	174	232	261	217	49	979	5%	18%	24%	27%	22%	12%	44%	52%	46%	32%	88%	39%
	Urban	332	226	218	306	461	7	1550	21%	15%	14%	20%	30%	88%	57%	48%	54%	68%	13%	61%
	Unknown		1	2		1	154	158	0%	1%	1%	0%	1%							
Colorectal	Total	2022	1970	2107	2354	2557	986	11996	18%	18%	19%	21%	23%							
	Rural	322	788	1112	1254	894	187	4557	7%	17%	24%	28%	20%	16%	40%	53%	53%	35%	81%	41%
	Urban	1691	1177	983	1099	1661	43	6654	25%	18%	15%	17%	25%	84%	60%	47%	47%	65%	19%	59%
	Unknown	9	5	12	1	2	756	785	1%	1%	2%	0%	0%							
Lung	Total	1502	1602	1910	2225	2968	784	10991	15%	16%	19%	22%	29%							
	Rural	210	627	927	967	820	129	3680	6%	17%	25%	26%	22%	14%	39%	49%	43%	28%	79%	36%
	Urban	1289	971	976	1257	2144	34	6671	19%	15%	15%	19%	32%	86%	61%	51%	57%	72%	21%	64%
	Unknown	3	4	7	1	4	621	640	0%	1%	1%	0%	1%							
Melanoma	Total	835	802	745	712	681	390	4165	22%	21%	20%	19%	18%							
	Rural	133	302	346	350	233	71	1435	9%	21%	24%	24%	16%	16%	38%	47%	49%	34%	77%	37%
	Urban	701	497	396	362	448	21	2425	29%	20%	16%	15%	18%	84%	62%	53%	51%	66%	23%	63%
	Unknown	1	3	3			298	305	0%	1%	1%	0%	0%							
Female breast	Total	2649	2362	2418	2562	2461	1574	14026	21%	19%	19%	21%	20%							
	Rural	343	894	1209	1239	801	270	4756	7%	19%	25%	26%	17%	13%	38%	50%	48%	33%	82%	37%
	Urban	2303	1462	1201	1319	1660	59	8004	29%	18%	15%	16%	21%	87%	62%	50%	52%	67%	18%	63%
	Unknown	3	6	8	4		1245	1266	0%	0%	1%	0%	0%							
Cervical	Total	198	255	272	302	399	126	1552	14%	18%	19%	21%	28%							
	Rural	31	79	118	137	104	20	489	6%	16%	24%	28%	21%	16%	31%	43%	45%	26%	77%	34%
	Urban	166	176	154	165	295	6	962	17%	18%	16%	17%	31%	84%	69%	57%	55%	74%	23%	66%
	Unknown	1					100	101	1%	0%	0%	0%	0%							

Table m.2 (continued)

		Case numbers by deprivation stratum 1 = least, 5 = most deprived, X = unknown							Row % by deprivation stratum (excluding unknown deprivation)					Column % by deprivation stratum (excluding unknown urban/rural status)						
		1	2	3	4	5	X	All	1	2	3	4	5	1	2	3	4	5	X	All
Prostate	Total	2533	2713	2975	3103	3164	1742	16230	17%	19%	21%	21%	22%							
	Rural	370	1208	1729	1696	1382	332	6717	6%	18%	26%	25%	21%	15%	45%	58%	55%	44%	81%	45%
	Urban	2154	1496	1235	1405	1781	80	8151	26%	18%	15%	17%	22%	85%	55%	42%	45%	56%	19%	55%
	Unknown	9	9	11	2	1	1330	1362	1%	1%	1%	0%	0%							
Lymphoma	Total	682	698	769	785	782	406	4122	18%	19%	21%	21%	21%							
	Rural	106	258	416	381	300	68	1529	7%	17%	27%	25%	20%	16%	37%	55%	49%	38%	83%	40%
	Urban	573	436	347	403	482	14	2255	25%	19%	15%	18%	21%	84%	63%	45%	51%	62%	17%	60%
	Unknown	3	4	6	1		324	338	1%	1%	2%	0%	0%							
Leukaemia	Total	452	466	438	452	480	312	2600	20%	20%	19%	20%	21%							
	Rural	62	187	269	235	192	43	988	6%	19%	27%	24%	19%	14%	40%	62%	52%	40%	84%	42%
	Urban	388	277	166	217	287	8	1343	29%	21%	12%	16%	21%	86%	60%	38%	48%	60%	16%	58%
	Unknown	2	2	3		1	261	269	1%	1%	1%	0%	0%							

Table m.3 Health Services Executive (HSE) area of residence for cancer patients in Ireland, 2008-2012, by cancer type, deprivation status (Pobal 2006 ED deprivation index) and urban/rural status. Column percentages are shown.

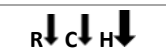
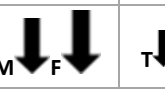
		Deprivation stratum (1 = least, 5 = most deprived)								
		1	2	3	4	5	X	All	Rural	Urban
All	Dublin / North-East	52.2%	26.6%	18.5%	24.1%	22.8%	27.5%	28.1%	15.1%	36.7%
	Dublin / Mid-Leinster	19.3%	22.2%	21.2%	17.6%	19.3%	21.0%	19.9%	11.9%	25.3%
	South	16.4%	28.7%	33.3%	31.8%	25.4%	22.4%	26.8%	32.3%	23.2%
	West	12.2%	22.5%	27.0%	26.6%	32.6%	29.0%	25.1%	40.7%	14.8%
Stomach	Dublin / North-East	56.1%	28.2%	19.9%	27.9%	28.6%	29.0%	30.8%	16.2%	40.1%
	Dublin / Mid-Leinster	22.5%	27.7%	26.1%	22.8%	19.0%	21.4%	23.0%	15.5%	27.7%
	South	11.1%	24.9%	29.4%	24.5%	23.6%	19.0%	22.9%	29.5%	18.6%
	West	10.3%	19.2%	24.6%	24.9%	28.9%	30.5%	23.4%	38.9%	13.5%
Colorectal	Dublin / North-East	52.1%	25.5%	17.6%	22.6%	20.7%	28.8%	27.3%	14.5%	36.0%
	Dublin / Mid-Leinster	19.1%	23.3%	22.4%	18.5%	19.9%	15.3%	20.1%	12.8%	25.2%
	South	16.0%	29.8%	33.7%	31.2%	25.6%	25.5%	27.2%	31.9%	24.0%
	West	12.8%	21.4%	26.2%	27.7%	33.8%	30.4%	25.4%	40.8%	14.8%
Lung	Dublin / North-East	55.3%	30.1%	20.3%	28.5%	26.9%	29.5%	30.6%	16.7%	38.4%
	Dublin / Mid-Leinster	19.8%	22.0%	25.3%	20.3%	22.2%	23.1%	22.1%	12.3%	27.5%
	South	14.8%	27.6%	31.4%	29.1%	24.1%	21.1%	25.4%	31.3%	22.1%
	West	10.1%	20.2%	22.9%	22.0%	26.8%	26.3%	21.9%	39.6%	12.0%
Melanoma skin	Dublin / North-East	49.1%	25.1%	17.3%	24.7%	20.9%	27.2%	28.0%	16.0%	35.1%
	Dublin / Mid-Leinster	20.2%	20.8%	23.1%	16.0%	20.9%	14.4%	19.7%	11.8%	24.5%
	South	18.6%	31.3%	37.6%	37.4%	28.0%	26.7%	29.9%	36.3%	26.1%
	West	12.1%	22.8%	22.0%	21.9%	30.2%	31.6%	22.4%	35.9%	14.3%
Female breast	Dublin / North-East	53.5%	25.4%	17.0%	22.4%	22.3%	25.7%	28.2%	13.2%	37.2%
	Dublin / Mid-Leinster	18.5%	22.9%	21.7%	16.8%	19.1%	28.0%	20.6%	12.2%	25.7%
	South	15.7%	27.7%	34.4%	33.6%	26.3%	22.6%	26.9%	34.0%	22.5%
	West	12.2%	24.0%	26.9%	27.1%	32.3%	23.7%	24.3%	40.6%	14.5%
Cervical	Dublin / North-East	45.5%	25.9%	20.6%	29.1%	23.9%	44.8%	29.1%	21.8%	32.9%
	Dublin / Mid-Leinster	20.7%	28.6%	24.3%	17.2%	24.6%	18.4%	22.8%	12.8%	28.0
	South	16.7%	25.9%	28.3%	28.5%	28.1%	19.2%	25.7%	28.4%	24.2%
	West	17.2%	19.6%	26.8%	25.2%	23.4%	17.6%	22.5%	36.9%	14.9%
Prostate	Dublin / North-East	52.0	25.5%	18.3%	23.6%	20.2%	25.0	26.8%	14.9%	36.5%
	Dublin / Mid-Leinster	19.1%	20.6%	18.7%	16.1%	16.2%	18.8%	18.1%	10.9%	24.0
	South	16.3%	30.7%	33.1%	31.7%	24.7%	22.7%	27.0	31.2%	23.6%
	West	12.7%	23.1%	29.9%	28.7%	38.9%	33.5%	28.0	43.0	15.8%
Lymphoma	Dublin / North-East	48.8%	26.6%	21.3%	24.5%	20.1%	22.7%	27.3%	14.8%	35.7%
	Dublin / Mid-Leinster	19.9%	22.3%	19.9%	18.6%	19.8%	20.9%	20.2%	11.5%	26.1%
	South	19.6%	28.9%	31.7%	29.4%	24.4%	23.2%	26.6%	32.1%	22.8%
	West	11.6%	22.1%	27.0%	27.5%	35.7%	33.3%	26.0%	41.7%	15.4%
Leukaemia	Dublin / North-East	54.0%	26.2%	23.3%	26.1%	22.9%	29.2%	30.3%	17.9%	39.3%
	Dublin / Mid-Leinster	17.7%	23.4%	14.2%	14.6%	18.1%	16.0%	17.5%	11.2%	22.0%
	South	18.6%	27.7%	33.1%	30.8%	23.1%	23.4%	26.2%	31.2%	22.6%
	West	9.7%	22.6%	29.5%	28.5%	35.8%	31.4%	26.0%	39.7%	16.1%

1 ALL INVASIVE CANCERS (excluding non-melanoma skin cancer)

Key points

- *Incidence*
  - Age-standardised incidence rates were about 10% higher in urban than in rural populations for both sexes.
  - Rates were significantly higher in the most deprived compared with the least deprived population quintile for both males (+10%) and, to a lesser extent, females (+4%), but the trends by incidence were not clearly linear.
  - Variation by age was more pronounced for males, with rates in the oldest group (75+) about 10 times higher than at ages 45-54; for women, rates at age 75+ were about 4 times higher than at ages 45-54. Rates in the under-55s were higher in females than in males, but rates in older groups were higher in males than in females.
- *Survival*
  - Urban patients had slightly but significantly poorer survival (age/sex-adjusted mortality risk 4% higher) than rural patients after adjustment for age and sex. The main difference was for males (urban mortality risk 8% higher).
  - Survival was significantly and substantially poorer (age/sex-adjusted mortality hazard 39% higher) among patients from the most deprived compared with the least deprived population quintile. Similar patterns were seen for both males and females.
  - Survival was significantly poorer (mortality hazard almost four [3.8 times] higher) at ages 75+ compared with 45-54, and also poorer at ages 55-64 and 65-74, but higher at ages 15-44.
  - Survival disparities between the oldest group (75+) and the age 45-54 group were higher for females (cancer mortality risk 5.2 times higher in the oldest group) than for males (2.6 times higher).
  - Adjustment for casemix (cancer type) reduced survival disparities between urban and rural cases (no longer significant), between the most and least deprived groups and, for females (but not males), between older and younger patients, i.e. some of the differences may reflect different proportions of more fatal cancers.

Table 1.k.1 Visual summary of the influence of urban status, deprivation and age on cancer in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Treatment[e]	Comorbidity[f]
Urban status				
Deprivation				
Older age				

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Treatment*
  - Urban patients were slightly but significantly less likely to have radiotherapy (-4% in relative terms), chemotherapy (-4%) or hormone therapy (-13%) than rural patients, having adjusted for age, sex and casemix.
  - Patients from the most deprived population quintile were slightly but significantly less likely (-6% in relative terms) to have tumour-directed surgery than those from the least deprived group, but more likely (+27%) to have recorded hormonal treatment (mostly for breast or prostate cancer). However, data on hormonal therapy were incomplete and the apparent relationship between deprivation and hormonal use could possibly be biased.
  - The relationship between hormonal treatment and deprivation was stronger for urban cases.
  - The oldest patients (age 75+) were significantly less likely to have any treatment (-30%), surgery (-41%), radiotherapy (-42%) or chemotherapy (-72%) compared with ages 45-54, but more likely to have confirmed hormonal treatment (+41%), adjusted for sex and cancer type.
- *Comorbidity*
  - Urban cancer patients were slightly but significantly more likely (+6% in relative terms) than rural patients to have other serious health conditions around the time of their cancer diagnosis, having adjusted for age and sex, though the difference was reduced (to +4%) if adjustment was also made for cancer type.
  - Patients from the most deprived population quintile were about 20% more likely to have one or more serious comorbidities, or 17% more likely after adjustment for cancer type.
  - Urban patients showed a stronger relationship between deprivation and comorbidity (25% higher prevalence in the most compared with least deprived group) than rural cases (4% higher in the most deprived group).
  - The oldest patients (75+) were more than twice (2.5 times) as likely to have comorbidities than patients aged 45-54, and comorbidity prevalence was also significantly higher at ages 55-64 and 65-74.

1.1 All cancers: incidence

Variation by urban/rural status

Age-standardised incidence rates ranged 465-509 cases per 100,000 males and 360-398 per 100,000 females between rural and urban cases (*Figure 1.1.1*) and were about 10% higher in urban than in rural populations for both men and women: directly age-standardised rate ratio (DSRR) 1.10 (1.08-1.12) and 1.11 (1.08-1.12), respectively (*Table 1.1.1*, *Figure 1.1.2*).

Variation by deprivation

Age-standardised rates ranged 467-534 cases per 100,000 males and 366-404 cases per 1000,000 females across the five deprivation strata (*Figure 1.1.1*). Overall incidence was significantly higher in the most deprived compared with the least deprived group for males (DSRR 1.10, 95% CI 1.06-1.13) and to a lesser extent for females (DSRR 1.04, 95% 1.01-1.07 (*Figure 1.1.2*). However, the overall trend was not clearly linear for either sex.

Interaction between deprivation and urban/rural status

Inequality in incidence by deprivation did not differ significantly between urban and rural populations, at least based on comparisons of the extremes: for males, a rate ratio 1.12 (95% CI 1.08-1.16) comparing the most with the least deprived urban populations versus 1.18 (1.11-1.26) for the same comparison among rural populations (z=1.61, P=0.11 for difference); for females, 1.07 (1.04-1.11) urban versus 1.11 (1.00-1.15) rural (z=0.14, P=0.89). That is, in both urban and rural populations, higher overall cancer incidence was associated with higher levels of deprivation and the strength of the association was broadly similar.

Table 1.1.1 Influence of deprivation on overall cancer incidence (excluding non-melanoma skin cancer), Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	Males				Females			
	HR most v least deprived	95% CI	z	P	HR most v least deprived	95% CI	z	P
Total	*1.10	1.01-1.13			*1.04	1.01-1.07		
Rural	*1.18	1.11-1.26			1.07	1.00-1.15		
Urban	*1.12	1.08-1.16	1.61	0.11	*1.07	1.04-1.11	0.14	0.89

Variation by age

Age-specific incidence rates ranged 61-3239 cases per 100,000 males and 105-1950 per 100,000 females across the age-groups considered here (*Figure 1.1.1*). Variation in incidence by age was more pronounced in males than in females, with rates in the oldest age-group (75+) about 10 times higher for men than in the 45-54 group, but about 4 times higher for women: DSRR 9.6 (9.2-10.0) and 3.9 (3.8-4.0), respectively (*Figure 1.1.2*). This reflects a combination of higher overall rates of cancer (notably breast cancer) in younger women (<55 years) compared with men, and higher rates of cancer in men than in women in older age-groups.

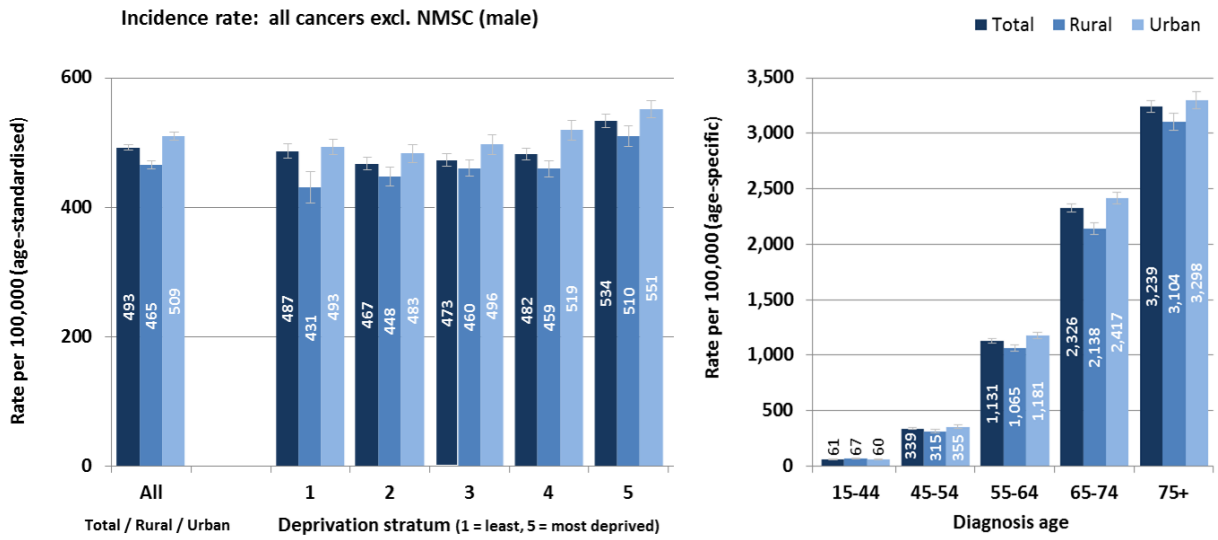


Figure 1.1.1(a) Incidence of all cancers in males (excluding non-melanoma skin cancer), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

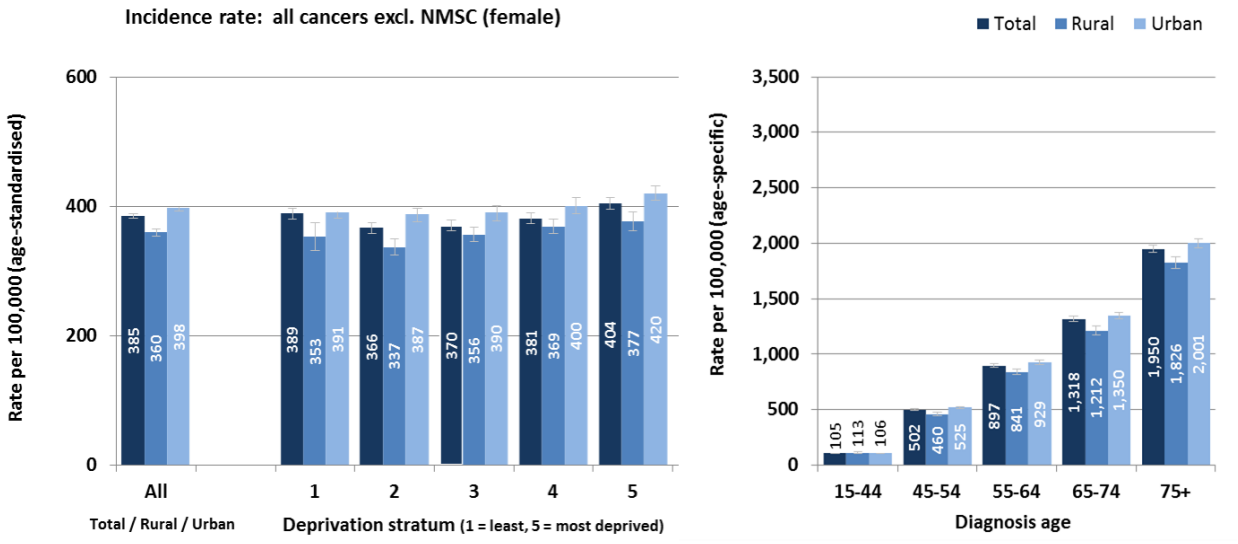


Figure 1.1.1(b) Incidence of all cancers in females (excluding non-melanoma skin cancer), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

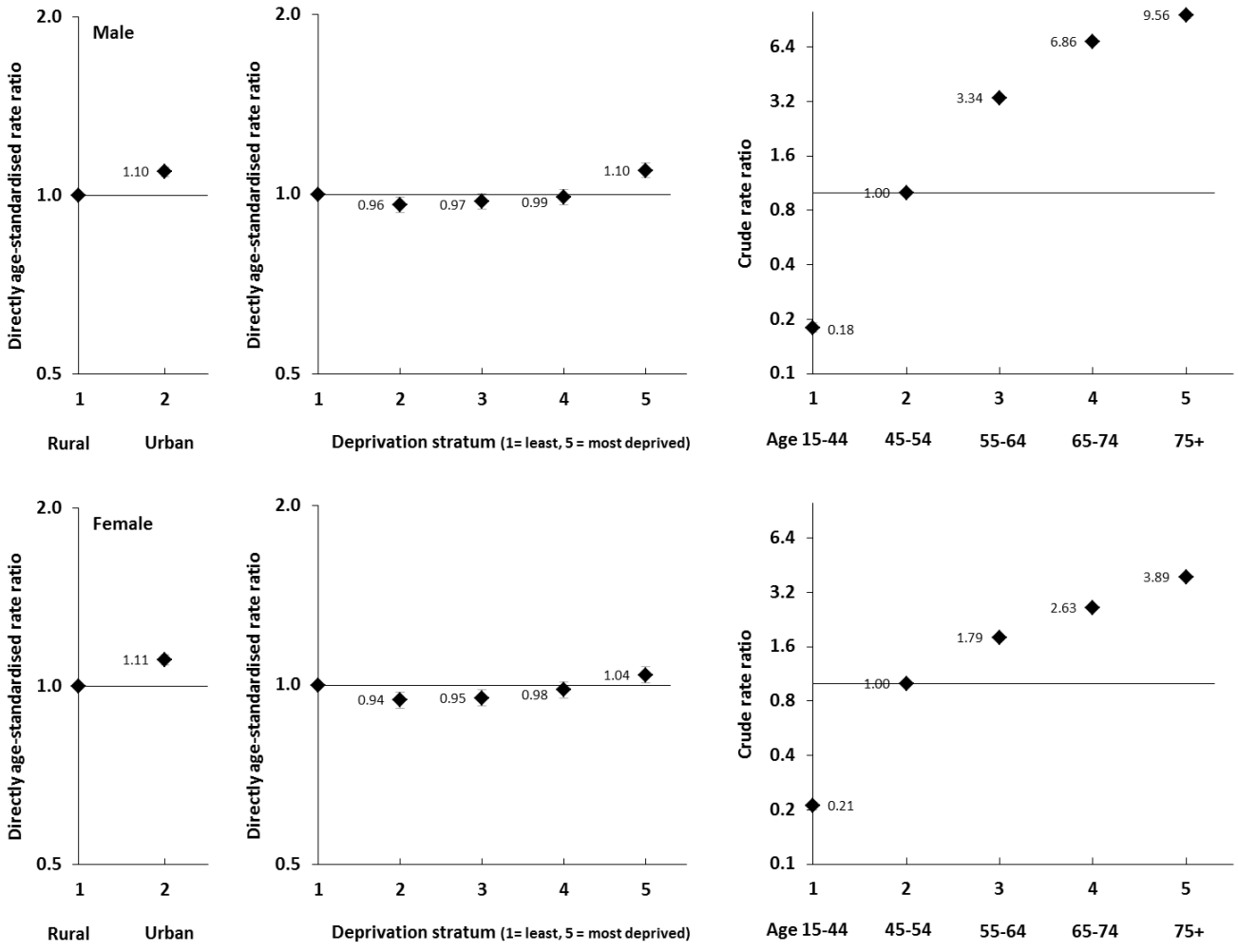


Figure 1.1.2 Rate ratios of cancer incidence, by urban/rural status, deprivation stratum and diagnosis age. Note: error bars (95% confidence intervals) are very narrow on all these estimates because of the large numbers of cases involved.

1.2 All cancers: cause-specific survival

Variation by urban/rural status

Five-year survival varied only slightly between rural and urban cases, ranging 59-60% overall, 59-61% for males and both 59% for females (*Figure 1.2.1*). For both sexes combined, age/sex-adjusted Cox modelling indicated that urban cases had slightly but significantly poorer survival than rural cases (hazard ratio [HR] 1.04 [95% CI 1.02-1.07], P=0.002), but this difference was no longer significant after adjustment for casemix (HR 0.98 [0.96-1.01), P=0.173) (*Figure 1.2.2*). The main difference was for males (age-adjusted HR 1.08, 1.04-1.11 for urban v rural cases) but, again, the difference disappeared after adjustment for casemix (HR 0.99, 0.95-1.02). For females, there was no significant survival difference between rural and urban cases: age-adjusted HR 0.99 (0.95-1.03), or 0.98 (0.94-1.01) after adjustment for casemix (*Figure 1.2.2*).

Variation by deprivation

Age-standardised five-year survival ranged 55-64% across the five deprivation strata for males and females combined, or 55-65% for males and 55-63% for females, with a clear pattern of decreasing survival with increasing deprivation (*Figures 1.2.1 & 1.2.3*). For all patients combined, cancer-specific mortality was about 40% higher in the most deprived compared with the least deprived stratum: age/sex-adjusted HR 1.39 (95% CI 1.34-1.45), or 1.27 (1.22-1.32) after adjustment for cancer-type (*Figure 1.2.2*). For males, the equivalent hazard ratios were 1.42 (1.34-1.49), or 1.27 (1.20-1.34) after casemix-adjustment; for females 1.36 (1.29-1.44), or 1.28 (1.21-1.35) after casemix-adjustment. For both sexes, survival was also significantly poorer among patients from intermediate deprivation strata (2-4) compared with stratum 1, with or without casemix-adjustment (*Figure 1.2.2*).

Adjustment for marital and smoking status had little further effect on these comparisons. Adjustment was not attempted for stage, as stage data were not comparable across cancer types.

Interaction between deprivation and urban/rural status

Patients from both urban and rural areas showed significant variation of survival by deprivation status, with age-adjusted mortality hazard ratio comparing patients from the most deprived with those from the least deprived populations of 1.48 (95% 1.42-1.55) for urban patients and 1.19 (1.09-1.31) for rural patients (*Table 1.2.1*, *Figure 1.2.4*). Based on this comparison, the deprivation effect was significantly stronger among urban than rural patients (P<0.001 for difference). For males, the equivalent age-adjusted hazard ratios were 1.53 (1.44-1.62) for urban patients and 1.21 (1.07-1.37) (P<0.001); for females, 1.43 (1.34-1.52) for urban patients and 1.16 (1.02-1.33) (P=0.004); i.e. both sexes showed stronger influences of deprivation on survival among urban patients. However, these comparisons do not account for possible influences of cancer-type (casemix).

Table 1.2.1 Influence of deprivation on overall cancer survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted hazard ratios)

	Sexes combined							
	HR most v least deprived	**95% CI**	**z**	**P**				
Total	*1.39	1.34-1.45						
Rural	*1.19	1.09-1.31						
Urban	*1.48	1.42-1.55	4.50	*<0.001				
	Males				**Females**			
	HR most v least deprived	**95% CI**	**z**	**P**	**HR most v least deprived**	**95% CI**	**z**	**P**
Total	*1.42	1.34-1.49			*1.36	1.29-1.44		
Rural	*1.21	1.07-1.37			*1.16	1.02-1.33		
Urban	*1.53	1.44-1.62	3.54	*<0.001	*1.43	1.34-1.52	2.88	*0.004

Variation by age

Five-year survival varied from 39% to 83% between age-groups overall, or 41-80% for males and 37-84% for females, with a clear pattern of decreasing survival with increasing age (*Figure 1.2.1*). Cancer-specific mortality was about four times higher in the oldest group (75+) compared with ages 45-54: sex-adjusted HR 3.82 (3.65-3.99), or 2.94 (2.80-3.07) after casemix-adjustment *(Figure 1.2.2*). However, the survival difference between these age-groups was higher for females (unadjusted HR 5.24, 4.91-5.59 / casemix-adjusted HR 3.24, 3.03-3.46) than for males (2.64, 2.48-2.81 / 2.67, 2.50-2.84). Both sexes also showed significantly poorer survival for age-groups 55-64 and 65-74, again more pronounced for females, and significantly better survival for age-group 15-44, compared with 45-54, with or without casemix-adjustment. For the three oldest age-groups, casemix appeared to account for a higher proportion of the survival disparities in females than in males.

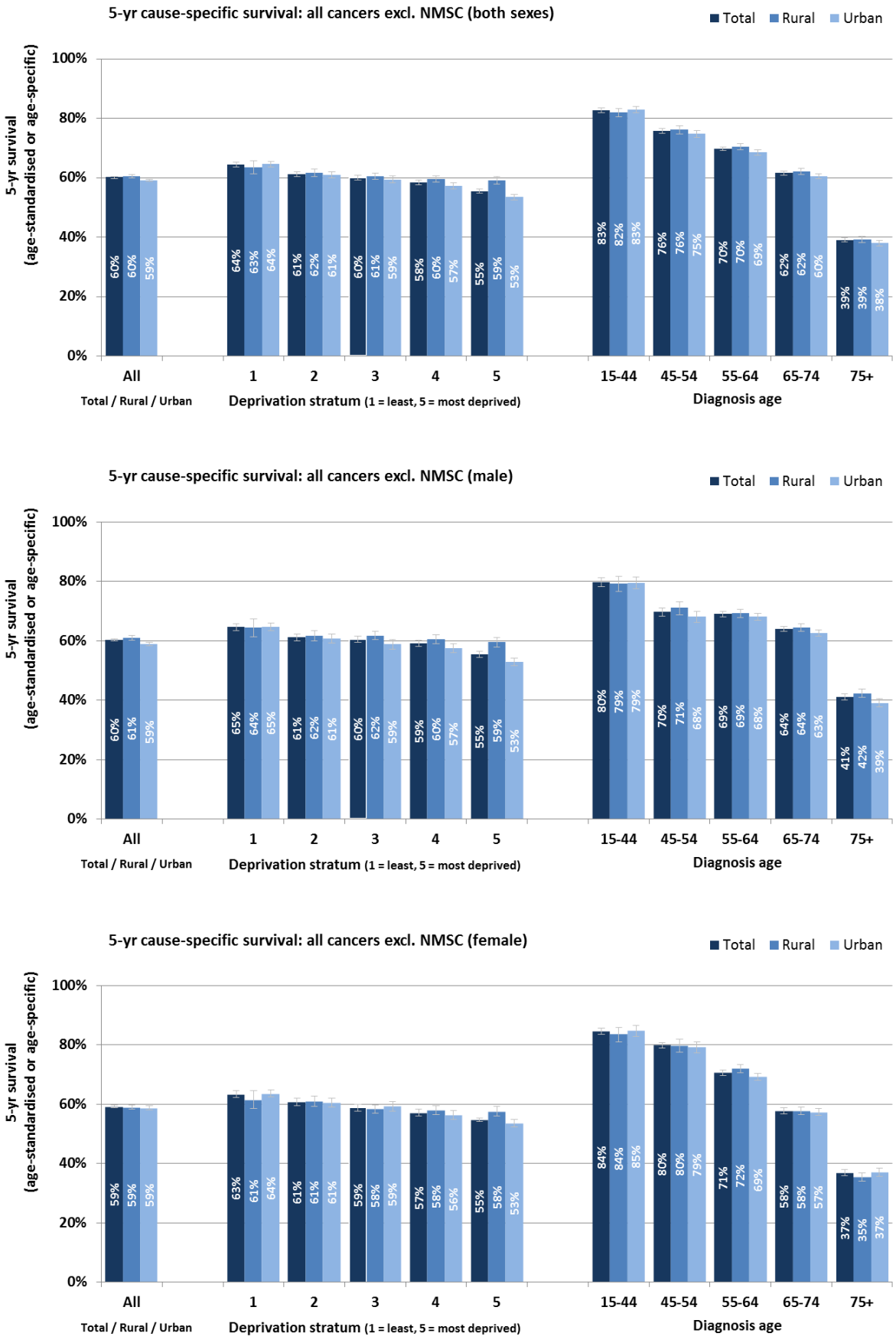


Figure 1.2.1 Cause-specific five-year survival of Irish cancer patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age.

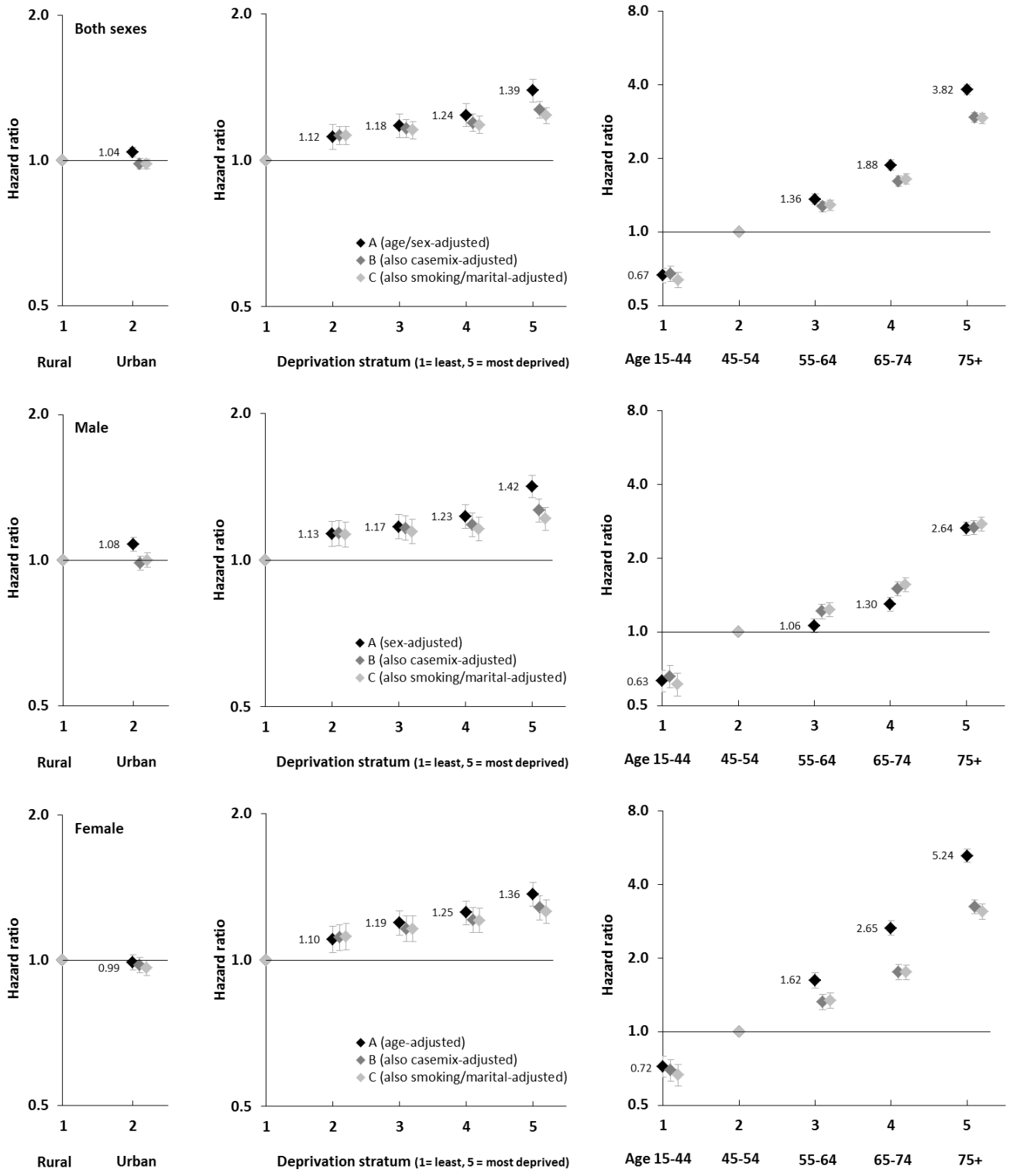


Figure 1.2.2 Mortality hazard ratios for cancer survival, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group) and fuller models.

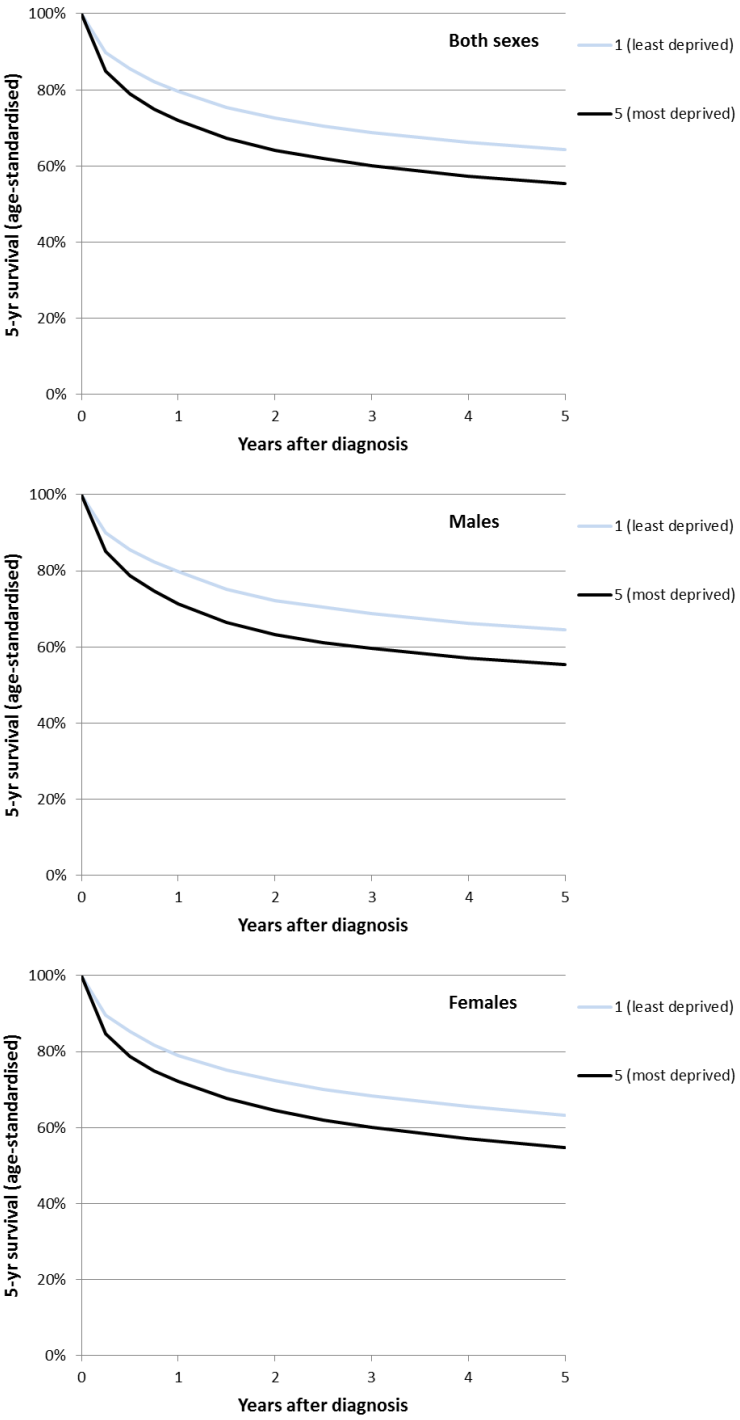


Figure 1.2.3 Cause-specific survival curves for Irish cancer patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

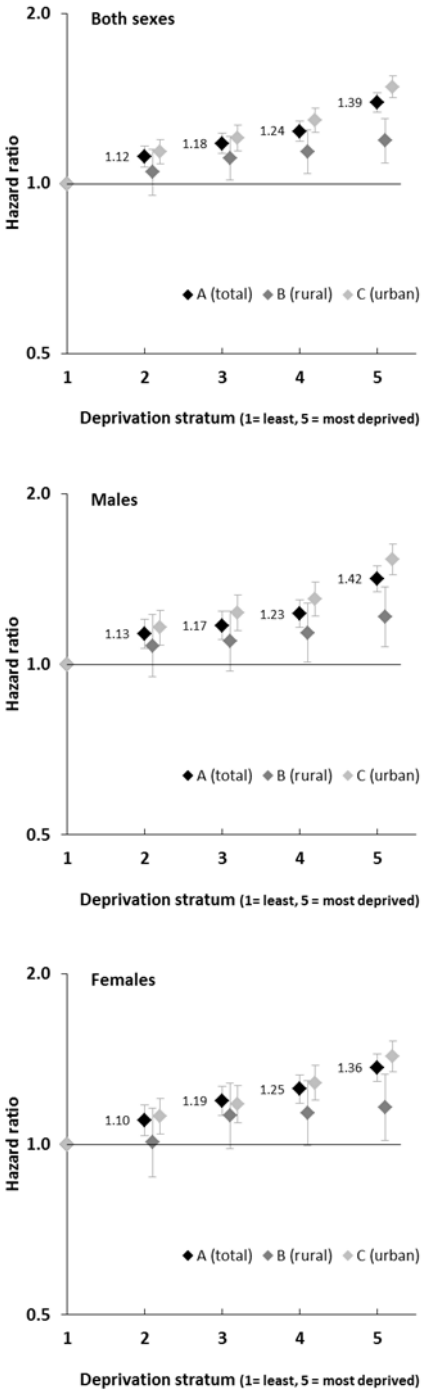


Figure 1.2.4 Mortality hazard ratios for cancer survival, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. See also *Table 1.2.1*.

1.3 All cancers: tumour-directed treatment

Variation by urban/rural status

Patients from urban areas were significantly less likely to have radiotherapy, chemotherapy or hormone therapy, compared with rural patients: relative risks (RRs) 0.96 (0.94-0.97) for radiotherapy, 0.96 (0.95-0.98) for chemotherapy and 0.87 (0.85-0.90) for hormone therapy, adjusted for age, sex and cancer type (*Figure 1.3.2*). Overall treatment and use of surgery did not differ significantly between rural and urban patients.

Variation by deprivation

The proportion of all cancer patients having tumour-directed treatment within a year of diagnosis varied from 76% to 79% between deprivation strata, apparently lowest in the most deprived groups (*Table 1.3.1*, *Figure 1.3.1*), but these figures were unadjusted for age, sex or casemix (cancer type). Tumour-directed surgery showed stronger indications of a deprivation influence, with 52% of patients in the least deprived group having surgical treatment compared with only 44% in the most deprived group, again unadjusted. Use of radiotherapy (34-35%), chemotherapy (31-32%) and hormone therapy (at least 13-14%) showed less variation and little or no apparent relationship to deprivation (*Figure 1.3.1*).

Modelling confirmed that patients from the most deprived stratum were significantly less likely to have tumour-directed surgery than those from the least derived group: RR 0.94 (95% CI 0.92-0.95), having adjusted for age, sex and cancer type (*Table 1.3.1*, *Figure 1.3.2*). Surgery use was also significantly low in stratum 4 (versus 1): adjusted RR 0.97 (0.96-0.99). Patients from the most deprived stratum were significantly more likely to have recorded hormonal treatment (mostly for breast or prostate cancer) – RR 1.27 (1.22-1.33) – a finding that was not apparent from the unadjusted percentages. Otherwise, there was no significant variation in overall treatment, radiotherapy or chemotherapy by deprivation status (*Table 1.3.1*, *Figure 1.3.2*).

Adjustment was not made for stage, as stage data were not comparable across cancer types.

Data on hormonal therapy were known to be incomplete (based on unpublished NCR work linking a sample of breast cancer cases to national prescription data), and the apparent relationship between deprivation and hormonal use could possibly be biased. For example, if a higher proportion of data was missing for patients treated in private hospitals, it might appear that patients from the least deprived group (the patients most likely to be treated in private hospitals) were less likely to have hormonal therapy.

Interaction between deprivation and urban/rural status

Both urban and rural groups appeared to show broadly similar patterns of treatment variation by deprivation, with both groups showing significantly lower use of surgery and higher use of hormone therapy in the most deprived stratum, as also seen overall (*Table 1.3.1*). However, the relationship between hormonal treatment and deprivation was apparently stronger for urban cases: RR 1.29 (95% CI 1.22-1.35) comparing the most deprived with least deprived urban cases versus RR 1.13 (1.03-1.24) for the equivalent rural comparison (P=0.012 for difference).

Table 1.3.1 Influence of deprivation on cancer treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Any treatment							
	RR most v least deprived	**95% CI**	**z**	**P**				
Total	1.00	0.99-1.01						
Rural	0.99	0.97-1.01						
Urban	1.00	0.98-1.01	0.80	0.42				
	Surgery				**Radiotherapy**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	*0.94	0.92-0.95			1.02	1.00-1.05		
Rural	*0.93	0.90-0.96			1.04	0.98-1.09		
Urban	*0.94	0.92-0.96	0.52	0.60	1.00	0.97-1.03	1.23	0.22
	Chemotherapy				**Hormonal therapy**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.00	0.97-1.03			*1.27	1.22-1.33		
Rural	1.03	0.97-1.08			*1.13	1.03-1.24		
Urban	0.97	0.95-1.00	1.84	0.066	*1.29	1.22-1.35	2.53	*0.012

Variation by age

Treatment variation by age was much more substantial than variation by deprivation, and this was a general feature also seen for specific cancer types considered elsewhere in this report. Unadjusted treatment percentages ranged 58-94%

between age-groups for overall treatment, 32-73% for surgery, 19-46% for radiotherapy, 14-49% for chemotherapy and 11-19% for hormone therapy (*Figure 1.3.1*). Overall treatment and surgery showed the most consistent decline with age, while radiotherapy and hormonal therapy peaked at intermediate ages. Chemotherapy use peaked in the two youngest groups but showed the biggest relative differences between the extremes (threefold variation in unadjusted percentages).

Models adjusted for sex and cancer type confirmed that patients from the oldest age-group (75+) were markedly less likely to have any tumour-directed treatment, compared with the 45-54 group: RR 0.70 (0.69-0.71) (*Figure 1.3.2*). Differences in proportions treated were even more marked for surgery, radiotherapy and, especially, chemotherapy: RRs 0.59 (0.58-0.60) for surgery, 0.58 (0.56-0.60) for radiotherapy and 0.28 (0.27-0.29) for chemotherapy. Overall treatment, surgery and chemotherapy use were also significantly lower in age-groups 55-64 and 65-74. In contrast, use of hormonal therapy was higher at ages 75+ than in the 45-54 group: RR 1.41 (1.36-1.46).

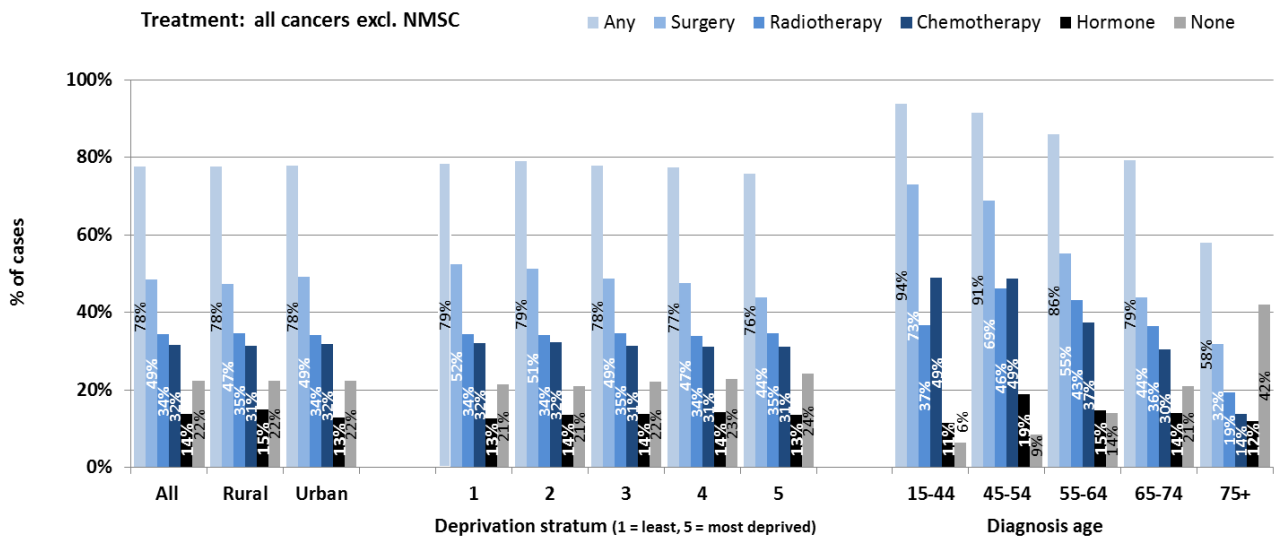


Figure 1.3.1 Treatment of cancer within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

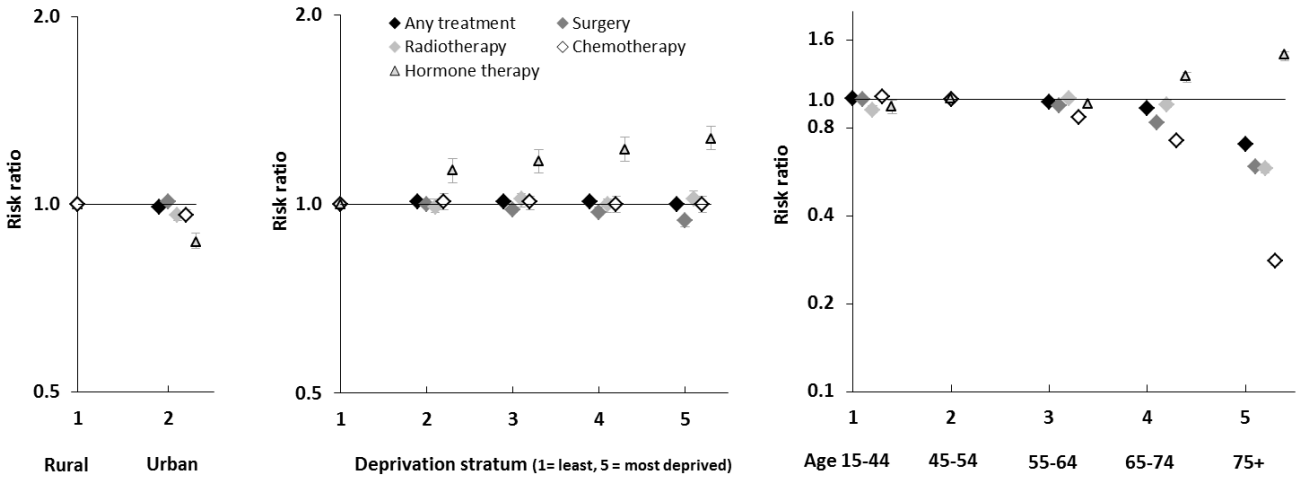


Figure 1.3.2 Risk ratios for treatment of cancer, by urban/rural status, deprivation stratum and diagnosis age: age/sex/casemix-adjusted models (or sex/casemix-adjusted models by age-group).

1.4 All cancers: comorbidity

Variation by urban/rural status

Broadly similar percentages of rural (18.9%) and urban patients (19.5%) had known comorbidities (*Figure 1.4.1*). However, comorbidity was slightly significantly more common among urban patients, having adjusted for age and sex: relative risk (RR) 1.06 (95% CI 1.02-1.10) (*Figure 1.4.3*). Similar findings applied to males (RR 1.07, 1.03-1.11) and females (RR 1.06, 1.01-1.11) (*Figure 1.4.3*). The RRs were reduced slightly after adjustment for casemix, to 1.04 (1.01-1.07) overall, and were no longer significant 1.03 (0.99-1.07) for males (1.03, 0.99-1.07) and females (1.04, 0.99-1.10) separately.

Variation by deprivation

The proportion of cancer patients known to have other clinically significant health conditions at or around the time of cancer diagnosis ranged 17-22% across the five deprivation strata (17-20% for males and 17-23% for females), and showed quite a clear pattern of increasing levels of comorbidity with increasing deprivation (*Figures 1.4.1-1.4.2*). Patients from the most deprived stratum were significantly more likely to have comorbidities compared with the least deprived stratum – age/sex-adjusted RR 1.20 (95% CI 1.14-1.26), or age-adjusted RR 1.19 (1.11-1.26) for males, 1.22 (1.13-1.32) for females (*Table 1.4.1*, *Figure 1.4.3*). Adjustment for casemix reduced these RRs slightly, to 1.17 (1.11-1.22) overall, 1.16 (1.09-1.23) for males and 1.18 (1.09-1.27) for females, but all remained significant (not tabulated). Patients from stratum 4 were also significantly more likely to have comorbidities, overall and for both sexes.

Interaction between deprivation and urban/rural status

Urban patients showed a stronger relationship between deprivation and comorbidity than rural cases: age/sex-adjusted RR 1.26 (1.19-1.33) comparing the most deprived with the least deprived rural group, RR 1.11 (0.99-1.25) for the equivalent rural comparison (P=0.05 for difference) (*Table 1.4.1*). This difference was also seen for males – RR 1.25 (1.16-1.35) urban v 1.04 (0.90-1.20) rural (P=0.0165) – but not for females.

Table 1.4.1 Influence of deprivation on comorbidity in cancer patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Sexes combined							
	RR most v least deprived	**95% CI**	**z**	**P**				
Total	*1.20	1.14-1.26						
Rural	1.11	0.99-1.25						
Urban	*1.26	1.19-1.33	1.96	*0.05				
	Males				**Females**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	*1.19	1.11-1.26			*1.22	1.13-1.32		
Rural	1.04	0.90-1.20			*1.23	1.01-1.51		
Urban	*1.25	1.16-1.35	2.40	*0.0165	*1.26	1.15-1.38	0.19	0.85

Variation by age

Percentages of patients with known comorbidities ranged 7-27% between age-groups overall (*Figure 1.4.1*), or 10-30% for males and 5-24% for females (*Figure 1.4.2*). Both sexes showed a strong pattern of increasing comorbidity with increasing age (*Figure 1.4.2*). Patients in the oldest age-group were two to three times more likely to have comorbidities than at ages 45-54: sex-adjusted RR 2.52 (95% CI 2.36-2.68) overall, or unadjusted RR 2.05 (1.89-2.23) for the oldest males, 3.06 (2.79-3.37) for the oldest females (*Figure 1.4.3*). Adjustment for casemix reduced the RRs slightly for combined sexes (to 2.41, 95% CI 1.92-3.02) and for females (to 2.12, 1.49-3.01), but increased the RR for the oldest males (2.57, 1.90-3.48). Comorbidity prevalence was also significantly higher at ages 55-64 and 65-74, but lower at ages 15-44, compared with ages 45-54.

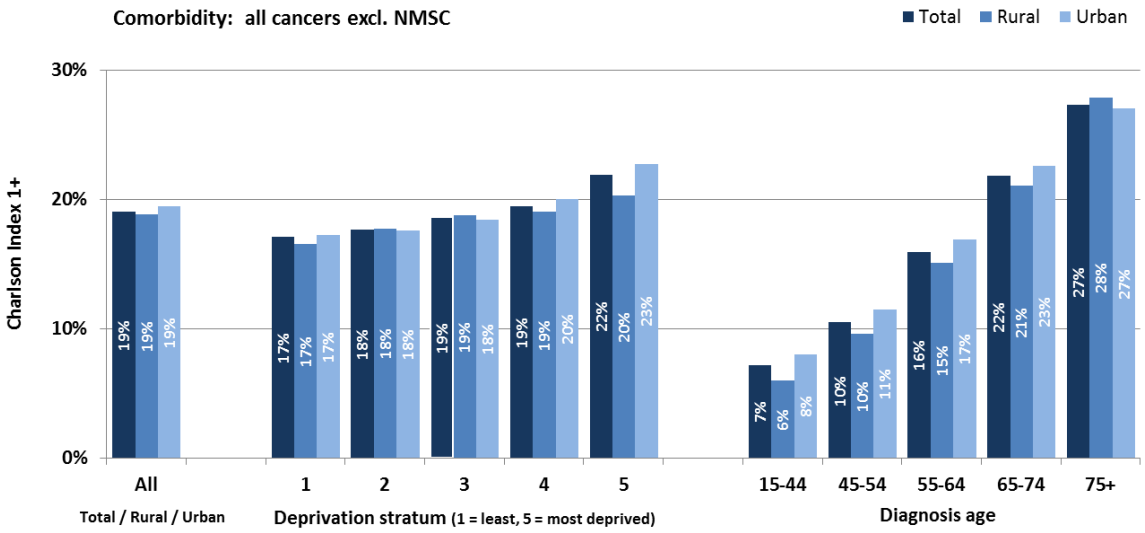


Figure 1.4.1 Comorbidity in cancer patients (sexes combined), 2008-2012, by urban/rural status, deprivation stratum and age.

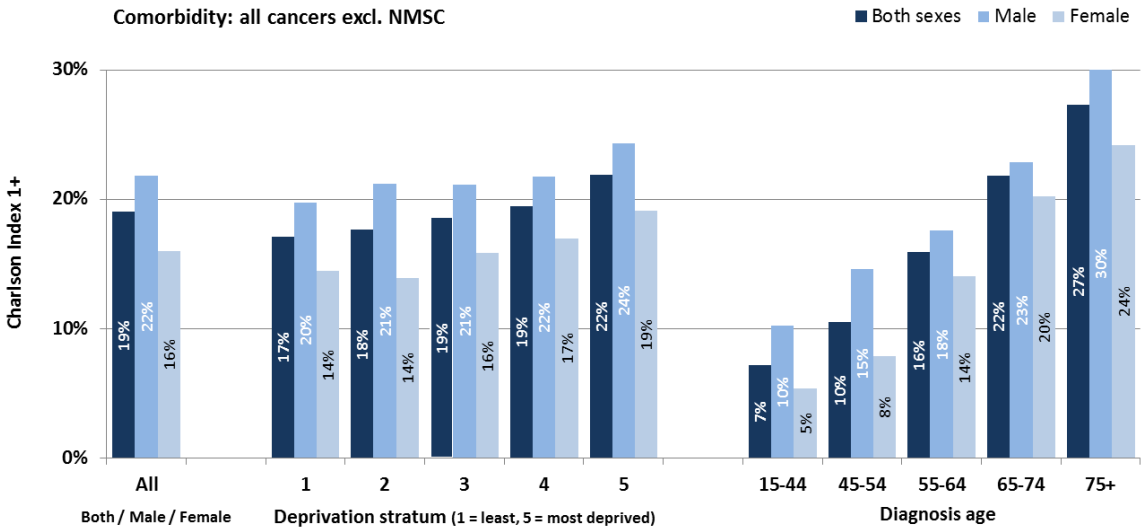


Figure 1.4.2 Comorbidity in cancer patients, 2008-2012, by sex, deprivation stratum and age.

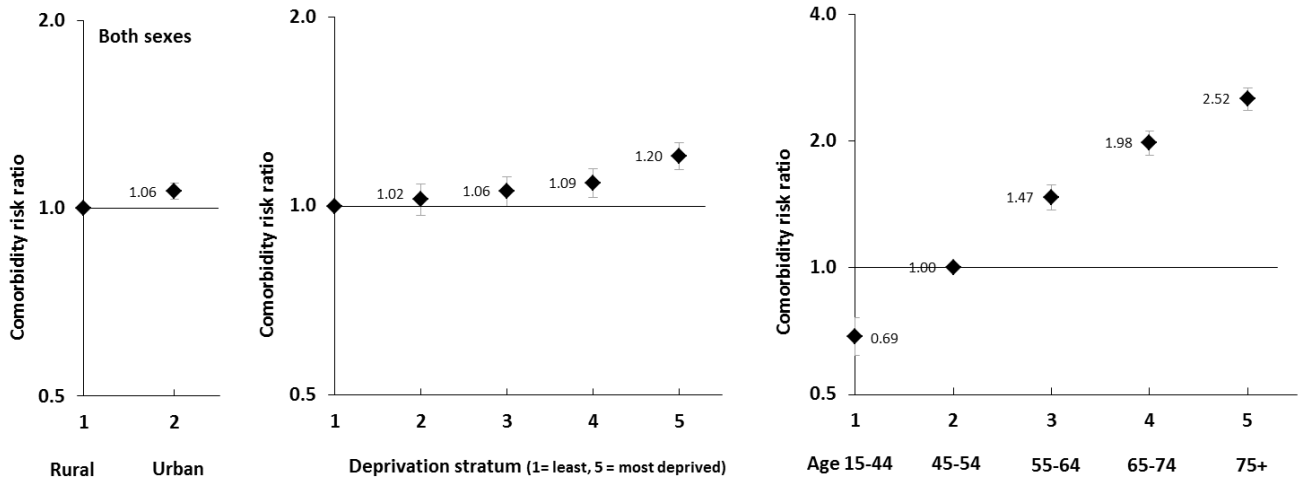


Figure 1.4.3(a) Risk ratios for comorbidity in cancer patients (sexes combined), by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

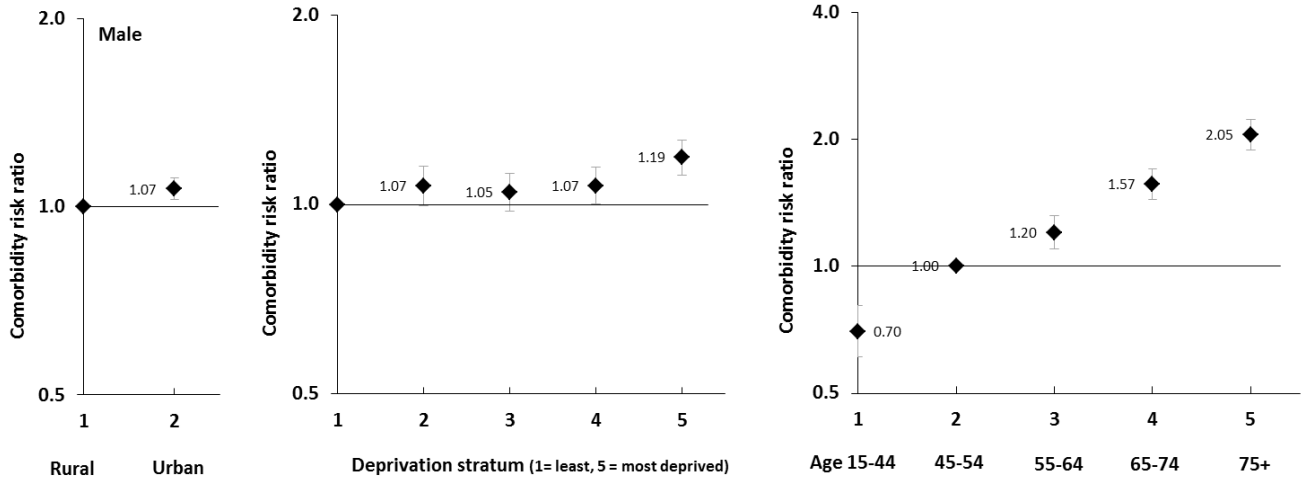


Figure 1.4.3(b) Risk ratios for comorbidity in male cancer patients, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group).

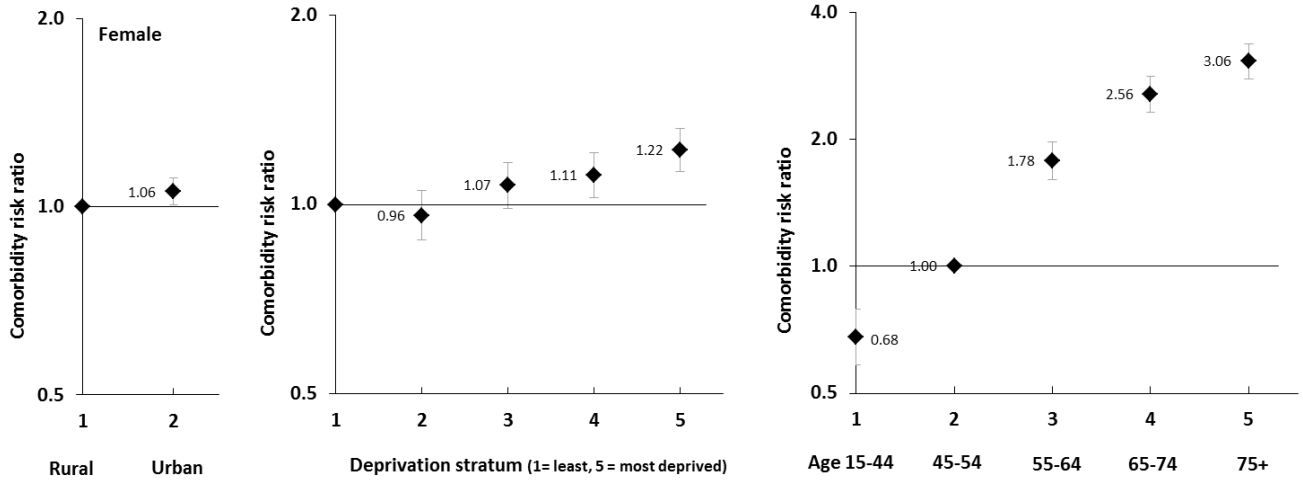


Figure 1.4.3(c) Risk ratios for comorbidity in female cancer patients, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group).

2 STOMACH CANCER

Key points

- *Incidence*
  - Urban males had 16% higher age-standardised incidence, urban females 26% higher incidence relative to rural populations.
  - The incidence rate was about 40% higher in the most deprived compared with the least deprived population quintile for both males and females.
  - The incidence rate of stomach cancer in the 75+ age-group was about 14 times higher than at ages 45-54.
- *Survival*
  - Survival was significantly poorer (mortality hazard 19% higher after adjustment for age and sex) in the most deprived compared with the least deprived group, although this was no longer significant after adjustment for stage.
  - Survival was significantly poorer (mortality hazard about twice [2.1 times] as high) at ages 75+ compared with 45-54.

Table 2.k.1 Visual summary of the influence of urban status, deprivation and age on stomach cancer in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, stage proportion, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
Urban status	M↑ F↑	=	=	III↑ IV=	R↓ TSC=	=
Deprivation	M↑ F↑	↓	=	IV↑ III=	S↓ TRC=	↑
Older age	M↑↑ F↑↑	↓	I↑ II↓	III↓ IV↓	T↓↓ S↓↓ R↓↓ C↓↓	↑

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2).

- *Stage*
  - Patients from the most deprived group were more likely (+24% in relative terms) to present at stage IV compared with the least deprived group
  - The oldest patients (age 75+) were significantly less likely to present at stage II (-39%) and stage III (-40%) compared with the 45-54 age-group.
- *Treatment*
  - Patients from the most deprived group were less likely (-13% in relative terms) to have surgery compared with the least deprived group.
  - The oldest patients (75+) were less likely to have any treatment (-47%), surgery (-43%), radiotherapy (-66%) or chemotherapy (-75%) relative to the 45-54 age group; patients in age-groups 55-64 and 65-74 were also less likely to have any treatment, radiotherapy or chemotherapy. The youngest patients (<45) were less likely to have any treatment or radiotherapy, compared with ages 45-54.
- *Comorbidity*
  - The oldest patients (75+) were 36% more likely to have other significant health conditions than those aged 45-54, a smaller difference than for the other major cancers in this report.

2.1 Stomach cancer: incidence

Variation by urban/rural status

Age-standardised rates were higher in urban populations for both males (17 v 15 cases per 100,000) and females (8.2 v 6.5 per 100,000) (*Figure 2.1.1*). These differences were statistically significant: directly age-standardised rate ratio (DSRR) 1.16 (95% CI 1.05-1.28) for males and 1.26 (1.10-1.44) for females (*Table 2.1.1*, *Figure 2.1.2*).

Variation by deprivation

Age-standardised rates of stomach cancer ranged 14-19 cases per 100,000 males and 6.1-9.6 cases per 100,000 females across the five deprivation strata (*Figure 2.1.1*). Rates were significantly higher, by about 40%, in the most deprived compared with the least deprived stratum: DSRR 1.40 (95% CI 1.20-1.63) for males and 1.39 (1.13-1.71) for females (*Figure 2.1.2*). Male rates were also significantly high in stratum 4 (DSRR 1.20, 1.02-1.41).

Interaction between deprivation and urban/rural status

The influence of deprivation on incidence did not differ significantly between urban and rural populations: for males, a rate ratio 1.47 (95% CI 1.22-1.76) comparing the most with the least deprived urban populations versus 1.58 (1.11-2.24) for the same comparison among rural populations (P=0.73 for difference); for females, 1.44 (1.14-1.82) urban versus 1.69 (1.04-2.76) rural (P=0.56) (*Table 2.1.1*). That is, in both urban and rural populations, higher stomach cancer incidence was associated with higher levels of deprivation and the strength of the association was broadly similar.

Table 2.1.1 Influence of deprivation on stomach cancer incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	Males				Females			
	DSRR most v least deprived	95% CI	z	P	DSRR most v least deprived	95% CI	z	P
Total	*1.40	1.20-1.63			*1.39	1.13-1.71		
Rural	*1.58	1.11-2.24			*1.69	1.04-2.76		
Urban	*1.47	1.22-1.76	0.34	0.73	*1.44	1.14-1.82	0.58	0.56

Variation by age

Male rates ranged from 1 to 137 cases and female rates from 1 to 71 cases per 100,000 between the youngest (15-44) and oldest (75+) age-groups examined, with a very strong pattern of increased incidence with age (*Figure 2.1.1*). Rates were about 14 to 15 times higher in the oldest group than in the 45-54 comparison group: DSRRs 14.1 (95% 11.3-17.7) for males, 13.5 (10.4-17.5) for females *(Figure 2.1.2*). Rates at ages 55-64 and 65-74 were also significantly higher, while rates at age 15-44 were significantly lower, than at ages 45-54.

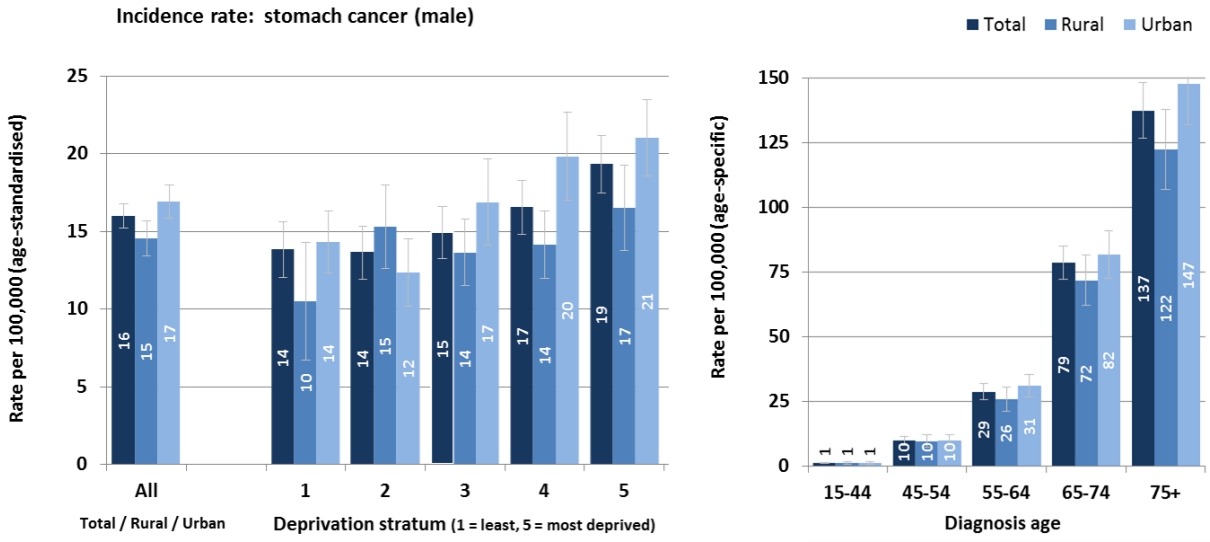


Figure 2.1.1(a) Incidence of stomach cancer (males), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

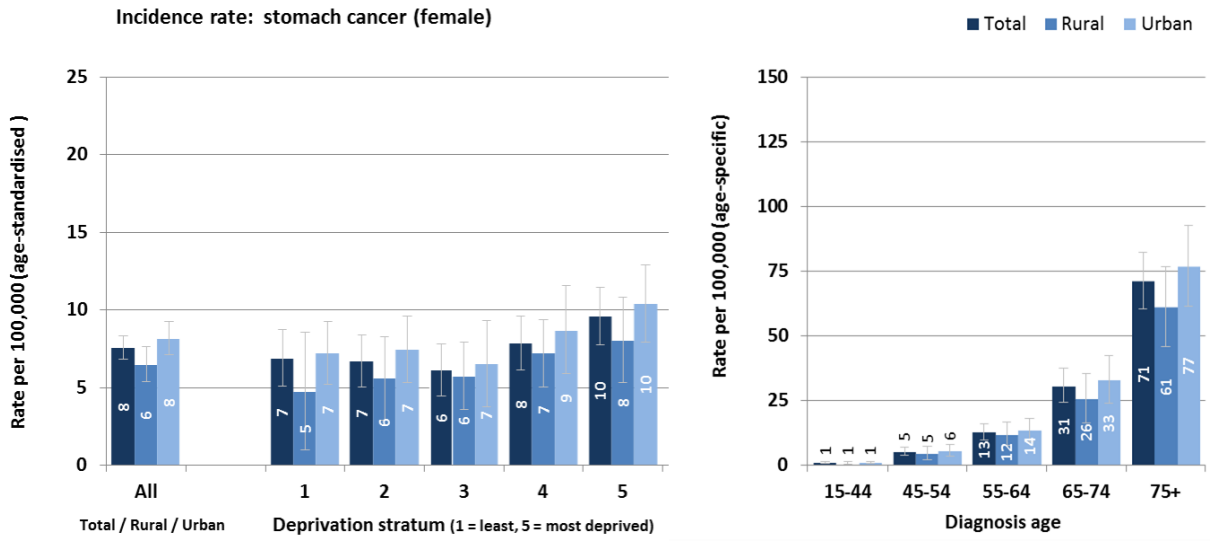


Figure 2.1.1 (b) Incidence of stomach cancer (females), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

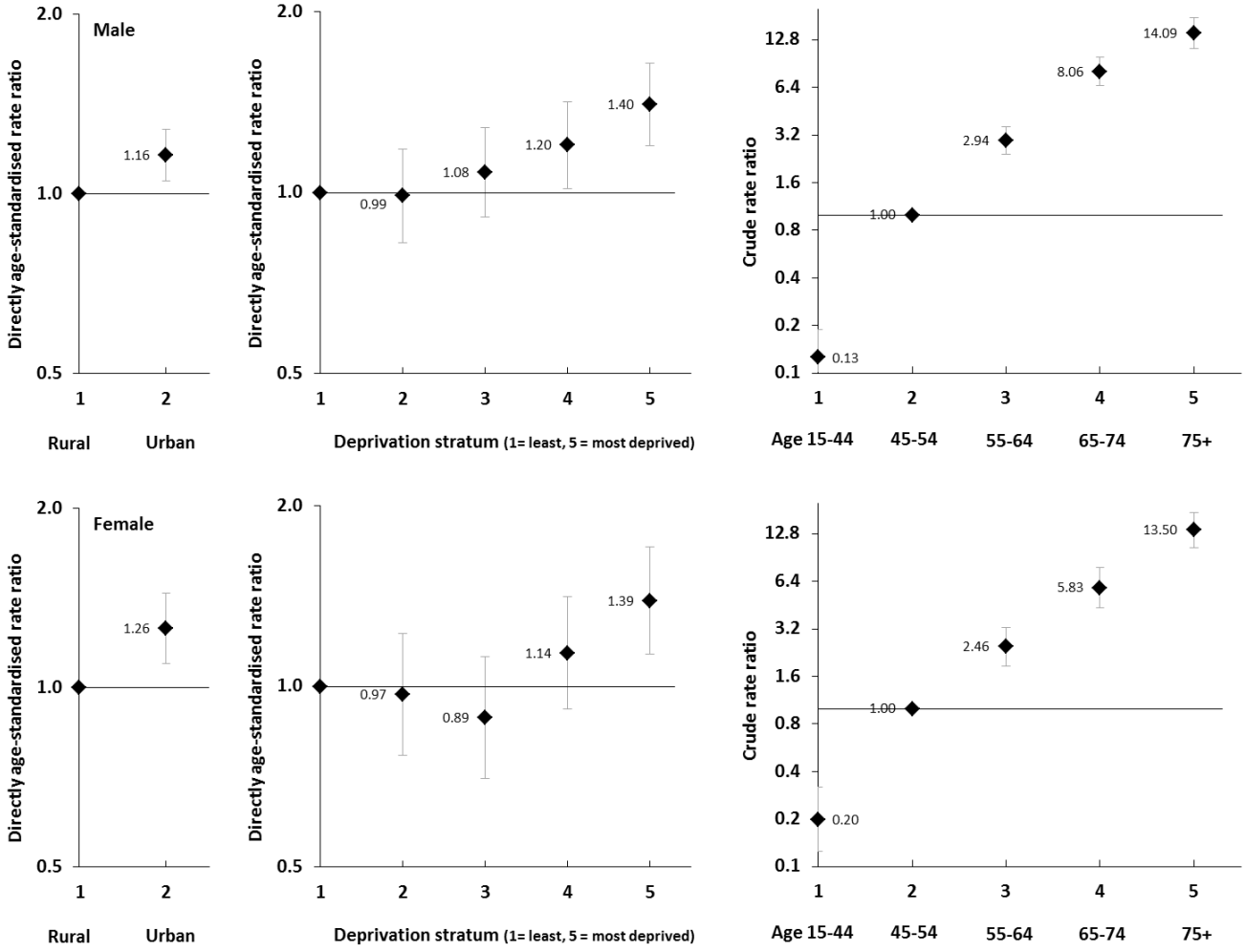


Figure 2.1.2 Rate ratios of stomach cancer incidence, by urban/rural status, deprivation stratum and diagnosis age.

2.2 Stomach cancer: cause-specific survival

Variation by urban/rural status

Five-year survival estimates were slightly higher for urban cases (28%) than rural cases (25%) (*Figure 2.2.1*), but the difference was not statistically significant (*Figure 2.2.2)*.

Variation by deprivation

Age-standardised estimates of five-year survival ranged 23-30% across the five deprivation strata, with only limited indications of poorer survival in the more deprived strata (*Figure 2.2.1*). Five-year survival estimate was only slightly lower in the most deprived group (29%), compared with least deprived group (30%). However, modelling indicated significantly poorer survival in the most deprived group (age/sex adjusted hazard ratio [HR] 1.19, 95% CI 1.00-1.41), P=0.045) (*Table 2.2.1*), although this was no longer significant after further adjustment for stage (HR 1.11, 0.94-1.32) or for smoking and marital status (HR 1.10, 0.92-1.31, P=0.39) *(Figure 2.2.2*). Comparison of survival curves for the least and most deprived groups (*Figure 2.2.3*) suggests that survival differences were greatest in the first two to three years after diagnosis but that differences had almost disappeared by five years, which may explain the discrepancy between five-year outcomes and model results. For intermediate deprivation strata (2-4), there were no significant differences in survival compared with stratum 1.

Interaction between deprivation and urban/rural status

Urban populations showed significant variation in survival by deprivation status, with an age/sex-adjusted mortality hazard ratio of 1.24 (95% CI 1.02-1.50) comparing patients from the most deprived with those from the least deprived urban populations, but variation by deprivation was not significant for rural populations – hazard ratio 0.83 (0.58-1.34) (*Table 2.2.1*, *Figure 2.2.4*). However, the difference was not significant (P=0.12), i.e. there was no confirmed heterogeneity of the deprivation influence between urban and rural patients.

Table 2.2.1 Influence of deprivation on stomach cancer survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	*1.19	1.00-1.41		
Rural	0.83	0.58-1.34		
Urban	*1.24	1.02-1.50	1.59	0.12

Variation by age

Five-year survival varied from 14% to 40% between age-groups (*Figure 2.2.1*), and was significantly poorer in the oldest group (75+) compared with ages 45-54: age/sex-adjusted HR 2.11 (95% CI 1.74-2.57), or 2.16 (1.77-2.64) after stage-adjustment, 2.04 (1.65-2.51) after further adjustment for marital and smoking status (*Figure 2.2.2*). Other age-related variation was not statistically significant.

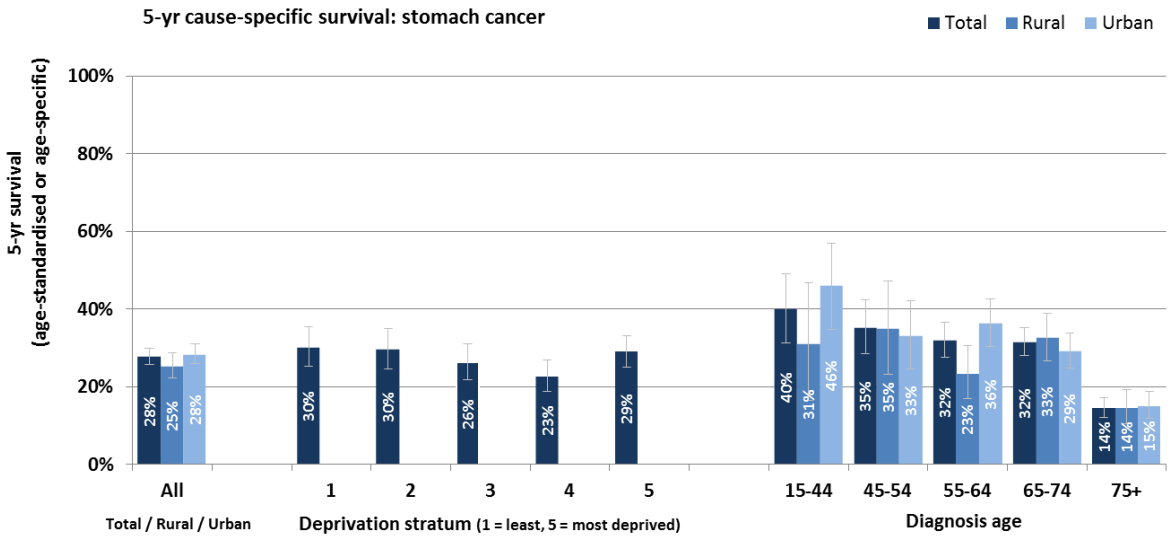


Figure 2.2.1 Cause-specific five-year survival of Irish stomach cancer patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age. Deprivation-specific urban and rural survival could not be calculated as there were too few patients in some age-groups to allow age-standardisation.

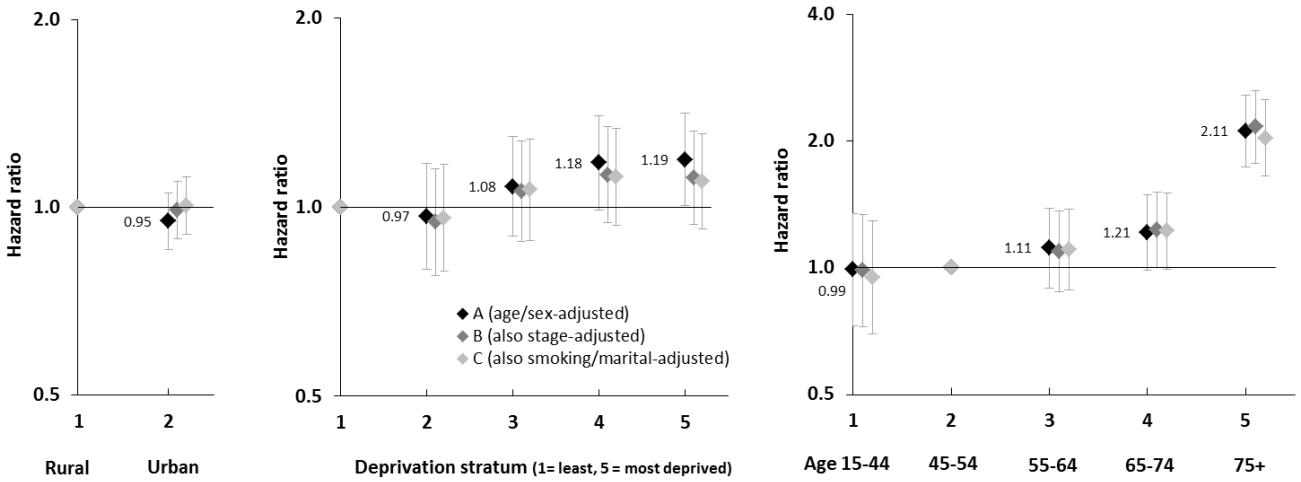


Figure 2.2.2 Mortality hazard ratios for stomach cancer survival, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group) and fuller models.

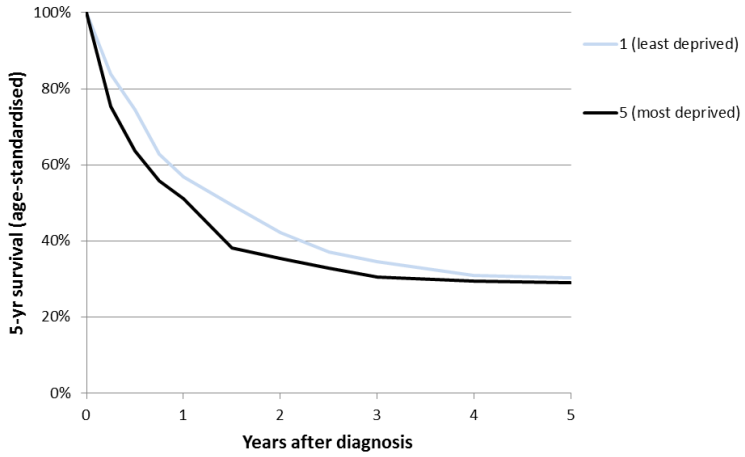


Figure 2.2.3 Cause-specific survival curves for stomach cancer patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

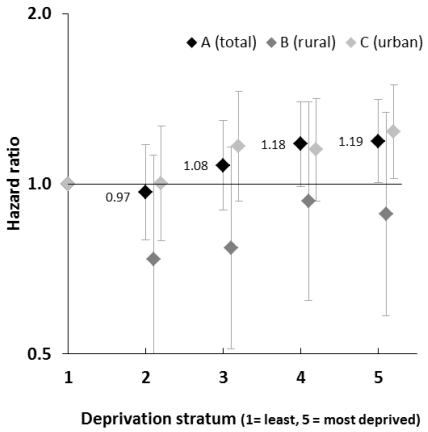


Figure 2.2.4 Mortality hazard ratios for stomach cancer survival, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. See also *Table 2.2.1*.

2.3 Stomach cancer: stage (TNM 5th edition)

Variation by urban/rural status

The stage breakdown of cases by urban/rural status was the same for stages I (11%) and II (9%) and ranged 16-17% for stage III, 34-37% for stage IV and (not graphed) 22-23% for unknown stage (*Figure 2.3.*1). None of the variation was significant, based on age/sex-adjusted models (*Figure 2.3.2*).

Variation by deprivation

The stage breakdown of stomach cancer cases ranged 9-13% for stage I, 7-10% for stage II, 15-19% for stage III, 31-38% for stage IV and 21-25% for unknown stage across the five deprivation strata (*Figure 2.3.1*). Patients from the most deprived strata were significantly more likely to present at stage IV: age/sex-adjusted relative risk (RR) 1.24 (95% CI 1.04-1.49) comparing stratum 5 (38%) with 1 (31%), or 1.23 (1.02-1.48) comparing stratum 4 (37%) with 1 (*Table 2.3.1*, *Figure 2.3.2*). No significant variation by deprivation was seen in the proportions of cases that were stages I-III or unknown.

Interaction between deprivation and urban/rural status

As seen for stomach cancers as a whole, the proportion of stage IV cancers was significantly higher in the most deprived compared with the least deprived urban stratum: age/sex-adjusted RR 1.30 (1.06-1.60). However, no significant variation by deprivation was seen for the same comparison among rural cases: RR 0.87 (0.61-1.24) (P=0.04 for difference) (*Table 2.3.1*). A significant difference in the pattern by deprivation were also seen for stage I: RR 2.6 (1.9-10.6) comparing the most with the least deprived rural stratum v 0.76 (0.49-1.08) for urban cases (P=0.005). Given the small numbers of stomach cancer cases included for rural deprivation stratum 1 (n=46 compared with n=174-261 in strata 2-5), further work may be needed to assess the validity of these apparent urban/rural differences.

Table 2.3.1 Influence of deprivation on stomach cancer stage, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Stage I				**Stage II**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.92	0.62-1.35			1.04	0.69-1.57		
Rural	*2.57	1.86-10.6			-	-		
Urban	0.76	0.49-1.18	2.82	*0.005	0.99	0.64-1.54	0.75	0.46
	Stage III				**Stage IV**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.91	0.70-1.19			*1.24	1.04-1.49		
Rural	1.20	0.57-2.52			0.87	0.61-1.24		
Urban	0.87	0.65-1.18	0.75	0.46	*1.30	1.06-1.60	2.04	*0.042

Variation by age

Proportions of cases by age ranged 8-12% for stage I, 6-13% for stage II, 13-22% for stage III, 32-38% for stage IV and 10-33% for unknown stage (*Figure 2.3.1*). Cases were significantly less likely to present at stages II or III in the oldest age-group (75+) than in the 45-54 group: sex-adjusted RR 0.61 (0.40-0.91) for stage II (8% v 13%) and 0.60 (0.45-0.81) for stage III (13% v 22%) (*Figure 2.3.2*). Age-related variation was not significant for stages I or IV. The proportion of cases that were of unknown stage was significantly higher in age-groups 55-64 (15%), 65-74 (18%) and 75+ (33%) than in the 45-54 group (10%): RRs 1.58 (1.00-2.50), 1.81 (1.17-2.80) and 3.3 (2.1-4.9), respectively.

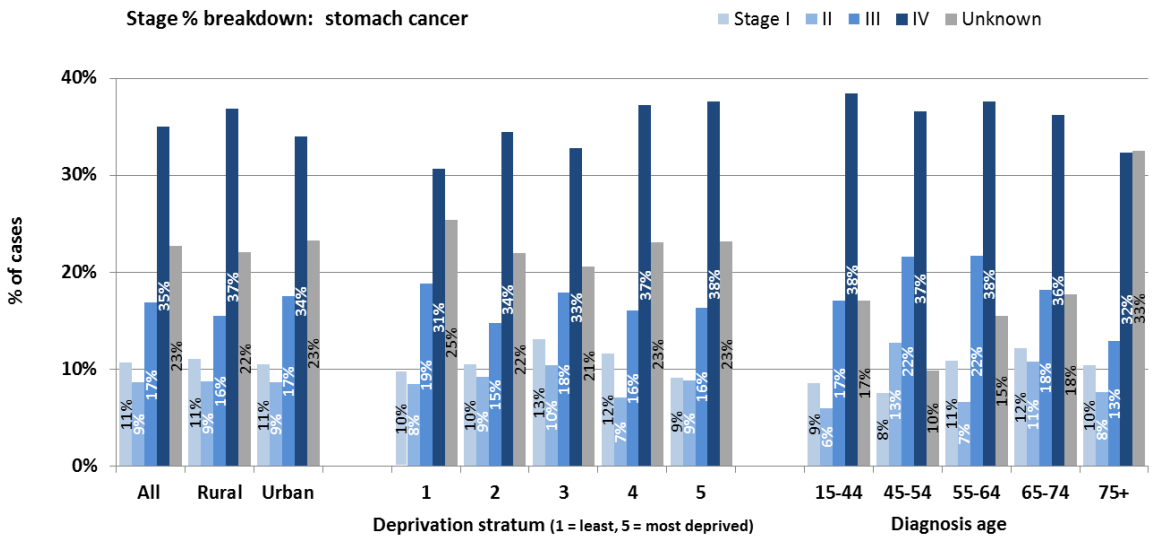


Figure 2.3.1 Stage breakdown of stomach cancer cases, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

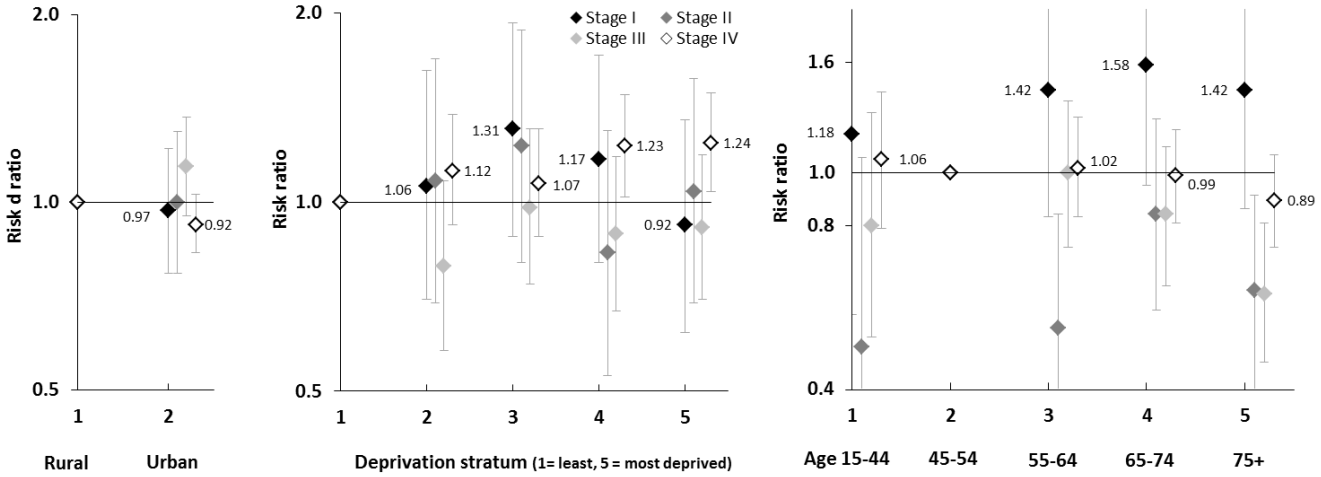


Figure 2.3.2 Risk ratios for stomach cancer stage, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group). RRs for unknown stage are not plotted but are noted in text if significant.

Text and graphical summaries above are based on comparisons of the percentage stage composition of cases. To provide further context, stage-specific incidence rates are presented in *Figure 2.3.3* (below). These rates reflect a combination of overall incidence rates and stage, thus may be more complex to interpret.

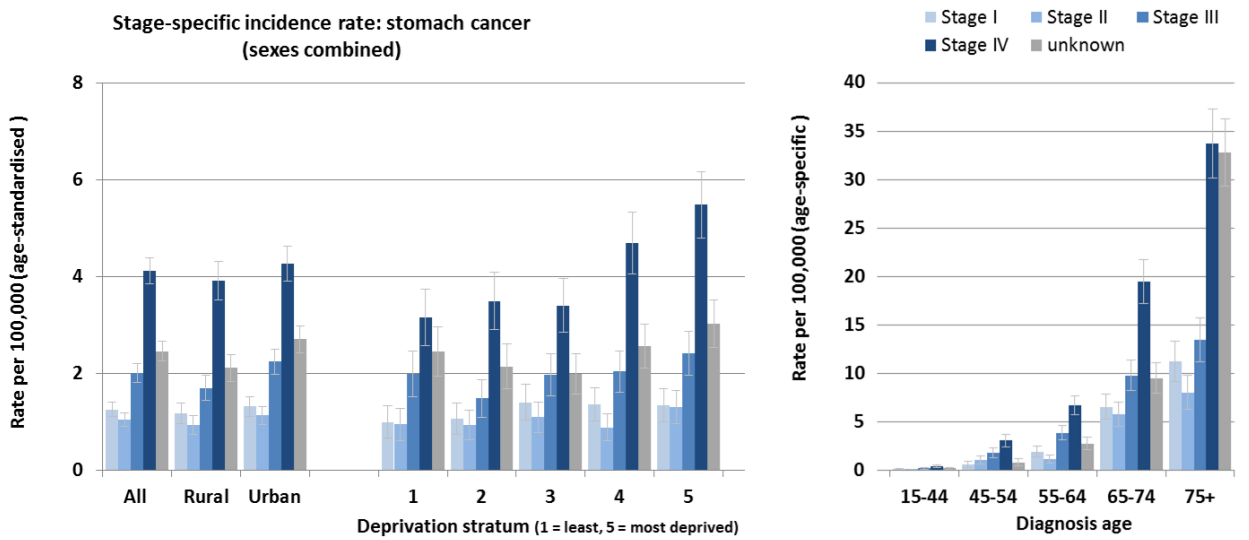


Figure 2.3.3 Stage-specific incidence of stomach cancer, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Rates are standardised for sex (i.e. assume equal populations of males and females in all age-groups). Note different scale for age-specific rates.

2.4 Stomach cancer: tumour-directed treatment

Variation by urban/rural status

Unadjusted treatment differed little between rural and urban cases, ranging 40-42% for surgery, 39-40% for chemotherapy, 15-17% for radiotherapy and 64-67% overall (*Figure 2.4.1*), and none of the variation was statistically significant when adjusted for age and sex (*Figure 2.4.2*).

Variation by deprivation

The crude (unadjusted) proportion of stomach cancer patients having any tumour-directed treatment ranged 62-69% between deprivation strata, or 35-47% for surgery, 36-43% for chemotherapy and 14-17% for radiotherapy (*Figure 2.4.1*). The only statistically significant variation by deprivation status was seen for surgery, which was less likely among patients

from the two most deprived strata (4 and 5) compared with stratum 1: age/sex-adjusted RRs 0.78 (95% CI 0.67-0.91) and 0.87 (0.75-0.99), respectively (*Table 2.4.1*, *Figure 2.4.2*). Adjustment for stage reduced the difference for the most deprived group and it was no longer significant: RR 0.91 (0.81-1.02) (not graphed).

Interaction between deprivation and urban/rural status

Urban cases showed significant variation in surgery use by deprivation status (RR 0.80, 95% CI 0.68-0.94 comparing the most with least deprived stratum, *Table 2.4.1*), as seen for overall cases. No clear deprivation effect was confirmed for surgery among rural cases (RR 1.27, 0.86-1.87), but the differences from urban cases was not quite significant (P=0.07). For chemotherapy, the opposite pattern was seen – significant variation by deprivation status among rural cases (RR 0.74, 0.56-0.97) but not urban cases (RR 0.98, 0.83-1.15) – but again the difference was not quite significant (P=0.07). For radiotherapy and overall treatment, there was no significant influence of deprivation among either rural or urban cases (and no significant heterogeneity in deprivation influence).

Table 2.4.1 Influence of deprivation on stomach cancer treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Any treatment RR most v least deprived	95% CI	z	P	Surgery RR most v least deprived	95% CI	z	P
Total	0.95	0.87-1.03			*0.87	0.75-0.99		
Rural	0.97	0.80-1.19			1.27	0.86-1.87		
Urban	0.95	0.87-1.05	0.18	0.85	*0.80	0.68-0.94	1.81	0.071
	Radiotherapy RR most v least deprived	**95% CI**	**z**	**P**	**Chemotherapy RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.98	0.74-1.29			0.93	0.81-1.07		
Rural	0.87	0.48-1.56			*0.74	0.56-0.97		
Urban	1.00	0.72-1.38	0.42	0.67	0.98	0.83-1.15	1.84	0.066

Variation by age

Proportions of patients treated ranged 47-89% overall between age-groups, 30-53% for surgery, 10-30% for radiotherapy and 17-68% for chemotherapy, all highest in age-group 45-54 (*Figure 2.4.1*). Patients in the oldest group were significantly less likely to have any treatment (sex-adjusted RR 0.53, 95% CI 0.49-0.58), surgery (RR 0.57, 0.49-0.67), radiotherapy (RR 0.34, 0.26-0.45) or chemotherapy (RR 0.25, 0.21-0.29) compared with ages 45-54 (*Figure 2.4.2*). These differences were moderated slightly by adjustment for stage: to RR 0.59 (0.54-0.63) overall, 0.67 (0.58-0.77) for surgery, 0.33 (0.25-0.42) for radiotherapy and 0.27 (0.23-0.31) for chemotherapy (not graphed). Patients in age-groups 55-64 and 65-74 were also significantly less likely to have any treatment, radiotherapy or chemotherapy, while the youngest patients (<45) were less likely to have any treatment or radiotherapy (*Figure 3.4.2*). Again, stage-adjustment modified these findings only slightly.

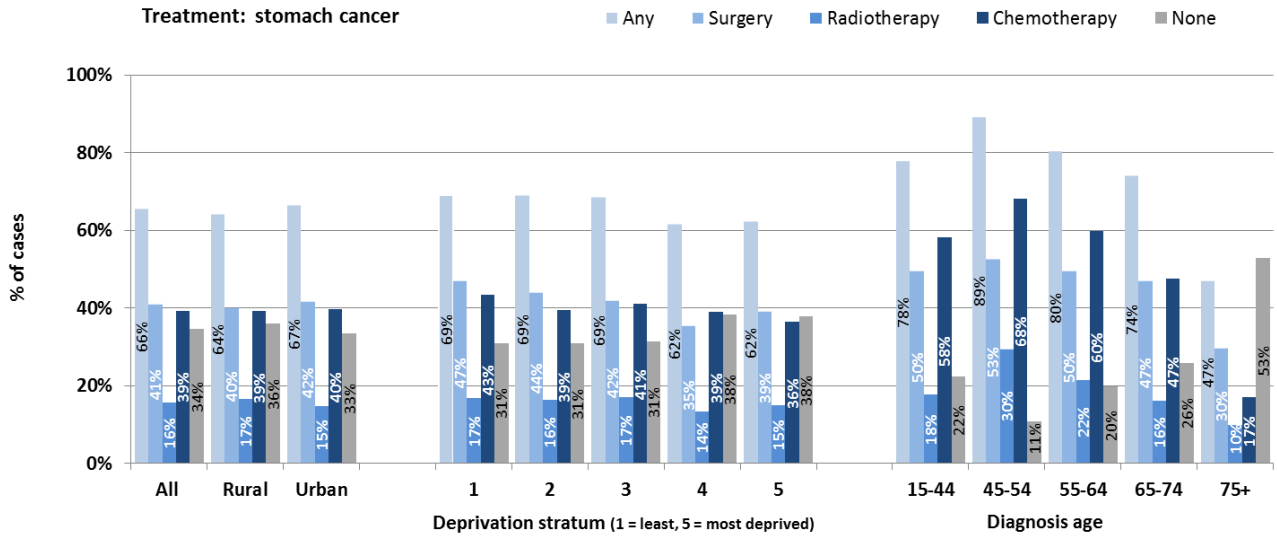


Figure 2.4.1 Treatment of stomach cancer within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

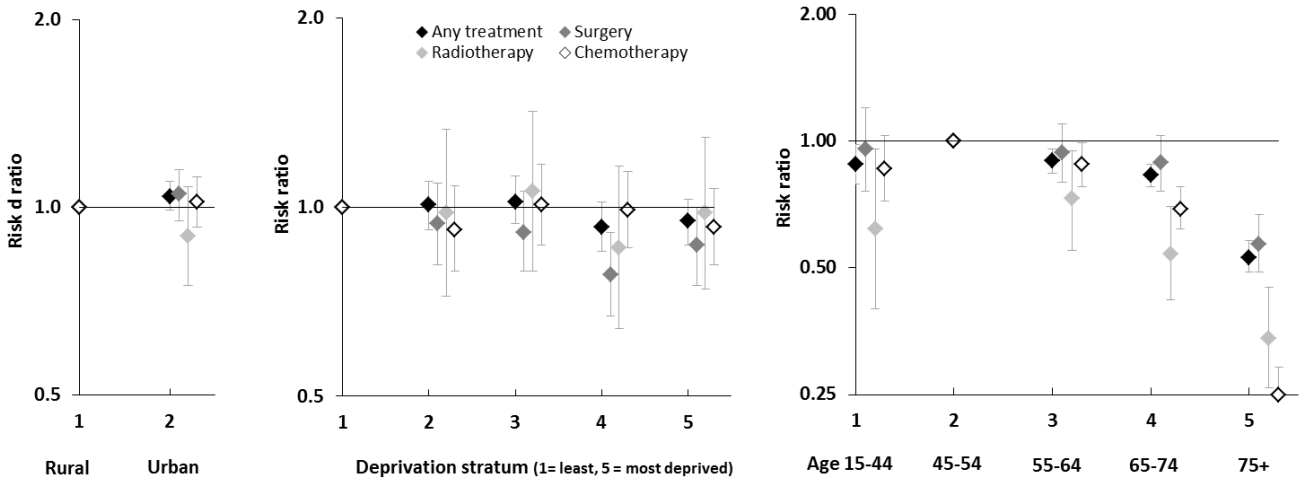


Figure 2.4.2 Risk ratios for treatment of stomach cancer, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

2.5 Stomach cancer: comorbidity

Variation by urban/rural status

Similar percentages of rural patients (25.5%) and urban patients (25.1%) had known comorbidities (*Figure 2.5.1*), with no significant difference after adjustment for age and sex: relative risk (RR) 0.99 (95% CI 0.85-1.15) comparing urban with rural patients (*Figure 2.5.3*).

Variation by deprivation

The proportion of stomach cancer patients known to have other clinically significant health conditions at or around the time of cancer diagnosis ranged 23-29% across the five deprivation strata (*Figure 2.5.1*), or 23-29% for males, 22-28% for females (*Figure 2.5.2*). Although comorbidity appeared to be most common in the most deprived stratum, this was not statistically significant after adjustment for age and sex: RR 1.17 (95% CI 0.92-1.49) compared with the least adjusted stratum (*Table 2.5.1*, *Figure 2.5.3*).

Interaction between deprivation and urban/rural status

The pattern of comorbidity by deprivation stratum (comparing the most with the least deprived stratum) did not differ significantly between rural and urban patients, and neither group showed any significant variation by deprivation (*Table 2.5.1*).

Table 2.5.1 Influence of deprivation on comorbidity in stomach cancer patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	1.17	0.92-1.48		
Rural	0.99	0.56-1.74		
Urban	1.22	0.93-1.60	0.71	0.48

Variation by age

Percentages of patients with known comorbidities ranged 11-28% between age-groups overall (*Figure 2.5.1*), or 7-30% for males and 15-27% for females (*Figure 2.5.2*). Patients in the oldest age-group were about 35% more likely to have comorbidities than at ages 45-54: sex-adjusted RR 1.36 (95% CI 1.01-1.82), a smaller difference than seen for the other major cancers in this report. However, the main difference by age appeared to be between the youngest group (<45 years) and older groups: RR 0.50 (0.27-0.94) compared with ages 45-54.

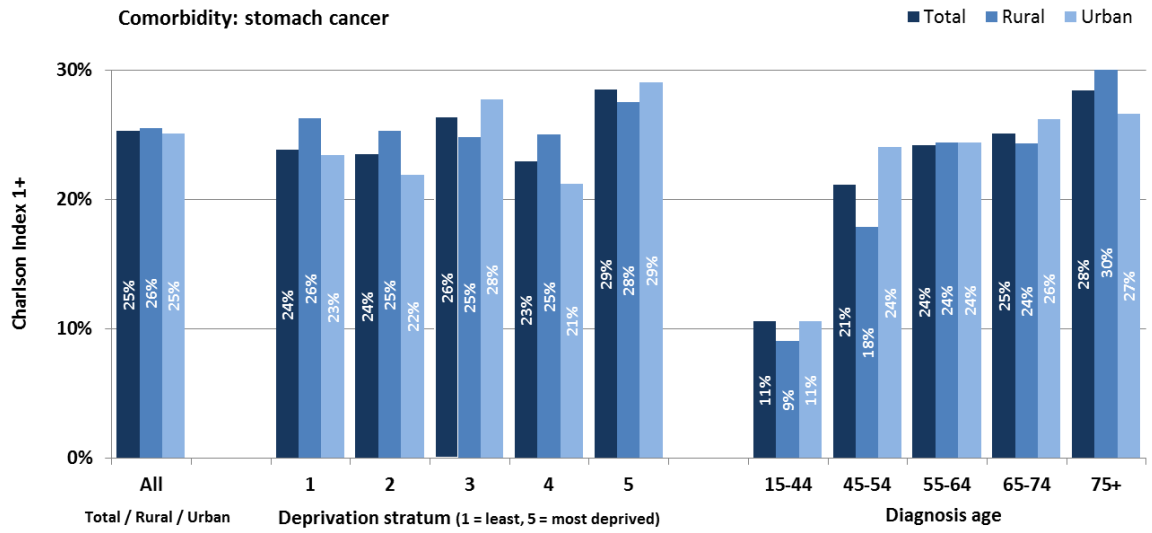


Figure 2.5.1 Comorbidity in stomach cancer patients, 2008-2012, by urban/rural status, deprivation stratum and age.

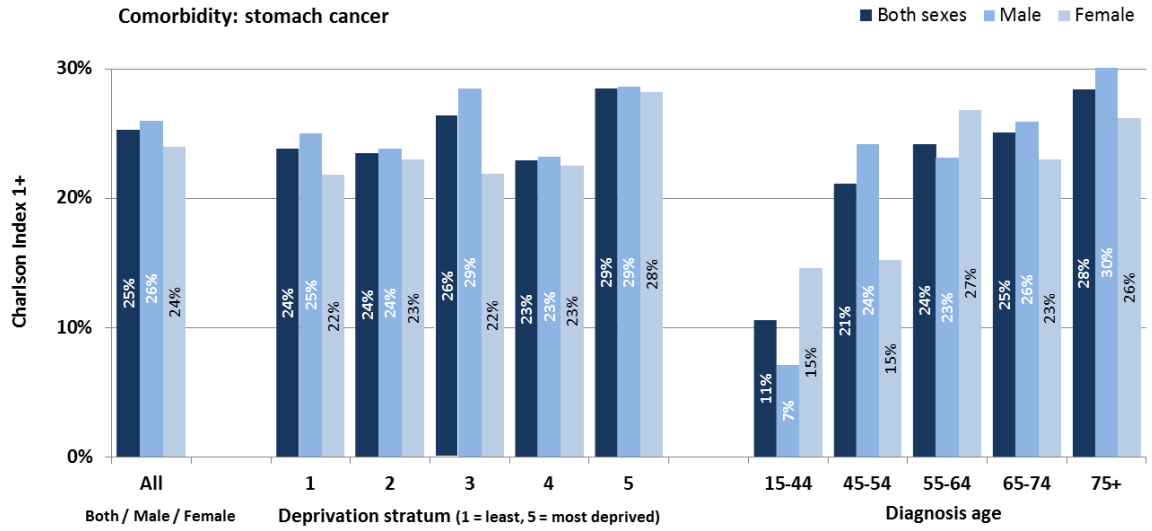


Figure 2.5.2 Comorbidity in stomach cancer patients, 2008-2012, by sex, deprivation stratum and age.

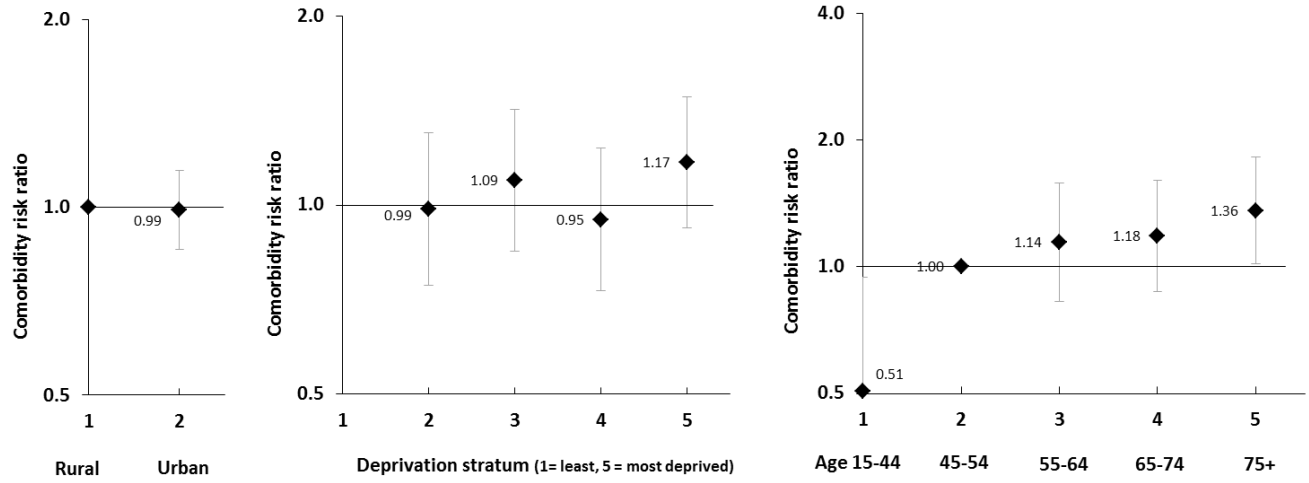


Figure 2.5.3 Risk ratios for comorbidity in stomach cancer patients, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

3 COLORECTAL CANCER

Note: Figures here include cancer of the colon (ICD-10 code C18), rectosigmoid junction (C19) and rectum (C20); for some analyses, adjustment is made for casemix (based on these three subgroups).

Key points

- *Incidence*
  - Overall, age-standardised incidence rates for urban males were 17% higher than for rural males.
  - For the comparison between the most deprived and least deprived quintile, urban males showed significantly (13%) higher incidence, compare with no difference for rural males (significant urban/rural heterogeneity in deprivation effect).
- *Survival*
  - Patients from the most deprived group showed significantly poorer survival (age/sex-adjusted mortality risk 24% higher) relative to the least deprived group.
  - For the comparison between the most and least deprived quintiles, urban patients showed poorer survival (32% higher mortality risk), a pattern not evident for rural patients (significant urban/rural heterogeneity in deprivation effect).
  - Survival was significantly poorer (mortality hazard over twice [2.4 times] as high) at ages 75+ compared with 45-54, and also poorer at ages 65-74.

Table 3.k.1 Visual summary of the influence of urban status, deprivation and age on colorectal cancer in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, stage proportion, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
Urban status	M ↑	=	=	=	S ↓ C ↓ TR=	=
Deprivation	=	↓	=	IV ↑ III=	T ↓ S ↓ RC=	=
Older age	M ↑ F ↑	↓	I ↓ II ↑	III ↓ IV ↓	T ↓ S ↓ R ↓ C ↓	↑

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Stage*
  - Urban patients from the most deprived group were significantly more likely (+20% in relative terms) to present at stage IV compared with the least deprived group, having adjusted for age and sex, a pattern not shown by rural patients (significant urban/rural difference in deprivation effect).
  - The oldest patients (75+) were significantly more likely to present at stage II (+46%) and less likely to present at stage III (-27%) or IV (-23%) relative to the 45-54 age group; those aged 65-74 showed a similar pattern, 55-64 were less likely to present at stage I and <45 were less likely present at stage IV compared with ages 45-54.
- *Treatment*
  - Urban cases were slightly but significantly less likely to have surgery (-3% in relative terms) or chemotherapy (-5%) compared with rural cases, having adjusted for age, sex and cancer site.
  - Patients from the most deprived group were slightly but significantly less likely to have surgery (-4% in relative terms) than those from the least deprived group. A similar pattern was seen for overall treatment (-4%).
  - The oldest patients (75+) were significantly less like to have any treatment (-21%), surgery (-20%), radiotherapy (-40%) or chemotherapy (-74%) relative to the 45-54 age-group; those aged 65-74 were also less likely to have any treatment, radiotherapy or chemotherapy, and chemotherapy use was also lower in age-group 55-64.
- *Comorbidity*
  - Patients aged 75+ were over twice (2.5 times) as likely to have other significant health conditions recorded compared with age-group 45-54; comorbidity prevalence was also higher at ages 55-64 and 65-74.

3.1 Colorectal cancer: incidence

Variation by urban/rural status

Age-standardised rates were significantly higher in urban populations for males (70 v 60 cases per 100,000) but not for females (39 v 40) (*Figure 3.1.1*), equivalent to directly age-standardised rate ratios (DSRRs) of 1.17 (95% CI 1.11-1.22) for males and 0.97 (0.91-1.03) for females (*Table 3.1.1*, *Figure 3.1.2*).

Variation by deprivation

Age-standardised rates of colorectal cancer ranged 62-70 cases per 100,000 males and 38-42 cases per 100,000 females across the five deprivation strata (*Figure 3.1.1*). There was no clear relationship to deprivation, and rates appeared to be highest among the least and most deprived populations, with lower rates in intermediate deprivation quintiles. Rates did not differ significantly between the most and the least deprived stratum: DSRR 1.03 (95% CI 0.96-1.12) for males and 0.97 (0.88-1.06) for females (*Table 3.1.1*, *Figure 3.1.2*). However, male rates were significantly lower in strata 2 (DSRR 0.92, 0.85-0.99) and 3 (0.91, 0.84-0.98).

Interaction between deprivation and urban/rural status

For males, urban populations showed more evidence of inequality in incidence by deprivation: a rate ratio 1.13 (95% CI 1.03-1.23) comparing the most with the least deprived urban populations versus 0.92 (0.78-1.10) for the same comparison among rural populations (z=2.03, P=0.042 for difference) (*Table 3.1.1*). For the same comparison in females, urban and rural populations showed no significant influence of deprivation and no significant variation of the deprivation effect (P=0.98).

Table 3.1.1 Influence of deprivation on colorectal cancer incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	Males				Females			
	DSRR most v least deprived	**95% CI**	**z**	**P**	**DSRR most v least deprived**	**95% CI**	**z**	**P**
Total	1.03	0.96-1.12			0.97	0.88-1.06		
Rural	0.92	0.78-1.10			0.97	0.79-1.19		
Urban	*1.13	1.03-1.23	2.03	*0.042	0.97	0.87-1.08	0.03	0.98

Variation by age

Male rates ranged from 4 to 535 cases and female rates from 5 to 312 cases per 100,000 between the youngest (15-44) and oldest (75+) age-groups examined, with a very strong pattern of increased incidence with age (*Figure 3.1.1*). Rates for males were about 13 times higher in the oldest group than in the 45-54 comparison group, or 9 times higher for females: DSRR 12.7 (95% CI 11.4-14.2) for males, 8.7 (7.8-9.6) for females *(Figure 3.1.2*). For both sexes, rates at ages 55-64 and 65-74 were also significantly higher, while rates at age 15-44 were significantly lower, than at ages 45-54.

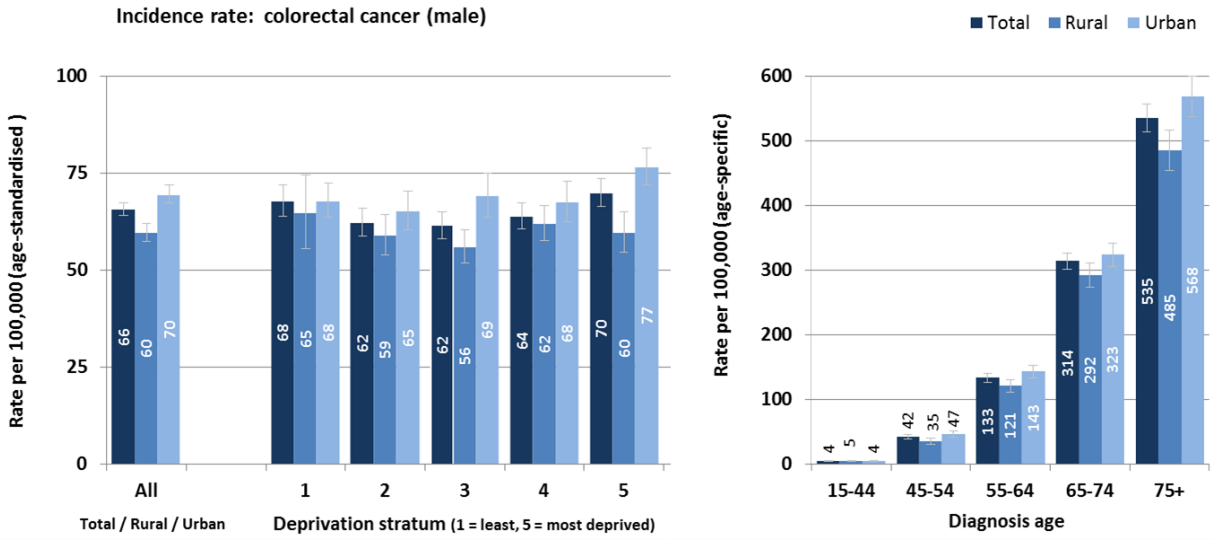


Figure 3.1.1(a) Incidence of colorectal cancer (males), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

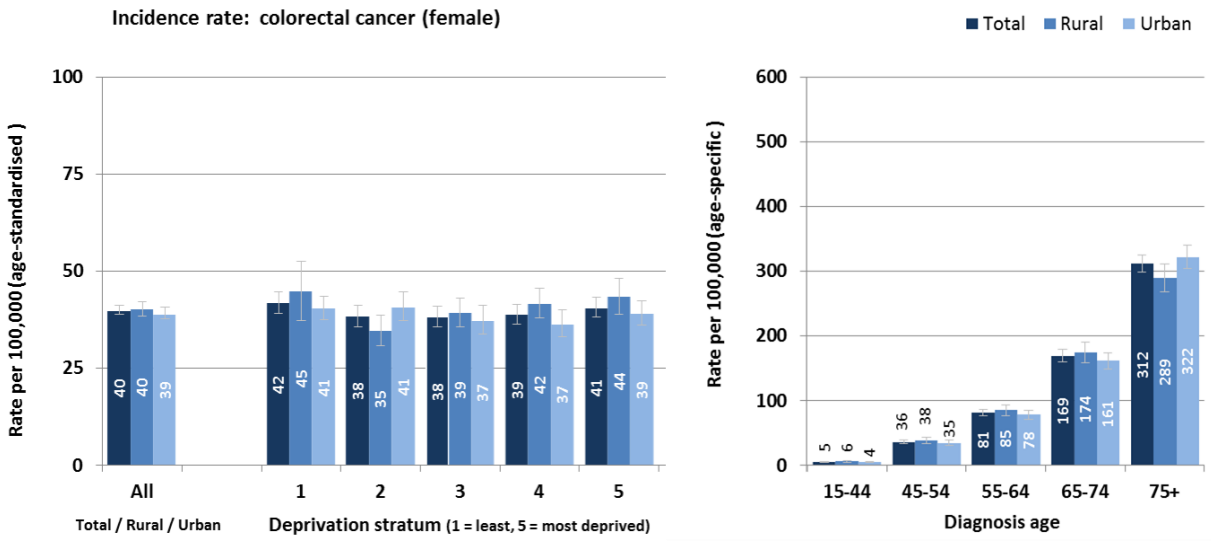


Figure 3.1.1(b) Incidence of colorectal cancer (females), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

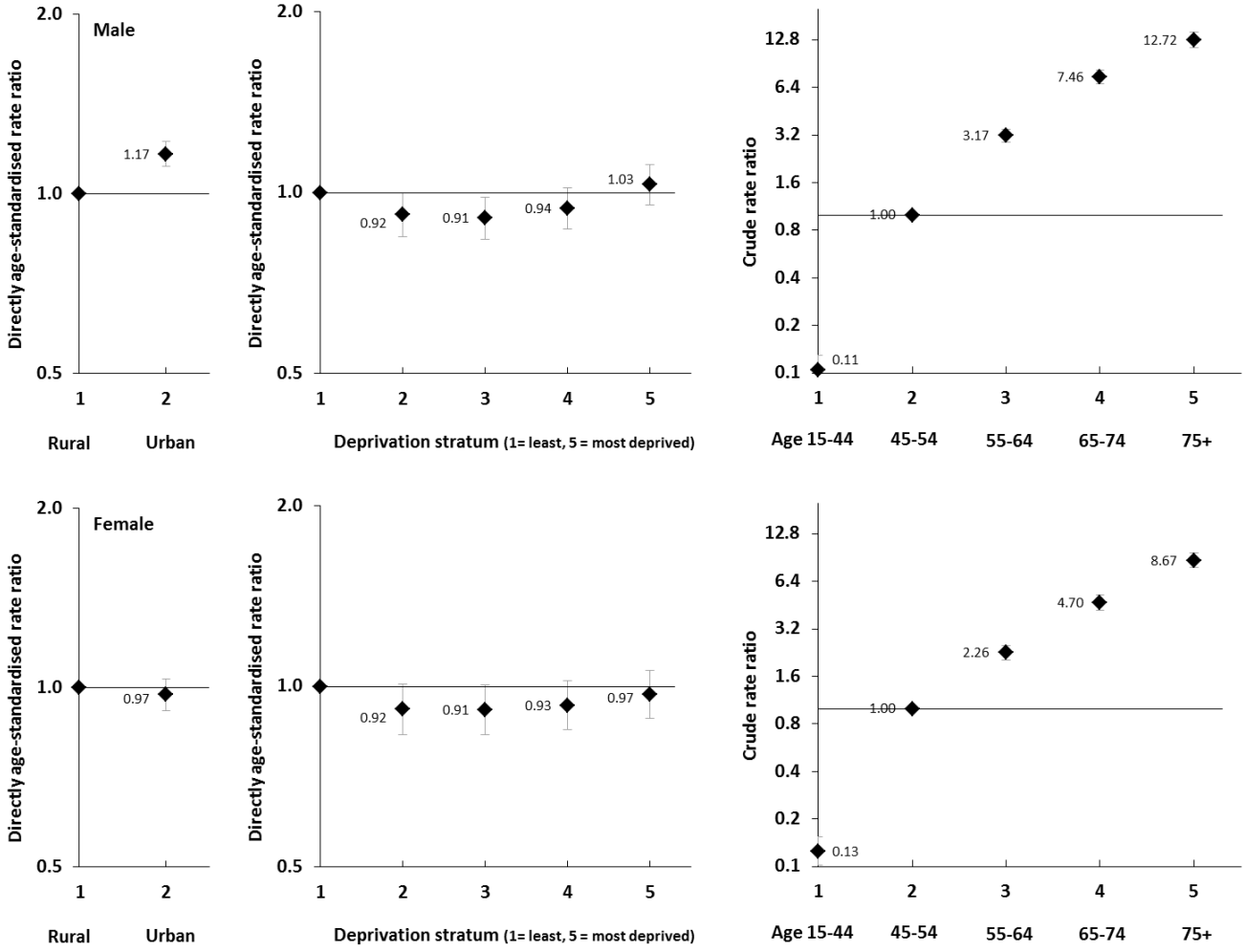


Figure 3.1.2 Rate ratios of colorectal cancer incidence, by urban/rural status, deprivation stratum and diagnosis age.

3.2 Colorectal cancer: cause-specific survival

Variation by urban/rural status

Five-year survival was similar for rural and urban patients (59% and 60%, respectively: *Figure 3.2.1*), with no significant variation after adjustment for age, sex, stage or other factors (*Figure 3.2.2*).

Variation by deprivation

Age-standardised estimates of five-year survival ranged 56-64% across the five deprivation strata, and survival appeared to decrease with increasing levels of deprivation (*Figures 3.2.1 & 3.2.3*). Cox modelling confirmed poorer survival (higher mortality hazards) for the most deprived versus least deprived group: age/sex-adjusted hazard ratio (HR) 1.24 (95% CI 1.11-1.38) (*Table 3.2.1*, *Figure 3.2.1*). Further adjustment, for stage, had little effect (HR 1.25, 1.12-1.39), likewise adjustment for cancer type, smoking and marital status (HR 1.23, 1.10-1.37). Survival adjusted for age and sex was also significantly poorer for intermediate deprivation strata 3-4, but differences were no longer significant after adjustment for stage and other factors.

Interaction between deprivation and urban/rural status

Urban populations showed significant variation in survival by deprivation status, with an age/sex-adjusted mortality hazard ratio of 1.32 (95% CI 1.16-1.49) comparing patients from the most deprived with those from the least deprived urban populations, but variation by deprivation was not significant for rural populations – hazard ratio 1.00 (0.79-1.26) *(Table 3.2.1*, *Figure 3.2.4*). The difference was statistically significant (P=0.03), i.e. there was significant heterogeneity of the deprivation influence between urban and rural patients.

Table 3.2.1 Influence of deprivation on colorectal cancer survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	*1.24	1.11-1.38		
Rural	1.00	0.79-1.26		
Urban	*1.32	1.16-1.49	2.16	*0.03

Variation by age

Five-year survival varied 46-71% between the age-groups examined, with a fairly clear-cut pattern of decreasing survival with increasing age (*Figure 3.2.1*). Cancer-specific mortality was significantly higher for ages 75+ compared with 45-54: sex-adjusted HR 2.39 (2.10-2.72), or 3.23 (2.83-3.68) after stage-adjustment, 3.13 (2.73-3.58) after casemix-adjustment (*Figure 3.2.2*). Survival was also significantly poorer for ages 65-74 and, after stage-adjustment, 55-64.

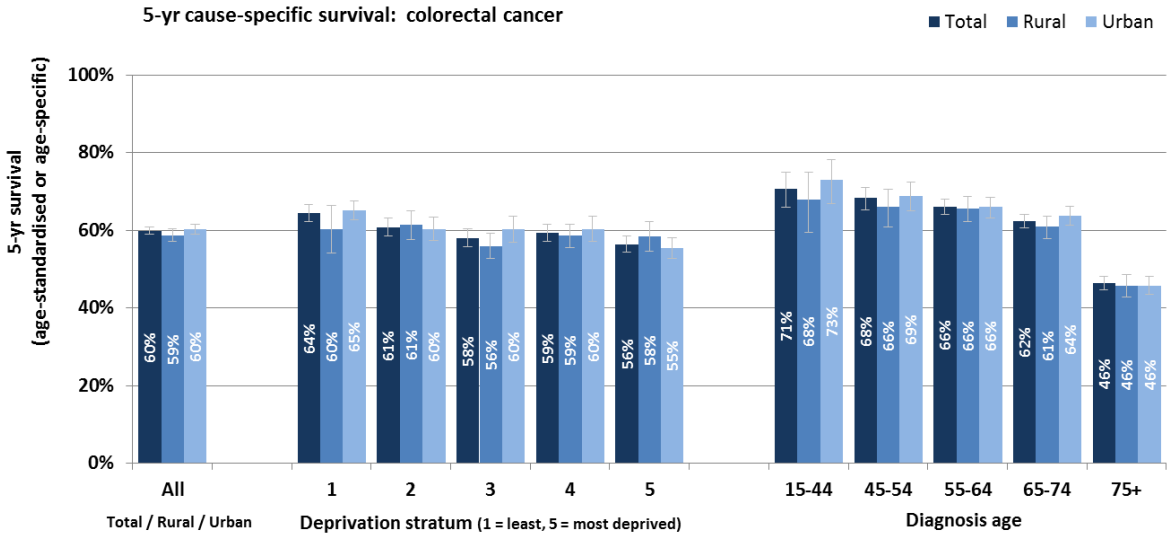


Figure 3.2.1 Cause-specific five-year survival of Irish colorectal cancer patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age.

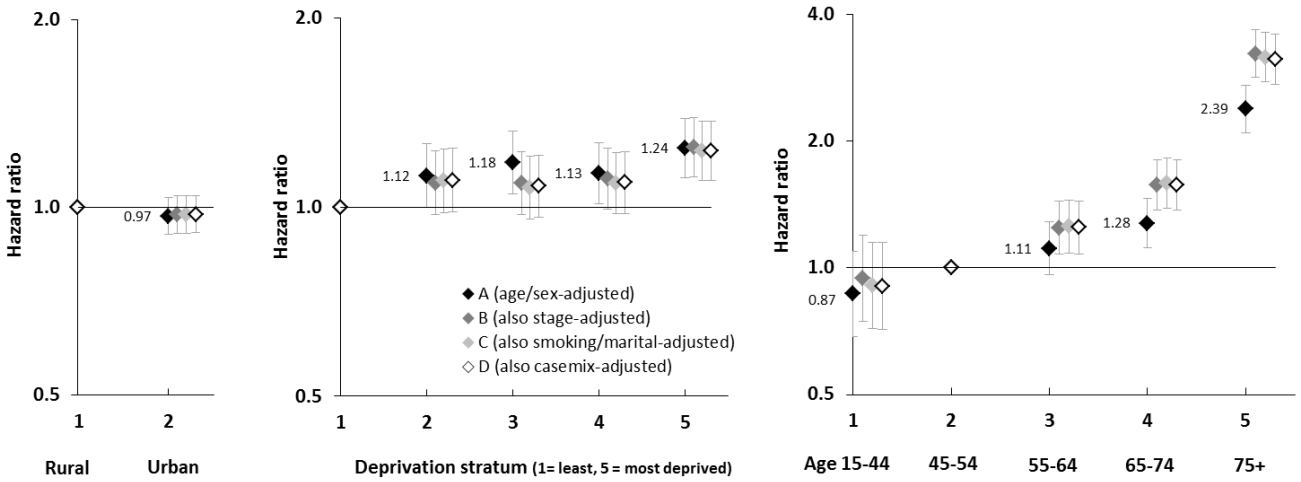


Figure 3.2.2 Mortality hazard ratios for colorectal cancer survival, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group) and fuller models.

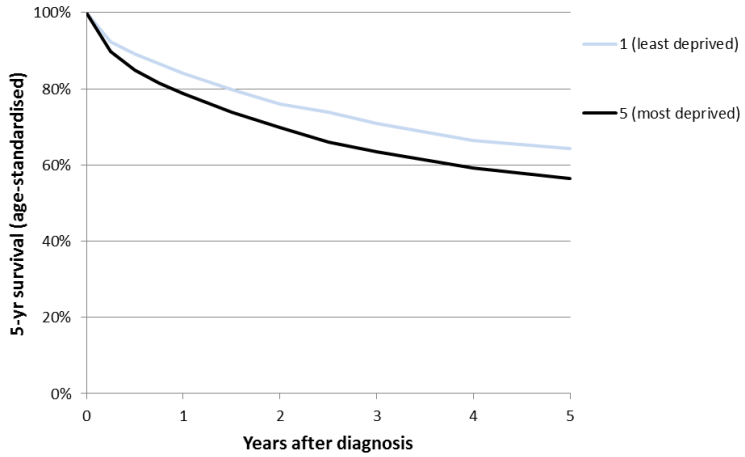


Figure 3.2.3 Cause-specific survival curves for colorectal cancer patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

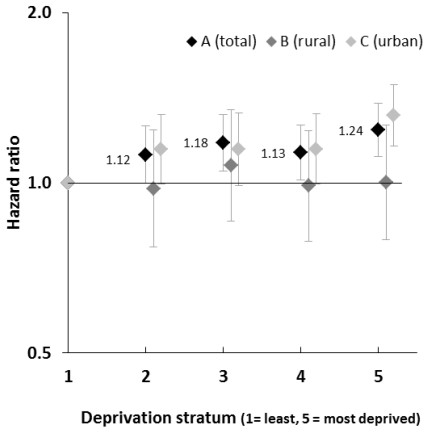


Figure 3.2.4 Mortality hazard ratios for colorectal cancer survival, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. See also *Table 3.2.1*.

3.3 Colorectal cancer: stage (TNM 5th edition)

Variation by urban/rural status

The stage breakdown of cases by urban/rural status was quite similar – 13% stage I, 25-26% stage II, 28-30% stage III, 21-22% stage IV and 7-10% unknown stage (*Figure 3.3.1*) – and did not vary significantly, having adjusted for age and sex (*Figure 3.3.3*).

Variation by deprivation

The stage breakdown of colorectal cancer cases ranged 13-14% for stage I, 25-26% for stage II, 28-30% for stage III, 20-23% for stage IV and 8-11% for unknown stage across the five deprivation strata (*Figure 3.3.1*). Models adjusted for age and sex showed no significant variation by deprivation status, comparing the most with the least deprived stratum (*Table 3.3.1*, *Figure 3.3.2*). For stages III and IV, there was some indication that these comprised a higher proportion of cases from more deprived strata, but the only statistically significant finding was a higher proportion of stage IV among cases from stratum 3 (intermediate deprivation): age/sex-adjusted relative risk (RR) 1.14 (95% CI 1.02-1.29).

Interaction between deprivation and urban/rural status

As for colorectal cancers as a whole, both rural and urban cases showed no significant influence of deprivation on the relative proportions of stages I, II or III. However, cases from most deprived stratum of urban cases were significantly more likely to present at stage IV, compared with the least deprived stratum: age/sex-adjusted RR 1.20 (1.05-1.37) (*Table 3.3.1*, *Figure 3.3.3*). In contrast, rural cases did not show this – RR 0.83 (0.66-1.04) – and formal testing confirmed that there was significant heterogeneity of deprivation influence by urban/rural status (P=0.003). Urban cases also showed a general pattern of higher proportions of stage IV in deprivation strata 2-4 compared with 1 (statistically significant for strata 2 and 4), not evident for rural cases.

Table 3.3.1 Influence of deprivation on colorectal cancer stage, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Stage I				**Stage II**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.95	0.82-1.10			1.01	0.92-1.12		
Rural	1.12	0.80-1.57			0.93	0.75-1.16		
Urban	0.91	0.76-1.08	1.01	0.31	1.03	0.92-1.16	0.84	0.40
	Stage III				**Stage IV**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.09	0.99-1.19			1.11	0.99-1.23		
Rural	1.21	0.99-1.47			0.83	0.66-1.04		
Urban	1.04	0.94-1.16	1.26	0.21	*1.20	1.05-1.37	2.93	*0.003

Variation by age

Stage proportions by age ranged 11-15% for stage I, 17-29% for stage II, 25-34% for stage III, 20-25% for stage IV and 6-13% for unknown age (*Figure 3.3.1*). The oldest patients (age 75+) were significantly more likely to present at stage II (sex-adjusted RR 1.46, 95% CI 1.29-1.66) and significantly less likely to present at stages III (RR 0.73, 0.66-0.80) or IV (RR 0.77, 0.69-0.77) than patients aged 45-54 (*Figure 3.3.2*). Patients aged 65-74 were also more likely to present at stage II (and stage I) and less likely to present at stages III or IV; those aged 55-64 more likely to present at stage I, and those aged <45 less likely to present at stage IV, compared with ages 45-54.

As also noted for lung cancer, it is possible that some of the age variation noted here could be an artefact of poorer quality data for older patients. If elderly patients were not investigated as fully for evidence of nodal or distant metastasis, they might be more conservatively staged than younger patients. This might help explain the lower than expected proportions of stage III and IV cancer in the oldest group. The higher proportion of unstaged colorectal cancers in the oldest group might also partly contribute to the lower proportions of stage III and stage IV cancers but would not fully account for the age differences seen. Alternatively, it may be that younger patients presented at more advanced stage, on average.

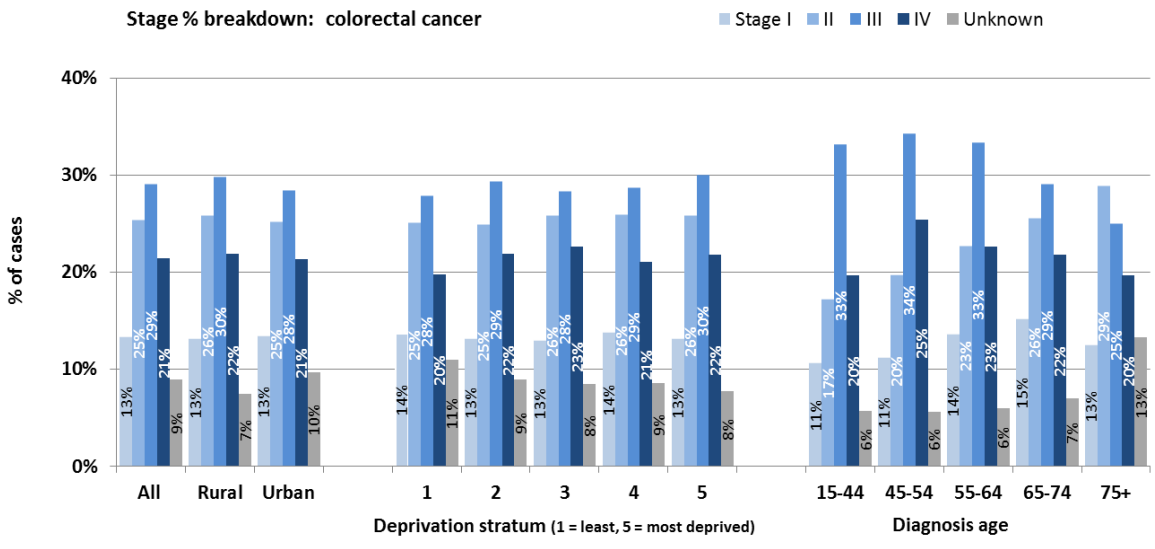


Figure 3.3.1 Stage breakdown of colorectal cancer cases, 2008-2012, by urban/rural status, deprivation stratum and age.

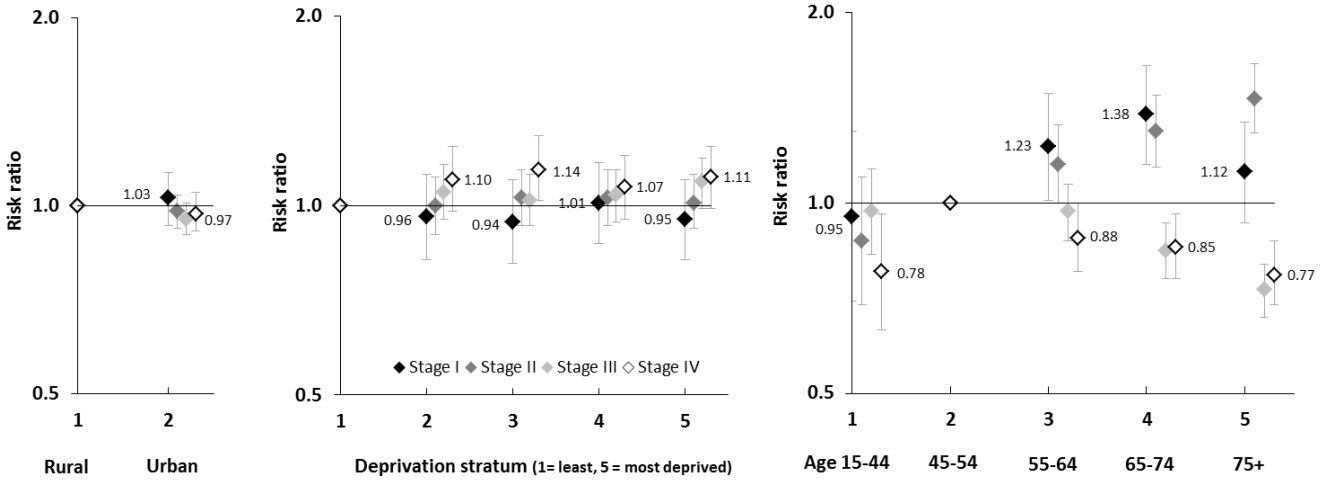


Figure 3.3.2 Risk ratios for colorectal cancer stage, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group). RRs for unknown stage are not shown but are noted in text if significant.

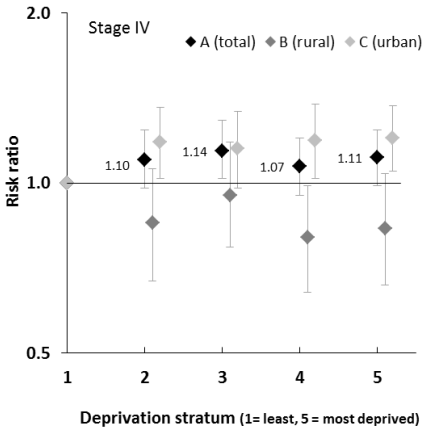


Figure 3.3.3 Risk ratios for colorectal cancer stage IV, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. The pattern by deprivation for stages I, II and III did not differ significantly between rural and urban cases. See also *Table 3.3.1*.

Text and graphical summaries above are based on comparisons of the percentage stage composition of cases. To provide further context, stage-specific incidence rates are presented in *Figure 3.3.4* (below). These rates reflect a combination of overall incidence rates and stage, thus are more complex to interpret.

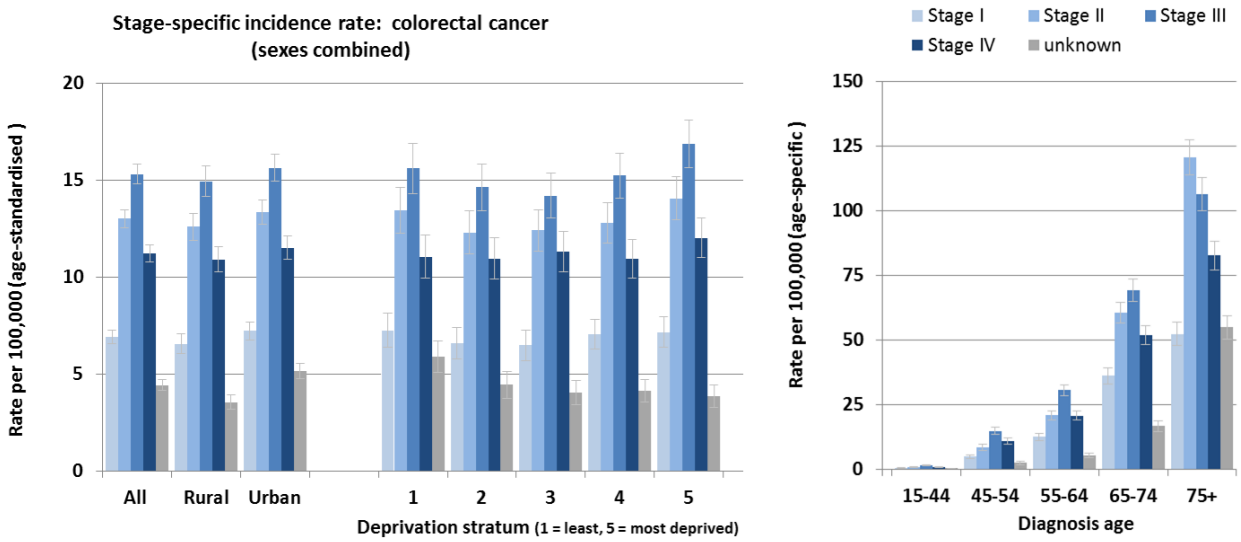


Figure 3.3.4 Stage-specific incidence of colorectal cancer, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Rates are standardised for sex (i.e. assume equal populations of males and females in all age-groups). Note different scale for age-specific rates.

3.4 Colorectal cancer: tumour-directed treatment

Variation by urban/rural status

Proportions of patients treated varied only slightly (86-87%) between urban and rural patients for overall treatment, likewise for surgery (76-78%), radiotherapy (both 17%) and chemotherapy (40-42%) (*Figure 3.4.1*). However, urban cases were slightly but significantly less likely to have surgery (relative risk [RR] 0.97, 95% CI 0.95-0.99) or chemotherapy (RR 0.95, 0.92-0.99) compared with rural cases, having adjusted for age, sex and casemix (*Figure 3.4.2*). Adjustment for stage reduced these effects only slightly (RRs 0.98, 0.94-1.01 and 0.97, 0.96-1.00, respectively). Radiotherapy use and overall treatment did not vary significantly by urban/rural status.

Variation by deprivation

The crude (unadjusted) proportion of colorectal cancer patients having any tumour-directed treatment ranged 84-88% between deprivation strata, or 74-78% for surgery, 40-42% for chemotherapy and 16-18% for radiotherapy (*Figure 3.4.1*). Radiotherapy is mainly used for rectal cancer, though some colon cancers extending to or overlapping the rectosigmoid junction may have radiotherapy. About 50% of rectal cancer cases had radiotherapy, compared with 15% for cancer of the rectosigmoid junction and <3% for colon cancer. Patients from the most deprived group were significantly less likely to have surgery, compared with the least deprived group (*Table 3.4.1*, *Figure 3.4.2*): age/sex/casemix-adjusted RR 0.96 (0.93-0.99), or (not graphed) 0.94 (0.92-0.87) after further adjustment for stage. A similar pattern was seen for overall treatment: RRs 0.96 (0.94-0.99) and 0.95 (0.93-0.97), respectively. Deprivation status did not significantly influence use of radiotherapy or chemotherapy.

Interaction between deprivation and urban/rural status

Urban patients from the most deprived stratum were, as seen overall (above), significantly less likely to have surgery or any treatment compared with the least deprived stratum: age/sex/casemix-adjusted RRs 0.94 (95% CI 0.90-0.98) and 0.96 (0.94-0.99), respectively (*Table 3.4.1*). For rural patients, the equivalent deprivation effects were not significant – RRs 0.98 (0.92-1.04) for surgery and 0.97 (0.93-1.01) for any treatment – but the pattern did not differ significantly from that among urban cases (surgery, P=0.28 for difference; any treatment, P=0.70). For chemotherapy and radiotherapy, there was no significant influence of deprivation among either rural or urban cases (and no significant heterogeneity in deprivation influence).

Table 3.4.1 Influence of deprivation on colorectal cancer treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex/casemix-adjusted relative risks)

	Any treatment RR most v least deprived	95% CI	z	P	Surgery RR most v least deprived	95% CI	z	P
Total	*0.96	0.94-0.99			*0.96	0.93-0.99		
Rural	0.97	0.93-1.01			0.98	0.92-1.04		
Urban	*0.96	0.94-0.99	0.39	0.70	*0.94	0.90-0.98	1.07	0.28
	Radiotherapy RR most v least deprived	**95% CI**	**z**	**P**	**Chemotherapy RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.07	0.96-1.19			1.05	0.98-1.11		
Rural	1.21	0.94-1.56			1.04	0.92-1.18		
Urban	1.03	0.91-1.17	1.07	0.29	1.03	0.96-1.12	0.13	0.90

Variation by age

The overall percentage of patients treated varied 75-96% between age-groups, or 67-86% for surgery, 11-26% for radiotherapy and, most markedly, 17-67% for chemotherapy (*Figure 3.4.1*). Patients aged 75+ were the least likely to have tumour-directed treatment: sex/casemix-adjusted RRs 0.79 (95% CI 0.77-0.81) overall, 0.80 (0.77-0.82) for surgery, 0.60 (0.54-0.67) for radiotherapy and 0.26 (0.24-0.29) for chemotherapy, relative to ages 45-54 (*Figure 3.4.2*). Adjustment for stage moderated these age-related patterns only slightly: for ages 75+ to RR 0.81 (0.80-0.83) overall, 0.81 (0.78-0.83) for surgery, 0.63 (0.57-0.70) for radiotherapy and 0.30 (0.28-0.32) for chemotherapy (not graphed). Patients aged 65-74 were also less likely to have any treatment, radiotherapy or chemotherapy, and chemotherapy use was also lower in age-group 55-64 (*Figure 3.4.2*); again, stage-adjustment had little effect.

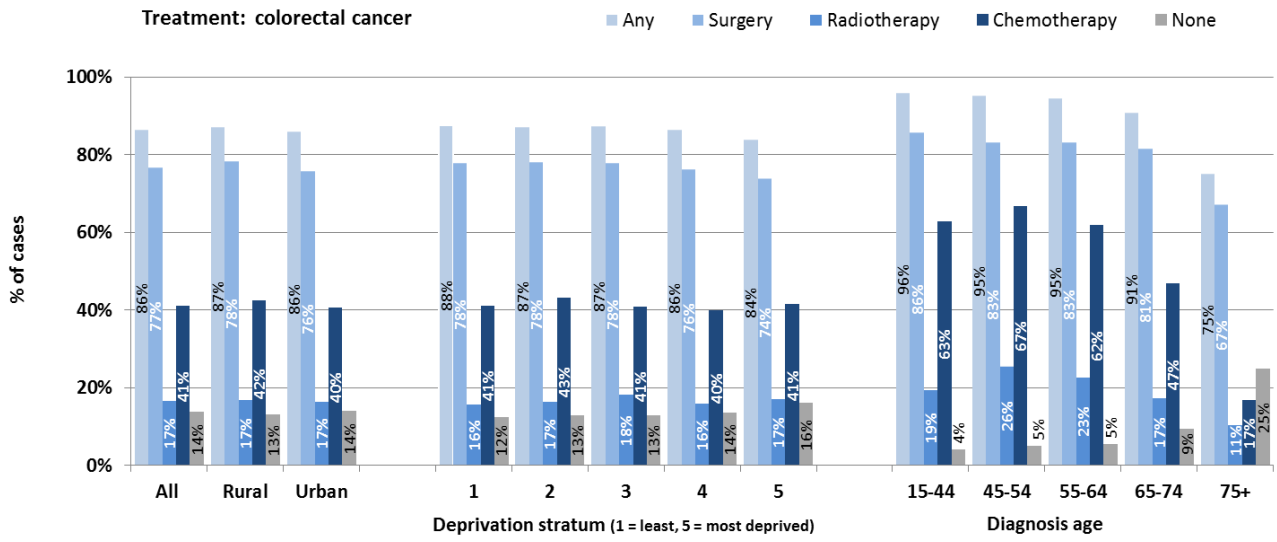


Figure 3.4.1 Treatment of colorectal cancer within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

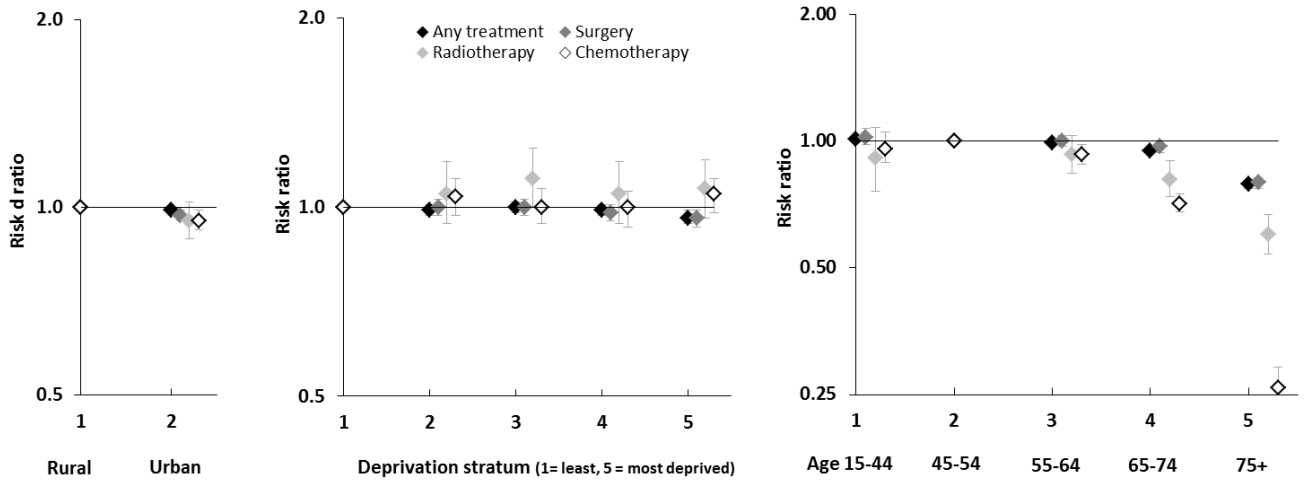


Figure 3.4.2 Risk ratios for treatment of colorectal cancer, by urban/rural status, deprivation stratum and diagnosis age: age/sex/casemix-adjusted models (or sex/casemix-adjusted models by age-group).

3.5 Colorectal cancer: comorbidity

Variation by urban/rural status

Similar percentages (21%) of rural patients and urban patients had known comorbidities (*Figure 3.5.1*), and there was no significant difference after adjustment for age and sex: relative risk (RR) 1.01 (95% CI 0.94-1.10) comparing urban with rural patients (*Figure 3.5.3*).

Variation by deprivation

The proportion of colorectal cancer patients with recorded clinically significant health conditions at or around the time of cancer diagnosis ranged 19-22% across the five deprivation strata (*Figure 3.5.1*), or 22-24% for males, 16-19% for females (*Figure 3.5.2*). Although comorbidity levels appeared to be lowest among patients from the least deprived stratum, variation was not statistically significant after adjustment for age and sex: RR 1.07 (95% CI 0.93-1.22) comparing the most with the least deprived stratum (*Table 3.5.1*, *Figure 3.5.3*).

Interaction between deprivation and urban/rural status

The pattern of comorbidity by deprivation did not differ significantly between rural and urban cases, comparing the most with the least deprived strata, and there was no significant variation in comorbidity by deprivation for either rural or urban cases (*Table 3.5.1*).

Table 3.5.1 Influence of deprivation on comorbidity in colorectal cancer patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	1.07	0.93-1.22		
Rural	0.88	0.66-1.17		
Urban	1.15	0.98-1.34	1.73	0.083

Variation by age

Comorbidity percentages ranged 6-27% across the age-groups examined (*Figure 3.5.1*), or 6-31% for males, 6-22% for females (*Figure 3.5.2*), with prevalence of comorbidity increasing markedly with increasing age. Patients in the oldest group (age 75+) were between two and three times more likely to have comorbidities than those at ages 45-54: age/sex-adjusted RR 2.55 (95% CI 2.09-3.11) (*Figure 3.5.3*). Recorded prevalence of comorbidity was also significantly high at ages 55-64 and 65-74, but was significantly lower at ages <45, compared with ages 45-54.

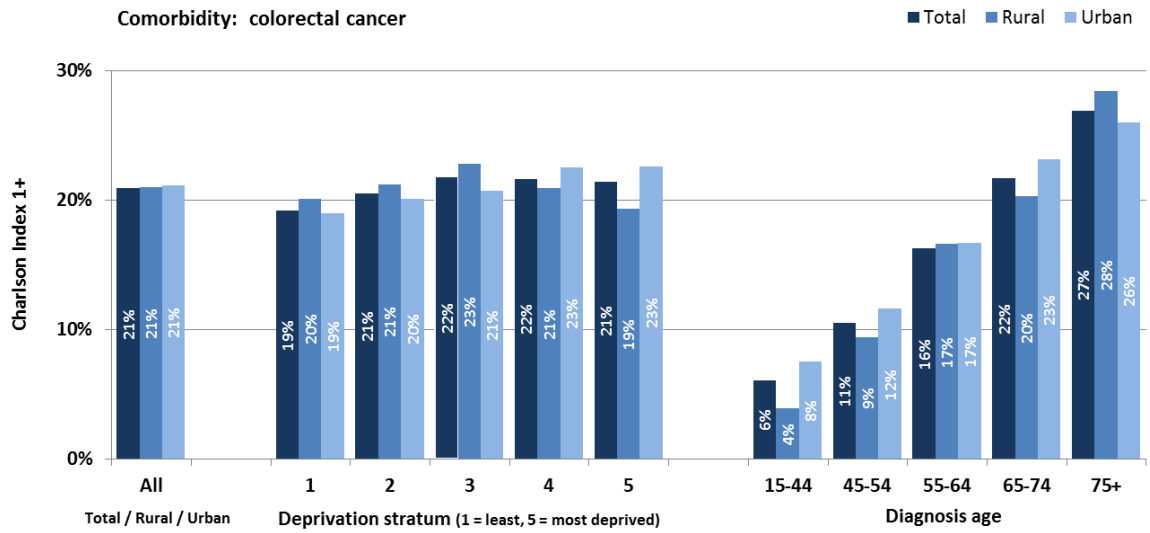


Figure 3.5.1 Comorbidity in colorectal cancer patients (sexes combined), 2008-2012, by urban/rural status, deprivation stratum and age.

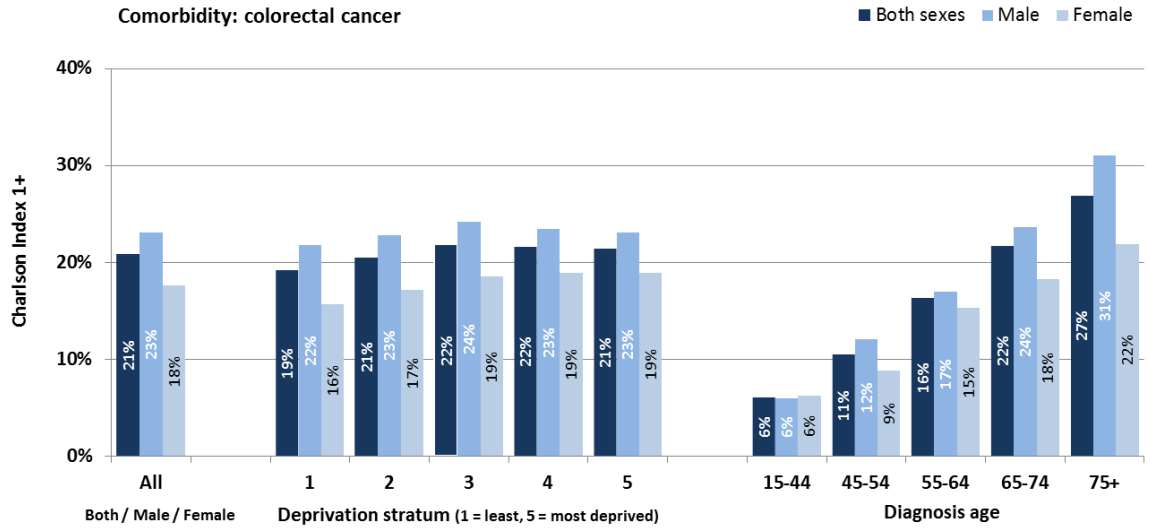


Figure 3.5.2 Comorbidity in colorectal cancer patients, 2008-2012, by sex, deprivation stratum and age.

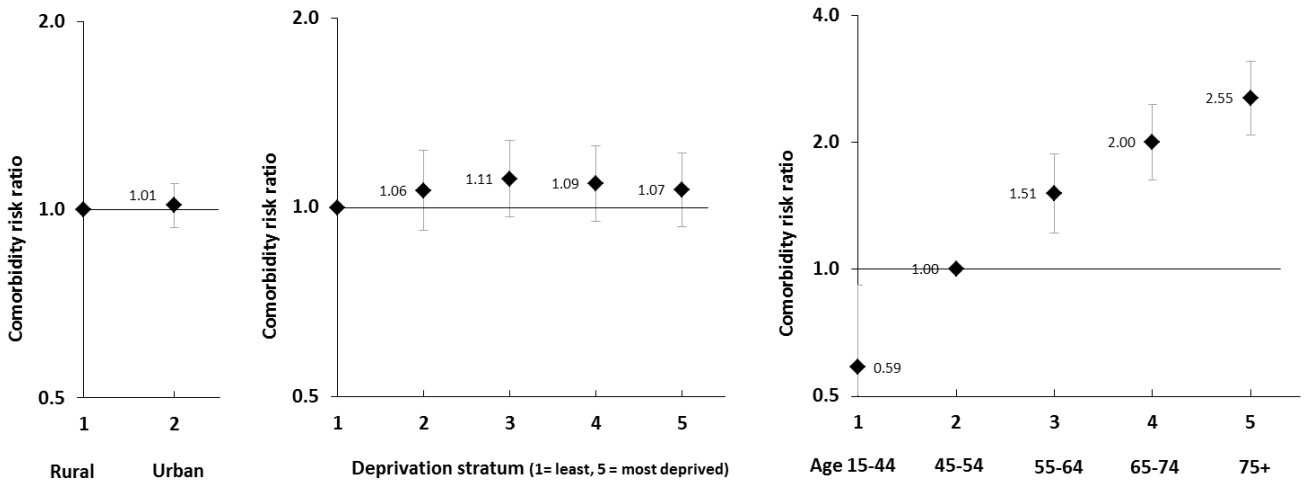


Figure 3.5.3 Risk ratios for comorbidity in colorectal cancer patients, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

4 LUNG CANCER

Note: Patterns presented here for lung cancer do not take into account possible differences in morphological subtype (e.g. small-cell v non-small-cell lung cancer) between compared groups; a fuller analysis is planned for a separate publication.

Key points

- *Incidence*
  - Urban males and urban females showed 36% and 38% higher age-standardised incidence rates respectively relative to their rural counterparts.
  - There was a clear trend of increasing incidence with increasing deprivation, and age-adjusted rates were about 60% higher for the most compared with the least deprived population quintiles in both sexes.
  - Both males and females showed significant urban/rural differences in strength of the deprivation effect: comparing the most and least deprived quintiles, urban males showed an 85% higher rate relative to 40% higher for rural males; urban females showed an 80% higher rate relative to 24% higher for rural females.
  - For the oldest age-group (75+), the incidence rate was 15 and 11 times higher than at ages 45-54 for males and females respectively.
- *Survival*
  - Survival was slightly but significantly higher (age/sex-adjusted mortality risk about 6% lower) for urban compared with rural patients, but this effect disappeared after adjustment for stage.
  - Survival was significantly poorer (mortality hazard 21% higher) in the most compared with least deprived group.
  - Survival was significantly poorer (mortality hazard almost twice [1.8 times] as high) at ages 75+ compared with 45-54, and also poorer at ages 65-74, but higher at ages <45.

Table 4.k.1 Visual summary of the influence of urban status, deprivation and age on lung cancer in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, stage proportion, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
Lung cancer						
Urban status	M↑ F↑	↑	I↑ II=	III↓ IV=	=	=
Deprivation	M↑ F↑	↓	II↑ I=	=	T↓ S↓ RC=	↑
Older age	M↑ F↑	↓	I↑ II↑	III↓ IV↓	T↓ S↓ R↓ C↓	↑

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Stage*
  - Urban patients were 13% more likely to present at stage I and 6% less likely to present at stage III compared with rural patients, having adjusted for age and sex.
  - Comparing the most and least deprived quintiles, in urban populations stage III made up a higher proportion of cases (+17% in relative terms) but the opposite pattern was seen among rural population (-23%) (a significant urban/rural difference in deprivation effect).
  - For the oldest age group (75+), the likelihood of presenting at stage I was higher(+72%) but at stage IV lower (-28%) relative to age-group 45-54.
- *Treatment*
  - Patients from the most deprived quintile were significantly less likely than those from the most deprived quintile to have any treatment (-7% in relative terms) or surgery (-21%), after adjustment for age and sex.
  - Compared with ages 45-54, older patients were significantly less likely to have tumour-directed treatment (overall and for all specific modalities) – for age 75+, 49% lower (in relative terms) for overall treatment, 63% lower for surgery, 43% lower for radiotherapy and 79% lower for chemotherapy.
- *Comorbidity*
  - A significantly higher proportion of cases (+16% in relative terms) from the most deprived group had comorbidities compared with the least deprived stratum, having adjusted for age and sex.
  - Variation by age in the proportion of lung cancer patients with significant non-cancer health conditions (60% higher at ages 75+ compared with 45-54) was less marked than for other cancers considered in this report; however, the prevalence of other health conditions was already comparatively high among younger patients.

4.1 Lung cancer: incidence

Variation by urban/rural status

Age-standardised incidence was significantly higher among urban populations compared with rural populations for both males (rate 67 v 49 cases per 100,000, directly age-standard rate ratio [DSRRs] 1.36, 95% CI 1.29-1.43) and females (rate 42 v 31, DSRR 1.38, 1.30-1.47) (*Figures 4.1.1-4.1.2*).

Variation by deprivation

Age-standardised rates of lung cancer ranged 49-79 cases per 100,000 males and 31-50 cases per 100,000 females across the five deprivation strata (*Figure 4.1.1*). Rates were significantly higher, by about 60%, in the most deprived compared with the least deprived stratum: DSRR 1.62 (95% CI 1.49-1.75) for males and 1.56 (1.42-1.72) for females (*Table 4.1.1*, *Figure 4.1.2*). Male rates were also significantly high in stratum 3 (DSRR 1.11, 1.02-1.22) and 4 (1.21, 1.11-1.32), and female rates in stratum 4 (1.16, 1.05-1.28).

Interaction between deprivation and urban/rural status

Urban populations showed significantly more marked inequality in incidence by deprivation than rural populations: for males, a rate ratio 1.85 (95% CI 1.68-2.03) comparing the most with the least deprived urban populations versus 1.40 (1.17-1.68) for the same comparison among rural populations (P=0.004 for difference); for females, 1.80 (1.62-2.00) urban versus 1.24 (0.99-1.86) rural (P=0.009) (*Table 4.1.1*).

Table 4.1.1 Influence of deprivation on lung cancer incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	Males				Females			
	DSRR most v least deprived	95% CI	z	P	DSRR most v least deprived	95% CI	z	P
Total	*1.62	1.49-1.75			*1.56	1.42-1.72		
Rural	*1.40	1.17-1.68			1.24	0.99-1.86		
Urban	*1.85	1.68-2.03	2.63	*0.004	*1.80	1.62-2.00	2.87	*0.009

Variation by age

Male rates ranged from 2 to 508 cases and female rates from 2 to 275 cases per 100,000 between the youngest (15-44) and oldest (75+) age-groups examined, with a very strong pattern of increased incidence with age (*Figure 4.1.1*). Rates for males were about 15 times and for females about 11 times higher in the oldest group than in the 45-54 comparison group: DSRRs 15.5 (13.7-17.5) for males, 10.9 (9.6-12.3) for females *(Figure 4.1.2*). Rates at ages 55-64 and 65-74 were also significantly higher, while rates at age 15-44 were significantly lower, than at ages 45-54.

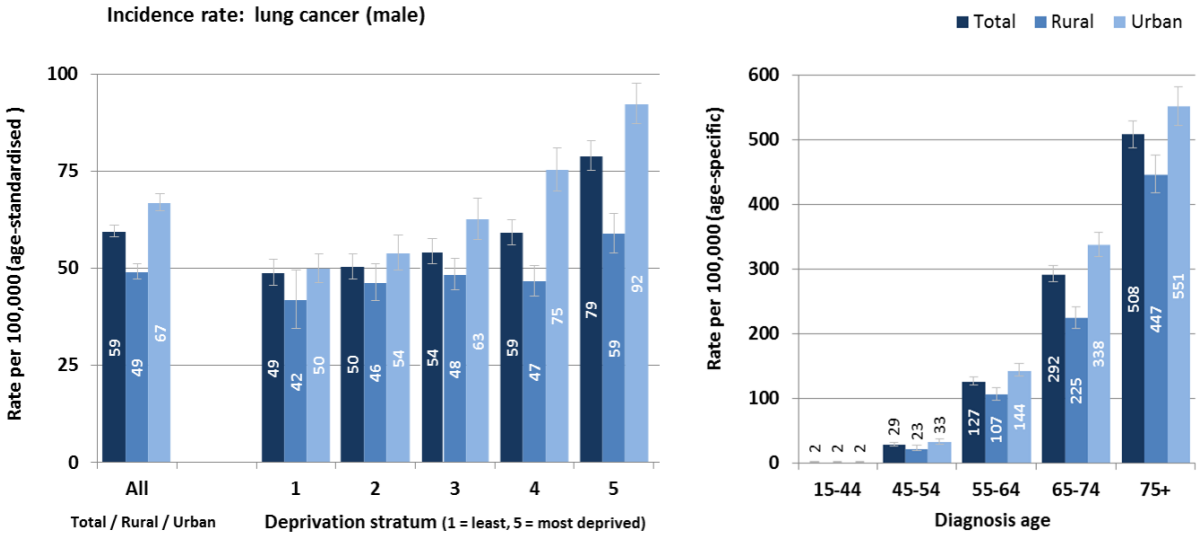


Figure 4.1.1(a) Incidence of lung cancer (males), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

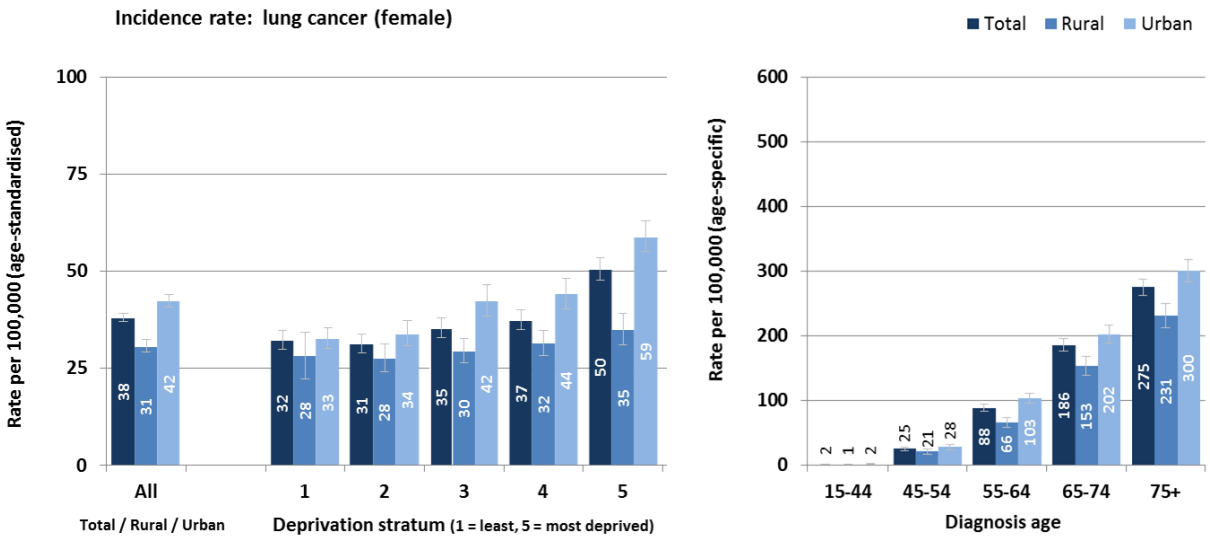


Figure 4.1.1(b) Incidence of lung cancer (females), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

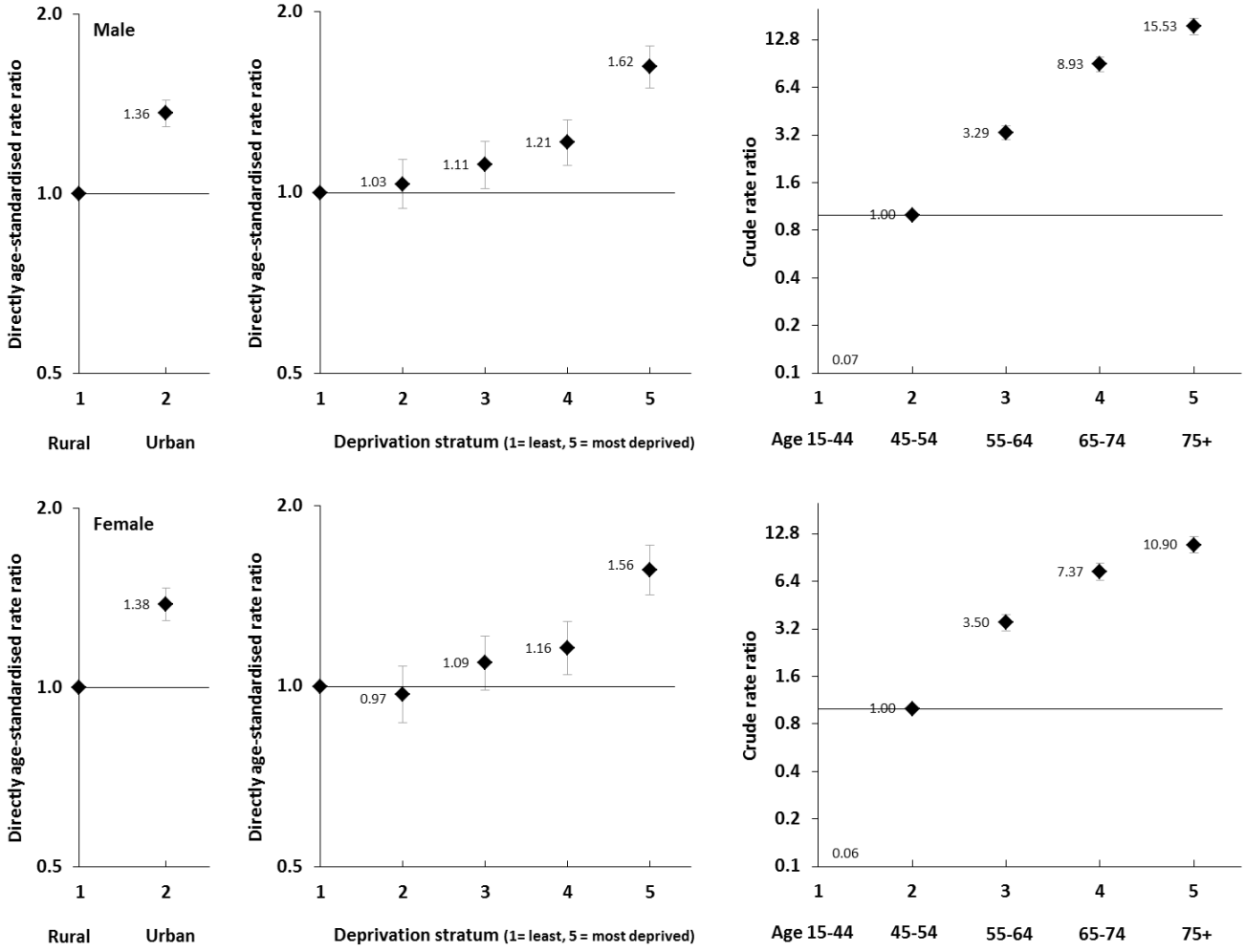


Figure 4.1.2 Rate ratios of lung cancer incidence, by urban/rural status, deprivation stratum and diagnosis age.

4.2 Lung cancer: cause-specific survival

Variation by urban/rural status

Average five-year survival appeared to be higher for urban cases (18%) than rural cases (15%) (*Figure 2.4.1*). This was confirmed by age/sex-adjusted modelling (hazard ratio [HR] 0.94, 95% CI 0.89-0.99) but the difference was no longer significant after adjustment for stage (HR 0.98, 0.93-1.03) (*Figure 2.4.2*).

Variation by deprivation

Age-standardised estimates of five-year survival varied 14-22% across the five deprivation strata, with fairly clear evidence of a decline in survival with increasing deprivation (*Figures 4.2.1 & 4.2.3*). Cancer-specific mortality was significantly higher for the most deprived compared with the least deprived group: age/sex-adjusted HR 1.21 (95% CI 1.11-1.30) (*Table 4.2.1*), or 1.25 (1.15-1.35) after stage-adjustment, 1.23 (1.13-1.32) after further adjustment for smoking and marital status (*Figure 4.2.2*). Survival was also poorer for intermediate strata 2-4 compared with stratum 1 (age/sex-adjusted HR range 1.16-1.19, or 1.18-120 after fuller adjustment).

Interaction between deprivation and urban/rural status

Both urban and rural populations showed significant variation in survival by deprivation status, with an age/sex-adjusted mortality hazard ratio comparing patients from the most deprived with those from the least deprived populations of 1.20 (95% CI 1.10-1.31) for urban patients and 1.22 (1.01-1.49) for rural patients (*Table 4.2.1*, *Figure 4.2.4*). Based on these comparisons, there was no significant heterogeneity of the deprivation influence between urban and rural patients (P=0.84).

Table 4.2.1 Influence of deprivation on lung cancer survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	*1.21	1.11-1.30		
Rural	*1.22	1.01-1.49		
Urban	*1.20	1.10-1.31	0.21	0.84

Variation by age

Five-year survival varied from 8 to 46% between the age-groups examined, in broad terms falling with increasing age but with relatively minor variation across the three intermediate age-groups (45-54 to 65-74) (*Figure 4.2.1*). Mortality was significantly higher for age-group 75+ compared with ages 45-54: sex-adjusted HR 1.79 (95% CI 1.63-1.97), or 2.18 (1.98-2.40) adjusted for stage, 2.20 (1.99-2.43) also adjusted for smoking and marital status (*Figure 4.2.2*). Survival was also significantly poorer for ages 65-74 and, after stage-adjustment, 55-64, but was significantly higher for ages <45.

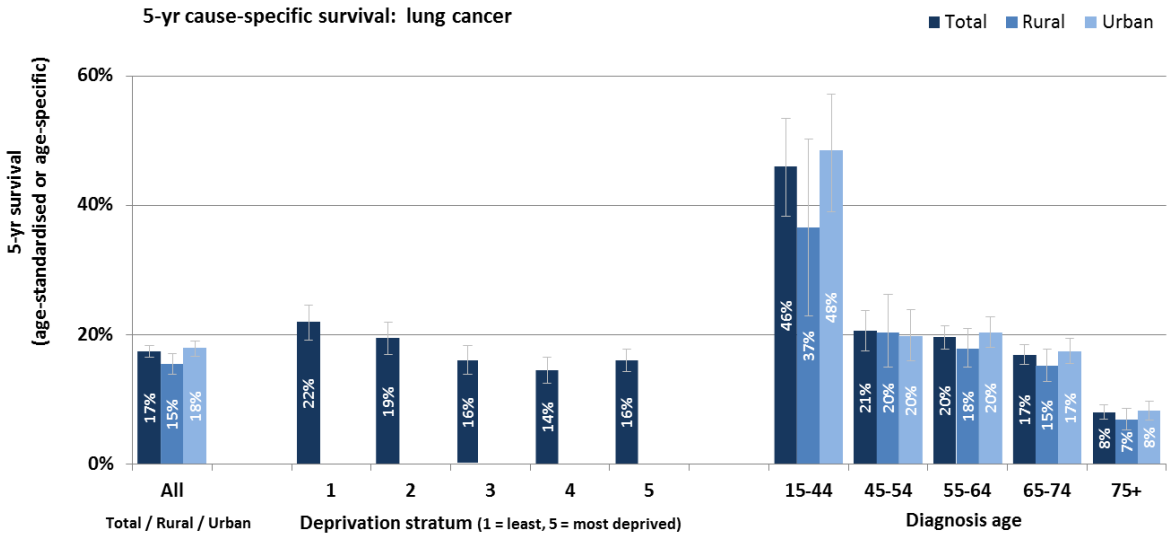


Figure 4.2.1 Cause-specific five-year survival of Irish lung cancer patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age. Deprivation-specific urban and rural survival could not be calculated as there were too few patients in some age-groups to allow age-standardisation.

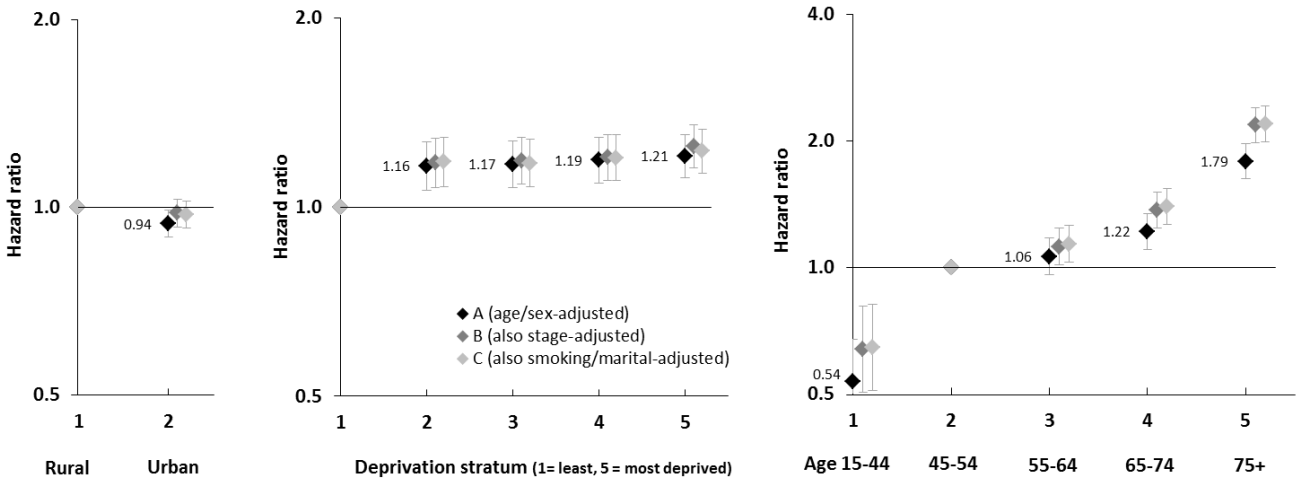


Figure 4.2.2 Mortality hazard ratios for lung cancer survival, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group) and fuller models.

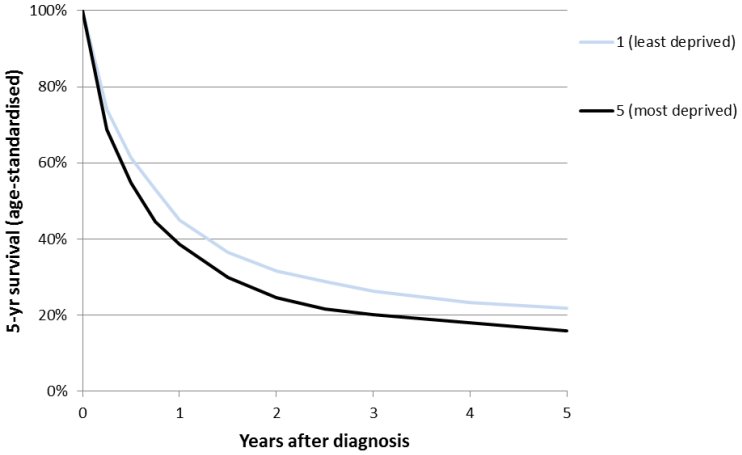


Figure 4.2.3 Cause-specific survival curves for lung cancer patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

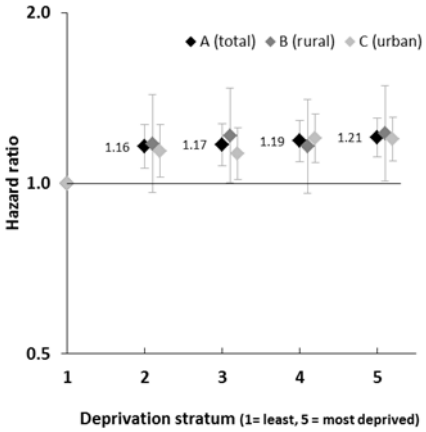


Figure 4.2.4 Mortality hazard ratios for lung cancer survival, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. See also *Table 4.2.1*.

4.3 Lung cancer: stage (TNM 5th edition)

Variation by urban/rural status

Stage proportions by urban/rural status 15-17% for stage I, 25-27% for stage III, 37-38% for stage IV and 10-12% for unknown stage, and were similar for stage II (7%) (*Figure 4.3.1*). Urban cases were significantly more likely to present at stage I (age/sex-adjusted relative risk [RR] 1.13, 95% CI 1.03-1.24) or with unknown stage (1.26, 1.13-1.42) and less likely to present at stage III (0.93, 0.87-0.99) (*Figure 4.3.2*).

Variation by deprivation

The stage breakdown of lung cancer cases ranged 15-17% for stage I, 6-8% for stage II, 23-26% for stage III, 35-38% for stage IV and 10-16% for unknown stage across the five deprivation strata (*Figure 4.3.1*). Variation by deprivation stratum was not statistically significant for stages I-IV (*Table 4.3.1*, *Figure 4.3.2*) but cases from the most deprived stratum were less likely to be of unknown stage than those from the most deprived stratum: age/sex-adjusted RR 0.69 (0.59-0.81) (not graphed). The proportion of cases that were of unknown stage was also significantly lower for deprivation strata 3 and 4 compared with stratum 1.

Interaction between deprivation and urban/rural status

In urban populations, stage III made up a higher proportion of cases from the most deprived compared with the least deprived stratum – RR 1.17 (1.03-1.32)– but the opposite pattern was seen among rural population: RR 0.77 (0.61-0.97) (P<0.001 for difference) (*Table 4.3.1*, *Figure 4.3.3*). For stages I-II and IV, neither urban nor rural cases showed a significant influence of deprivation and the influence of deprivation on stage composition did not vary significantly by urban/rural status (comparing the most deprived with least deprived stratum).

Table 4.3.1 Influence of deprivation on lung cancer stage, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Stage I				**Stage II**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.06	0.92-1.22			1.11	0.88-1.40		
Rural	1.11	0.78-1.57			1.70	0.89-3.24		
Urban	1.05	0.90-1.22	0.28	0.78	1.00	0.78-1.30	1.22	0.22
	Stage III				**Stage IV**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.09	0.97-1.22			1.06	0.98-1.15		
Rural	0.77	0.61-0.97			0.98	0.80-1.20		
Urban	*1.17	1.03-1.32	3.39	*<0.001	1.09	0.99-1.19	0.98	0.33

Variation by age

Stage proportions by age ranged 10-18% for stage I, 1-8% for stage II, 18-28% for stage III, 32-44% for stage IV and 6-18% for unknown stage (*Figure 4.3.1*). Perhaps surprisingly, the oldest patients (age 75+) were significantly more likely to have stage I cancer (sex-adjusted RR 1.72, 95% CI 1.39-1.14) and significantly less likely to have stage III (0.87, 0.76-0.98) or stage IV cancer (0.72, 0.66-0.79) compared with ages 45-54 (*Figure 4.3.2*). They were also more likely to be of unknown stage. Age-groups 55-64 and 65-74 also had a higher proportion of stage I cancers, and ages 65-74 a lower proportion of stage IV and a higher proportion of unknown stage, than ages 45-54. The youngest patients (<45 years) were significantly less likely to present at stage II or III.

It is possible that some of the age variation noted here could be an artefact of poorer quality data for older patients – for example, if elderly patients with lung cancer were not investigated as fully for evidence of nodal or distant metastasis, they might be more conservatively staged than younger patients. This might help explain higher than expected proportions of stage I and lower than expected proportions of stage III and IV cancer in the oldest group, and would be consistent with the high proportion of wholly unstaged cases in this group (18% lacking information even on primary tumour extent). Only 68% of lung cancer patients aged 75+ had microscopically verified tumours, compared with 93% in the under-75s, and greater reliance on clinical or imaging methods of diagnosis in older patients may be correlated with the completeness or quality of staging. Alternatively, lung cancers diagnosed in older patients might be, on average, slower growing or present at an earlier stage than in younger patients.

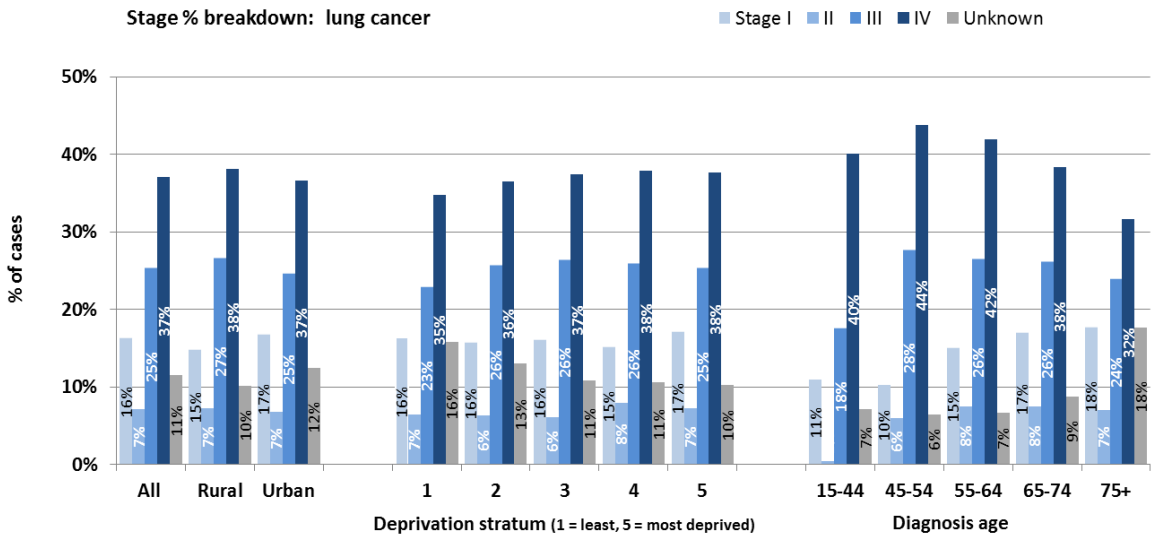


Figure 4.3.1 Stage breakdown of lung cancer cases, 2008-2012, by urban/rural status, deprivation stratum and age.

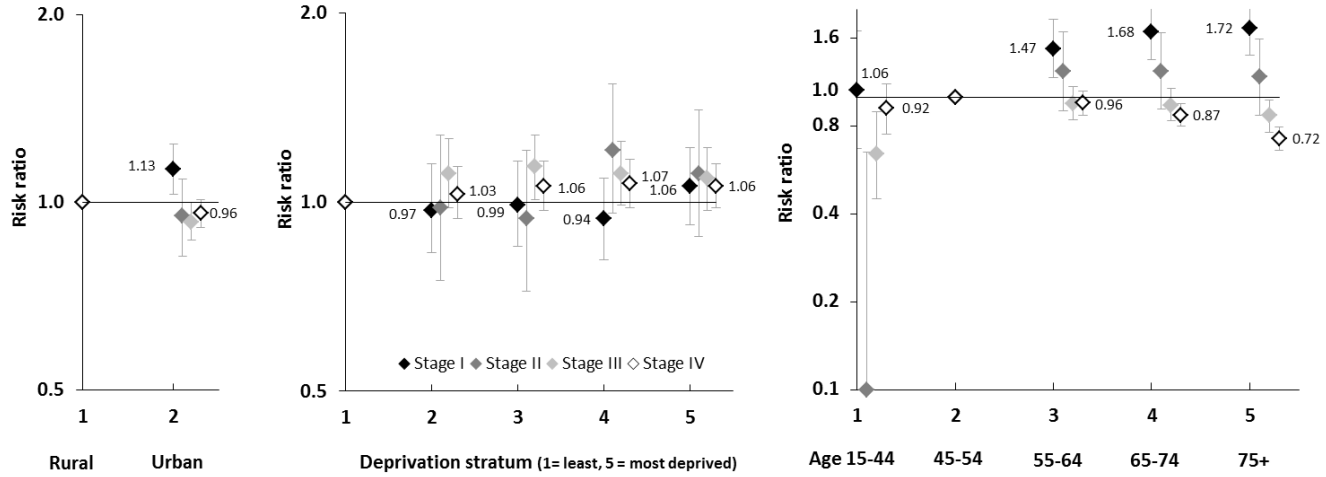


Figure 4.3.2 Risk ratios of lung cancer stage, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group). RRs for unknown stage are not plotted but are noted in text if significant.

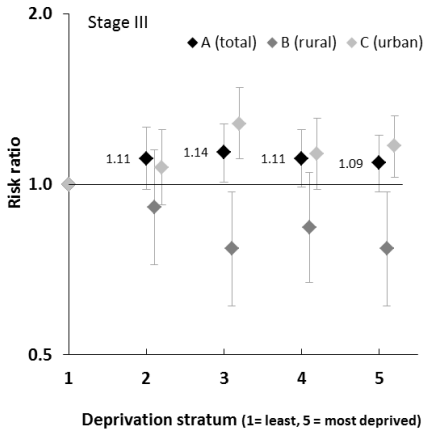


Figure 4.3.3 Risk ratios for lung cancer stage III, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. The pattern by deprivation for stages I, II and IV did not differ significantly between rural and urban cases. See also *Table 4.3.1*.

Text and graphical summaries above are based on comparisons of the percentage stage composition of cases. To provide further context, stage-specific incidence rates are presented in *Figure 4.3.4* (below).

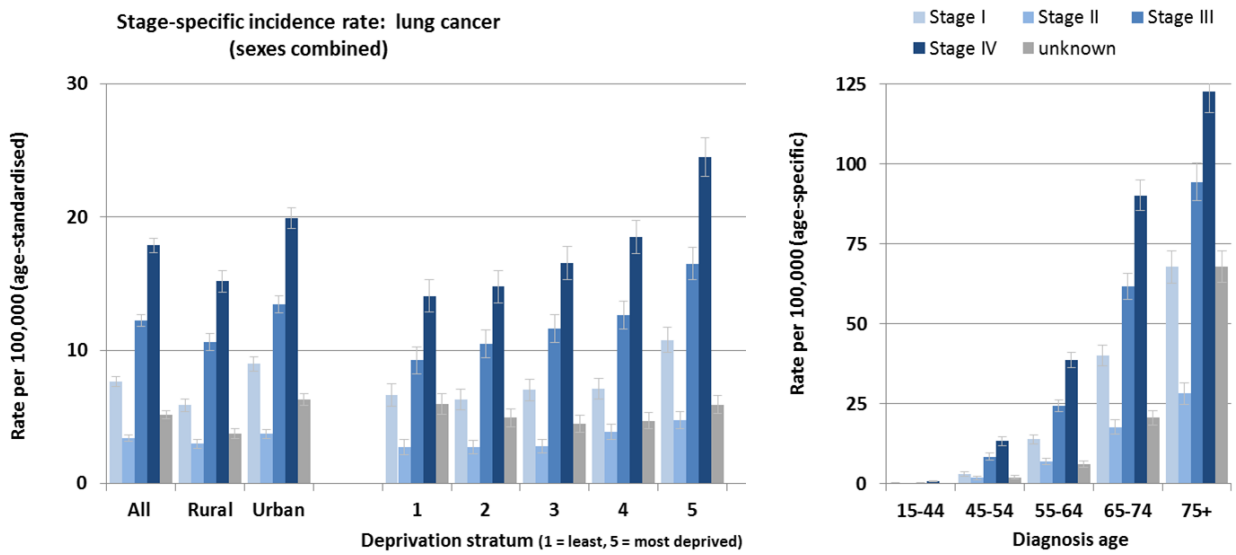


Figure 4.3.4 Stage-specific incidence of lung cancer, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Rates are standardised for sex (i.e. assume equal populations of males and females in all age-groups). Note different scale for age-specific rates.

4.4 Lung cancer: tumour-directed treatment

Variation by urban/rural status

Proportions of patients treated varied little overall (65-66%) between rural and urban cases, ranged 16-19% for surgery and 40-42% for radiotherapy, and were the same (34%) for chemotherapy (*Figure 4.4.*1). None of the differences were significant after adjustment for age and sex (*Figure 4.4.2*).

Variation by deprivation

The crude (unadjusted) proportion of lung cancer patients having any tumour-directed treatment ranged 64-68% between deprivation strata, or 16-21% for surgery, 39-42% for radiotherapy and 32-35% for chemotherapy (*Figure 4.4.2*). Patients from the most deprived stratum were significantly less likely than those from the least deprived stratum to have surgery or any tumour-directed treatment (*Table 4.4.1*, *Figure 4.4.2*): age/sex-adjusted relative risks [RRs] 0.79 (95% CI 0.70-0.89) and 0.93 (0.89-0.96), respectively. Further adjustment for stage (not tabulated) reduced these disparities only slightly, to RR 0.77 (0.69-0.85) for surgery and 0.90 (0.87-0.94) for overall treatment. Chemotherapy use did not vary significantly with deprivation, while radiotherapy use was significantly low in strata 2 and 3 only (*Figure 4.4.2*).

Interaction between deprivation and urban/rural status

Both rural and urban cases showed a pattern of significantly lower use of surgery among patients from the most deprived compared with the least deprived stratum: age/sex-adjusted RRs 0.74 (0.55-0.99) and 0.81 (0.71-0.93), respectively (P=0.57 for differences) (*Table 4.4.1*). Overall treatment showed the same pattern in both groups, statistically significant for urban cases (RR 0.92, 0.87-0.96) though not for rural cases (RR 0.95, 0.87-1.05) (P=0.56 for differences). For chemotherapy and radiotherapy, variation by deprivation (comparing the extremes) was not significant but, again, the patterns did not differ between rural and urban cases.

Table 4.4.1 Influence of deprivation on lung cancer treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Any treatment RR most v least deprived	95% CI	z	P	Surgery RR most v least deprived	95% CI	z	P
Total	*0.93	0.89-0.96			*0.79	0.70-0.89		
Rural	0.95	0.87-1.05			*0.74	0.55-0.99		
Urban	*0.92	0.87-0.96	0.58	0.56	*0.81	0.71-0.93	0.57	0.57
	Radiotherapy RR most v least deprived	**95% CI**	**z**	**P**	**Chemotherapy RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.94	0.87-1.01			0.96	0.89-1.05		
Rural	0.89	0.75-1.04			0.94	0.78-1.14		
Urban	0.94	0.86-1.02	0.60	0.57	0.95	0.87-1.05	0.10	0.92

Variation by age

Proportions of patients treated ranged 44-86% overall between different age-groups, 9-40% for surgery, 30-53% for radiotherapy and 13-62% for chemotherapy (*Figure 4.4.1*). Patients aged <45 years were the most likely to have surgical treatment, <55 the most likely to have any tumour-directed treatment, 45-54 the most likely to have chemotherapy, and 45-64 the most likely to have radiotherapy. Compared with ages 45-54, the two oldest groups (65-74 and 75+) were significantly less likely to have tumour-directed treatment (overall and for all specific modalities) – for age 75+, sex-adjusted RRs 0.51 (95% CI 0.49-0.53) for overall treatment, 0.37 (0.31-0.43) for surgery, 0.57 (0.53-0.62) for radiotherapy and 0.21 (0.19-0.23) for chemotherapy (*Figure 4.4.2*). Adjustment for stage modified these effects only slightly – for age 75+, to RR 0.52 (0.50-0.54) for overall treatment, 0.32 (0.28-0.36) for surgery, 0.61 (0.57-0.66) for radiotherapy and 0.23 (0.21-0.25) for chemotherapy (not graphed). In addition, patients in age-group 55-64 were significantly less likely to have any treatment, radiotherapy or chemotherapy, while those in the youngest group (<45) were less likely to have chemotherapy or radiotherapy but more likely to have surgery, compared with ages 45-54 (*Figure 4.4.2*).

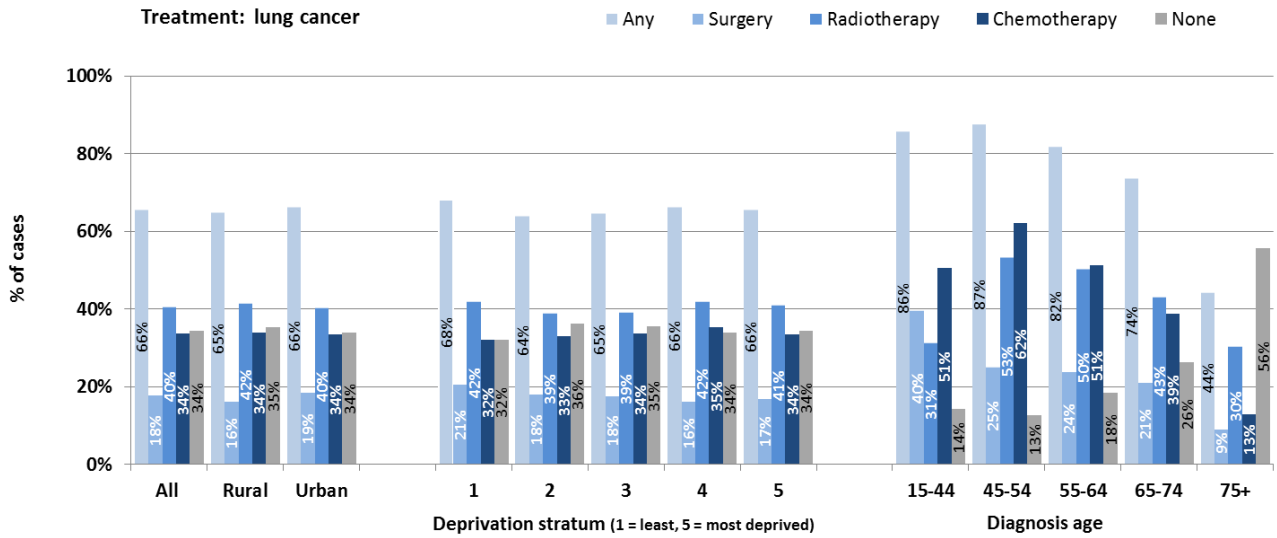


Figure 4.4.1 Treatment of lung cancer within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and age.

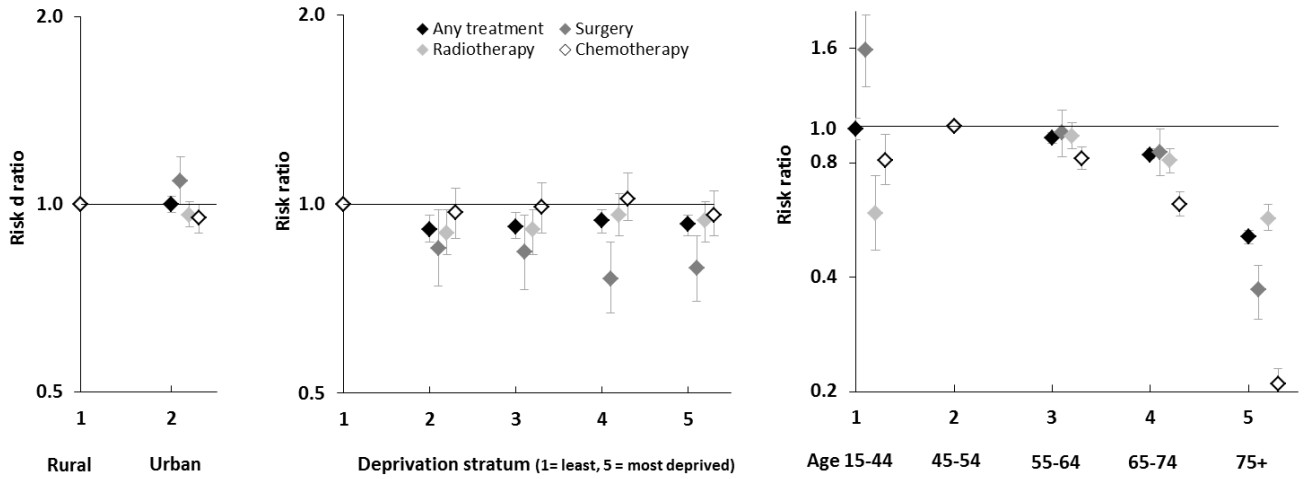


Figure 4.4.2 Risk ratios for treatment of lung cancer, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

4.5 Lung cancer: comorbidity

Variation by urban/rural status

Similar percentages of rural patients (30.5%) and urban patients (30.8%) had known comorbidities (*Figure 4.5.1*), and there was no significant difference after adjustment for age and sex: relative risk (RR) 1.02 (95% CI 0.95-1.09) (*Figure 4.5.3*).

Variation by deprivation

The proportion of lung cancer patients with recorded clinically significant health conditions at or around the time of cancer diagnosis ranged 28-33% across the five deprivation strata (*Figure 4.5.1*), or 28-33% for males, 23-32% for females (*Figure 4.5.2*). A significantly higher proportion of cases from the most deprived stratum had comorbidities, compared with the least deprived stratum: age/sex-adjusted RR 1.16 (95% CI 1.04-2.30) (*Table 4.5.1*, *Figure 4.5.3*).

Across deprivation strata 1-5 as a whole, there was also a significant influence of deprivation on comorbidity: age/sex-adjusted RR 1.04 (1.02-1.07) per unit increase in deprivation stratum

Interaction between deprivation and urban/rural status

A significantly higher proportion of urban patients from the most deprived stratum had comorbidities than in the least deprived stratum (RR 1.13, 95% CI 1.02-1.30); rural cases showed a similar pattern, albeit not statistically significant (RR 1.26, 0.96-1.64) (P=0.59 for difference from urban pattern) *(Table 4.5.1*).

Table 4.5.1 Influence of deprivation on comorbidity in lung cancer patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	*1.16	1.04-2.30		
Rural	1.26	0.96-1.64		
Urban	*1.13	1.02-1.30	0.55	0.59

Variation by age

Comorbidity percentages ranged 17-33% across the age-groups examined (Figure 4.5.1), or 20-34% for males, 13-32% for females (Figure 4.5.2), with prevalence of comorbidity increasing markedly with increasing age. Patients from the oldest group (75+) were about 60% more likely to have recorded comorbidities compared with ages 45-54: sex-adjusted RR 1.58 (95% CI 1.36-1.84) (Figure 4.5.3). Age-groups 55-64 and 65-74 also showed significantly higher levels of comorbidity (similar to the 75+ group for ages 65-74), while levels were significantly lower for ages <45, compared with ages 45-54.

Variation by age in the proportion of lung cancer patients with significant non-cancer health conditions was less marked than for other cancers considered in this report. However, the prevalence of other health conditions was already comparatively high among younger lung cancer patients.

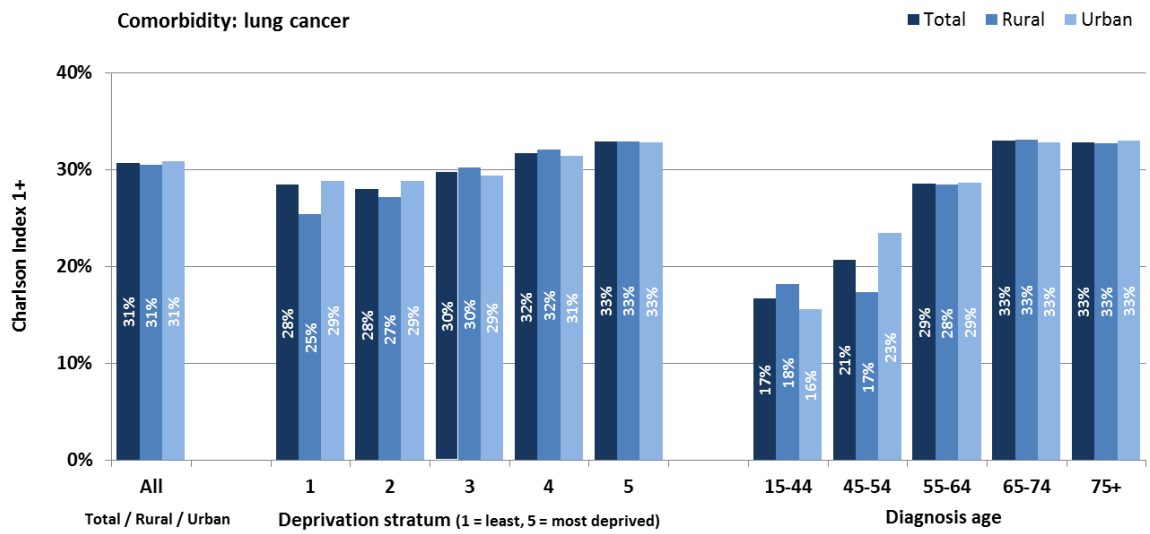


Figure 4.5.1 Comorbidity in lung cancer patients (sexes combined), 2008-2012, by urban/rural status, deprivation stratum and age.

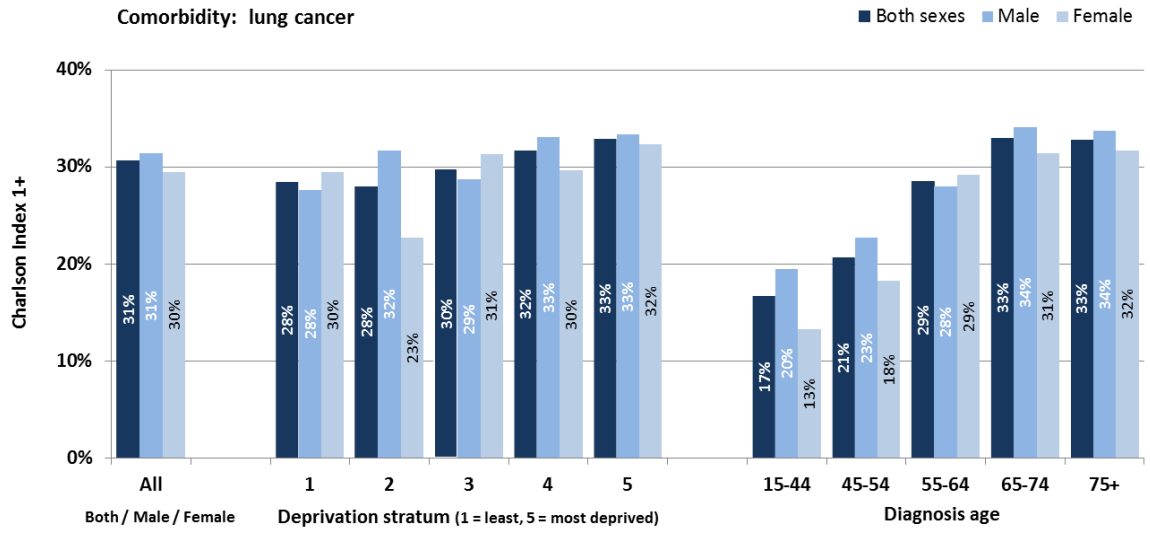


Figure 4.5.2 Comorbidity in lung cancer patients, 2008-2012, by sex, deprivation stratum and age.

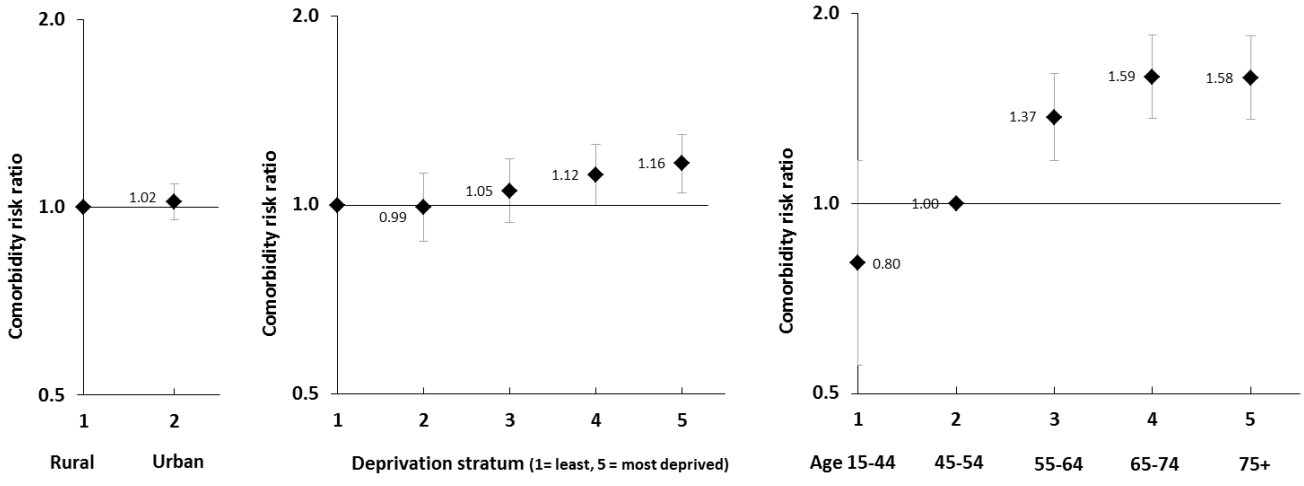


Figure 4.5.3 Risk ratios for comorbidity in lung cancer patients, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

5 MELANOMA OF SKIN

Key points

- *Incidence*
  - The age-standardised incidence rate in urban populations was significantly higher than in rural populations (17% and 15% higher for males and female respectively).
  - Lower melanoma incidence rates were observed with higher levels of deprivation (30% lower in the most deprived compared with the least deprived population quintile).
  - There was a clear pattern of increased incidence with age (rates 3.5 and 5 times higher at ages 75+ than at ages 45-54 for males and females respectively).
- *Survival*
  - Survival was significantly poorer (sex-adjusted mortality hazard over three [3.5] times higher) at ages 75+ compared with 45-54, and also poorer at ages 55-64 and 65-74.

Table 5.k.1 Visual summary of the influence of urban status, deprivation and age on melanoma of skin in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, stage proportion, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
Melanoma of skin						
Urban status	M↑ F↑	↑	=	IV↓ III=	T↓ C↓ SR=	=
Deprivation	M↓ F↓	↓	II↑ I=	III↑ IV↓	R↑ C↑ TS=	↓
Older age	M↑↑ F↑	↓↓	I↓↓ II↑	III↑↑ IV↑	T↓↓ S↓ C↓↓ R=	↑↑

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Stage*
  - Patients from the most deprived group were significantly more likely to present at stage III (+30% in relative terms) compared with the least deprived group, having adjusted for age and sex.
  - The oldest patients (75+) were significantly less likely to present at stage I (-43%) but significantly more likely to present at stage II (+80%) or III (+116%) than patients aged 45-54. Age-group 65-74 showed a similar but less marked pattern, while age-group 55-64 were also less likely to present at stage I compared with ages 45-54; age-groups 55-64 and 65-74 were more likely to be of unknown stage.
- *Treatment*
  - Urban patients were significantly less likely to have immunotherapy/chemotherapy (-26% in relative terms) than rural patients, having adjusted for age and sex.
  - The oldest patients (75+) were less likely to have immunotherapy (-82%), surgery (-4%) or any treatment (-4%) than those aged 45-54; those aged 55-64 and 65-74 were also less likely to have immunotherapy, while those under 45 years were less likely to have radiotherapy.
- *Comorbidity*
  - The oldest patients (75+) were over three (3.5) times more likely to have at least other serious health conditions, relative to the 45-54 age group, and comorbidity prevalence was also higher at ages 65-74.

5.1 Melanoma of skin: incidence

Variation by urban/rural status

Age-standardised rates were about 15% higher in urban populations than in rural populations for both males (18 v 16 cases per 100,000) and females (21 v 18 per 100,000) (*Figure 5.1.1*). These differences were statistically significant: directly age-standard rate ratio (DSRR) 1.17 (1.06-1.29) for males and 1.15 (1.06-1.26) for females (*Table 5.1.1*, *Figure 5.1.2*).

Variation by deprivation

Age-standardised rates of invasive melanoma of the skin ranged 15-22 cases per 100,000 males and 16-23 cases per 100,000 females across the five deprivation strata (*Figure 5.1.1*). Rates were significantly lower, by about 30%, in the most deprived compared with the least deprived stratum: DSRRs 0.70 (85% CI 0.60-0.82) for males and 0.72 (0.62-0.83) for females (*Table 5.1.1*, *Figure 5.1.2*). Rates were also significantly lower in strata 2-4 for males (DSRRs ranging 0.69-0.83) and strata 3-4 for females (DSRRs 0.77-0.87).

Interaction between deprivation and urban/rural status

The influence of deprivation on incidence did not differ significantly between urban and rural populations: for males, a rate ratio 0.71 (95% CI 0.59-0.84) comparing the most with the least deprived urban populations versus 0.73 (0.53-1.02) for the same comparison among rural populations (P=0.92 for difference); for females, 0.75 (0.64-0.88) urban versus 0.68 (0.49-0.94) rural (P=0.60). That is, in both urban and rural populations, lower melanoma incidence was associated with higher levels of deprivation and the strength of the association was broadly similar.

Table 5.1.1 Influence of deprivation on melanoma incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	Males				Females			
	DSRR most v least deprived	**95% CI**	**z**	**P**	**DSRR most v least deprived**	**95% CI**	**z**	**P**
Total	*0.70	0.60-0.82			*0.72	0.62-0.83		
Rural	*0.73	0.53-1.02			*0.68	0.49-0.94		
Urban	*0.71	0.59-0.84	0.20	0.92	*0.75	0.64-0.88	0.53	0.60

Variation by age

Male rates ranged from 6 to 98 cases and female rates from 12 to 81 cases per 100,000 between the youngest (15-44) and oldest (75+) age-groups examined, and there was a clear pattern of increased incidence with age (*Figure 5.1.1*). Rates were about three to five times higher in the oldest group than in the 45-54 comparison group: DSRRs 5.03 (4.15-6.11) for males, 3.45 (2.95-4.03) for females *(Figure 5.1.2*). Rates at ages 55-64 and 65-74 were also significantly higher, while rates at age 15-44 were significantly lower, than at ages 45-54.

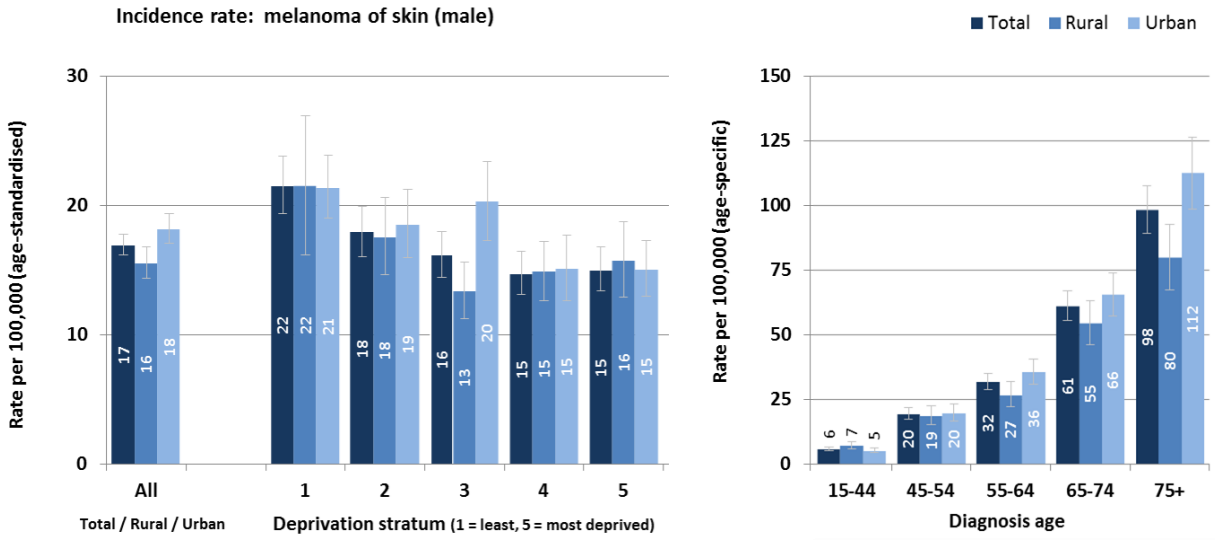


Figure 5.1.1(a) Incidence of melanoma of skin (males), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

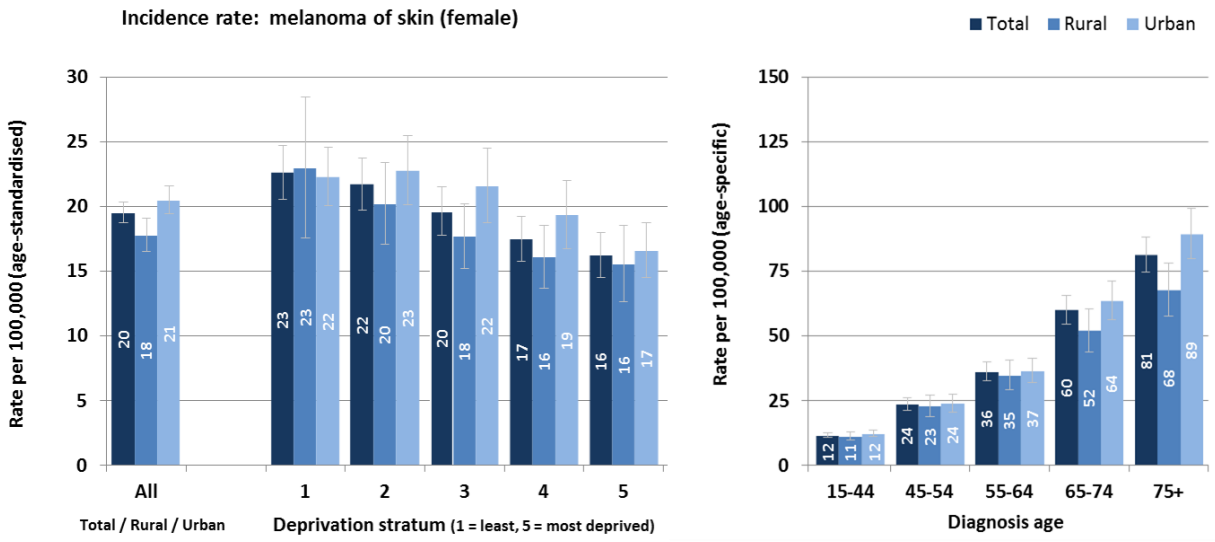


Figure 5.1.1(b) Incidence of melanoma of skin (females), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

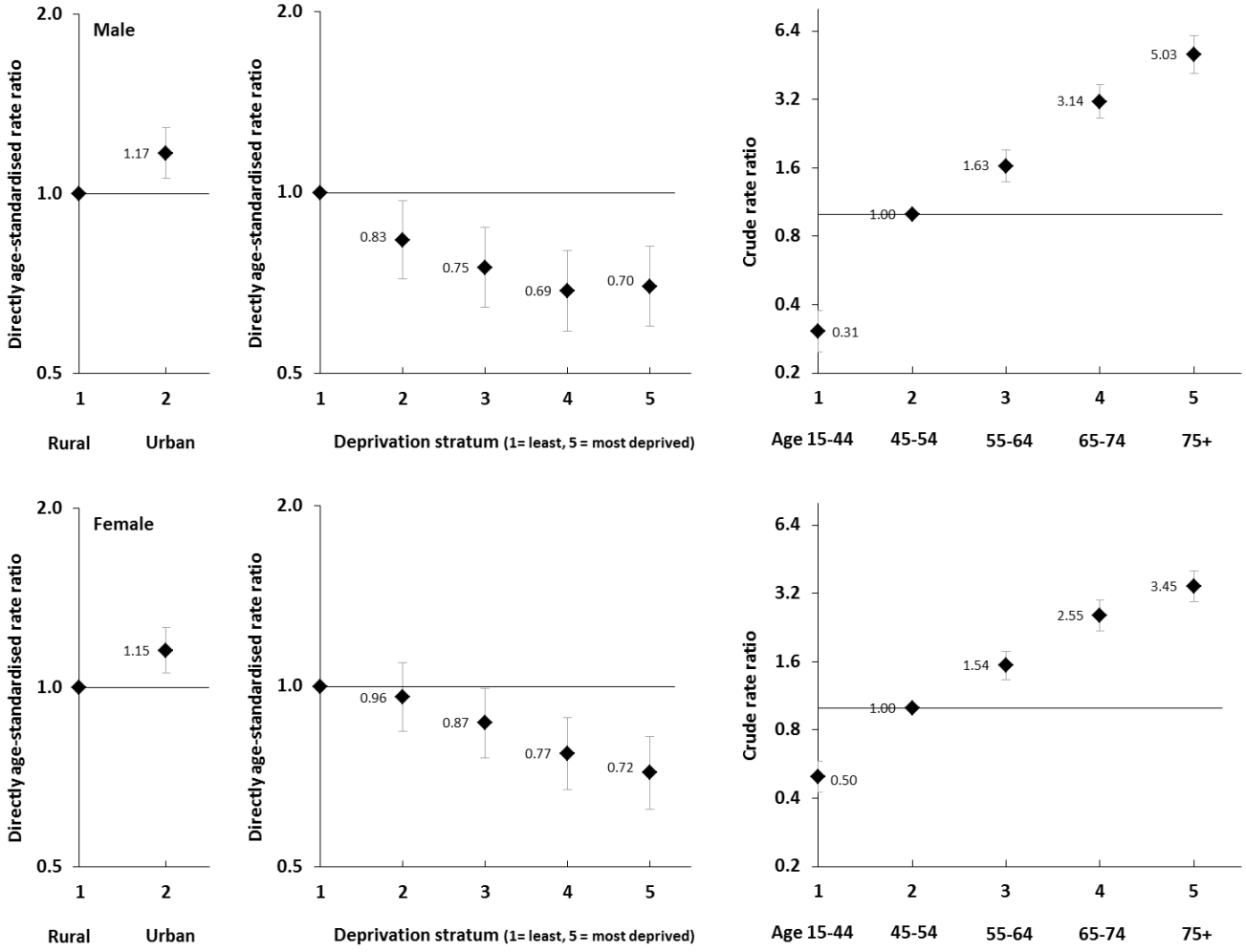


Figure 5.1.2 Rate ratios of skin melanoma incidence, by urban/rural status, deprivation stratum and diagnosis age.

5.2 Melanoma of skin: cause-specific survival

Variation by urban/rural status

Five-year survival appeared to be higher for urban cases (87%) than rural cases (85%) (*Figure 5.2.1*), but the difference was not statistically significant: age/sex-adjusted hazard ratio (HR) 0.87 (95% CI 0.81-1.07), or 0.98 (0.79-1.21) after stage-adjustment (*Table 5.2.1*, *Figure 5.2.2*).

Variation by deprivation

Five-year age-standardised survival ranged 83-88% across the deprivation strata, with some indications that survival was lower for the more deprived groups but with no clear-cut trend (*Figures 5.2.1 & 5.2.3*). Modelling did not confirm any significant variation in survival by deprivation status; for the most deprived compared with the least deprived group, age/sex-adjusted HR 1.15 (95% CI 0.83-1.59) (*Table 5.2.1*, *Figure 5.2.2*), or 0.90 (0.64-1.26) after stage-adjustment, 0.82 (0.58-1.17) after further adjustment for smoking and marital status (*Figure 5.2.2*).

Interaction between deprivation and urban/rural status

Both urban and rural populations showed no significant variation in survival by deprivation status and, based on comparisons between the most and least deprived strata, there was no significant heterogeneity of the deprivation influence between urban and rural patients (P=0.55) (*Table 5.2.1*, *Figure 5.2.4*).

Table 5.2.1 Influence of deprivation on melanoma survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	1.15	0.83-1.59		
Rural	1.40	0.67-2.94		
Urban	1.07	0.73-1.56	0.59	0.55

Variation by age

Five-year survival was high across all age-groups (ranging 75-92%; Figure *5.2.1*) and, at face value, appeared to vary less by age than for other cancers in this report. Nevertheless, there was significant variation: for ages 75+, age/sex-adjusted HR 3.52 (2.48-4.97) relative to ages 45-54, or 2.34 (1.65-3.33) after stage-adjustment, little changed by further adjustment for smoking and marital status (*Figure 5.2.2*). Survival was also significantly poorer for ages 65-74 and 55-64 compared with 45-54, but differences were not significant after stage-adjustment.

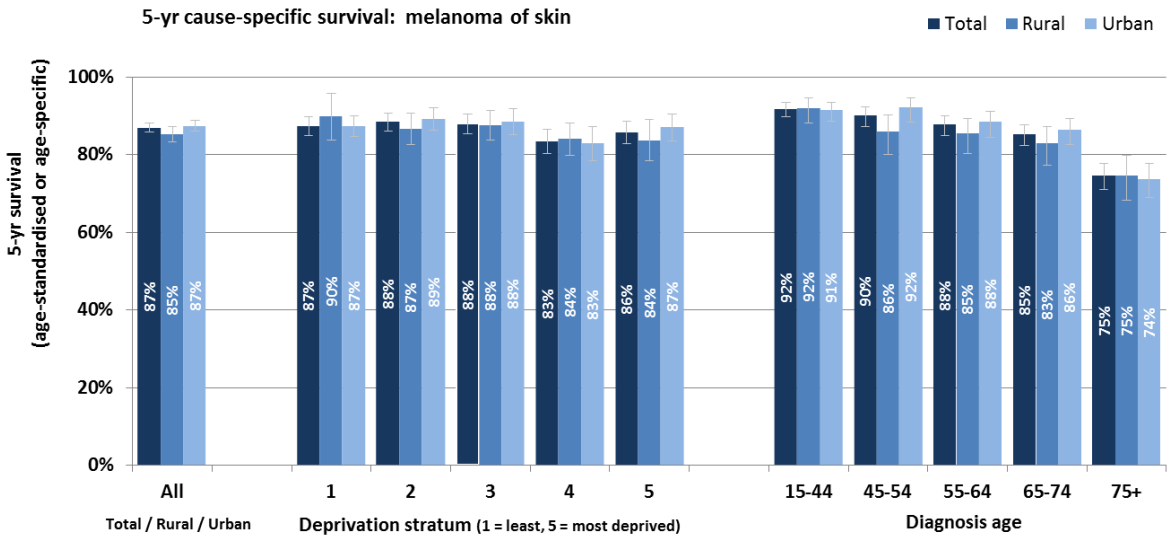


Figure 5.2.1 Cause-specific five-year survival of Irish melanoma patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age.

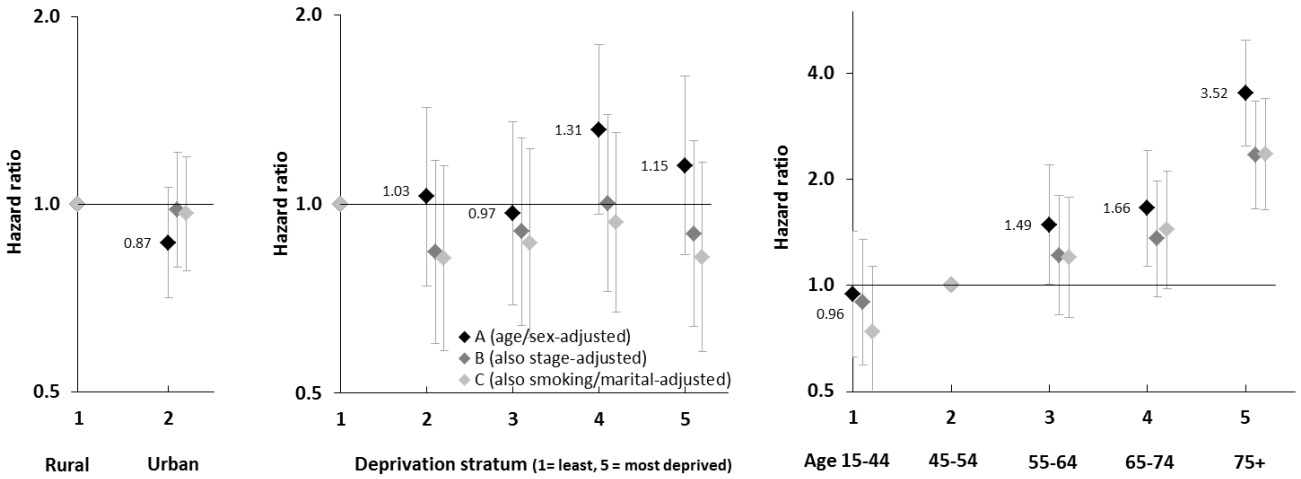


Figure 5.2.2 Mortality hazard ratios for melanoma survival, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group) and fuller models.

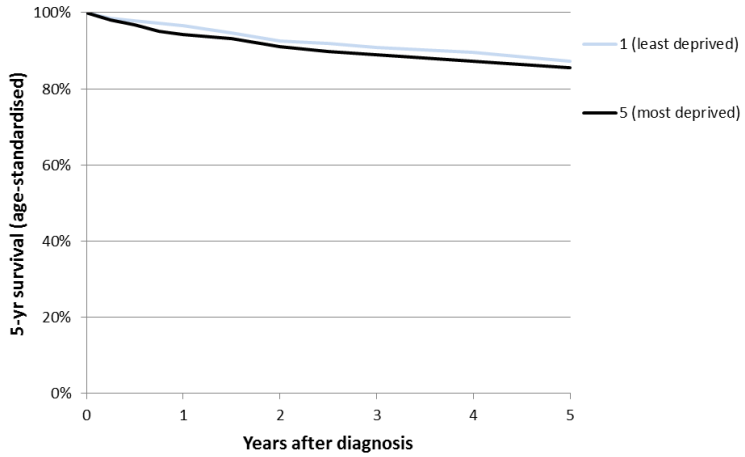


Figure 5.2.3 Cause-specific survival curves for melanoma patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

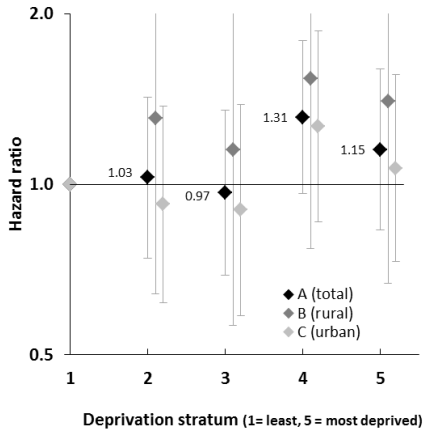


Figure 5.2.4 Mortality hazard ratios for melanoma survival, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. See also *Table 5.2.1*.

5.3 Melanoma of skin: stage (TNM 5th edition)

Variation by urban/rural status

Stage proportions ranged 55-56% for stage I, 17-18% for stage II, 16-17% for stage III, 1.6-2.5% for stage IV and 8-9% for unknown stage between rural and urban cases (*Figure 5.3.*1). There was no significant variation in stage composition between rural and urban cases for any of stages I-III, having adjusted for age and sex, although there was an apparently (not quite statistically significant) lower proportion of stage IV among urban cases: age/sex-adjusted relative risk (RR) 0.65 (95% CI 0.41-1.01) (*Figure 5.3.2*).

Variation by deprivation

The stage breakdown of melanoma cases ranged 51-58% for stage I, 16-20% for stage II, 14-20% for stage III, 0.8-2.6% for stage IV and 6-12% for unknown stage across the five deprivation strata (*Figure 5.3.1*). There was no significant variation by deprivation (comparing the most with the least deprived stratum) in the proportion that were stage I, II or IV, but cases from the most deprived stratum were significantly more likely to present at stage III: age/sex-adjusted RR 1.26 (95% CI 1.00-1.57) *(Table 5.3.1*, *Figure 5.3.2*). In addition, cases from all strata 2-5 were significantly less likely to be of unknown stage (RR 0.66, 0.48-0.90 for stratum 5 v 1).

Interaction between deprivation and urban/rural status

Among urban patients, stage II made up a significantly higher proportion of cases among patients from the most deprived groups: RR 1.29 (1.02-1.65) comparing stratum 5 (most deprived) with 1 (least deprived) (*Table 5.3.1*). Rural cases showed no significant deprivation influence, but the pattern was not significantly different from that shown by urban cases (P=0.202 for difference, based on comparisons of stratum 5 with 1). Otherwise, comparing the extremes, there was no significant deprivation influence within urban or rural groups in the proportions of stage I, III or IV cases, and no significant heterogeneity of the deprivation effect by urban/rural status. The proportion of unstaged cases was lower for deprived urban areas – RR 0.55 (0.37-0.81) comparing stratum 5 v 1 – but, again, significant heterogeneity of the deprivation effect by urban/rural status was not confirmed.

Table 5.3.1 Influence of deprivation on melanoma stage, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Stage I				**Stage II**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.95	0.87-1.04			1.20	0.97-1.49		
Rural	0.89	0.75-1.06			0.95	0.61-1.48		
Urban	0.96	0.86-1.07	0.74	0.46	*1.29	1.02-1.65	1.28	0.20
	Stage III				**Stage IV**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	*1.26	1.00-1.57			0.86	0.37-2.01		
Rural	1.65	0.94-2.88			0.84	0.14-5.01		
Urban	1.21	0.94-1.56	0.89	0.37	0.87	0.45-2.38	0.04	0.97

Variation by age

Stage proportions by age ranged 37-69% for stage I, 12-24% for stage II, 11-27% for stage III, 1.0-2.4% for stage IV and 7-11% for unknown stage, with clear decreases in the stage I proportion but increases in stage II-IV proportions with increasing age (*Figure 5.3.1*). Patients in the oldest age-group (75+) were significantly less likely than those at ages 45-54 to present at stage 1 (sex-adjusted RR 0.57, 95% CI 0.52-0.63) but significantly more likely to present at stages II (1.71, 1.37-2.14) or III (2.27, 1.79-2.88) (*Table 5.3.2*). Age-group 65-74 showed a similar but less marked pattern, while age-group 55-64 were also less likely to present at stage I compared with ages 45-54. Age-groups 55-64 and 65-74 were more likely to be of unknown stage (RRs not graphed).

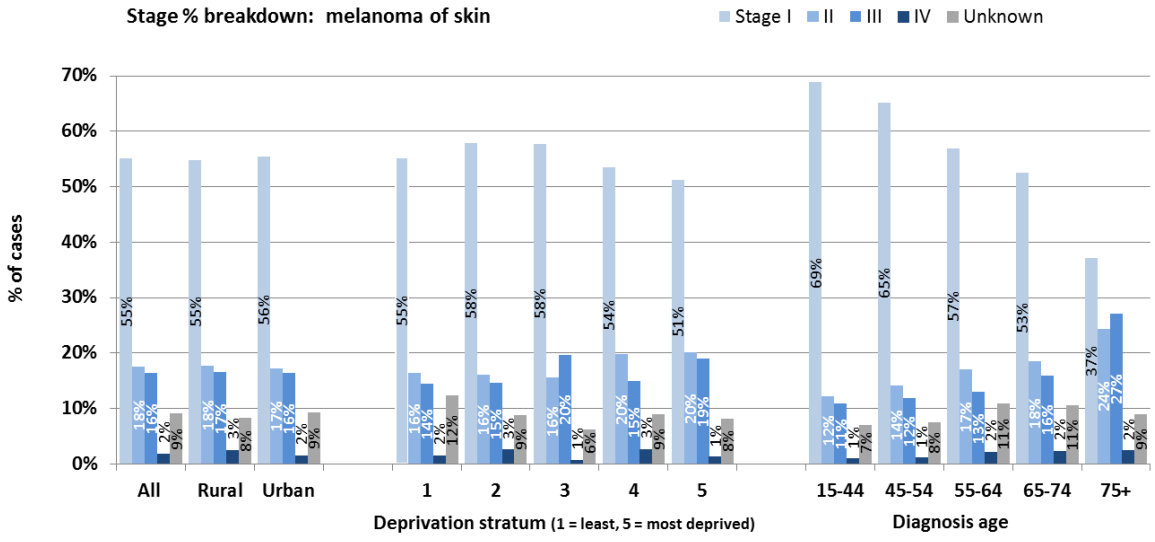


Figure 5.3.1 Stage breakdown of melanoma cases, 2008-2012, by urban/rural status, deprivation stratum and age.

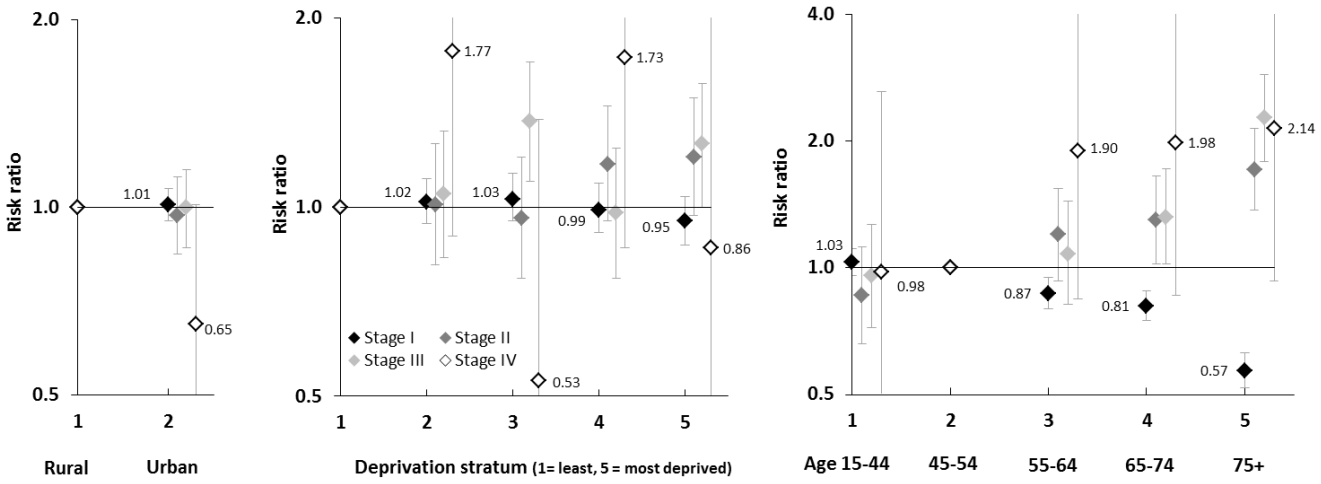


Figure 5.3.2 Risk ratios for melanoma stage, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or sex-adjusted models by age-group). RRs for unknown stage are not plotted but are noted in text if significant.

Text and graphical summaries above are based on comparisons of the percentage stage composition of cases. To provide further context, stage-specific incidence rates are presented in *Figure 5.3.3* (below).

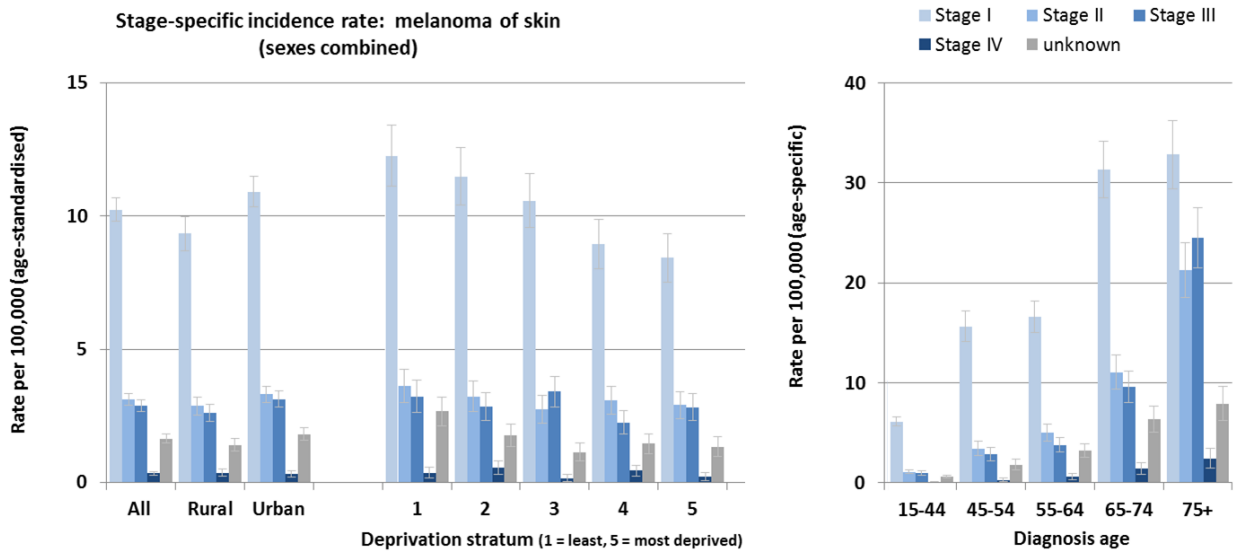


Figure 5.3.3 Stage-specific incidence of melanoma of skin, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Rates are standardised for sex (i.e. assume equal populations of males and females in all age-groups). Note different scale for age-specific rates.

5.4 Melanoma of skin: tumour-directed treatment

Variation by urban/rural status

Overall treatment percentages ranged 94-96% between rural and urban cases, or 93-94% for surgery, 4-6% for immunotherapy or chemotherapy and no difference (3%) for radiotherapy (*Figure 5.4.1*). Urban cases were significantly less likely to have immunotherapy/chemotherapy (age/sex-adjusted relative risk [RR] 0.74, 95% CI 0.56-0.97 or 0.76, 0.59-0.98 after stage-adjustment) or, less markedly, any treatment (RR 0.98, 0.97-0.99, unchanged after stage-adjustment) (*Figure 5.4.2*).

Variation by deprivation

The crude (unadjusted) proportion of melanoma patients having any tumour-directed treatment ranged 93-96% between deprivation strata, or 91-95% for surgery, 3-4% for radiotherapy and 3-6% for immunotherapy or chemotherapy (*Figure 5.4.1*). Comparing the most with least deprived groups, there was no significant variation in treatment after adjustment for age and sex (*Table 5.4.1*, *Figure 5.4.2*) and apparently higher use of radiotherapy and immunotherapy in the most deprived group could not be confirmed as confidence intervals were very wide. Deprivation strata 2 and 3 (low to medium deprivation) were significantly more likely to have surgical excision, compared with the least deprived stratum – age/sex-adjusted RRs 1.04 (95% CI 1.01-1.07) and 1.05 (1.02-1.08), respectively – but this effect was no longer significant after adjustment for stage. A similar pattern was seen for overall treatment.

Interaction between deprivation and urban/rural status

The patterns of treatment by deprivation, comparing the most with the least deprived stratum, did not differ significantly between rural and urban cases (not graphed).

Table 5.4.1 Influence of deprivation on melanoma treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Any treatment				Surgery			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.02	0.99-1.04			1.02	0.99-1.05		
Rural	0.99	0.95-1.03			0.98	0.93-1.03		
Urban	1.02	0.98-1.05	1.14	0.25	1.03	0.99-1.07	1.59	1.11
	Radiotherapy				**Chemotherapy/immunotherapy**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.13	0.66-1.96			1.21	0.79-1.83		
Rural	5.77	0.74-45.3			1.71	0.70-4.18		
Urban	0.87	0.46-1.65	0.81	0.42	1.04	0.62-1.74	0.81	0.37

Variation by age

Proportions of patients treated ranged 92-97% overall between different age-groups, or 90-96% for surgery, 1-7% for immunotherapy/chemotherapy and 2-4% for radiotherapy (*Figure 5.4.1*). Patients in the oldest group (75+) were significantly less likely to have immunotherapy/chemotherapy, surgery or overall any treatment, compared with ages 45-54: RRs 0.18 (95% CI 0.10-0.33), 0.96 (0.94-0.99) and 0.96 (0.93-0.98), respectively (*Figure 5.4.2*). For immunotherapy, this difference was even more pronounced after adjustment for stage (not graphed) – RR 0.10 (0.06-0.18) – but the pattern after stage adjustment was unchanged for surgery and overall treatment. Patients aged 55-64 and 65-74 were also less likely to have immunotherapy, having adjusted for stage: RRs 0.64 (0.45-0.92) and 0.50 (0.35-0.71), respectively, compared with ages 45-54. Those under 45 years were less likely to have radiotherapy: RR 0.52 (0.27-0.99), unchanged by further adjustment for stage.

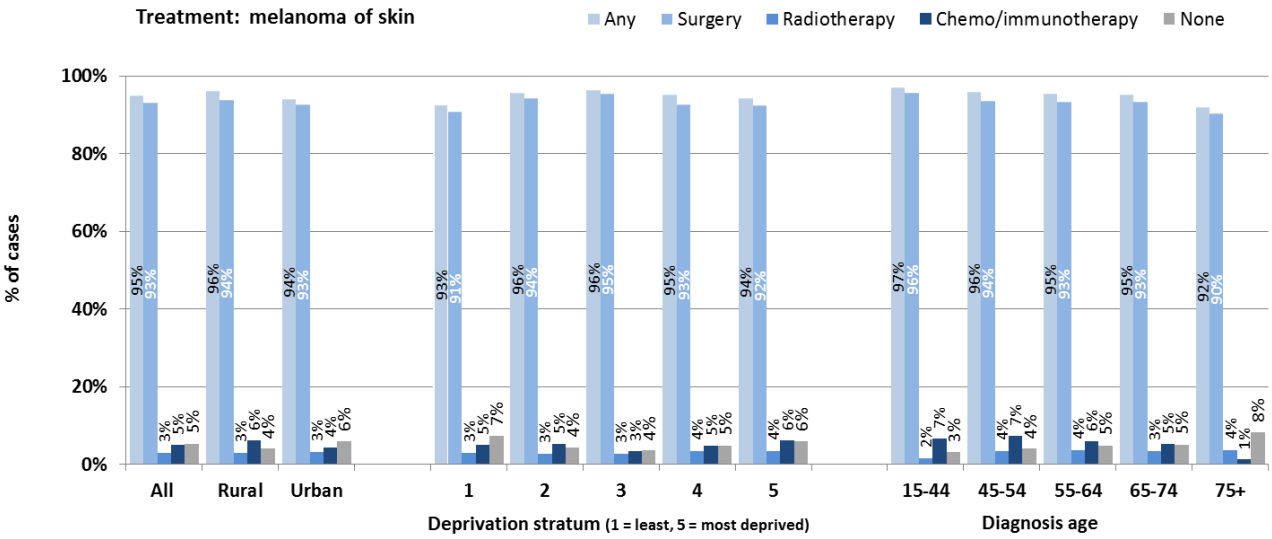


Figure 5.4.1 Treatment of melanoma of skin within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

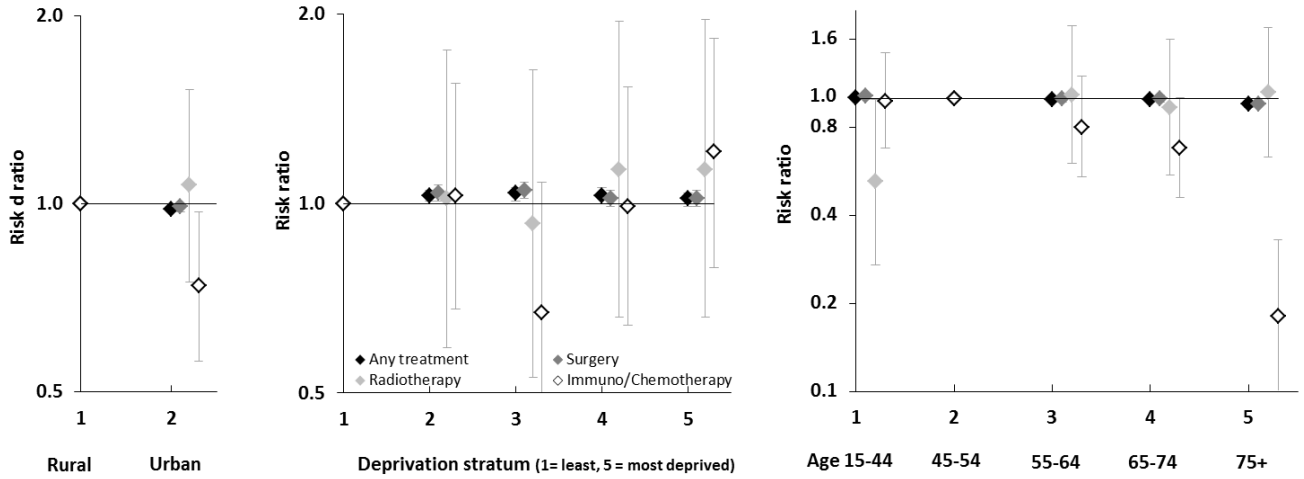


Figure 5.4.2 Risk ratios for treatment of melanoma of skin, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

5.5 Melanoma of skin: comorbidity

Variation by urban/rural status

About 8% of rural patients and 9% of urban patients had known comorbidities (*Figure 5.5.1*). Differences were not statistically significant: age/sex-adjusted relative risk (RR) 1.05 (95% CI 0.80-1.37) comparing urban with rural cases (*Figure 5.5.3*).

Variation by deprivation

The proportion of melanoma patients with recorded clinically significant health conditions at or around the time of cancer diagnosis ranged 6-11% across the five deprivation strata (*Figure 5.5.1*), or 8-16% for males, 5-9% for females (*Figure 5.5.2*). However, there was no significant variation by deprivation between the most deprived or intermediate strata and the least deprived stratum; for the most deprived stratum, an age/sex-adjusted RR of 0.76 (95% CI 0.49-1.16) (*Table 5.5.1*, *Figure 5.5.3*).

Interaction between deprivation and urban/rural status

Neither rural nor urban patients showed any significant variation in comorbidity by deprivation stratum and, based on comparisons of the most deprived with least deprived stratum, the pattern of variation by deprivation did not differ significantly between rural and urban cases (P=0.17) (*Table 5.5.1*).

Table 5.5.1 Influence of deprivation on comorbidity in melanoma patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	0.76	0.49-1.16		
Rural	0.47	0.19-1.13		
Urban	0.88	0.54-1.44	1.37	0.17

Variation by age

Comorbidity percentages ranged 2-15% overall between age-groups (*Figure 5.5.1*), or 3-21% for males, 1-10% for females (*Figure 5.5.2*). There was quite a strong pattern of increasing levels of comorbidity with increasing age, and patients from the oldest group were between three and four times as likely to have recorded comorbidities as those aged 45-54: sex-adjusted RR 3.54 (95% CI 2.06-6.19) (*Figure 5.5.3*). Patients aged 65-74 also had significantly higher comorbidity levels, while those aged 15-44 had significantly lower levels, compared with aged 45-54.

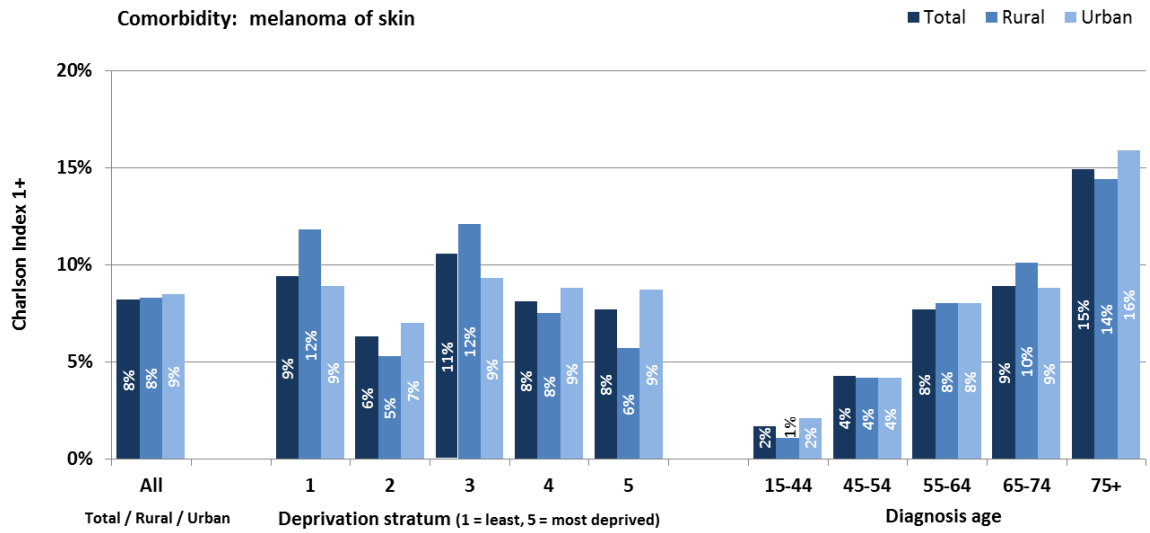


Figure 5.5.1 Comorbidity in skin melanoma patients (sexes combined), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

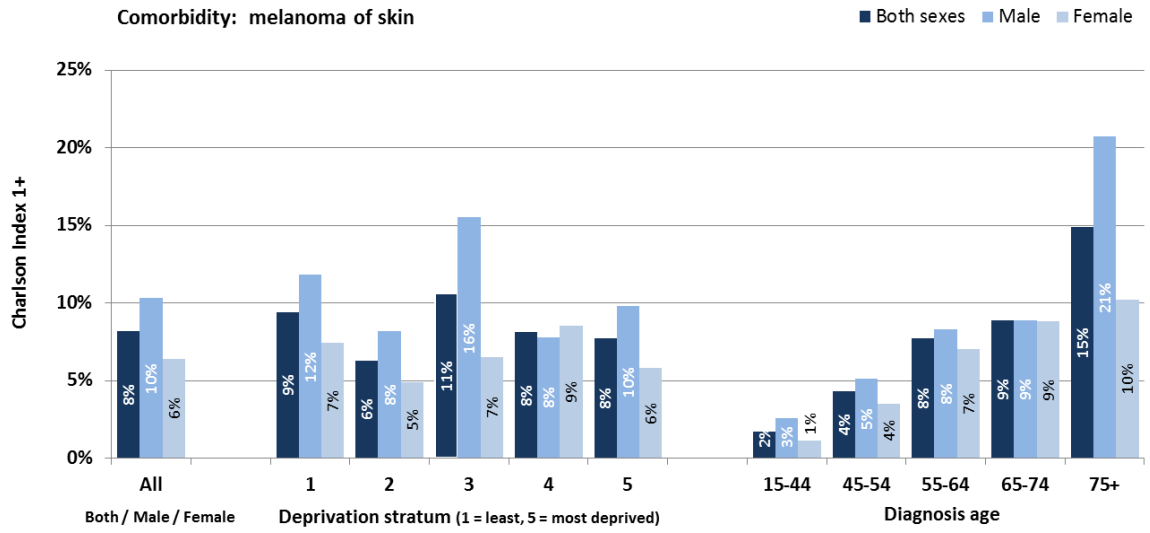


Figure 5.5.2 Comorbidity in skin melanoma patients, 2008-2012, by sex, deprivation stratum and diagnosis age.

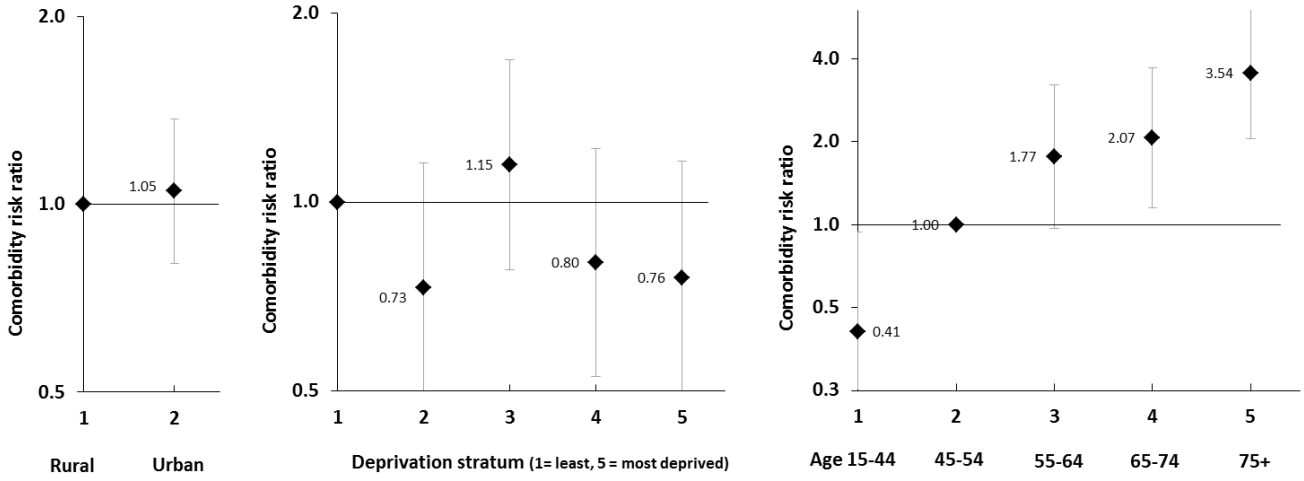


Figure 5.5.3 Risk ratios for comorbidity in skin melanoma patients, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

6 FEMALE BREAST CANCER

Key points

- *Incidence*
  - Age-standardised incidence rates were significantly higher (+13%) in urban than in rural populations.
  - Incidence rates were significantly lower (-15%) in the most deprived compared with the least deprived population quintile.
  - For the oldest age group (75+), the incidence rate was 37% higher relative to age group 45-54.
- *Survival*
  - Survival was significantly poorer (age-adjusted mortality risk 54% higher) in the most deprived compared with the least deprived group.
  - Survival in the oldest group (75+) was significantly poorer (mortality hazard about six [5.9] times higher) than at ages 45-54, and also poorer at ages <45, 55-64 and 65-74.

Table 6.k.1 Visual summary of the influence of urban status, deprivation and age on female breast cancer in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, stage proportion, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
Urban status	↑	=	I↑ II=	III↓ IV=	C↓ H↓ TSR=	=
Deprivation	↓	↓	I↓ II=	IV↑ III=	S↓ H↑ TRC=	↑
Older age	↑	↓	I↓ II↓	III↑ IV↑	T↓ S↓ R↓ C↓ H↑	↑

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Stage*
  - Patients from the most deprived group were significantly less likely to present at stage I (-9% in relative terms) but more likely to present at stage IV (+69%) compared with the least deprived stratum, having adjusted for age.
  - Urban cases were significantly more likely to present at stage I (+6%) and significantly less likely to present at stage III (-10%) compared with rural cases
- *Treatment*
  - Urban cases were significantly less likely to have chemotherapy (-5% relative) or hormone therapy (-8%) than rural cases.
  - Patients from the most deprived stratum were slightly but significantly less likely to have surgery than those from the least deprived group (-4%, or -2% after adjustment for stage).
  - Compared with age-group 45-54, the oldest patients (75+) had significantly lower use of chemotherapy (-88% in relative terms), surgery (-50%), radiotherapy (-58%) or any treatment (-15%); conversely, use of hormonal therapy was most frequent in the oldest group (+8%).
- *Comorbidity*
  - Patients from the most deprived group were about 40% more likely (age-adjusted) to have other serious health conditions than those from the least deprived group.
  - The oldest patients (75+) were over four (4.5) times more likely to have a comorbidities, relative to the 45-54 age group, and comorbidity prevalence was also higher at ages 55-64 and 65-74.
- *Screen-detection status (ages 50-64 only)*
  - The age-standardised incidence rate of screen-detected breast cancer among urban women was significantly higher (+22%) than in rural women, reflecting a combination of higher proportions of screen-detected cases and higher overall breast cancer incidence rates in urban women.
  - The incidence rate of screen-detected breast cancer was significantly lower (-19%) in the most compared with the least deprived group, mainly reflecting lower overall incidence of breast cancer.

6.1 Female breast cancer: incidence

Variation by urban/rural status

Age-standardised rates were significantly higher in urban than in rural populations – 130 v 115 cases per 1000,000 (*Figure 6.1.1*): directly age-standard rate ratio (DSRR) 1.13 (1.09-1.17) (*Figure 6.1.2*).

Variation by deprivation

Age-standardised rates of female breast cancer ranged 118-139 cases per 100,000 across the five deprivation strata (*Figure 6.1.1*). Rates were significantly lower, by about 15%, in the most deprived compared with the least deprived stratum: DSRR 0.85 (95% CI 0.80-0.90) (*Table 6.1.1*, *Figure 6.1.2*). Rates in strata 2-4 were also significantly lower than in stratum 1 (DSRRs ranging 0.87-0.88).

Interaction between deprivation and urban/rural status

Urban populations showed some evidence of more marked inequality in incidence by deprivation, with a rate ratio 0.85 (95% CI 0.80-0.91) comparing the most with the least deprived urban populations versus 0.99 (0.87-1.12) for the same comparison among rural populations (*Table 6.1.1*). However, the difference was not quite statistically significant (P=0.051).

Table 6.1.1 Influence of deprivation on female breast cancer incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	DSRR most v least deprived	95% CI	z	P
Total	*0.85	0.80-0.90		
Rural	0.99	0.87-1.12		
Urban	*0.85	0.80-0.91	1.95	0.051

Variation by age

Rates varied from 37 to 346 cases per 100,000 between the youngest (15-44) and oldest (75+) age-groups examined, peaking in the groups from age 55 onwards (*Figure 6.1.1*), i.e. with no consistent upward trend with age. Rates were 30-40% higher in the three oldest groups than in the 45-54 comparison group: DSRRs 1.36 (1.30-1.42) for ages 55-64, 1.28 (1.21-1.35) for 65-74 and 1.37 (1.30-1.45) for 75+ *(Figure 6.1.2*). Rates at ages 15-44 were significantly lower than at ages 45-54.

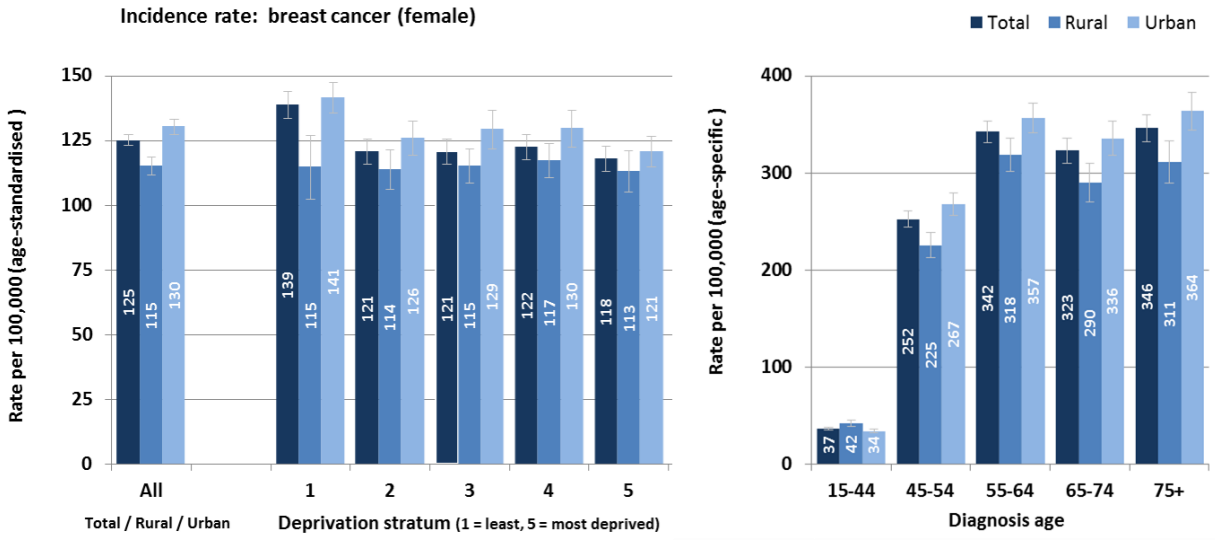


Figure 6.1.1 Incidence of female breast cancer 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

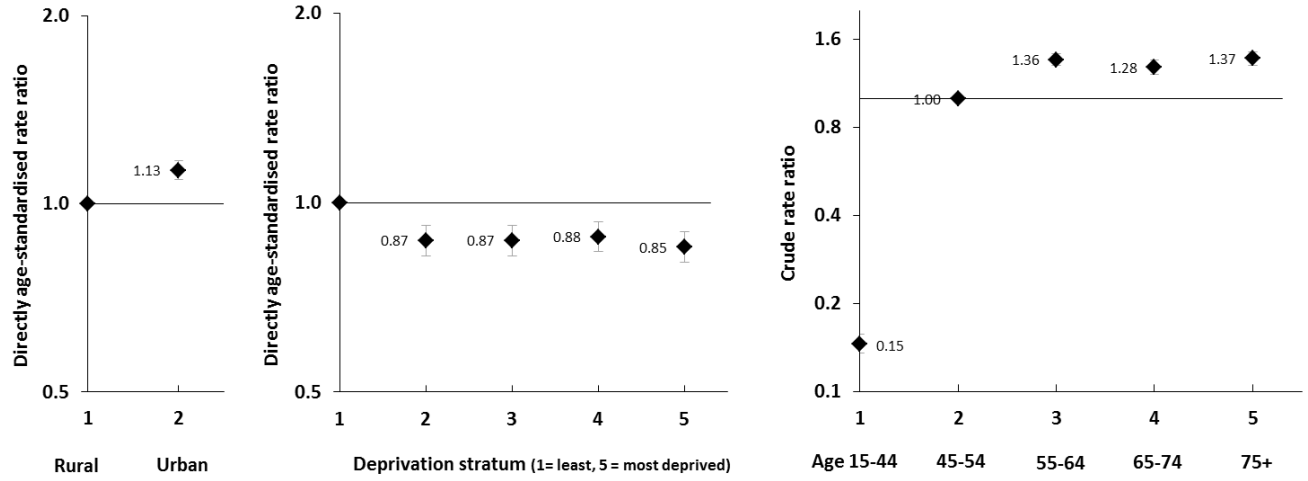


Figure 6.1.2 Rate ratios of female breast cancer incidence, by urban/rural status, deprivation stratum and diagnosis age.

6.2 Female breast cancer: cause-specific survival

Variation by urban/rural status

There was no significant difference in survival between patients from rural and those from urban areas, with five-year age-standardised survival averaging 81% in both groups (*Figures 6.2.1-6.2.2*).

Variation by deprivation

Age-standardised, five-year cause-specific survival for breast cancer patients was poorer in the most deprived stratum (78% age-standardised) than in the least deprived stratum (84%) (*Figures 6.2.1 & 6.2.3*). Cox modelling indicated an age-adjusted mortality risk 54% higher in the most deprived group (hazard ratio 1.54 [95% CI 1.29-1.84], P<0.001) (*Table 6.2.1*), or 38% higher (HR 1.38 [95% CI 1.15-1.65], P<0.001) having adjusted for both age and stage (*Figure 6.2.2*). Further adjustment, for smoking, marital and screen-detection status, reduced this disparity only slightly (HR 1.32 [1.10-1.59] for the most deprived group.

Interaction between deprivation and urban/rural status

Both rural and urban patients showed variation in survival by deprivation broadly similar to the overall pattern (*Figure 6.2.1*), although it was not statistically significant for rural patients. There was some indication that survival inequality by deprivation status was more marked in urban than in rural patients, but this was not statistically significant: age-adjusted risk ratio 1.63 (95% CI 1.33-1.99) comparing the most with the least deprived urban populations versus 1.24 (0.81-1.89) for the same comparison among rural populations (P=0.21 for difference) (*Table 6.2.1*, *Figure 6.2.4*). That is, no significant heterogeneity of deprivation influence by urban/rural status was confirmed.

Table 6.2.1 Influence of deprivation on female breast cancer survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	*1.54	1.29-1.84		
Rural	1.24	0.81-1.89		
Urban	*1.63	1.33-1.99	1.24	0.21

Variation by age

Survival was highest in the age-group 55-64 (average five-year survival 91%), and ranged 66-90% in other age-groups, lowest for age 75+ (66%) (*Figure 6.2.1*) Cox modelling which indicated an unadjusted mortality hazard almost six times higher in the 75+ group (hazard ratio 5.91 [95% CI 5.00-7.00], P<0.001) compared with the 45-54 group (*Figure 6.2.2*). Adjustment for stage reduced this disparity substantially (HR 4.43 [3.73-5.25], P<0.001), with some further reduction after adjustment for smoking, marital and screening status (HR 3.66 [3.03-4.41], P<0.001). Survival in other age-groups (<45, 55-64 and 65-74) was also significantly poorer than at age 45-54, based on comparison of mortality hazards, though the differences were less marked.

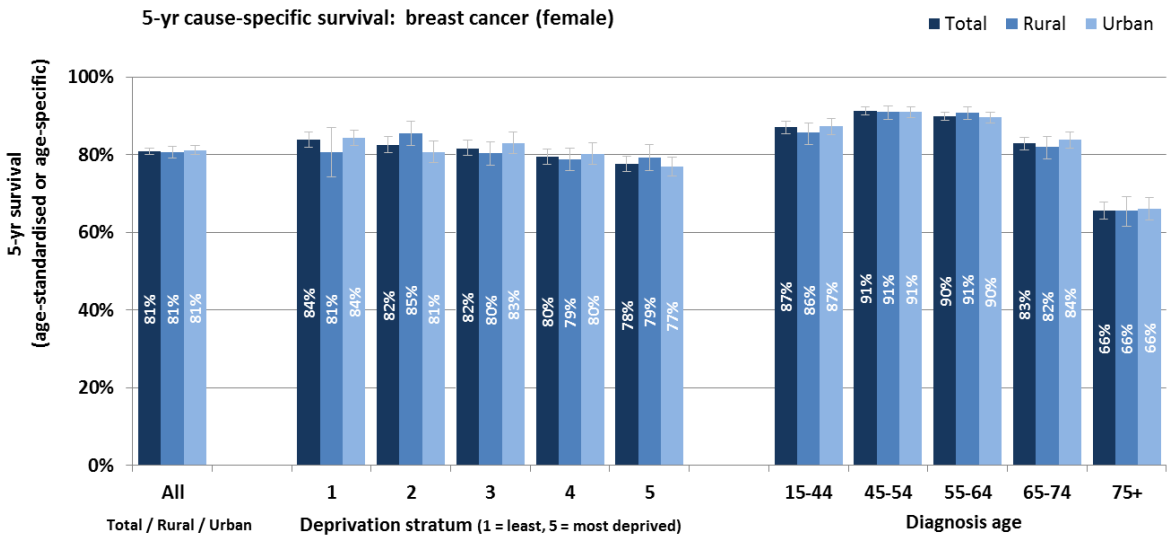


Figure 6.2.1 Cause-specific five-year survival of female breast cancer patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age.

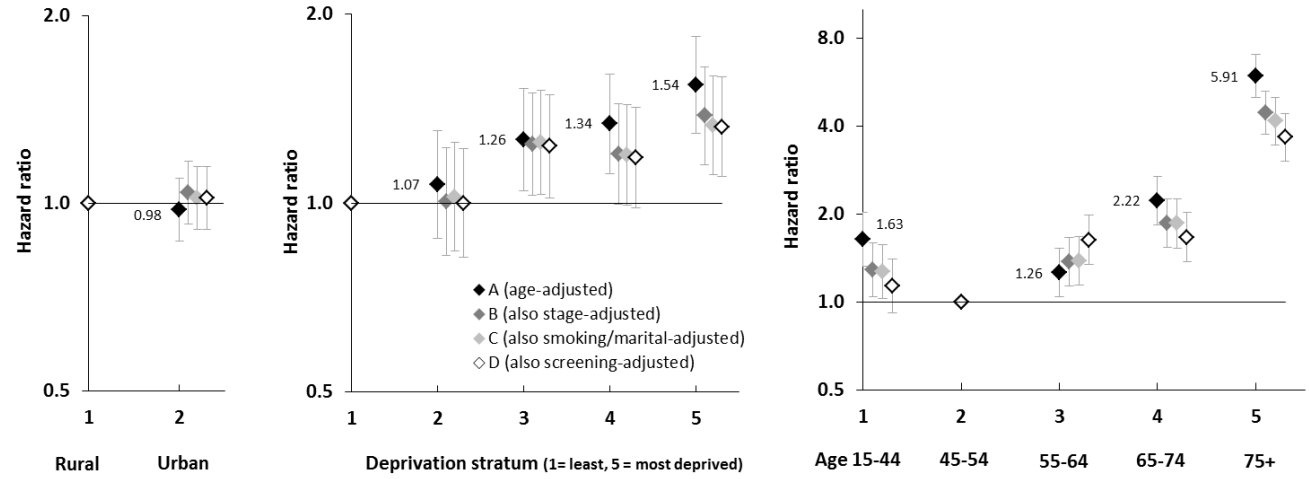


Figure 6.2.2 Mortality hazard ratios for female breast cancer survival, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group) and fuller models.

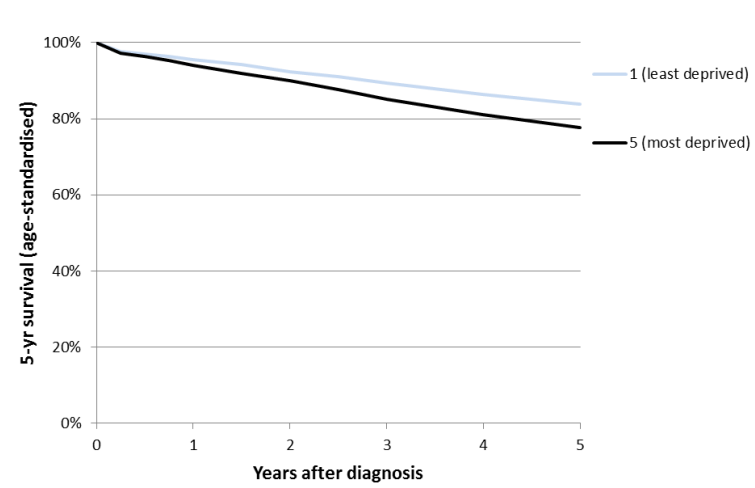


Figure 6.2.3 Cause-specific survival curves for female breast cancer patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

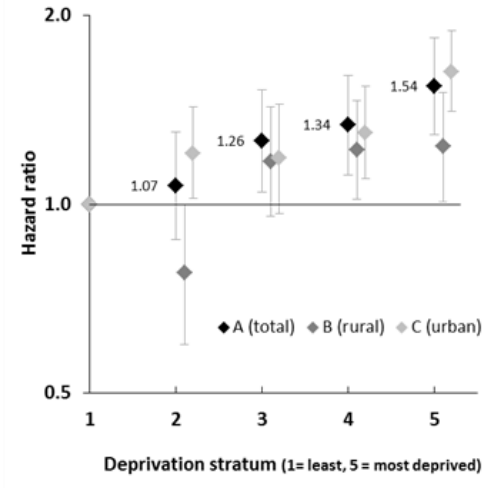


Figure 6.2.4 Mortality hazard ratios for female breast cancer survival, by deprivation stratum: age-adjusted models – all, rural and urban cases compared. See also *Table 6.2.1*.

6.3 Female breast cancer: stage (TNM 5th edition)

Variation by urban/rural status

Stage proportions ranged 31-32% for stage I, 12-14% for stage III and 6.4-6.9% for stage IV between rural and urban cases, and were similar (44%) for stage II and (4%) for unknown stage (*Figure 6.3.*1). Urban cases were significantly more likely to present at stage I (age-adjusted relative risk [RR] 1.06, 95% CI 1.01-1.12) and significantly less likely to present at stage III (0.90, 0.82-0.98) compared with rural cases (*Figure 6.3.2)*.

Variation by deprivation

The stage breakdown of female breast cancer cases ranged 30-33% for stage I, 43-45% for stage II, 12-14% for stage III, 5.1-8.8% for stage IV and 3.5-4.9% for unknown stage across the five deprivation strata, with deprivation-related variation most apparent for stages I and IV (*Figure 6.3.1*). Patients from the most deprived group were significantly less likely to present at stage I (age-adjusted RR 0.91, 95% CI 0.84-0.99) but more likely to present at stage IV (1.69, 1.37-2.08) compared with the least deprived stratum (*Table 6.3.1*, *Figure 6.3.2*). Patients from stratum 4 were also more likely to present at stage IV, while those from strata 3 and 4 were more likely to present at stage III and less likely to present at stage I, compared with stratum 1. Patients from strata 4 and 5 were less likely to be of unknown stage – RRs 0.72 (0.56-0.92) and 0.63 (0.49-0.82), respectively.

Interaction between deprivation and urban/rural status

Stage IV made up a higher proportion of cases from the most deprived compared with the least deprived stratum for both rural and urban patients: age-adjusted RR 1.56 (1.23-1.98) rural, 2.17 (1.26-3.74) urban (P=0.95 for difference) (*Table 6.3.1*). For stages I-III, only urban cases showed a significant influence of deprivation – RR 0.89 (0.81-0.98) for stage I comparing the most with the least deprived stratum – but the influence of deprivation on stage composition did not vary significantly by urban/rural status.

Table 6.3.1 Influence of deprivation on female breast cancer stage, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	Stage I				**Stage II**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	*0.91	0.84-0.99			1.02	0.96-1.08		
Rural	1.02	0.85-1.23			0.91	0.80-1.05		
Urban	*0.89	0.81-0.98	1.24	0.21	1.05	0.98-1.12	1.86	0.063
	Stage III				**Stage IV**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.07	0.93-1.25			*1.69	1.37-2.08		
Rural	0.96	0.70-1.32			*1.56	1.23-1.98		
Urban	1.08	0.91-1.29	0.66	0.51	*2.17	1.26-3.74	0.97	0.95

Variation by age

Stage proportions by age-group ranged 21-43% for stage I, 41-49% for stage II, 10-17% for stage III, 5-9% for stage IV and 3-12% for unknown stage, but with no consistent trends across the full age-range (*Figure 6.3.1*). The oldest patients (age 75+) were significantly less likely to present at stage I (RR 0.60, 0.55-0.66) or stage II (0.90, 0.85-0.96), and more likely to present at stage III (1.30, 1.14-1.48) or stage IV (1.82, 1.50-2.20) (*Figure 6.3.2*). Patients at ages 65-74 were also less likely to present at stage I and more likely to present at stage IV; those at ages 55-64 were more likely to present at stage I and less likely at stages II and III. Those from the youngest age-group (<45) were less likely to present at stage I and more likely at stages II-IV, compared with ages 45-54 (*Figure 6.3.2*). The oldest patients were also significantly more likely to be of unknown stage: RR 1.74 (1.28-2.37) for ages 65-74, 5.76 (4.47-7.41) for ages 75+ (not graphed).

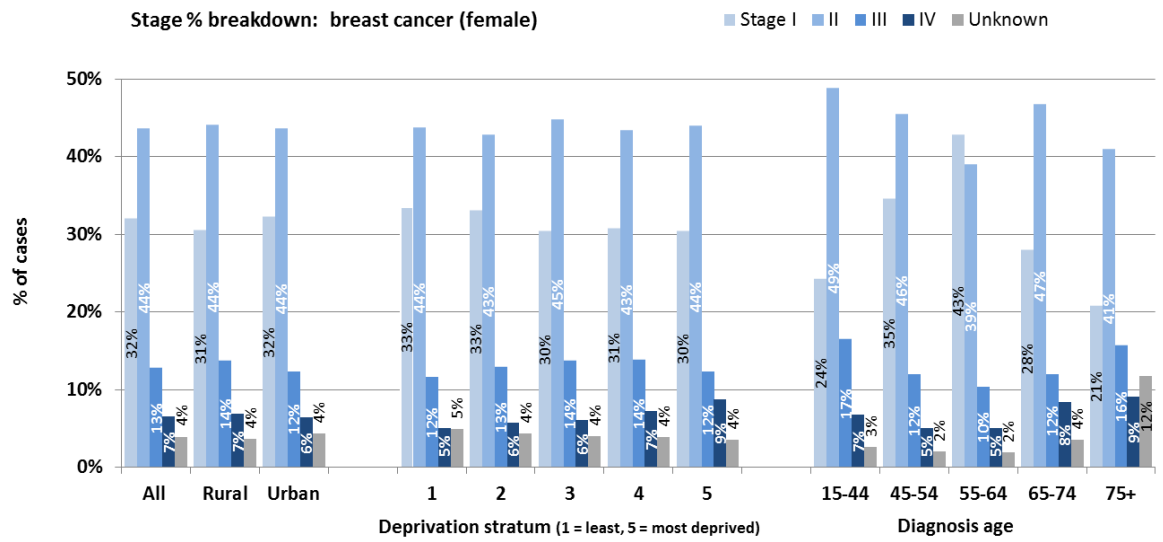


Figure 6.3.1 Stage breakdown of female breast cancer cases, 2008-2012, by urban/rural status, deprivation stratum and age.

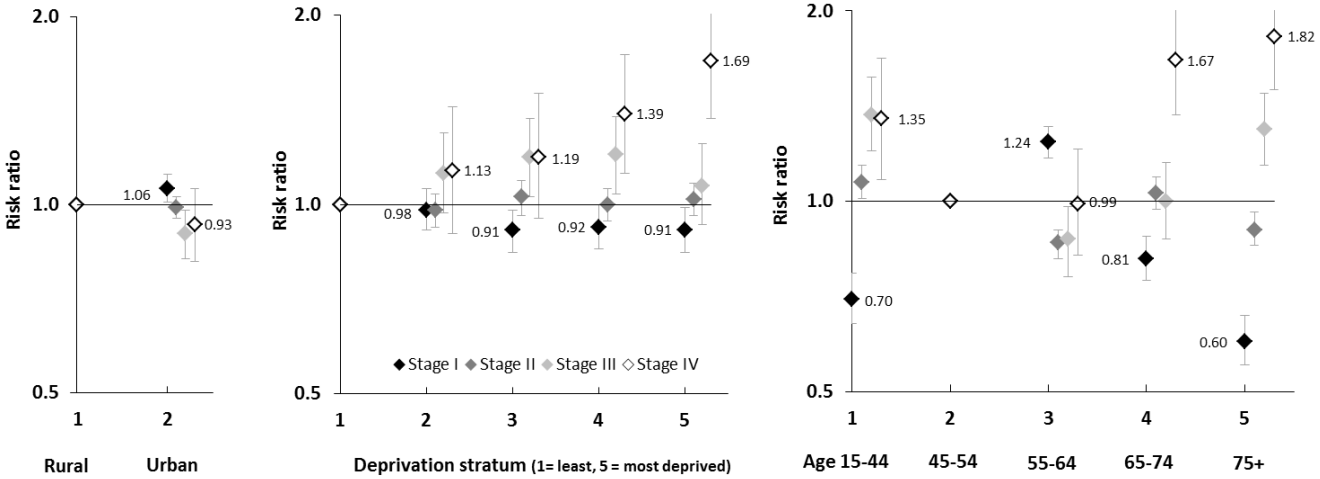


Figure 6.3.2 Risk ratios for female breast cancer stage, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group). RRs for unknown stage are not plotted but are noted in text if significant.

Text and graphical summaries above are based on comparisons of the percentage stage composition of cases. To provide further context, stage-specific incidence rates are presented in *Figure 6.3.4* (below). These rates reflect a combination of overall incidence rates and stage, thus are more complex to interpret. For example, rates of stage I breast cancer peaked in the least deprived stratum, consistent with patterns of overall incidence and of stage I percentages by deprivation; but rates of stage IV cancer peaked in the most deprived stratum, consistent with the pattern shown by stage IV percentage but opposite to the pattern of overall incidence.

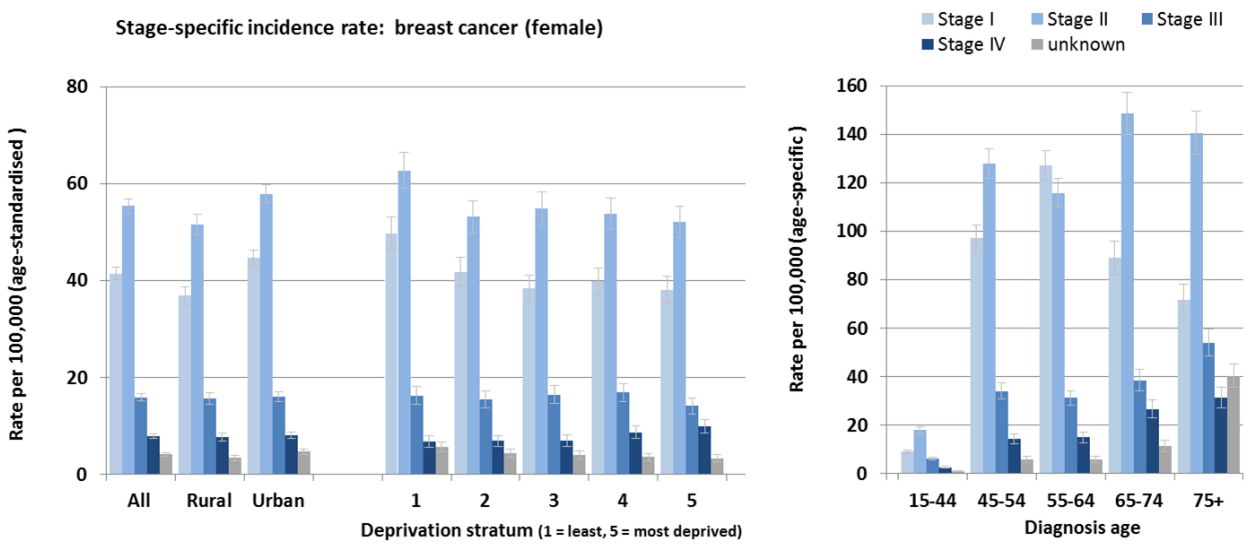


Figure 6.3.3 Stage-specific incidence of female breast cancer, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

6.4 Female breast cancer: tumour-directed treatment

Variation by urban/rural status

Proportions of patient treated ranged 49-52% for chemotherapy and at least 54-59% for hormone therapy between rural and urban cases, with little or no variation for radiotherapy (70-71%), surgery (both 85%) and overall treatment (both 96%) (*Figure 6.4.1*). Urban cases were significantly less likely to have chemotherapy (age-adjusted relative risk [RR] 0.95, 95% CI 0.92-0.98) or recorded hormone therapy (RR 0.92, 0.89-0.95) than rural cases (*Figure 6.4.2*). Use of radiotherapy, surgery and overall treatment did not vary significantly by urban/rural status. Adjustment for stage had little or no effect on these comparisons.

Variation by deprivation

The crude (unadjusted) proportion of breast cancer patients having any tumour-directed treatment ranged 95-97% between deprivation strata, or 81-88% for surgery, 67-72% for radiotherapy, 47-52% for chemotherapy and at least 52-59% for hormone therapy (*Figure 6.4.1*). Patients from the most deprived stratum were significantly less likely to have surgery than those from the least deprived group (*Table 6.4.1*, *Figure 6.4.2*): age-adjusted RR 0.96 (95% CI 0.94-0.98), or RR 0.98 (0.97-0.99) after further adjustment for stage (not tabulated). Patients from the most deprived group were more likely to have hormonal therapy recorded: RR 1.11 (1.06-1.17), or 1.10 (1.05-1.16) after stage-adjustment. The proportions of patients having chemotherapy, radiotherapy or any tumour-directed treatment did not vary significantly.

Data on hormonal therapy were known to be incomplete (based on unpublished NCR work linking breast cancer cases to national prescription data), and the apparent relationship between deprivation and hormonal use could possibly be biased. For example, if a higher proportion of data was missing for patients treated in private hospitals, it might appear that patients from the least deprived group (the patients most likely to be treated in private hospitals) were less likely to have hormonal therapy.

The influence of deprivation on the specific type of surgery involved was not examined in this analysis, but an earlier study (covering the period 1999-2008) found that patients from more deprived areas were significantly less likely to have breast-conserving surgery and significantly more likely to have mastectomy (Walsh et al. 2014). Radiotherapy use after breast-conserving surgery and overall radiotherapy and chemotherapy use were not influenced by deprivation in that study, but again there was a strong apparent influence on use of hormonal therapy.

Interaction between deprivation and urban/rural status

Urban and rural groups appeared to show broadly similar patterns of overall treatment, surgery and radiotherapy variation by deprivation (not graphed). However, rural cases showed some evidence of higher use of chemotherapy in the most deprived compared with least deprived group (RR 1.12, 95% CI 0.99-1.25), not evident for urban patients (RR 0.97, 0.92-1.03) (P=0.03 for differences) (*Table 6.4.1*). The opposite tendency was seen for hormonal treatment – RR 1.00 (0.90-

1.12) for rural patients, RR 1.12 (1.06-1.19) for urban patients – but the difference was not quite statistically significant (P=0.06).

Table 6.4.1 Influence of deprivation on female breast cancer treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	Any treatment RR most v least deprived	95% CI	z	P	Surgery RR most v least deprived	95% CI	z	P
Total	1.00	0.98-1.01			*0.96	0.94-0.98		
Rural	1.00	0.97-1.03			0.98	0.94-1.03		
Urban	1.00	0.98-1.01	0.01	1.00	*0.96	0.93-0.98	0.80	0.42
	Radiotherapy RR most v least deprived	**95% CI**	**z**	**P**	**Chemotherapy RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.98	0.95-1.01			1.01	0.96-1.06		
Rural	0.99	0.92-1.07			1.12	0.99-1.25		
Urban	0.97	0.93-1.01	0.47	0.64	0.97	0.92-1.03	2.16	*0.031
	Hormonal therapy RR most v least deprived	**95% CI**	**z**	**P**				
Total	*1.11	1.06-1.17						
Rural	1.00	0.90-1.12						
Urban	*1.12	1.06-1.19	1.87	0.06				

Variation by age

Unadjusted proportions of patients treated ranged 8-79% for chemotherapy between age-groups, with less marked but still substantial variation for radiotherapy (34-81%), surgery (47-95%), hormone therapy (at least 49-61%) and overall treatment (84-98%) (*Figure 6.4.1*). The proportion having chemotherapy fell markedly with age, especially in the oldest group, while use of surgery and radiotherapy was fairly stable across the three youngest groups and use of hormones showed a broad increase with age. The three oldest groups had significantly lower use of chemotherapy than age-group 45-54 (notably an age-adjusted RR 0.12, 95% CI 0.10-0.13 for age 75+), while the two oldest groups had significantly lower use of surgery (RR 0.50, 0.47-0.52 for 75+), radiotherapy (RR 0.42, 0.40-0.45 for 75+) and overall treatment (RR 0.85.0.83-0.86 for 75+) (*Figure 6.4.2*). In contrast, hormonal therapy was most frequent in the oldest group (RR 1.08, 1.03-1.13). Patients in the youngest group (15-44) were significantly less likely to have hormonal therapy (RR 0.87, 0.83-0.92), radiotherapy (RR 0.94, 0.92-0.97) or surgery (RR 0.98, 0.97-0.99) (*Figure 6.4.2*).

Adjustment for stage moderated these age effects only slightly, and variation remained significant (with the exception of surgery below age 45 and overall treatment at ages 65-74) (not graphed). This suggests that stage at diagnosis was not the main factor influencing treatment variation by age, and factors such as other health conditions and tumour risk factors other than stage (including grade and receptor status) are likely also to have been important in treatment decisions.

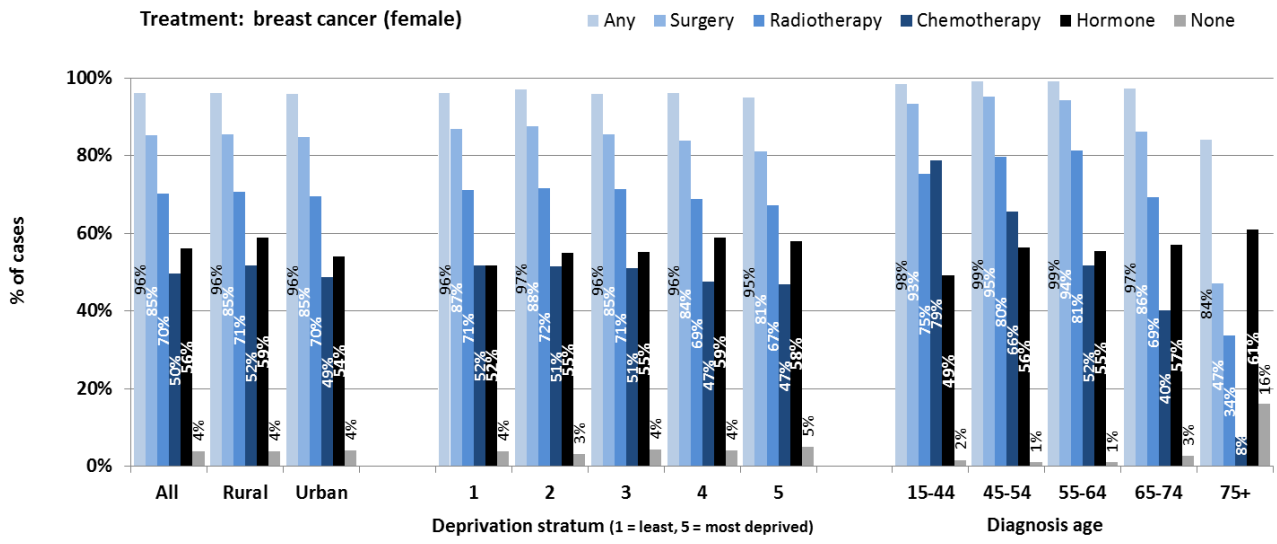


Figure 6.4.1 Treatment of female breast cancer within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

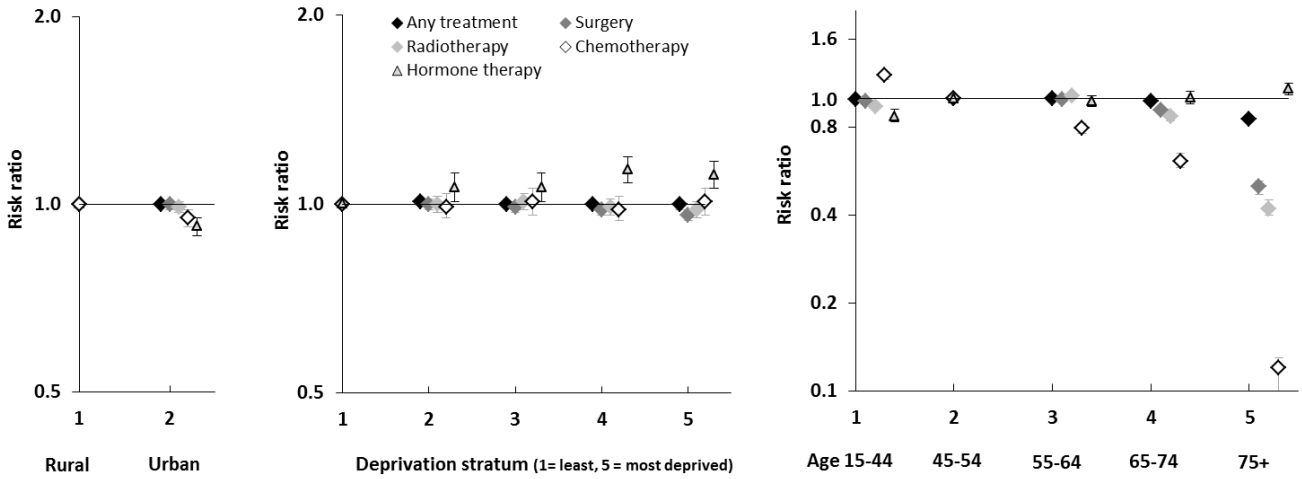


Figure 6.4.2 Risk ratios for treatment of female breast cancer, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group).

6.5 Female breast cancer: comorbidity

Variation by urban/rural status

A slightly higher percentage of urban patients (8.5%) than rural patients (7.5%) had recorded comorbidities (*Figure 6.5.1*), but the difference was not statistically significant after adjustment for age: relative risk (RR) 1.09 (95% 0.95-1.24) (*Figure 6.5.2*).

Variation by deprivation

The proportion of female breast cancer patients with recorded clinically significant health conditions at or around the time of cancer diagnosis ranged 7-11% across the five deprivation strata and appeared to increase with increasing levels of deprivation (*Figure 6.5.1*). Adjusted for age, patients from the most deprived stratum were about 40% more likely to have comorbidities than those from the least deprived stratum: RR 1.41 (95% CI 1.14-1.75) (*Table 6.5.1*, *Figure 6.5.*2).

Interaction between deprivation and urban/rural status

Urban patients appeared to show a more marked pattern of comorbidity variation by deprivation, comparing the most with the least deprived stratum – RR 1.56 (1.24-1.96) for urban cases v 1.19 (0.69-2.06) for rural cases – but the strength of the effect did not differ significantly (P=0.33) (*Table 6.5.1*).

Table 6.5.1 Influence of deprivation on comorbidity in female breast cancer patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	*1.41	1.14-1.75		
Rural	1.19	0.69-2.06		
Urban	*1.56	1.24-1.96	0.97	0.33

Variation by age

Proportions of patients with recorded comorbidity ranged 3-17% across the age-groups examined and showed a strong relationship to age (*Figure 6.5.1*). Patients from the oldest group (75+) were over four times more likely to have comorbidities than those aged 45-54 – RR 4.47 (95% CI 3.62-5.53) – and patients aged 55-64 and 65-74 also had significantly higher levels of comorbidity (*Figure 6.5.2*).

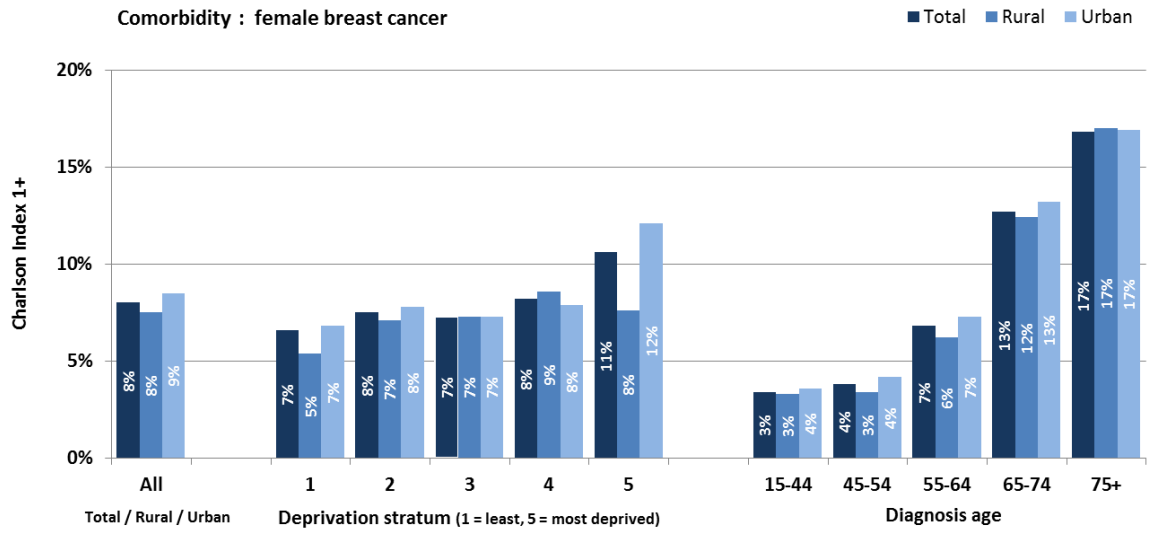


Figure 6.5.1 Comorbidity in female breast cancer patients, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

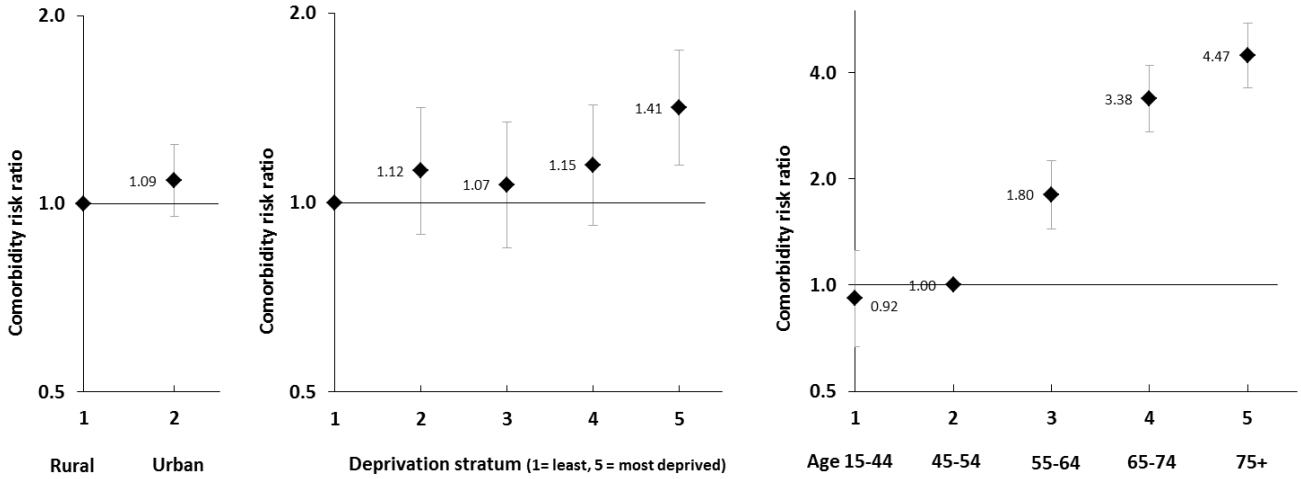


Figure 6.5.2 Risk ratios for comorbidity in female breast cancer patients, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group).

6.6 Female breast cancer: screen-detection status (age 50-64)

Population-based mammographic screening is currently offered to women aged 50-64 in Ireland. Analyses in this section focus on this age-group, but models are adjusted by five-year age-group within this broader grouping.

Variation by urban/rural status

Cases in woman from urban populations were significantly more likely than those from rural populations to be screen-detected: age-adjusted relative risk (RR) 1.07 (95% CI 1.01-1.13) based on comparisons of percentages (*Figure 6.6.3*). The per-population incidence rate of screen-detected breast cancer among urban women was also significantly high: directly age-standardised rate ratio (DSRR) 1.22 (1.13-1.31) (*Figure 6.6.4*). The greater disparity in rates than in proportions of screen-detected cases probably reflects the overall higher rates of breast cancer in urban women noted earlier. Note: The overall percentage of screen-detected cases was slightly higher (53.0%) than that for either rural (49.6%) or urban cases (52.6%). 11% of cases in age-range 50-64 could not be assigned to urban/rural status, and the mismatch in screen-detection percentages suggests that the completeness of address information was lower for screen-detected cases.

Variation by deprivation

The proportion of cases that were screen-detected did not vary significantly by deprivation status – relative risk 0.97 (95% CI 0.89-1.05) comparing the most with the least deprived group (*Table 6.6.1*, *Figure 6.6.3*) – and ranged only 50-53% between strata (*Figure 6.6.1*).

However, the age-standardised incidence rate of screen-detected cases among populations aged 50-64 was significantly lower in the most deprived group, with a rate ratio of 0.81 (95% CI 0.75-0.89) compared with the least deprived group (*Table 6.6.1*, *Figure 6.6.4*). Incidence averaged 202 screen-detected cases per 100,000 in the least deprived group, compared with 164-171 in the other groups (*Figure 6.6.2*). The higher rate of screen-detected cases in the least deprived group seems to reflect the overall influence of deprivation on breast cancer incidence more strongly than its influence on screening.

Interaction between deprivation and urban/rural status

Variation in the screen-detected proportion of cases by deprivation did not differ significantly between urban and rural populations: a risk ratio 0.95 (95% CI 0.87-1.05) comparing the most with the least deprived urban populations versus 1.06 (0.87-1.31) for the same comparison among rural populations (P=0.36 for difference) (*Table 6.6.1*).

However, as seen for overall rates, the pattern of incidence of screen-detected cases by deprivation differed significantly between urban and rural populations: a DSRR of 0.81 (95% CI 0.71-0.93) comparing the most with the least deprived urban populations versus 1.12 (0.85-1.48) for the same comparison among rural populations (P=0.04 for difference) (*Table 6.6.1*). That is, in urban populations lower incidence of screen-detected breast cancer was associated with higher levels of deprivation but in rural populations there was no clear association (perhaps even the opposite pattern). These screening-specific incidence figures, however, reflect variation in both overall incidence and in screen-detected proportions by deprivation and by rural/status, thus interpretation is potentially complex.

Table 6.6.1 Influence of deprivation on screen-detection status in female breast cancer patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks and age-standardised rate ratios)

	Screen-detected (relative proportions)				Screen-detected (relative rates)			
	RR most v least deprived	95% CI	z	P	DSRR most v least deprived	95% CI	z	P
Total	0.97	0.89-1.05			0.81	0.75-0.89		
Rural	1.06	0.87-1.31			1.12	0.85-1.48		
Urban	0.95	0.87-1.05	0.93	0.36	0.81	0.71-0.93	2.06	*0.04

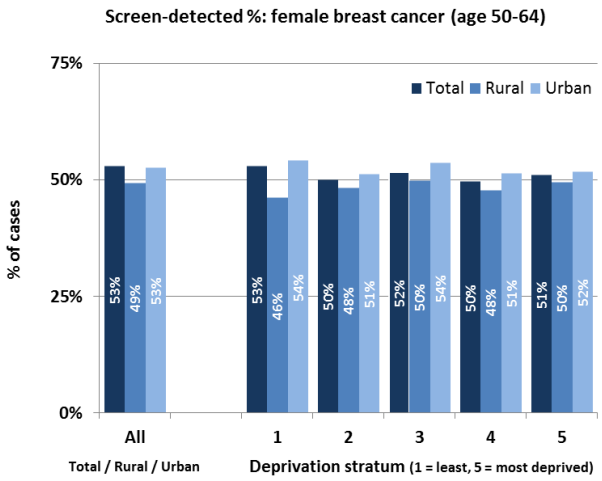


Figure 6.6.1 Proportion of cases screen-detected for female breast cancer (ages 50-64), 2008-2012, by rural/urban status and deprivation stratum.

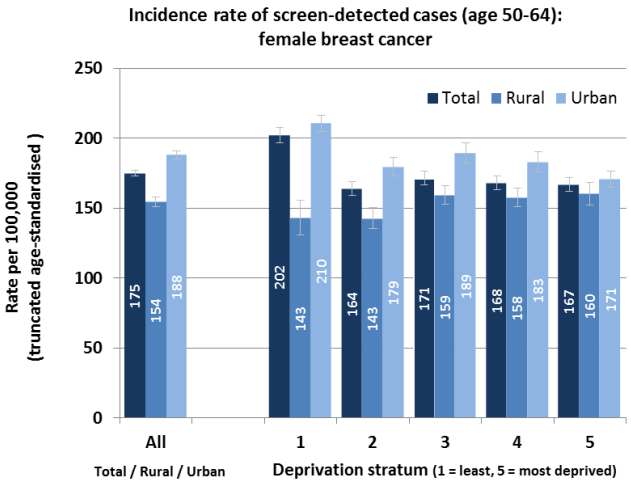


Figure 6.6.2 Incidence of screen-detected female breast cancer (ages 50-64), 2008-2012, by rural/urban status and deprivation stratum.

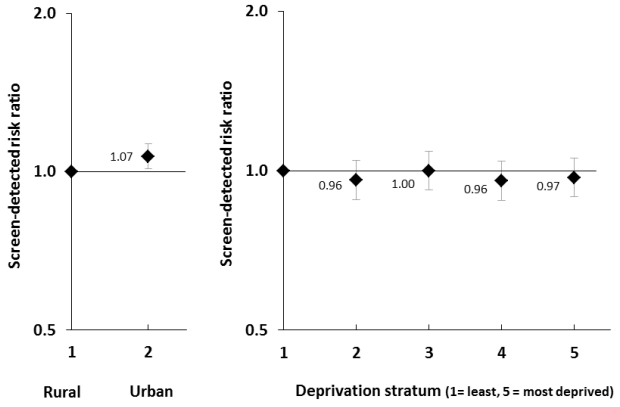


Figure 6.6.3 Risk ratios for proportion screen-detected among female breast cancers, by rural/urban status and deprivation stratum: age-adjusted models for age-group 50-64 (adjusted for 50-54, 55-59, 60-64 breakdown).

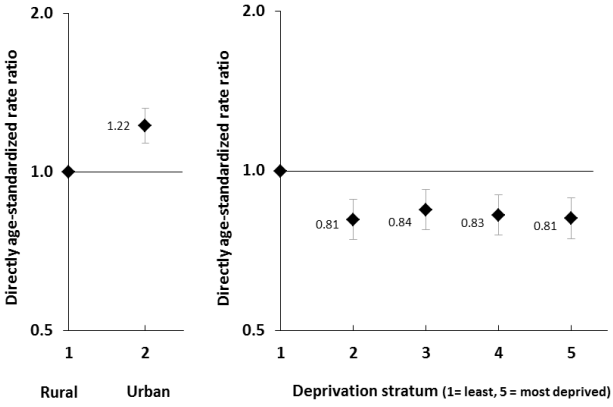


Figure 6.6.4 Rate ratios for screen-detected cases of female breast cancer, by rural/urban status and deprivation stratum: age-adjusted models for age-group 50-64 (adjusted for 50-54, 55-59, 60-64 breakdown).

7 CERVICAL CANCER

Key points

- *Incidence*
  - Age-standardised rates of cervical cancer were significantly higher (+21%) in urban than in rural populations.
  - Rates were about twice (2.2 times) as high in the most deprived compared with the least deprived stratum, the most marked variation of incidence by deprivation seen for any of the main cancers in this report.
  - Urban populations showed stronger evidence of disparities in incidence by deprivation: rates about 150% higher in the most compared with the least deprived urban populations, compared with 64% higher in the most deprived rural populations (significant urban/rural different in deprivation effect).
  - Rates peaked at intermediate ages (45-54 and 55-64), a pattern not shown by the other main cancers in this report.
- *Survival*
  - Survival was significantly poorer (mortality hazard over three [3.6] times higher) at ages 75+ compared with 45-54, and also significantly poorer at ages 65-74.

Table 7.k.1 Visual summary of the influence of urban status, deprivation and age on cervical cancer in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, stage proportion, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
Urban status	↑	=	=	=	C↑ TSR=	=
Deprivation	↑	↓	=	III↑ IV=	C↑ TSR=	↑
Older age	↓	↓	I↓ II↑	III↓ IV↑	T↓S↓C↓R=	↑

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Stage*
  - The oldest patients (age 75+) were significantly less likely to present at stage I (-74% in relative terms) and more likely to present at stage IV (+160%) than those aged 45-54. Similar but less marked findings applied to ages 65-74.
- *Treatment*
  - The oldest patients (age 75+) were less likely to have surgery (-54% in relative terms), chemotherapy (-76%) or any treatment (-20%) than those aged 45-54. Surgery use was also lower at ages 65-74, but radiotherapy use was higher at ages 55-64 and 65-74, compared with ages 45-54. The youngest group (<45) had higher use of surgery but lower use of radiotherapy and chemotherapy.
- *Comorbidity*
  - Patients in the oldest group (75+) were almost four (3.7) times more likely to have other serious health conditions recorded than those aged 45-54, and comorbidity prevalence was also higher at ages 55-64 and 65-74.

7.1 Cervical cancer: incidence

Variation by urban/rural status

Age-standardised rates were higher in urban populations: 14 v 12 cases per 100,000 (*Figure 7.1.1*). These differences were statistically significant: directly age-standardised rate ratio (DSRR) 1.21 (1.09-1.35) (*Figure 7.1.2*).

Variation by deprivation

Age-standardised rates of cervical cancer ranged 9-20 cases per 100,000 across the five deprivation strata, and increased quite linearly with increasing levels of deprivation (*Figure 7.1.1*). Rates were significantly higher (about twice as high) in the most deprived compared with the least deprived stratum: DSRR 2.23 (95% CI 1.88-2.64) (*Table 7.1.1*, *Figure 7.1.2*). This is the most marked variation of incidence by deprivation seen for any main cancer in this report. Rates were also significantly high in strata 2-4 (DSRR range 1.31-1.64).

Interaction between deprivation and urban/rural status

Urban populations showed stronger evidence of inequality in incidence by deprivation, with a rate ratio 2.51 (95% CI 2.05-3.07) comparing the most with the least deprived urban populations versus 1.64 (1.13-2.37) for the same comparison among rural populations (P=0.047 for difference) (*Table 7.1.1*).

Table 7.1.1 Influence of deprivation on cervical cancer incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	DSRR most v least deprived	95% CI	z	P
Total	*2.23	1.88-2.64		
Rural	*1.64	1.13-2.37		
Urban	*2.51	2.05-3.07	1.99	*0.047

Variation by age

Rates varied from 13 to 23 cases per 100,000 between age-groups, but peaked at intermediate ages (45-54 and 55-64) (*Figure 7.1.1*), a pattern not shown by other cancers in this report. Rates were significantly lower in the oldest group than in the 45-54 comparison group: DSRR 0.58 (0.47-0.72) *(Figure 7.1.2*). Rates at ages 15-44 and 65-74 were also significantly lower than at ages 45-54.

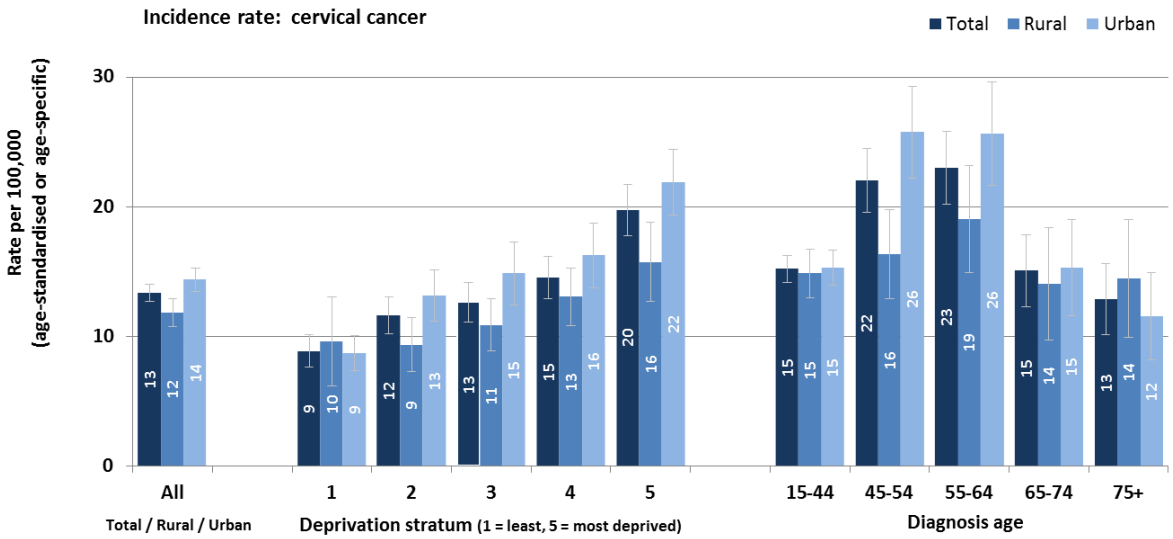


Figure 7.1.1 Incidence of cervical cancer, 2008-2012, by urban/rural status, deprivation stratum and age.

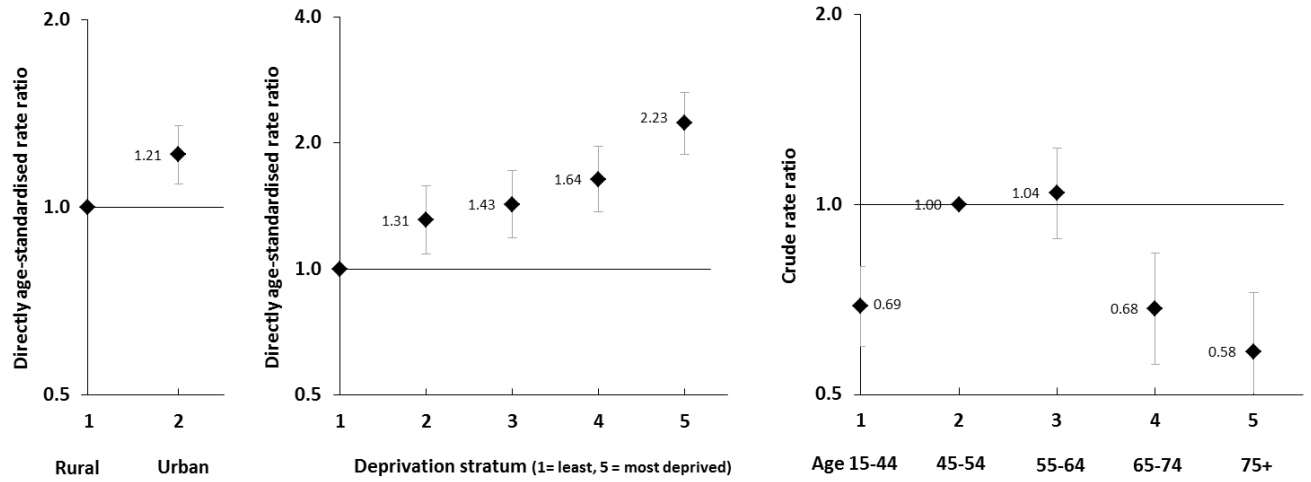


Figure 7.7.2 Rate ratios of cervical cancer incidence, by urban/rural status, deprivation stratum and age.

7.2 Cervical cancer: cause-specific survival

Variation by urban/rural status

Five-year survival averaged 63% for both urban and rural cases (*Figure 7.2.1*), and age/stage-adjusted mortality did not differ significantly: hazard ratio (HR) 1.01 (0.79-1.29) (*Figure 7.2.2*).

Variation by deprivation

Age-standardised five-year survival ranged 60-67% across the five deprivation strata (*Figure 7.2.1)*. Although there were indications of lower survival in the more deprived groups (*Figures 7.2.1 & 7.2.3*), differences were not statistically significant: age-adjusted HR 1.31 (95% CI 0.88-1.95) comparing the most with the least deprived group (*Table 7.2.1*), or 1.15 (0.74-1.74) after adjustment for stage (*Figure 7.2.2*). Adjustment for marital and smoking status had little further effect: HR 1.13 (0.75-1.70).

Given the small numbers of patients included in analyses for this cancer (compared with other cancers in this report), and the apparent survival patterns seen, it cannot be ruled out that survival is influenced by deprivation and further analysis based on a wider range of calendar years might confirm this. The apparent 'crossover' seen between the most and least deprived groups in the five-year survival curve (*Figure 7.2.3*) might be an artefact of small samples sizes and unstable survival estimates, although the possibility that it reflected the true survival of patients cannot be excluded.

Interaction between deprivation and urban/rural status

As seen for cervical cancer cases as a whole, no significant variation of survival by deprivation status was confirmed among either urban or rural cases, with an age-adjusted mortality hazard ratio comparing patients from the most deprived with those from the least deprived populations of 1.27 (95% CI 0.82-1.97) for urban patients and 1.71 (0.59-4.93) for rural patients (*Table 7.2.1*, *Figure 7.2.4*). There was no significant heterogeneity of the deprivation influence between urban and rural patients (P=0.65), based on these comparisons.

Table 7.2.1 Influence of deprivation on cervical cancer survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	1.31	0.88-1.95		
Rural	1.71	0.59-4.93		
Urban	1.27	0.82-1.97	0.45	0.65

Variation by age

Five-year survival varied from 31% to 85% between the age-groups examined here, and showed a clear pattern of decreasing survival with increasing age (*Figure 7.2.1*). For the oldest group (75+), cancer-specific mortality was significantly higher than for ages 45-54: unadjusted HR 3.58 (95% CI 2.42-5.30), or 2.42 (1.63-3.60) after stage-adjustment, 3.49 (2.21-5.75) after further adjustment for smoking and marital status (*Figure 7.2.2*). Survival was also significantly poorer for age-group 65-74 compared with 45-64, and higher for ages <45 (but not after stage-adjustment).

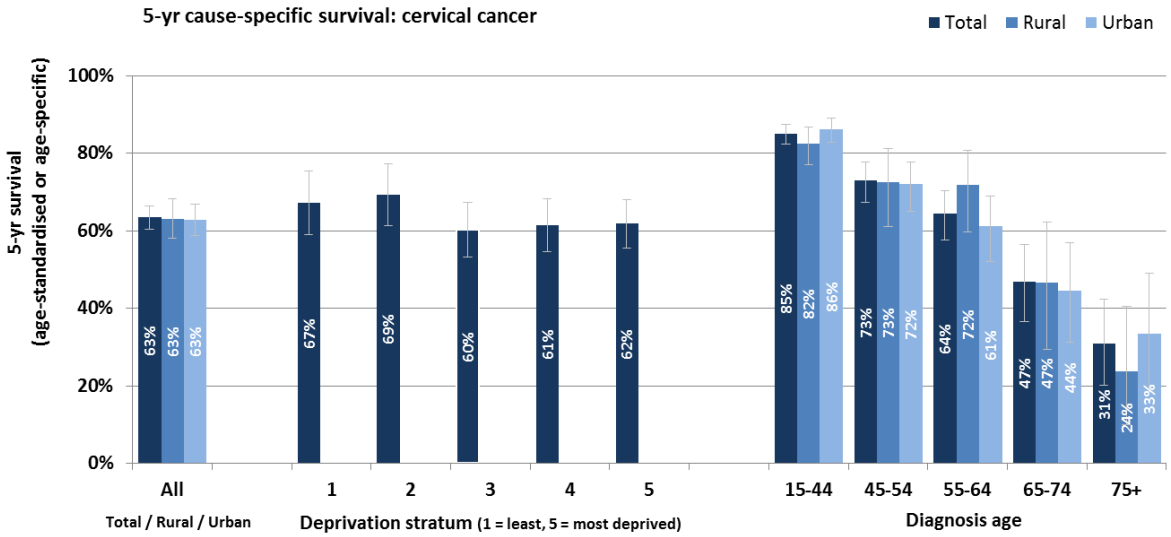


Figure 7.2.1 Cause-specific five-year survival of Irish cervical cancer patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age. Age-standardised survival for deprivation strata by urban/rural status could not be calculated because of insufficient numbers of cases in some subgroups.

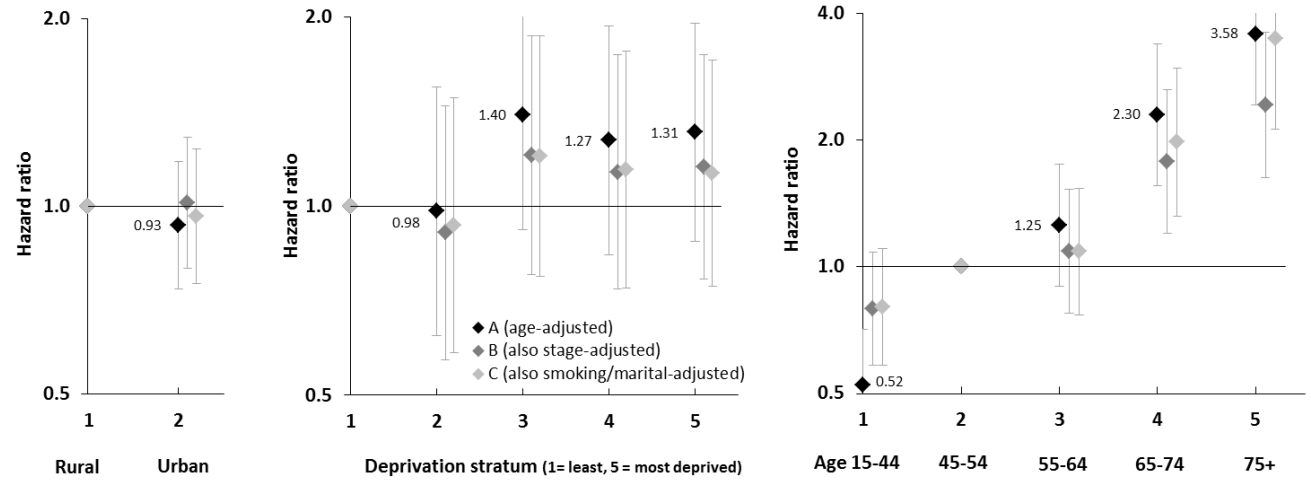


Figure 7.2.2 Mortality hazard ratios for cervical cancer survival, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group) and fuller models.

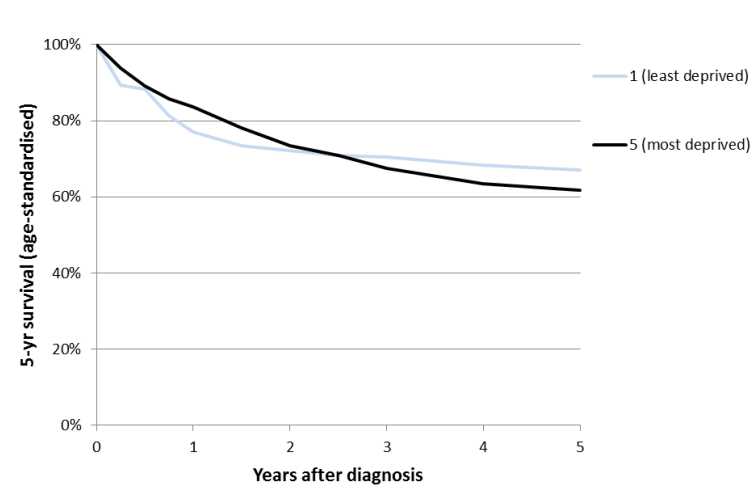


Figure 7.2.3 Cause-specific survival curves for cervical cancer patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

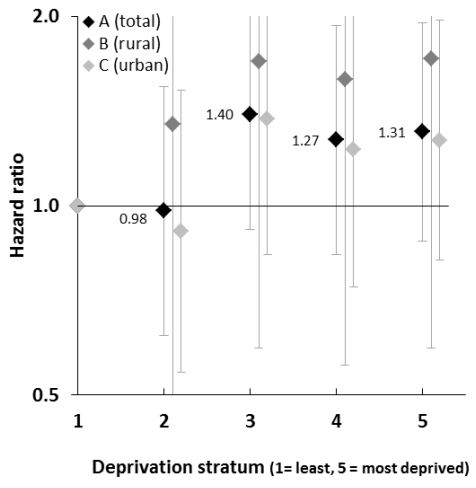


Figure 7.2.4 Mortality hazard ratios for cervical cancer survival, by deprivation stratum: age-adjusted models – all, rural and urban cases compared. See also *Table 7.2.1*.

7.3 Cervical cancer: stage (TNM 5th edition)

Variation by urban/rural status

Stage proportions by urban/rural status ranged 45-47% for stage I, 12-13% for stage II, 11-14% for stage IV and 7-8% for unknown stage, and were the same (20%) for stage III (*Figure 7.3.1*). The stage breakdown of cases did not vary significantly by urban/rural status, having adjusted for age (*Table 7.3.1*, *Figure 7.3.2*).

Variation by deprivation

The stage breakdown of cervical cancer cases ranged 43-49% for stage I, 11-14% for stage II, 15-26% for stage III, 9-15% for stage IV and 5-10% for unknown stage across the five deprivation strata (*Figure 7.3.1*). No significant variation in stage breakdown of cases by deprivation stratum was found, having adjusted for age (*Figure 7.3.2*), but note that confidence intervals on the relative risk estimates were very wide, reflecting the small numbers of cases involved for this cancer.

Interaction between deprivation and urban/rural status

The influence of deprivation on stage breakdown did not differ significantly between rural and urban cases and was not significant for either group, based on comparisons between the most and least deprived groups (*Table 7.3.1*).

Table 7.3.1 Influence of deprivation on cervical cancer stage, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	Stage I				Stage II			
	RR most v least deprived	95% CI	z	P	RR most v least deprived	95% CI	z	P
Total	0.97	0.82-1.16			1.05	0.67-1.63		
Rural	0.80	0.57-1.14			1.08	0.53-2.81		
Urban	1.01	0.83-1.23	1.19	0.23	1.07	0.66-1.75	0.02	0.98
	Stage III				**Stage IV**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.21	0.88-1.66			1.07	0.65-1.75		
Rural	1.40	0.66-2.97			1.01	0.49-2.61		
Urban	1.19	0.84-1.69	0.36	0.72	1.03	0.58-1.84	0.04	0.97

Variation by age

Stage proportions by age ranged 10-59% for stage I, 8-23% for stage II, 16-28% for stage III, 6-29% for stage IV and 7-12% for unknown stage, with very strong trends of decreasing proportions of stage I and increasing proportions of stage IV cancers with increasing age (*Figure 7.3.*1). Significantly higher proportions of cases in the three oldest age-group (55-64, 65-74 and 75+) were stage IV, compared with age-group 45-54 – age-adjusted relative risks (RRs) 1.59 (95% CI 1.06-2.40), 2.24 (1.43-3.50) and 2.60 (1.65-4.10), respectively. Significantly lower proportions of cases in the two oldest groups were stage I – RR 0.42 (0.28-0.65) for ages 65-74 and 0.26 (0.14-0.49) for ages 75+. The youngest patients (age 15-44) had a significantly higher proportion of stage I cases compared with ages 45-54 – RR 1.47 (1.26-1.70) – and lower proportions of stage II, III and IV cases – RRs 0.55 (0.38-0.78), 0.67 (0.52-0.86) and 0.55 (0.36-0.83), respectively.

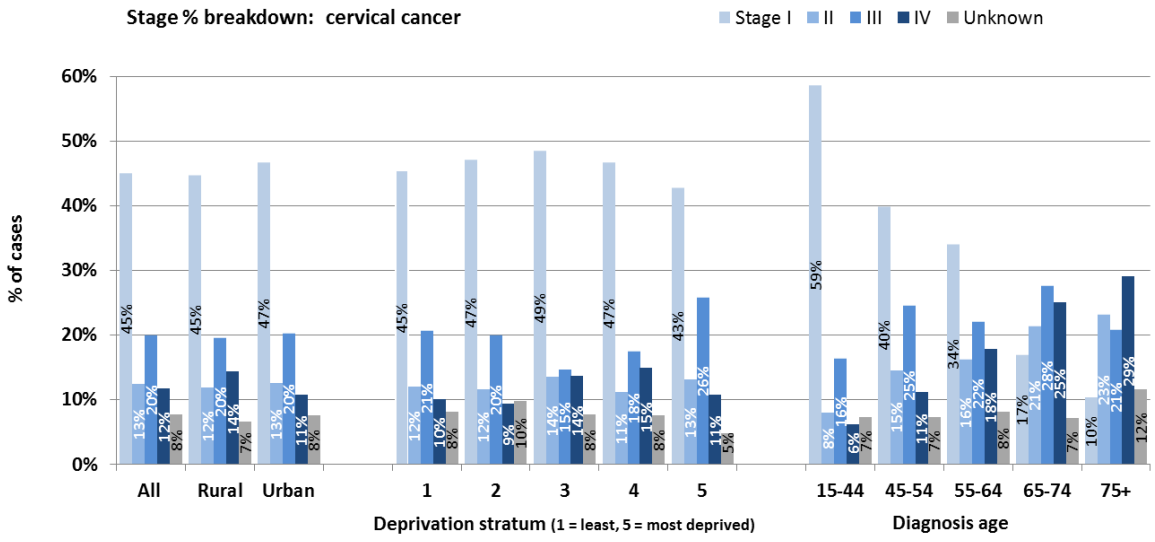


Figure 7.3.1 Stage breakdown of cervical cancer cases, 2008-2012, by urban/rural status, deprivation stratum and age.

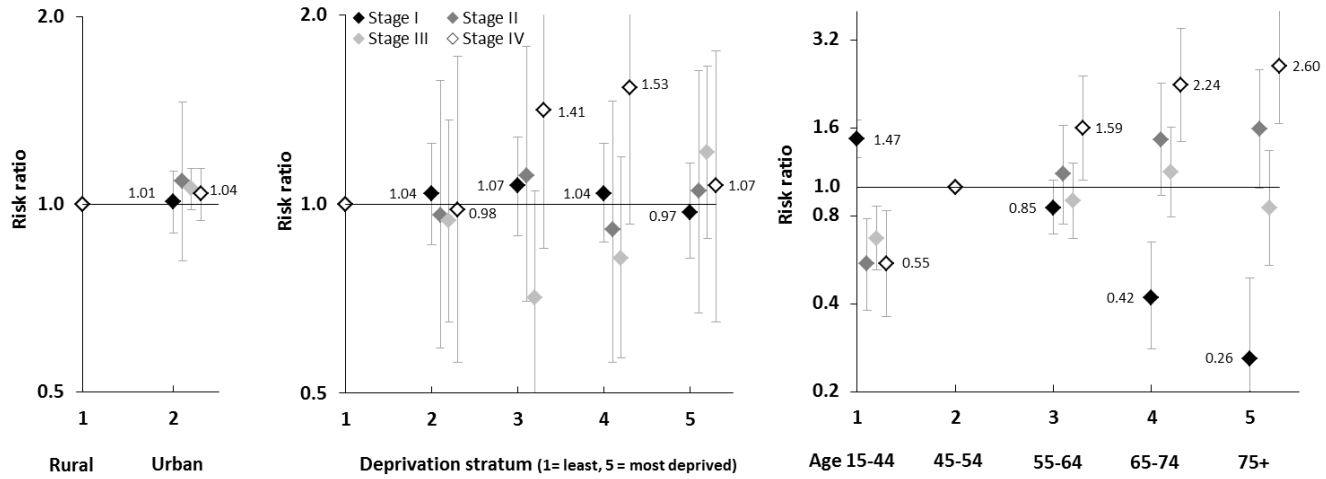


Figure 7.3.2 Risk ratios of cervical cancer stage, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group). RRs for unknown stage are not plotted but are noted in text if significant.

Text and graphical summaries above are based on comparisons of the percentage stage composition of cases. To provide further context, stage-specific incidence rates are presented in *Figure 7.3.3* (below). These rates reflect a combination of overall incidence rates and stage, thus are more complex to interpret.

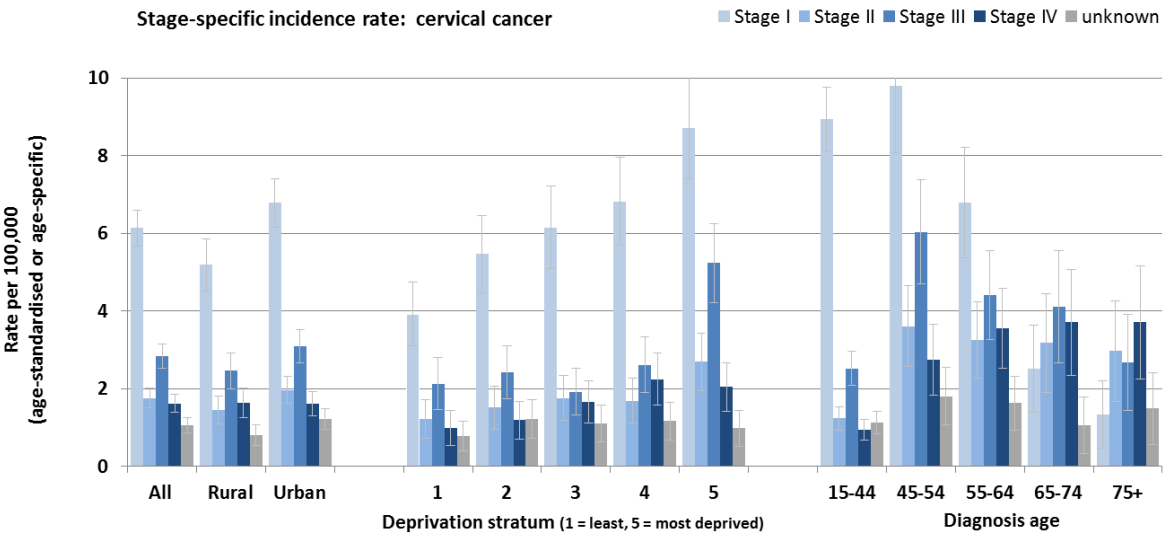


Figure 7.3.3 Stage-specific incidence of cervical cancer, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

7.4 Cervical cancer: tumour-directed treatment

Note: Patients with confirmed invasive cervical cancer who had conisation (sometimes referred to as "cone biopsy", more extensive than a typical biopsy) are included under tumour-directed surgery here.

Variation by urban/rural status

Unadjusted treatment percentages varied only slightly by urban/rural status for surgery (65-66%), chemotherapy (37-38%) and overall (both 96%), but more markedly for radiotherapy (53-57%) (*Figure 7.4.1*). None of the variation was statistically significant after adjustment for age (*Figure 7.4.2*).

Variation by deprivation

The crude (unadjusted) proportion of cervical cancer patients having any tumour-directed treatment ranged 95-97% between deprivation strata, or 63-67% for surgery, 51-58% for radiotherapy and 35-39% for chemotherapy (*Figure 7.4.1*). There was some indication that radiotherapy and chemotherapy use was highest in the most deprived stratum (*Figure 7.4.2*). However, differences were not statistically significant after age adjustment: for chemotherapy, a relative risk (RR) of 1.12 (95% CI 0.90-1.40) comparing the most with the least deprived group (*Table 7.4.1*), or 1.02 (0.86-1.21) after adjustment for stage; for radiotherapy, 1.06 (0.92-1.23) and 0.99 (0.88-1.11), respectively.

Interaction between deprivation and urban/rural status

Rural and urban cases showed no significant deprivation effects and no significant differences in deprivation effect (comparing the most with the least deprived strata) for any treatment modality (*Table 7.4.1*).

Table 7.4.1 Influence of deprivation on cervical cancer treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	Any treatment				**Surgery**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.01	0.98-1.05			0.96	0.86-1.08		
Rural	1.05	0.97-1.14			0.95	0.74-1.21		
Urban	1.00	0.96-1.04	1.03	0.31	0.96	0.84-1.09	0.08	0.94
	Radiotherapy				**Chemotherapy**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.06	0.92-1.23			1.12	0.90-1.40		
Rural	1.22	0.90-1.64			1.56	0.87-2.80		
Urban	1.01	0.85-1.19	1.02	0.31	1.07	0.84-1.36	1.01	0.31

Variation by age

As seen for other cancers in this report, treatment variation by age was much more substantial. The proportions of cases treated ranged 16-49% for chemotherapy, 28-79% for surgery, 41-80% for radiotherapy and 78-98% overall (*Figure 7.4.1*). Use of surgery (and overall treatment) fell with age, while radiotherapy use peaked at ages 65-74 and chemotherapy at ages 45-74. Compared with patients aged 45-54, those aged 75+ were significantly less likely to have chemotherapy (RR 0.34, 95% CI 0.21-0.56), surgery (RR 0.46, 0.32-0.65) or any treatment (RR 0.80, 0.72-0.90) (*Figure 7.4.2*). Those aged 65-74 were also less likely to have surgery, but were more likely to have radiotherapy (RR 1.30, 1.15-1.48) compared with ages 45-54. Radiotherapy use was also significantly higher among ages 55-64, but was lower in the youngest age-group; the youngest group also had lower use of chemotherapy and higher use of surgery (*Figure 7.4.2*).

Adjustment for stage generally moderated the age-related variation but, apart from chemotherapy use in age-group 15-44 and radiotherapy in age-group 65-74, variation remained significant. For age-group 75+, stage-adjusted RRs were 0.26 (0.16-0.43) for chemotherapy, 0.61 (0.44-0.86) for surgery and 0.81 (0.73-0.91) for any treatment relative to ages 45-54 (not graphed).

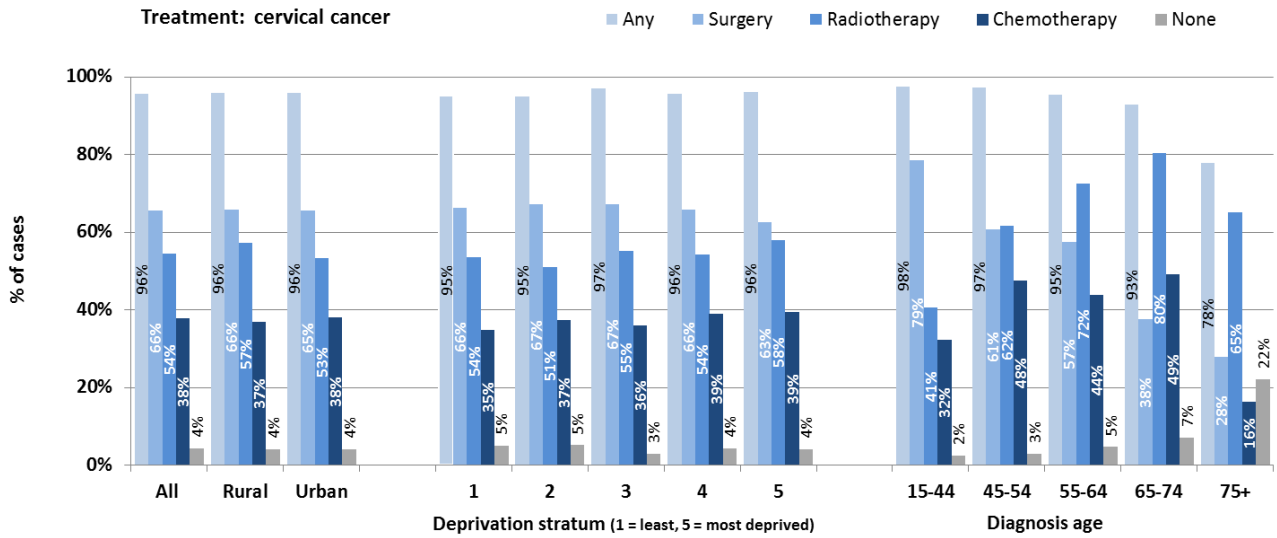


Figure 7.4.1 Treatment of cervical cancer within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

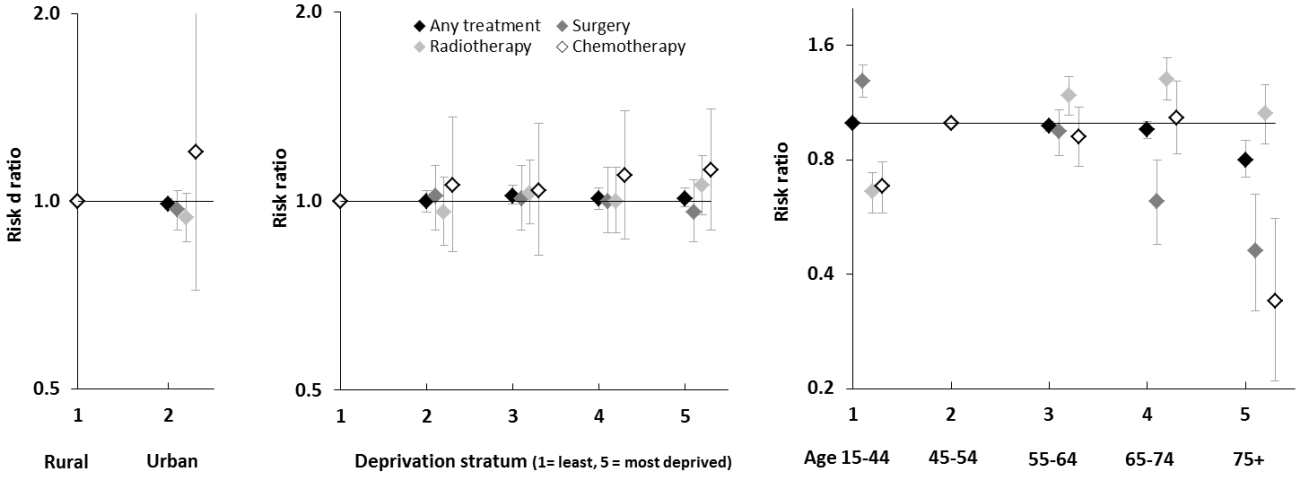


Figure 7.4.2 Risk ratios for treatment of cervical cancer, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group).

7.5 Cervical cancer: comorbidity

Variation by urban/rural status

Similar percentages of rural patients (11.3%) and urban patients (10.7%) had known comorbidities (*Figure 7.5.1*), and there was no significant difference after adjustment for age: relative risk (RR) 1.03 (95% CI 0.75-1.41) for urban v rural patients (*Figure 7.5.2*).

Variation by deprivation

The proportion of cervical cancer patients with recorded clinically significant health conditions at or around the time of cancer diagnosis ranged 8-13% across the five deprivation strata and appeared to increase with increasing levels of deprivation (*Figure 7.5.1*). However, variation was not statistically significant after adjustment for age: for the most deprived stratum, a RR of 1.59 (95% CI 0.90-2.80) compared with the least deprived stratum (*Table 7.5.1*, *Figure 7.5.2*).

Interaction between deprivation and urban/rural status

Rural patients appeared to show a stronger pattern of increasing comorbidity with increasing deprivation (*Figure 7.5.1*). However, variation by deprivation was not significant for either rural or urban cases and, comparing the most with the

least deprived stratum, the strength of the deprivation effect did not differ significantly: RR 4.66 (0.65-33.6) for rural cases, RR 1.23 (0.67-2.27) for urban cases (P=0.47 for difference) (*Table 7.5.1*).

Table 7.5.1 Influence of deprivation on comorbidity in cervical cancer patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	1.59	0.90-2.80		
Rural	4.66	0.65-33.6		
Urban	1.23	0.67-2.27	0.73	0.47

Variation by age

Between 4% and 33% of patients in each age-group had known comorbidities, and there was a very strong pattern of increase with age (*Figure 7.5.1*). Patients in the oldest group (75+) were almost four times as likely to have comorbidities as those aged 45-54: RR 3.69 (95% CI 2.26-6.03) (*Figure 7.5.2*). Comorbidity prevalence was also significantly higher at ages 55-64 and 65-74, but was significantly lower at ages <45, compared with ages 45-54.

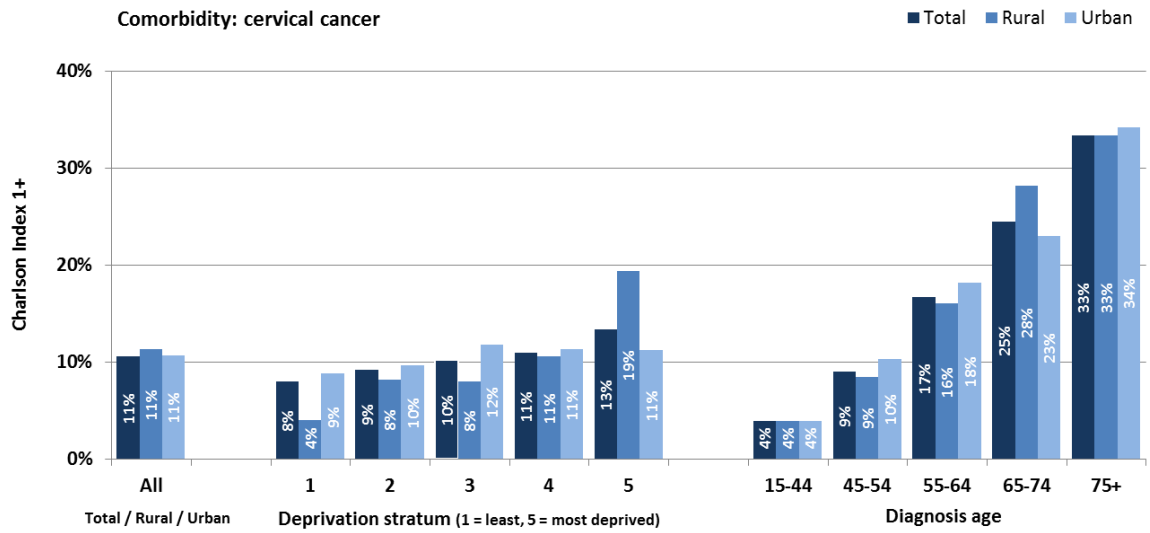


Figure 7.5.1 Comorbidity in cervical cancer patients, 2008-2012, by urban/rural status, deprivation stratum and age.

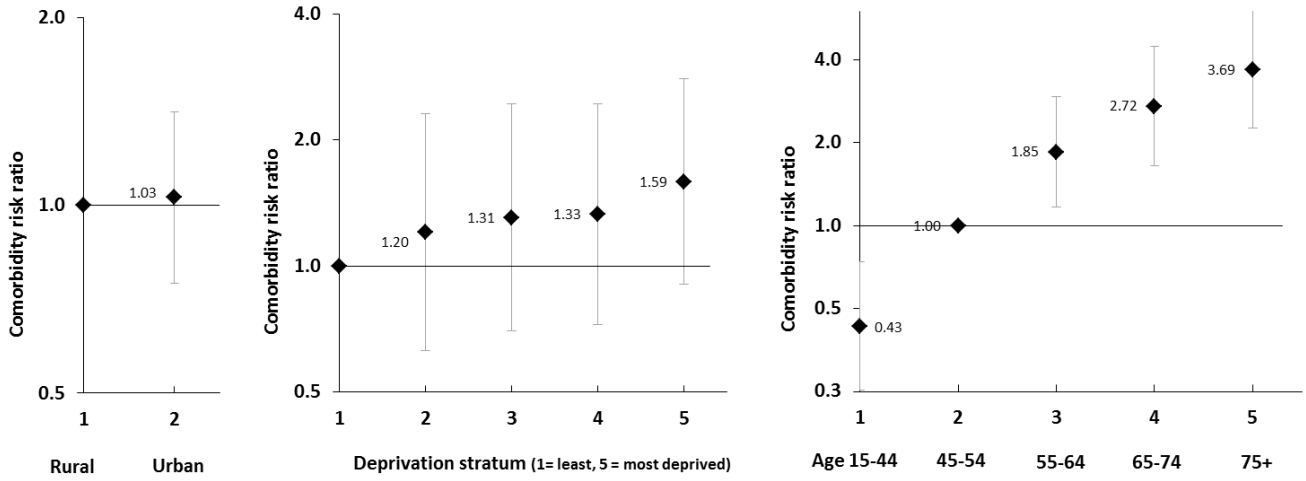


Figure 7.5.2 Risk ratios for comorbidity in cervical cancer patients, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group).

8 PROSTATE CANCER

Note: Age-specific groupings used for this cancer differ from other cancers presented in this report: age-groups 15-44 and 45-54 are combined and age-group 75+ is split into 75-84 and 85+ for prostate cancer, to better reflect the age-distribution of cases.

Key points

- *Incidence*
  - Urban and rural populations showed significantly different (in fact opposite) patterns of inequality in incidence by deprivation: for urban populations, age-standardised rates were 12% lower in the most deprived compared with the least deprived group; conversely, for rural populations rates were 27% higher in the most compared with least deprived group. This in effect cancelled out any overall influence of deprivation on incidence.
  - Incidence rates were 63% higher at ages 85+ than at 55-64, and also significantly higher at ages 65-74 and 75-84 (peaking at 65-74).
- *Survival*
  - Survival was significantly poorer (age-adjusted mortality hazard 13% higher) in urban than in rural populations.
  - Survival was significantly poorer (mortality hazard 33% higher) in the most compared with least deprived group.
  - Survival was significantly poorer (mortality hazard about 26 times higher) at ages 85+ compared with 55-64, and also poorer at ages 65-74 and 75-84, but higher at ages <55.
  - Stage-adjustment reduced the urban and age effects substantially but the deprivation effect only moderately.

Table 8.k.1 Visual summary of the influence of urban status, deprivation and age on prostate cancer in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, stage proportion, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 85+ (v. 55-64) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
Urban status	=	↓	=	IV ↑ III=	T ↓ S ↑ R ↓ H ↓	=
Deprivation	=	↓	I ↓ II ↓	III ↑ IV ↑	T ↑ S ↓ R ↑ C ↑ H ↑	↑
Older age	↑	↓	I ↓ II ↓	III ↓ IV ↑	T ↓ S ↓ R ↓ H ↑ C=	↑

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Stage*
  - Urban patients were significantly more likely to present at stage IV (+20% in relative terms) compared with rural patients, having adjusted for age.
  - Patients from the most deprived group were less likely to present at stage II (-5% relative) and more likely to present at stages III (+20%) and IV (+26%) compared with the least deprived group.
  - The oldest patients (age 85+) were almost five (4.9) times more likely to present at stage IV, but less likely to present at stages II (-64%) or III (-81%), compared with those aged 55-64. Similar but less marked findings applied to ages 75-84, and those aged 65-74 were also more likely to present at stage IV.
- *Treatment*
  - Urban patients were significantly more likely to have surgery (+12% in relative terms) and less likely to have radiotherapy (-9%), hormonal therapy (-18%) or any active treatment (-4%), having adjusted for age.
  - Patients from the most deprived populations were less likely to have surgery (-19% relative) but more likely to have radiotherapy (+12%), chemotherapy (+95%), hormonal therapy (+61%) or any treatment (+8%) compared with the least deprived group.
  - The influence of deprivation on use of hormonal therapy was significantly stronger for urban patients (66% more likely among the most deprived group) than for rural patients (32% more likely among the most deprived group).
  - Patients from the oldest age-group (85+) were less likely to have surgery (-58%), radiotherapy (-87%) or any active treatment (-27%) compared with those aged 55-64, but twice as likely to have hormonal therapy. Similar findings, but higher use of chemotherapy, applied to ages 75-84; age-group 65-74 had higher use of hormone therapy and radiotherapy and lower use of surgery, while patients <55 years had higher use of surgery and lower use of radiotherapy and hormone therapy, compared with ages 55-64.
- *Comorbidity*
  - Older patients were significantly more likely to have other serious health conditions recorded - six times more likely for the oldest (85+) compared with those aged 55-64.

8.1 Prostate cancer: incidence

Variation by urban/rural status

Age-standardised rates differed only slightly between rural and urban populations – 156 and 153 cases per 100,000, respectively (*Figure 8.1.1*) – and this variation was not statistically significant: directly age-standard rate ratio (DSRR) 0.98 (0.95-1.01) for urban v rural populations (*Table 8.1.1*, *Figure 8.1.2*).

Variation by deprivation

Age-standardised rates of prostate cancer ranged 150-159 cases per 100,000 across the five deprivation strata, with only limited indications of any relationship to deprivation (*Figure 8.1.1*). Rates were not significantly different in the most deprived compared with the least deprived stratum (DSRR 0.97, 95% CI 0.92-1.02), but were significantly lower in stratum 4 (DSRR 0.95, 0.90-0.99) (*Figure 8.1.2*).

Interaction between deprivation and urban/rural status

Urban and rural populations showed significantly different (in fact opposite) patterns of inequality in incidence by deprivation: DSRR 0.88 (95% CI 0.83-0.94) comparing the most with the least deprived urban populations versus 1.27 (1.14-1.42) for the same comparison among rural populations (P<0.001 for difference) (*Table 8.1.1*). This unexpected finding – i.e. higher incidence being associated with lower levels of deprivation in urban populations but with higher levels of deprivation in rural populations – may account for the lack of any overall association between prostate cancer incidence and deprivation noted above. We have not, however, ruled out the possibility that this difference could be confounded by other geographic differences in prostate cancer incidence (or diagnostic activity) rather than deprivation *per se*.

Table 8.1.1 Influence of deprivation on prostate cancer incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	DSRR most v least deprived	95% CI	z	P
Total	0.97	0.92-1.02		
Rural	*1.27	1.14-1.42		
Urban	0.88	0.83-0.94	5.73	*<0.001

Variation by age

Rates ranged from 19 to 880 cases per 100,000 between the youngest (15-54) and oldest (85+) age-groups examined, peaking at ages 65-74 but also high in the two oldest groups (*Figure 8.1.1*). Rates were about 60% higher in the oldest group compared with ages 55-64: DSRR 1.63 (1.48-1.80) *(Figure 8.1.2*). Rates at ages 55-64 and 65-74 were also significantly higher, while rates at age 15-54 were significantly lower, than at ages 55-64.

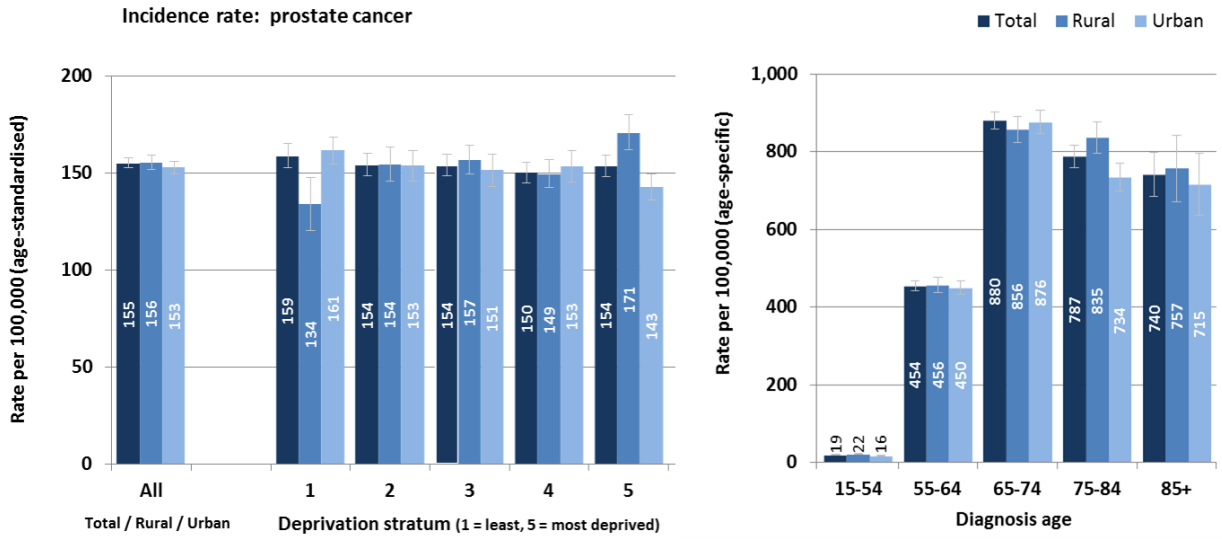


Figure 8.1.1 Incidence of prostate cancer, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

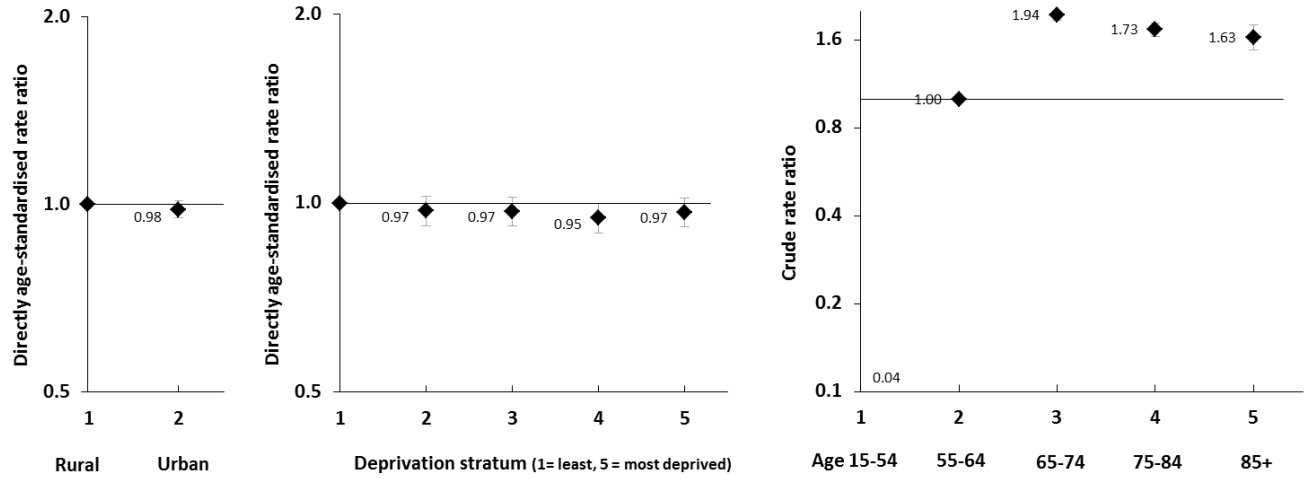


Figure 8.1.2 Rate ratios of prostate cancer incidence, by urban/rural status, deprivation stratum and diagnosis age.

8.2 Prostate cancer: cause-specific survival

Variation by urban/rural status

Five-year survival was similar for rural and urban patients (87.9% and 86.5% respectively: *Figure 8.2.1*). Modelling suggested poorer survival for urban patients but this was borderline significant (age-adjusted hazard ratio [HR] 1.13, 95% CI 1.00-1.28, P=0.05) and no longer significant after adjustment for stage (HR 1.03, 0.91-1.17) (*Figure 8.2.2*).

Variation by deprivation

Age-standardised estimates of five-year survival varied little (87-89%) across the deprivation strata, and appeared to show little clear evidence of a relationship to deprivation (*Figures 8.2.1 & 8.2.3*). Nevertheless, Cox modelling adjusted for age showed significantly poor survival (higher mortality) in the most deprived compared with the least deprived stratum: HR 1.33 (95% CI 1.08-1.63) (*Table 8.2.1*, *Figure 8.2.2*) or 1.27 (1.03-1.56) adjusted for stage, 1.22 (0.99-1.50) further adjusted for smoking and marital status (*Figure 8.2.2*). Survival of patients from stratum 3 was also significantly poorer: age/stage-adjusted HR 1.27 (1.03-1.57), or 1.25 (1.01-1.55) after adjustment for smoking and marital status. The apparent mismatch between the pattern shown by five-year outcomes and the model results may in part reflect the high survival percentages (thus mortality differentials less obvious from *Figure 8.2.1*). Perhaps more importantly, the model results are based on differences in mortality hazard across follow-up rather the fixed end-points. Some impression of this can be got from *Figure 8.2.3*, which compares five-year survival curves for the most and least deprived strata, though again the differences are somewhat obscured by the high absolute survival percentages.

Interaction between deprivation and urban/rural status

Urban populations showed significant variation in survival by deprivation status, with an age-adjusted mortality hazard ratio of 1.41 (95% CI 1.11-1.77) comparing patients from the most deprived with those from the least deprived urban populations (*Table 8.2.1*, *Figure 8.2.4).* Variation by deprivation was not quite statistically significant for rural populations – HR 1.70 (0.97-2.98) comparing the extremes – but there was no significant heterogeneity of the deprivation influence between urban and rural patients (P=0.56).

Table 8.2.1 Influence of deprivation on prostate cancer survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	*1.33	1.08-1.63		
Rural	1.70	0.97-2.98		
Urban	*1.41	1.11-1.77	0.58	0.56

Variation by age

Average five-year survival varied from 97% in the youngest patients (age 15-54) to 40% in the oldest (age 85+) (*Figure 8.2.1*). Expressed in terms of mortality hazards, this represented a 50-fold variation in relative risk of dying, or a 25-fold difference in risk between the baseline group (55-64) and the oldest group (85+): HR 25.6 (20.8-31.5) (*Figure 8.2.2*). Survival was also significantly poorer at ages 75-84 and 65-84, but was higher at ages <55, compared with aged 55-64.

Adjusting for stage reduced the age-related disparities substantially, for the two oldest groups, but they remained substantial: HR 8.8 (7.1-10.9) comparing ages 85+ with 55-64, or 4.0 (3.3-4.8) comparing 75-84 with 55-64. Further adjustment, for smoking and marital status, had little or no further effect on these comparisons. Stage thus appeared to be the main factor, of those examined, contributing to differences in survival by age, but only partly accounted for the disparities seen. As noted in the next section, substantial proportions of patients in the oldest age-groups presented at stage IV.

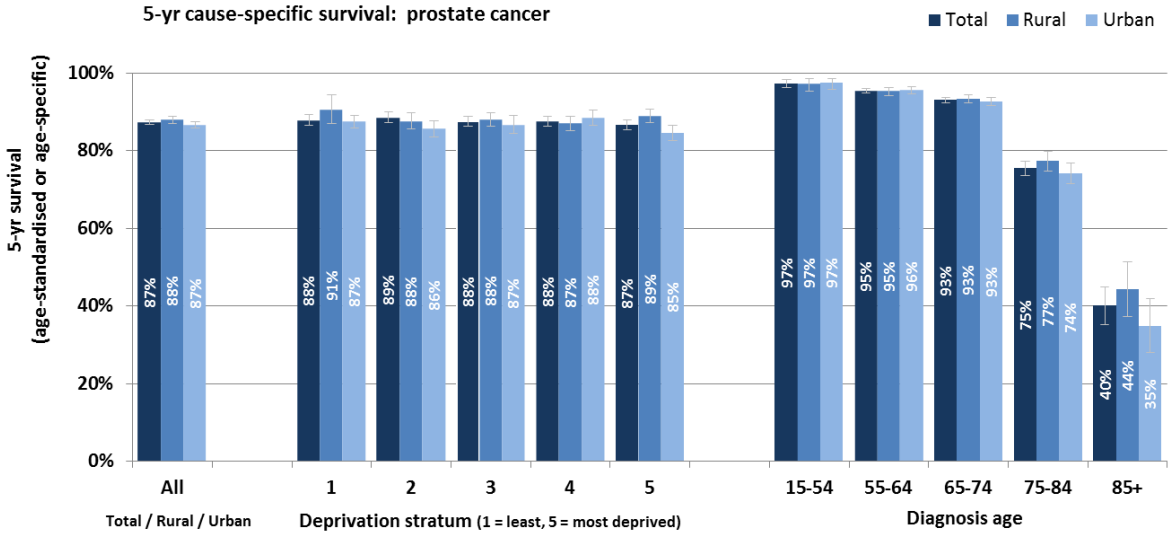


Figure 8.2.1 Cause-specific five-year survival of Irish prostate cancer patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age.

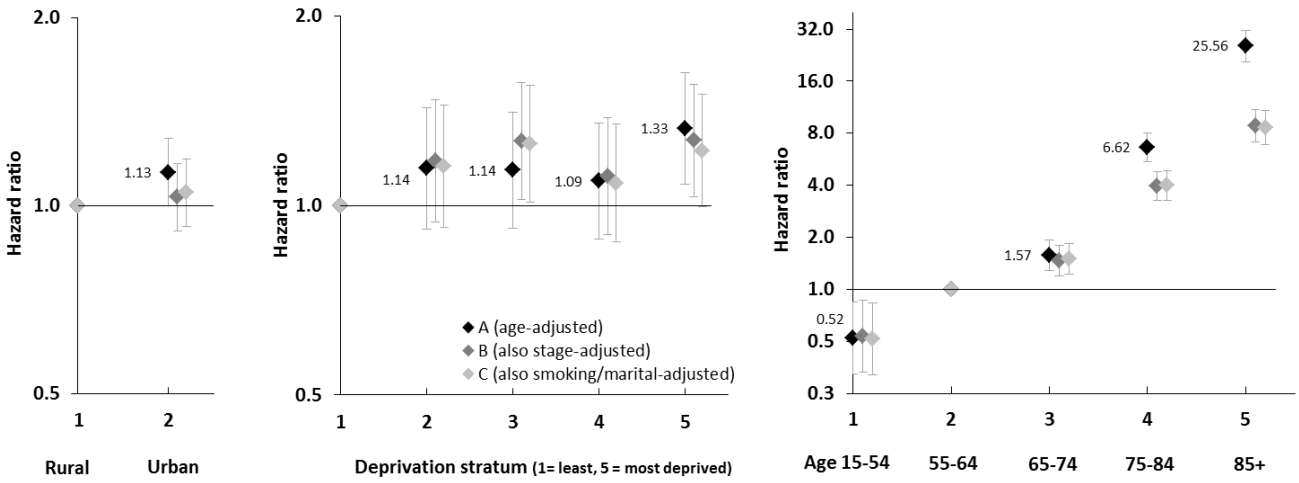


Figure 8.2.2 Mortality hazard ratios for prostate cancer survival, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group) and fuller models.

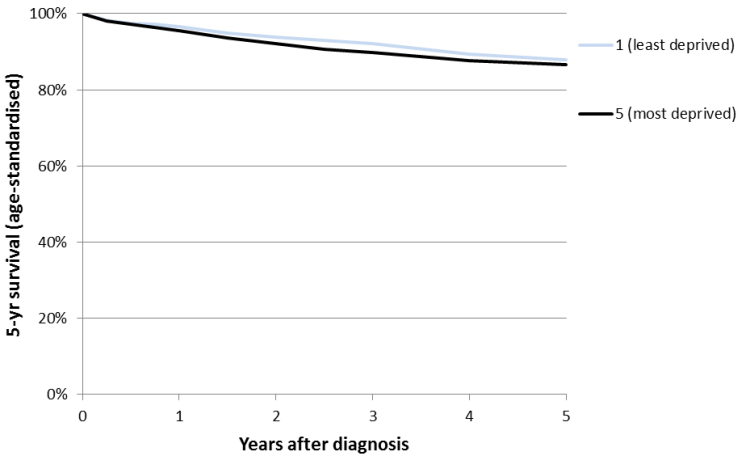


Figure 8.2.3 Cause-specific survival curves for prostate cancer patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

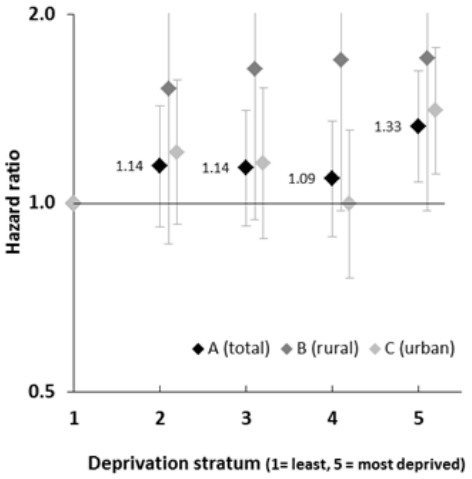


Figure 8.2.4 Mortality hazard ratios for prostate cancer survival, by deprivation stratum: age-adjusted models – all, rural and urban cases compared. See also *Table 8.2.1*.

8.3 Prostate cancer: stage (TNM 5th edition)

Note: In the 5th edition of TNM, Stage I cases for prostate cancer include only cases where the tumour is an incidental histological finding in 5% or less of tissue resected and with histopathological grade 1. Because of this restricted definition, few cases fall within Stage I. The definition of Stage I in the 7th edition of TNM is less restricted, but not applicable to the cases included below.

Variation by urban/rural status

Stage proportions ranged 68-69% for stage II, 12-13% for stage III, 8-9% for stage IV and 9-10% for unknown stage between rural and urban patients, with no difference for stage I (0.7%) (*Figure 8.3.*1). Urban patients were significantly more likely to present at stage IV, compared with rural patients: age-adjusted relative risk (RR) 1.20 (95% CI 1.08-1.33) (*Table 8.3.1*, *Figure 8.3.2*).

Variation by deprivation

The stage breakdown of prostate cancer cases ranged 0.6-0.9% for stage I, 66-70% for stage II, 11-13% for stage III, 8-10% for stage IV and 8-10% for unknown stage across the five deprivation strata (*Figure 8.3.1*). Patients from the most deprived stratum were less likely to present at stage II – age-adjusted RR 0.95 (0.92-0.99) compared with the least deprived group – and more likely to present at stages III and IV: RRs 1.20 (1.03-1.38) and 1.26 (1.06-1.48), respectively (*Table 8.3.1*, *Figure 8.3.2*).

Interaction between deprivation and urban/rural status

Rural cases showed a significant association of stage I with deprivation – RR 0.18 (0.05-0.63) for stratum 5 v 1 – not seen among urban cases: RR 0.98 (0.49-1.98) (P=0.03 for difference) (*Table 8.3.1*). Only urban cases showed a significant association of stages II and III with deprivation – RRs 0.93 (0.89-0.97) and 1.28 (1.08-1.51), respectively for stratum 5 v 1 – but significant urban/rural heterogeneity of the effects was not confirmed (P=0.33 and P=0.13, respectively). Both rural and urban cases showed a significant association between presentation at stage IV and deprivation – RR 1.70 (1.06-27.3) and 1.34 (1.11-1.61) respectively comparing the most deprived with the least deprived stratum – with no significant heterogeneity by urban/rural status (P=0.40).

Table 8.3.1 Influence of deprivation on prostate cancer stage, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	Stage I				Stage II			
	RR most v least deprived	95% CI	z	P	RR most v least deprived	95% CI	z	P
Total	0.62	0.33-1.14			*0.95	0.92-0.99		
Rural	*0.18	0.05-0.63			0.97	0.90-1.05		
Urban	0.98	0.49-1.98	2.17	*0.03	*0.93	0.89-0.97	0.97	0.33
	Stage III				**Stage IV**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	*1.20	1.03-1.38			*1.26	1.06-1.48		
Rural	0.99	0.73-1.34			*1.70	1.06-2.73		
Urban	*1.28	1.08-1.51	1.53	0.13	*1.34	1.11-1.61	0.84	0.40

Variation by age

Stage proportions by age ranged 0.2-0.9% for stage I, 27-76% for stage II, 3-14% for stage III, 6-28% for stage IV and 3-42% for unknown stage, with strong patterns of decreasing proportions of stage II and increasing proportions of stage IV with increasing age (*Figure 8.3.1*). Compared with patients aged 55-64, the oldest patients were almost five times more likely to present at stage IV (RR 4.90, 95% CI 4.16-5.78), and less likely to present at stage II (RR 0.36, 0.32-0.41) or III (RR 0.19, 0.12-0.30) (*Figure 8.3.2*). Similar (less marked) findings applied to patients aged 75-84, and those aged 65-74 were also more likely to present at stage IV.

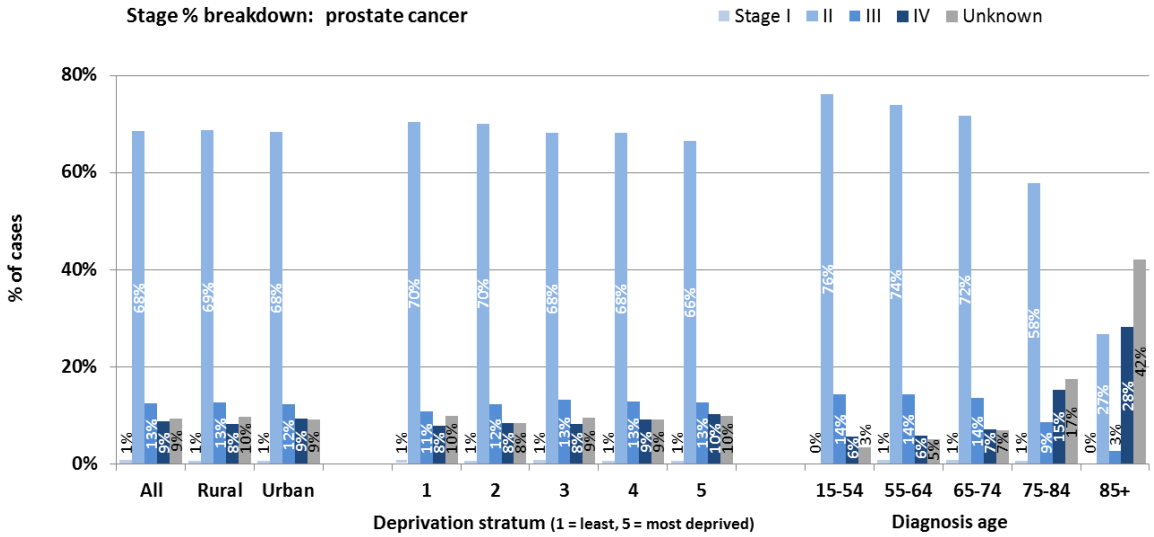


Figure 8.3.1 Stage breakdown of prostate cancer cases, 2008-2012, by urban/rural status, deprivation stratum and age.

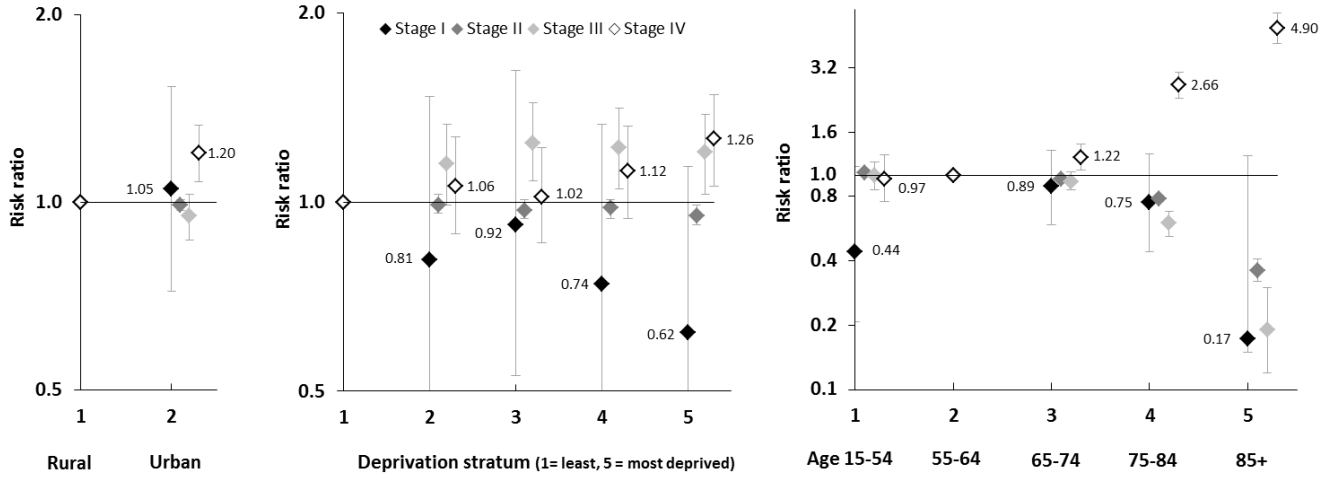


Figure 8.3.2 Risk ratios for prostate cancer stage, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group). RRs for unknown stage are not plotted but are noted in text if significant.

Text and graphical summaries above are based on comparisons of the percentage stage composition of cases. To provide further context, stage-specific incidence rates are presented in *Figure 8.3.3* (below). These rates reflect a combination of overall incidence rates and stage, thus are more complex to interpret.

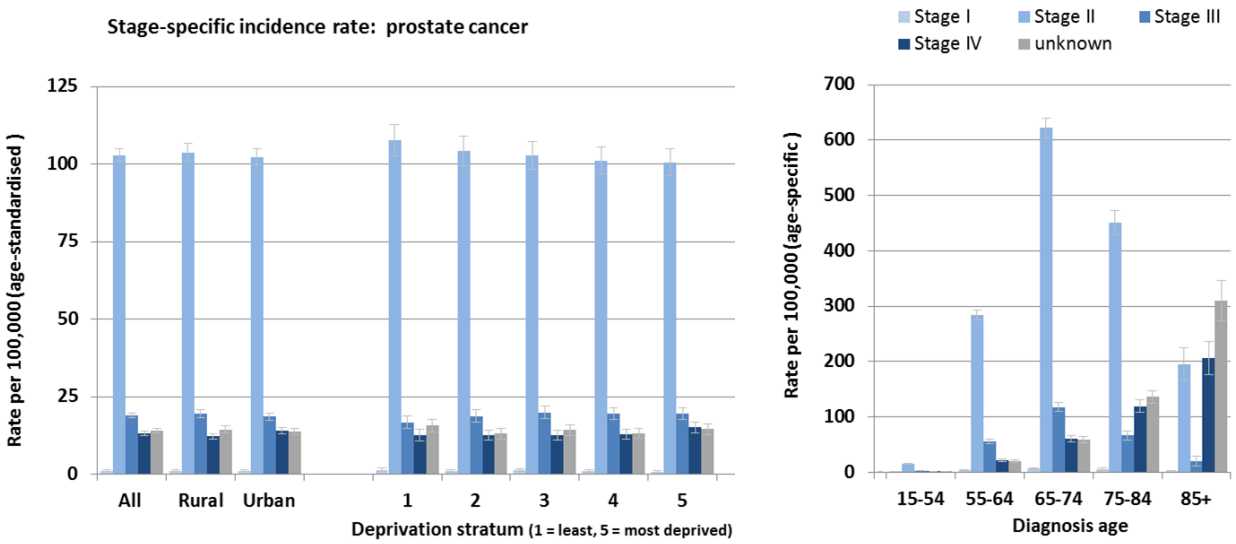


Figure 8.3.3 Stage-specific incidence of prostate cancer, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

8.4 Prostate cancer: tumour-directed treatment

Note: Treatments analysed here are those within a year after (or up to one month before) formal date of diagnosis. However, for substantial numbers of prostate cancer patients, 'active surveillance' may be the initial care plan, or planned treatment may not start until more than a year after diagnosis. Thus the absolute treatment percentages quoted below may underestimate planned or actual treatment for this cancer, though the relative patterns and comparisons are less likely to be affected.

Variation by urban/rural status

Unadjusted proportions of patients treated ranged 76-78% overall between rural and urban cases, 42-45% for radiotherapy, at least 29-35% for hormonal therapy and 24-28% for surgery, and were similar (1.1%) for chemotherapy (*Figure 8.4.1*). Urban cases were significantly more likely to have surgery (age-adjusted relative risk [RR] 1.12, 95% CI 1.06-1.18) and significantly less likely to have recorded hormonal therapy (RR 0.82, 0.78-0.86), radiotherapy (RR 0.91, 0.88-0.94) or any treatment (RR 0.96, 0.94-0.98) (*Figure 8.4.2*). Adjustment for stage had little or no effect: RRs 1.13 (1.07-1.19) for surgery, 0.80 (0.77-0.84) for hormonal therapy, 0.91 (0.88-0.95) for radiotherapy and 0.96 (0.94-0.98) overall (not graphed).

Variation by deprivation

The crude (unadjusted) proportion of prostate cancer patients having any tumour-directed treatment ranged 72-78% between deprivation strata, or 42-47% for radiotherapy, 23-38% for hormone therapy, 21-31% for surgery and 0.8-1.5% for chemotherapy (*Figure 8.4.1*). Patients from the most deprived stratum were significantly more likely than those from the least deprived stratum to have chemotherapy (age-adjusted RR 1.95, 95% CI 1.15-3.32), hormone therapy (RR 1.61, 1.48-1.75), radiotherapy (RR 1.12, 1.06-1.19) or any treatment (RR1.08, 1.05-1.12) (*Table 8.4.1*, *Figure 8.4.2*). In contrast, those from the most deprived stratum were less likely to have surgery: RR 0.81 (0.74-0.89). Adjustment for stage reduced these differences slightly (not tabulated) – most strongly for chemotherapy (to RR 1.69, 1.00-2.85), less markedly for hormone therapy (RR 1.54, 1.42-1.66), surgery (RR 0.80, 0.74-0.88), radiotherapy (RR 1.12, 1.05-1.08) and overall treatment (RR 1.07, 1.04-1.11).

Data on hormonal therapy are likely to be incomplete (as some outpatient prescriptions are likely to be missed), and the apparent relationship between deprivation and hormonal use could possibly be biased. For example, if a higher proportion of data was missing for patients treated in private hospitals, it might appear that patients from the least deprived group (the patients most likely to be treated in private hospitals) were less likely to have hormonal therapy.

Interaction between deprivation and urban/rural status

The influence of deprivation on use of hormonal therapy was stronger for urban patients (RR 1.66, 1.50-1.83 comparing stratum 5 v 1) than rural patients (1.32, 1.10-1.56) (P=0.017 for difference) (*Table 8.4.1*). Likewise, for overall treatment the deprivation influence was stronger for urban patients (RR 1.12, 1.08-1.16) than rural patients (0.99, 0.93-1.06) (P<0.001). For surgery, however, the deprivation influence was stronger for rural patients (RR 0.67, 0.55-0.83) than urban patients (0.94, 0.84-1.04) (P=0.0019). No significant variation in deprivation influence was evident for radiotherapy, and chemotherapy data were too sparse to allow comparison (*Table 8.4.1*).

Table 8.4.1 Influence of deprivation on prostate cancer treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	Any treatment							
	RR most v least deprived	**95% CI**	**z**	**P**				
Total	*1.08	1.05-1.12						
Rural	0.99	0.93-1.06						
Urban	*1.12	1.08-1.16	3.45	*<0.001				
	Surgery				**Radiotherapy**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	*0.81	0.74-0.89			*1.12	1.06-1.19		
Rural	*0.67	0.55-0.83			1.06	0.94-1.19		
Urban	0.94	0.84-1.04	3.11	*0.0019	*1.11	1.03-1.19	0.67	0.50
	Chemotherapy				**Hormonal therapy**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	*1.95	1.15-3.32			*1.61	1.48-1.75		
Rural	-	-			*1.32	1.10-1.56		
Urban	1.77	0.99-3.16	-	-	*1.66	1.50-1.83	2.39	*0.017

Variation by age

The proportions of patients treated ranged 58-82% overall between age-groups, 6-54% for radiotherapy, 14-52% for surgery, at least 13-49% for hormonal therapy and 0.9-1.6% for chemotherapy (*Figure 8.4.1*). Use of hormonal therapy increased with age, surgery and overall treatment decreased with age, while radiotherapy use peaked in the age 65-74 group. Compared with ages 55-64, the two oldest groups (75-84 and 85+) were significantly more likely to have hormonal therapy and significantly less likely to have surgery, radiotherapy or any treatment: for age-group 85+, RRs 2.05 (95% CI 1.86-2.27) for hormone therapy, 0.42 (0.34-0.50) for surgery, 0.13 (0.10-0.18) for radiotherapy and 0.73 (0.68-0.78) for any treatment (*Figure 8.4.2*). Age-group 75-84 also had higher use of chemotherapy (RR 1.77, 1.18-2.65). Age-group 65-74 had significantly higher use of hormone therapy and radiotherapy and lower use of surgery, compared with ages 55-64; patients <55 years had higher use of surgery and lower use of radiotherapy and hormone therapy.

Age-related variations remained significant and largely unchanged after adjustment for stage, except that chemotherapy use was no longer significantly high for ages 75-84 (RR 1.06, 0.69-1.64) (not graphed).

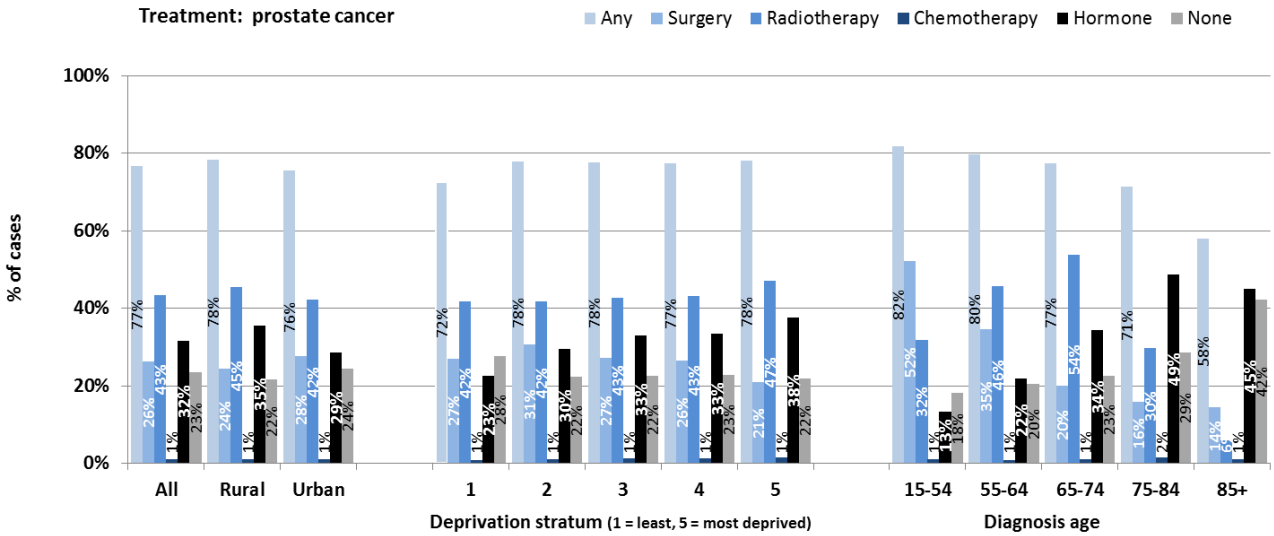


Figure 8.4.1 Treatment of prostate cancer within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

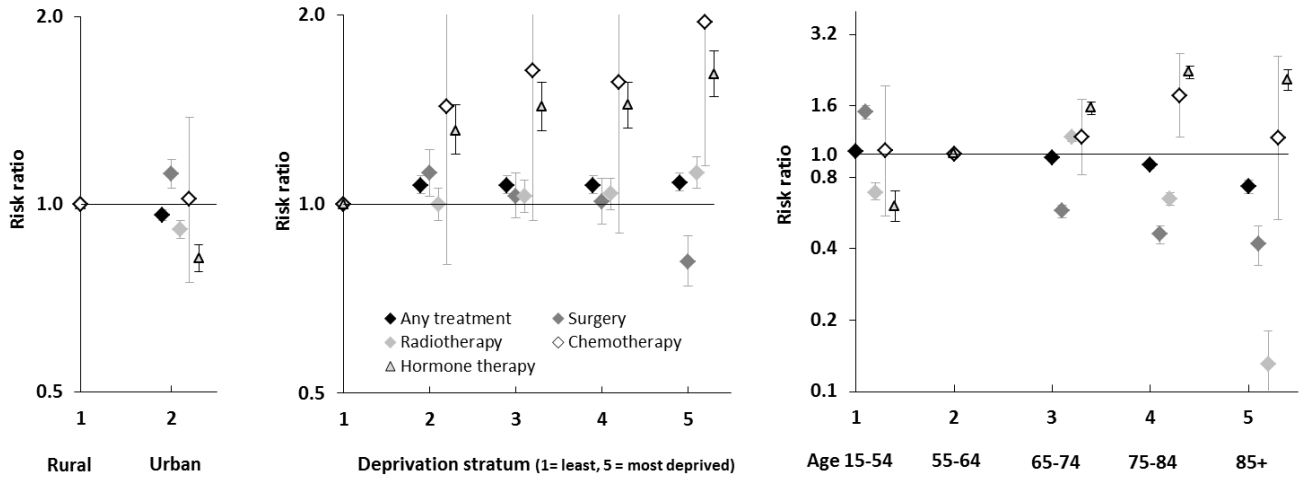


Figure 8.4.2 Risk ratios for treatment of prostate cancer, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group).

8.5 Prostate cancer: comorbidity

Variation by urban/rural status

Similar percentages of rural patients (10.0%) and urban patients (9.7%) had clinically significant health conditions recorded at or around the time of cancer diagnosis (*Figure 8.5.1*), with no significant difference after adjustment for age: relative risk (RR) 1.02 (95% CI 0.90-1.15) (*Figure 8.5.2*).

Variation by deprivation

The proportion of prostate cancer patients with one or more serious comorbidities ranged 9-11% across the five deprivation strata, and appeared to increase slightly with increasing levels of deprivation (*Figure 8.5.1*). However, variation was not statistically significant; comparing the most with the least deprived stratum, an age-adjusted RR of 1.14 (95% CI 0.93-1.39) (*Table 8.5.1*, *Figure 8.5.2*).

Interaction between deprivation and urban/rural status

Variation by deprivation was not significant for either rural or urban patients (not graphed) and, based on comparisons between the most and least deprived strata, the strength of the deprivation effect did not differ significantly between urban and rural patients (P=0.82) (*Table 8.5.1*).

Table 8.5.1 Influence of deprivation on comorbidity in prostate cancer patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	1.14	0.93-1.39		
Rural	1.11	0.70-1.76		
Urban	1.18	0.93-1.49	0.23	0.82

Variation by age

Comorbidity percentages varied from 5% to 35% across the age-groups examined, and beyond ages 55-64 showed a very strong increase with increasing age (*Figure 8.5.1*). Patients in the oldest group (85+) were six times more likely to have recorded comorbidities than those aged 55-64 – RR 6.33 (95% CI 5.17-7.74)– and those aged 65-74 and 75-84 also had significantly higher comorbidity prevalence (*Figure 8.5.2*).

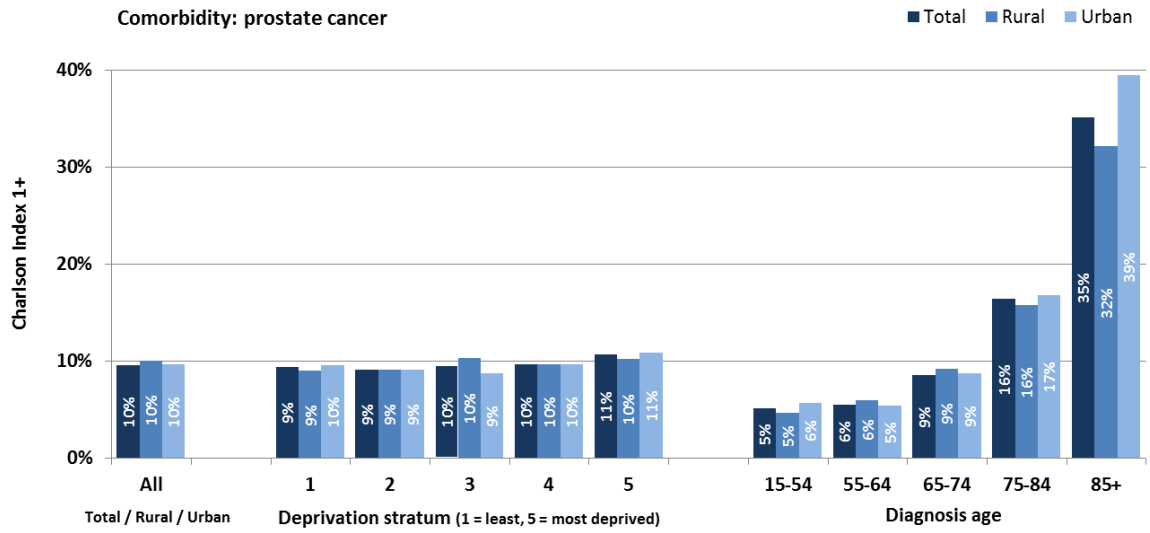


Figure 8.5.1 Comorbidity in prostate cancer patients, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

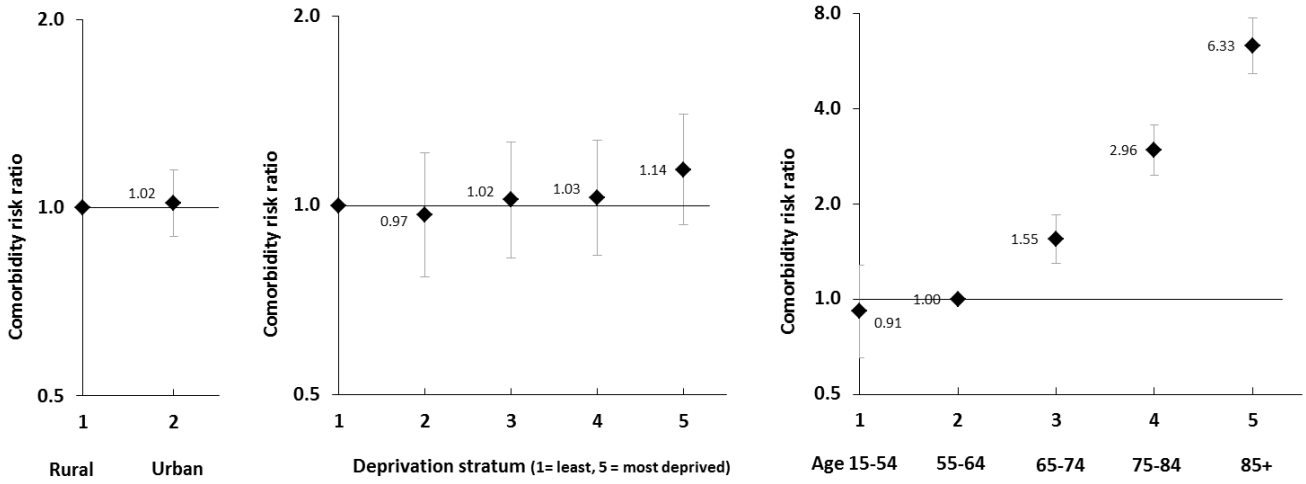


Figure 8.5.2 Risk ratios for comorbidity in prostate cancer patients, by urban/rural status, deprivation stratum and diagnosis age: age-adjusted models (or unadjusted models by age-group).

9 LYMPHOMA

Note: Both Hodgkin and non-Hodgkin lymphomas are included here, but some analyses are adjusted for casemix based on 3-digit ICD10 codes: C81 Hodgkin lymphoma, and four individual codes C82-C85 for non-Hodgkin lymphomas. Acute v chronic disease status was not adjusted for.

Key points

- *Incidence*
  - Incidence rates were about five times higher in the oldest group (75+) than at ages 45-54.
- *Survival*
  - Survival was significantly poorer (age/sex-adjusted mortality risk 36% higher) in the most compared with the least deprived population quintile.
  - Survival was significantly poorer (mortality hazard over five [5.5] times higher) at ages 75+ compared with 45-54, and also poorer at ages 55-64 and 65-74, but higher at ages 15-44.

Table 9.k.1 Visual summary of the influence of urban status, deprivation and age on lymphoma in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, stage proportion, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Early stage[c]	Late stage[d]	Treatment[e]	Comorbidity[f]
Urban status	=	=	=	=	S↑ TSRC=	=
Deprivation	=	↓	II↑ I=	=	R↑ TSC=	↑
Older age	M↑ F↑	↓	I↓ II↓	III= IV=	T↓S↓C↓R=	↑

For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Stage*
  - Patients from the most deprived group were significantly more likely (+23% in relative terms) to present at stage II, compared with the least deprived group, adjusted for age and sex.
  - The oldest patients (age 75+) were significantly less likely (-24%) to present at stage I, and more likely to be of unknown stage, than those aged 45-54. Patients aged 15-44 were more likely to be stage II and less likely to be stage IV or unknown stage.
- *Treatment*
  - Chemotherapy, surgery and overall treatment use were significantly lower among the oldest patients (age 75+) compared with age-group 45-54: 31% lower in relative terms for chemotherapy, 32% lower for surgery and 24% lower for overall treatment. Patients aged 65-74 were also less likely to have chemotherapy, and those aged 55-64 and 65-74 less likely to have any treatment, compared with ages 45-54.
- *Comorbidity*
  - Patients in the most deprived group were significantly more likely (+32% in relative terms) to have at least one serious comorbidity than patients from the least deprived group.
  - The oldest patients (age 75+) were almost twice (1.8 times) as likely to have other significant health conditions recorded, compared with ages 45-54; comorbidity prevalence was also higher at ages 65-74.

9.1 Lymphoma: incidence

Variation by urban/rural status

Age-standardised rates were similar in urban populations for males (21 cases per 100,000) and slightly higher for females (16 v 15 per 100,000) (*Figure 9.1.1*). Variation was not statistically significant: directly age-standardised rate ratio (DSRR) 1.00 (0.91-1.09) for males and 1.07 (0.97-1.18) for females (*Figure 9.1.2*).

Variation by deprivation

Age-standardised rates of lymphoma ranged 20-22 cases per 100,000 males and 15-16 cases per 100,000 females across the five deprivation strata (*Figure 9.1.1*). There was no clear relationship with deprivation, and none of the deprivation-specific rates differed significantly from the rate in the least deprived (*Table 9.1.1*, *Figure 9.1.2*).

Interaction between deprivation and urban/rural status

Neither sex showed any significant influence of deprivation on incidence and, based on comparisons between the most with the least deprived strata, the deprivation influence did not differ significantly between urban and rural populations (P=1.00 for males, P=0.35 for females) (*Table 9.1.1*).

Table 9.1.1 Influence of deprivation on lymphoma incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	Males				Females			
	DSRR most v least deprived	95% CI	z	P	DSRR most v least deprived	95% CI	z	P
Total	0.98	0.85-1.13			1.03	0.89-1.20		
Rural	0.97	0.71-1.30			1.21	0.86-1.70		
Urban	0.97	0.81-1.15	0.002	1.00	1.00	0.84-1.20	0.94	0.35

Variation by age

Male rates ranged from 8 to 112 cases and female rates from 7 to 74 cases per 100,000 between the youngest (15-44) and oldest (75+) age-groups examined, with a very strong pattern of increased incidence with age (*Figure 9.1.1*). Rates were about five times higher in the oldest group than in the 45-54 comparison group: DSRR 5.0 (4.1-6.0) for males, 4.8 (4.0-5.7) for females *(Figure 9.1.2*). Rates at ages 55-64 and 65-74 were also significantly higher, while rates at age 15-44 were significantly lower, than at ages 45-54.

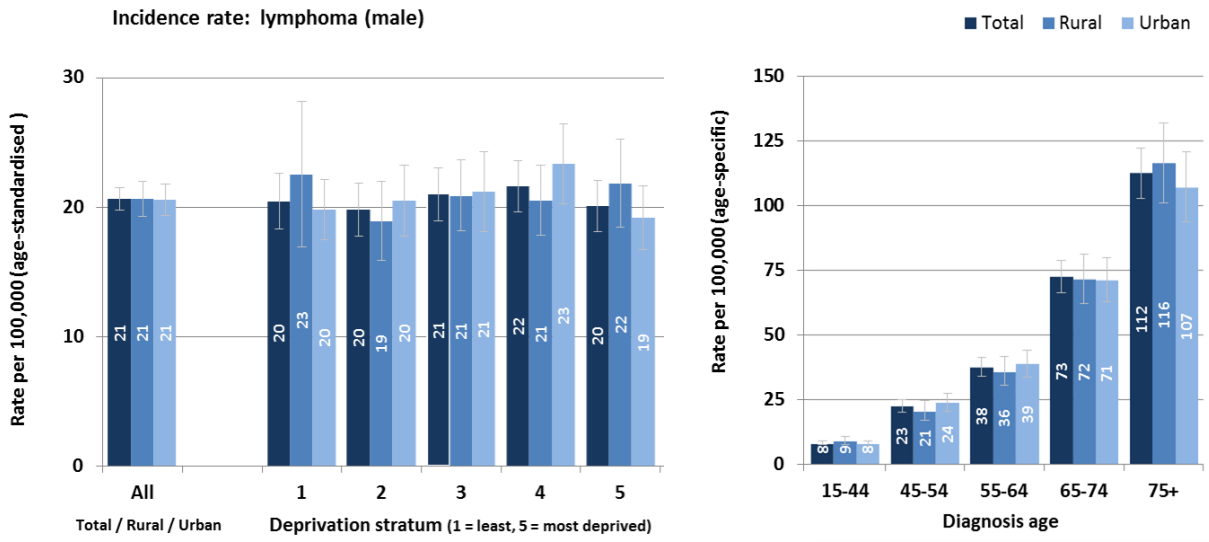


Figure 9.1.1(a) Incidence of lymphoma (males), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

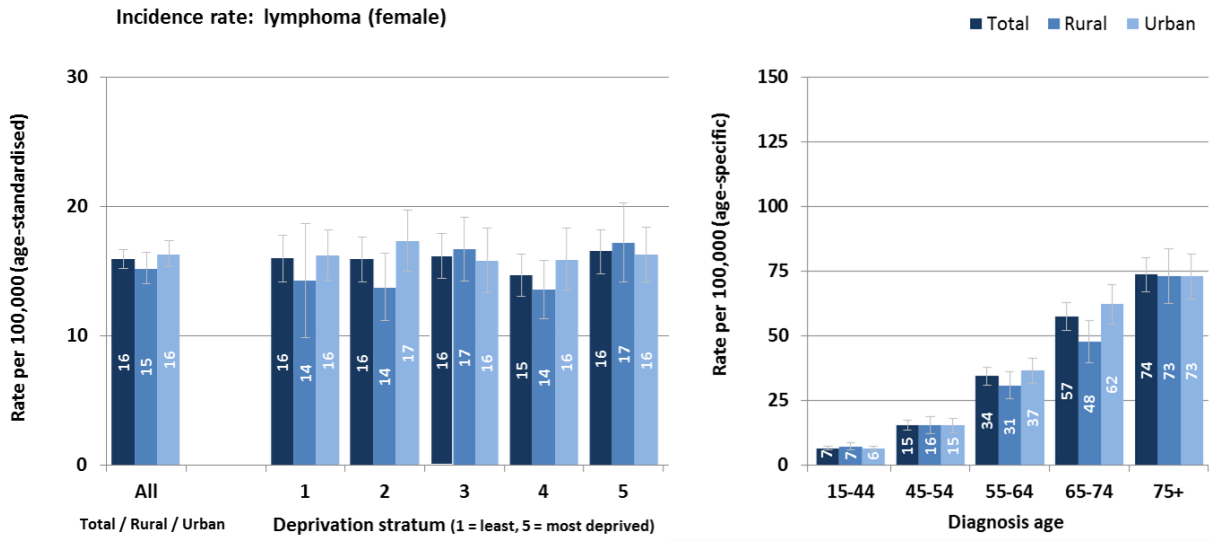


Figure 9.1.1(b) Incidence of lymphoma (females), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

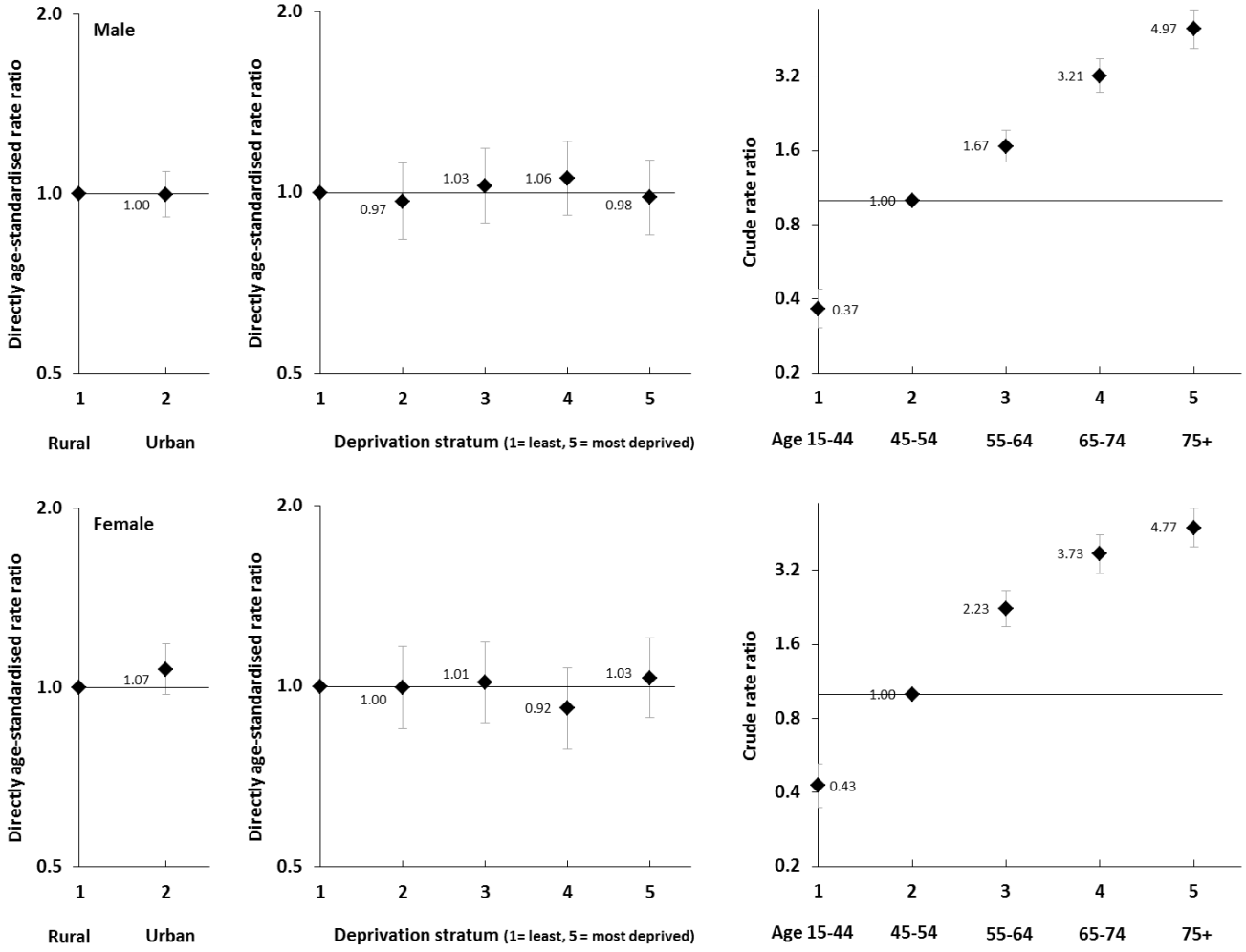


Figure 9.1.2 Rate ratios of lymphoma incidence, by urban/rural status, deprivation stratum and diagnosis age.

9.2 Lymphoma: cause-specific survival

Variation by urban/rural status

Rural and urban cases had similar average five-year survival (66%: *Figure 9.2.1*), with no significant difference in mortality hazards: age/sex-adjusted hazard ratio (HR) 1.00 (95% CI 0.87-1.15), or 0.99 (0.86-1.14) after fuller adjustment (*Figure 9.2.2*).

Variation by deprivation

Age-standardised five-year survival varied from 63% to 70% across deprivation strata, with fairly clear evidence of a trend (albeit not fully linear) towards poor survival among patients from the most deprived strata (*Figures 9.2.1 & 9.2.3*). Cox modelling confirmed poorer survival (a higher mortality hazard) for the most deprived compared with the least deprived stratum: age/sex-adjusted HR 1.36 (95% CI 1.08-1.65) (*Table 9.2.1*), or 1.31 (1.04-1.64) after further adjustment for casemix, stage, smoking and marital status (*Figure 9.2.2*). Hazard ratios for intermediate strata were not statistically significant.

Interaction between deprivation and urban/rural status

Urban populations showed significant variation in survival by deprivation status, with an age/sex-adjusted hazard ratio of 1.48 (95% CI 1.14-1.92) comparing patients from the most deprived with those from the least deprived urban populations (*Table 9.2.1*, *Figure 9.2.4*). Variation by deprivation was not significant for rural patients but significant heterogeneity of the deprivation influence between urban and rural patients was not confirmed (P=0.09).

Table 9.2.1 Influence of deprivation on lymphoma survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	*1.36	1.08-1.65		
Rural	0.96	0.60-1.54		
Urban	*1.48	1.14-1.92	1.71	0.09

Variation by age

Five-year survival ranged 41-92% across the five age-groups examined, and showed a clear decrease with increasing age (*Figure 9.2.1*). Cancer-specific mortality was significantly higher for ages 75+ compared with 45-54: sex-adjusted HR 5.45 (4.22-7.03), or 5.43 (4.20-7.01) after stage-adjustment, 4.48 (3.43-5.69) after casemix-adjustment (*Figure 9.2.2*). Survival was also significantly poorer for ages 65-74 and 55-64 compared with ages 45-54, but significantly higher for ages 15-44.

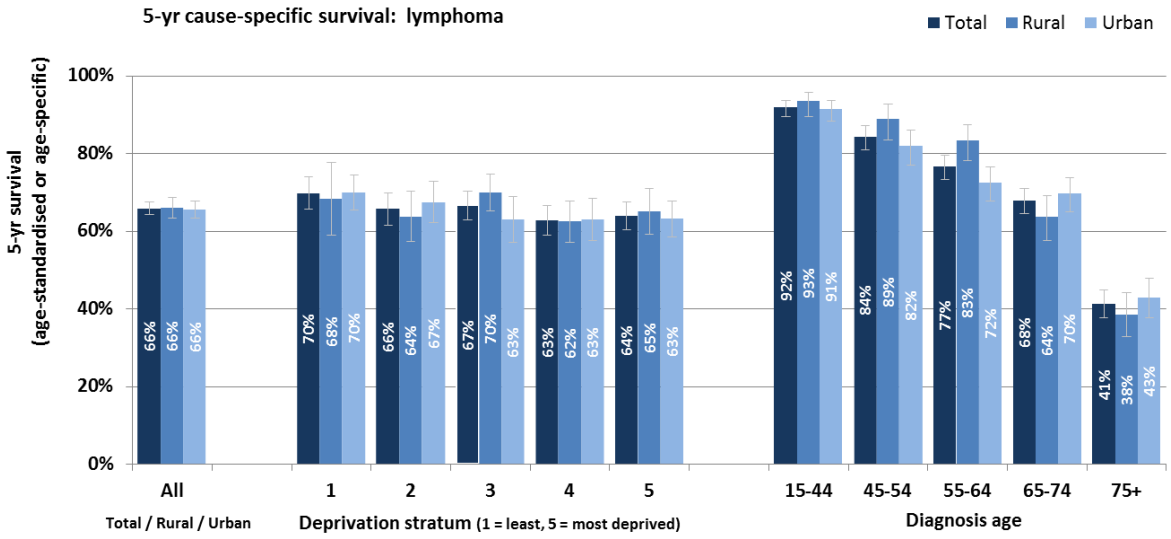


Figure 9.2.1 Cause-specific five-year survival of Irish lymphoma patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age.

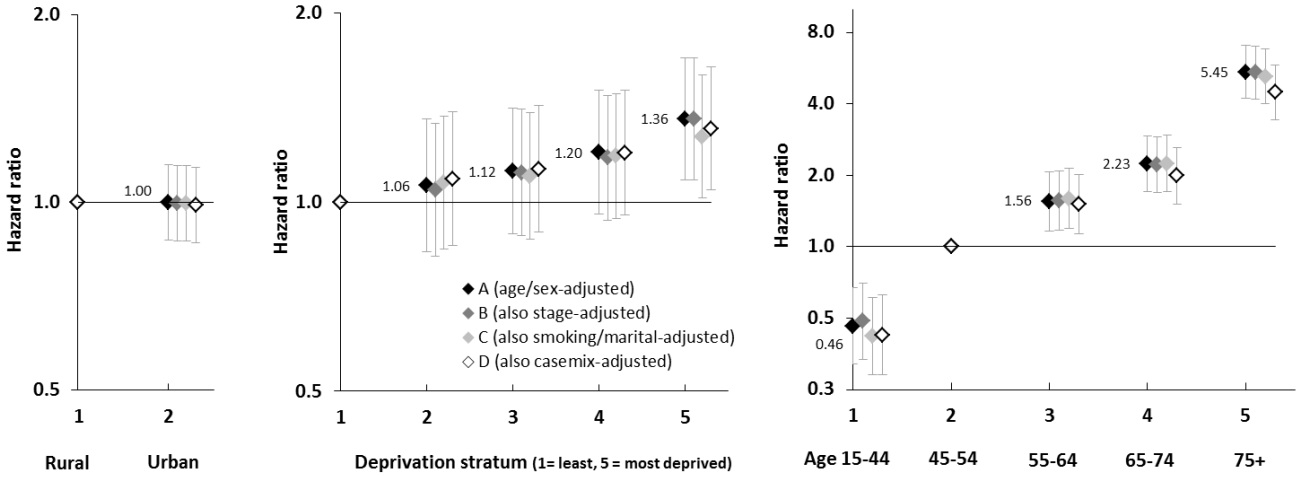


Figure 9.2.2 Mortality hazard ratios for lymphoma survival, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or unadjusted sex-adjusted models by age-group) and fuller models.

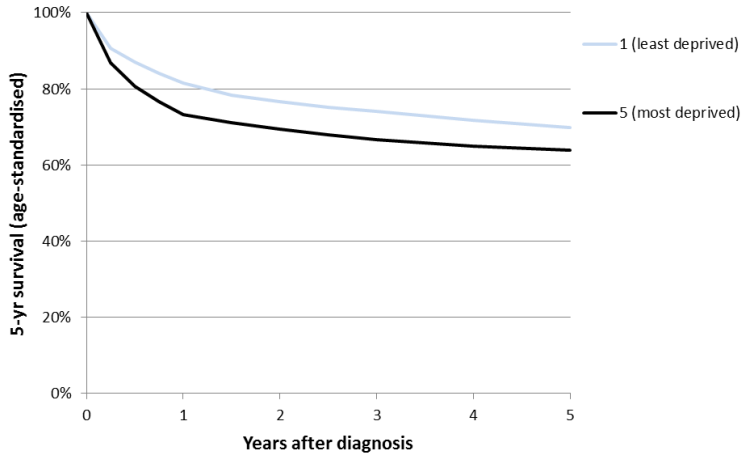


Figure 9.2.3 Cause-specific survival curves for lymphoma patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

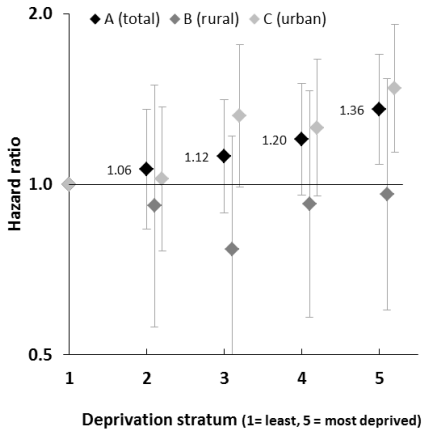


Figure 9.2.4 Mortality hazard ratios for lymphoma survival, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. See also *Table 9.2.1*.

9.3 Lymphoma: stage (Ann Arbor staging)

Variation by urban/rural status

Stage proportions ranged 20-21% for stage I, 19-20% for stage II, 18-19% for stage III, 26-27% for stage IV and 14-15% for unknown stage between rural and urban populations (*Figure 9.3.1*), with no significant differences after adjustment for age and sex (*Figure 9.3.2*).

Variation by deprivation

The stage breakdown of cases ranged 19-24% for stage I, 17-22% for stage II, 17-20% for stage III, 25-28% for stage IV and 13% for unknown stage across the five deprivation strata (*Figure 9.3.1*). Patients from the most deprived stratum were significantly more likely to present at stage II than those from the least deprived stratum: age/sex-adjusted relative risk (RR) 1.23 (95% CI 1.00-1.52). Otherwise, apart from a higher proportion of stage II cases in patients from stratum 2, and lower proportions of unknown stage for strata 2-4, there was no significant association of stage with deprivation.

Interaction between deprivation and urban/rural status

In rural populations, stage III made up a lower proportion of cases from the most deprived compared with the least deprived stratum – RR 0.55 (0.36-0.84) – but the opposite pattern (although not statistically significant) was seen among urban population: RR 1.20 (0.91-1.57) (P=0.001 for difference) (*Table 9.3.1, Figure 9.3.3*). A similar pattern was seen

comparing deprivation stratum 4 with the least deprived stratum, with RR 0.71 (0.49-1.06) for rural cases but 1.36 (1.04-1.79) for urban cases (z=2.72, P=0.007 for difference). For stages I-II and IV, neither urban nor rural cases showed a significant influence of deprivation and the influence of deprivation on stage composition did not vary significantly by urban/rural status (comparing the most deprived with least deprived stratum).

Table 9.3.1 Influence of deprivation on lymphoma stage, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Stage I				Stage II			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.92	0.75-1.13			*1.23	1.00-1.52		
Rural	0.75	0.49-1.15			1.45	0.86-2.43		
Urban	1.00	0.79-1.27	1.23	0.22	1.23	0.97-1.57	0.54	0.59
	Stage III				**Stage IV**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	0.99	0.79-1.25			0.94	0.79-1.12		
Rural	*0.55	0.36-0.84			0.84	0.58-1.22		
Urban	1.20	0.91-1.57	3.20	*0.0014	1.00	0.82-1.23	0.84	0.40

Variation by age

Stage proportions by age-group ranged 19-14% for stage I, 16-35% for stage II, 15-21% for stage III, 22-28% for stage IV and 8-22% for unknown stage (*Figure 9.3.1*). The oldest patients (age 75+) were significantly less likely to present at stage I (sex-adjusted RR 0.76, 95% CI 0.63-0.93) and more likely to be of unknown stage (1.76, 1.37-.2.27) compared with ages 45-54 (*Figure 9.3.2*). Patients aged 15-44 were significantly more likely be stage II, and less likely to be stage IV or unknown stage, than ages 45-54.

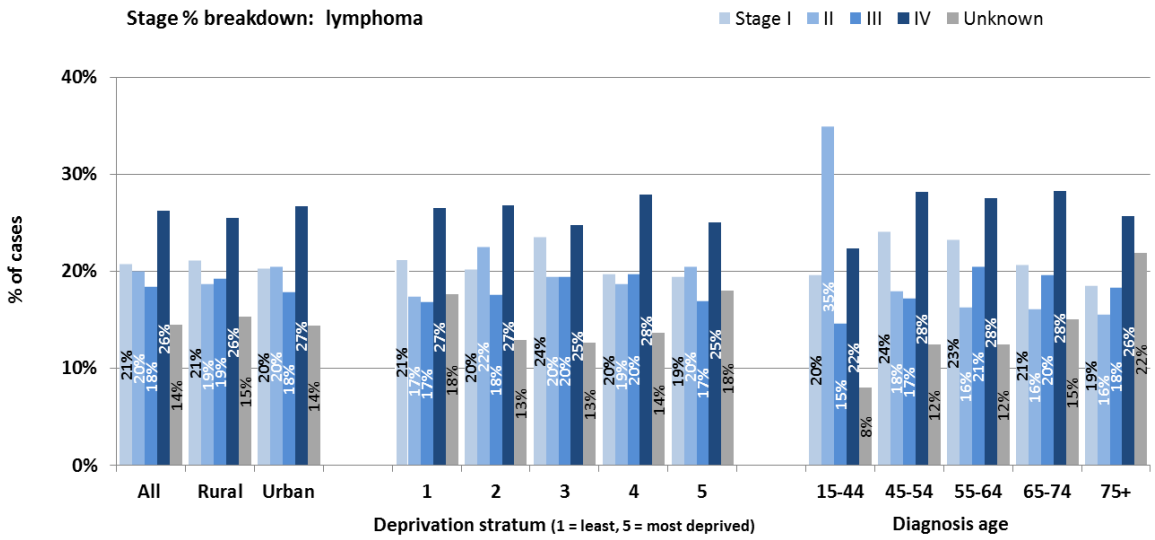


Figure 9.3.1 Stage breakdown of lymphoma cases, 2008-2012, by urban/rural status, deprivation stratum and age.

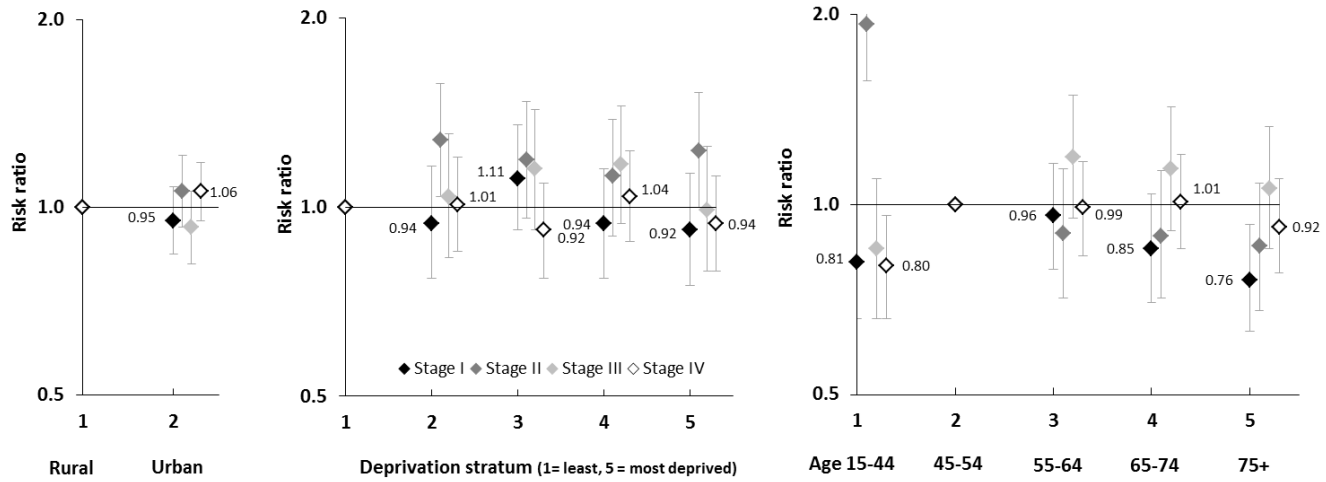


Figure 9.3.2 Risk ratios for lymphoma stage, by urban/rural status, deprivation stratum and diagnosis age: age/sex - adjusted models (or sex/casemix-adjusted models by age-group). RRs for unknown stage are not plotted but are noted in text if significant.

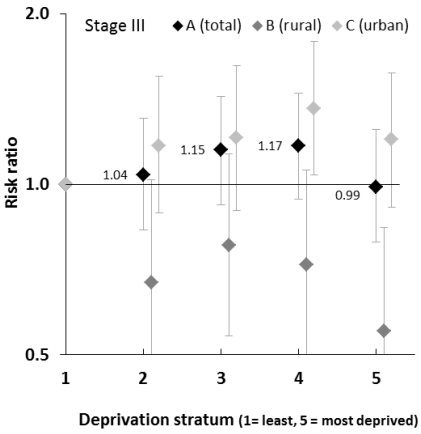


Figure 9.3.3 Risk ratios for lymphoma stage III, by deprivation stratum: age/sex-adjusted-– all, rural and urban cases compared. The pattern by deprivation for stages I, II and IV did not differ significantly between rural and urban cases. See also *Table 9.3.1*.

Text and graphical summaries above are based on comparisons of the percentage stage composition of cases. To provide further context, stage-specific incidence rates are presented in *Figure 9.3.4* (below).

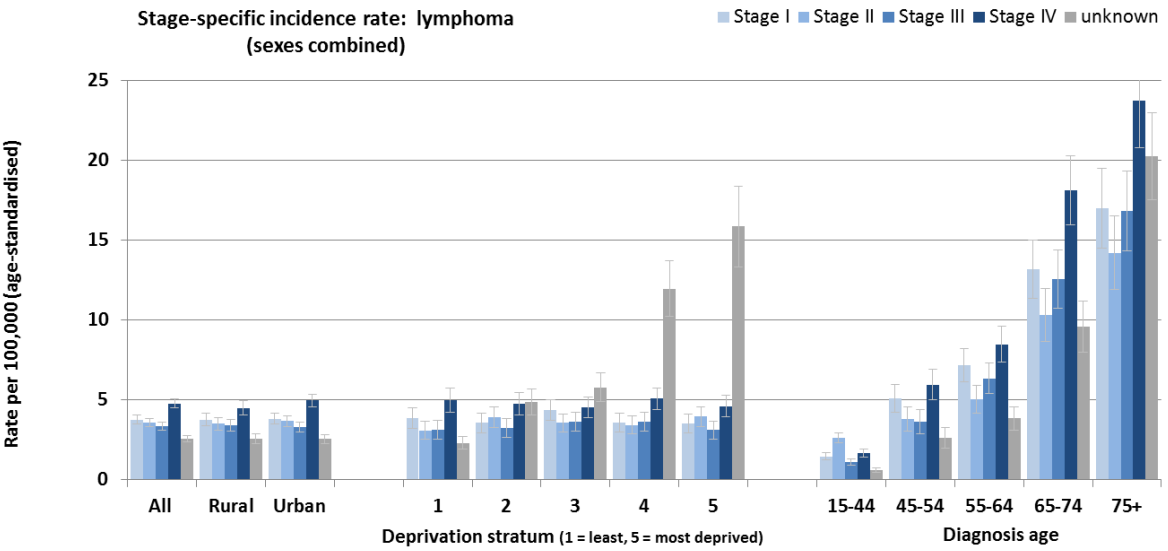


Figure 9.3.4 Stage-specific incidence of lymphoma, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Rates are standardised for sex (i.e. assume equal populations of males and females in all age-groups).

9.4 Lymphoma: tumour-directed treatment

Variation by urban/rural status

The basic treatment percentages showed only minor variation between rural and urban cases – ranges 77-78% overall, 69-71% for chemotherapy, 17-19% for radiotherapy and both 9% for surgery (*Figure 9.4.1*) – and none of the differences was significant having adjusted for age, sex and casemix (*Figure 9.4.2*).

Variation by deprivation

Crude (unadjusted) proportions of lymphoma patients having any tumour-directed treatment ranged 75-79% between deprivation strata, or 67-72% for chemotherapy, 16-19% for radiotherapy and 9-10% for surgery (*Figure 9.4.1*). However, there was no significant variation by deprivation status (*Table 9.4.1*, *Figure 9.4.2*).

Interaction between deprivation and urban/rural status

Rural and urban cases showed no significant deprivation effects, and no significant differences in deprivation effect (comparing the most with the least deprived strata), for any treatment modality (*Table 9.4.1*).

Table 9.4.1 Influence of deprivation on lymphoma treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	Any treatment				Surgery			
	RR most v least deprived	95% CI	z	P	RR most v least deprived	95% CI	z	P
Total	1.02	0.96-1.07			1.02	0.74-1.41		
Rural	1.07	0.96-1.19			1.15	0.56-2.33		
Urban	0.99	0.93-1.06	1.19	0.23	1.00	0.68-1.46	0.33	0.74
	Radiotherapy				**Chemotherapy**			
	RR most v least deprived	95% CI	z	P	RR most v least deprived	95% CI	z	P
Total	1.15	0.92-1.44			1.01	0.95-1.08		
Rural	1.26	0.78-2.01			1.03	0.91-1.17		
Urban	1.07	0.82-1.40	0.56	0.57	1.01	0.93-1.08	0.26	0.80

Variation by age

Percentages of patients treated ranged 66-91% overall, 54-85% for chemotherapy, 15-23% for radiotherapy and 6-10% for surgery (*Figure 9.4.1*). Chemotherapy, surgery and overall treatment were significantly less likely among the oldest patients (age 75+) compared with age-group 45-54: sex/casemix-adjusted relative risks (RRs) 0.69 (95% CI 0.64-0.74), 0.68 (0.51-0.92) and 0.76 (0.72-0.81), respectively (*Figure 9.4.2*). Adjustment for stage made little further difference: RRs 0.71 (0.66-0.76) for chemotherapy, 0.72 (0.53-0.97) for radiotherapy and 0.79 (0.74-0.83) overall (not graphed). Patients aged 65-74 were also significantly less likely to have chemotherapy or any treatment, and those aged 55-64 less likely to have any treatment (*Figure 9.4.2*). Chemotherapy and overall treatment (largely chemotherapy) showed the clearest patterns of decreasing use with increasing age, with trends less clear-cut for radiotherapy and surgery.

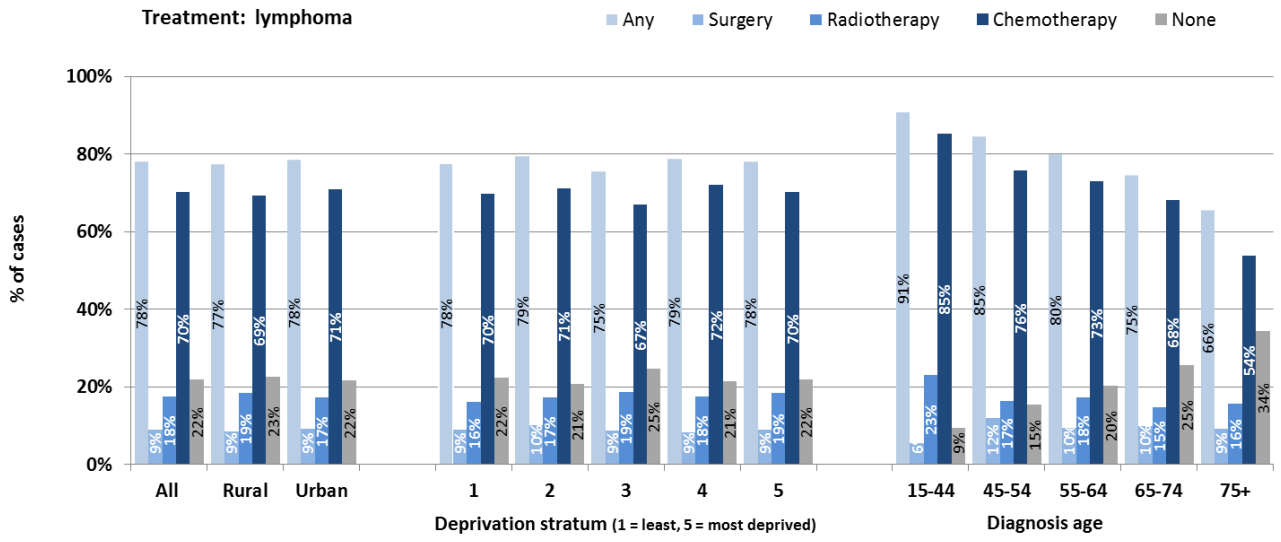


Figure 9.4.1 Treatment of lymphoma within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

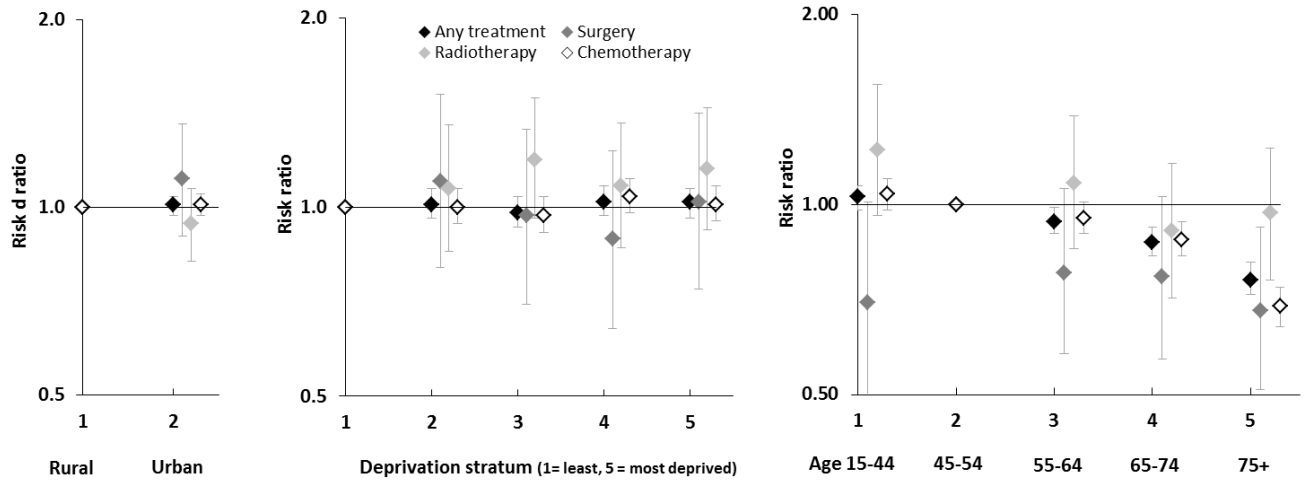


Figure 9.4.2 Risk ratios for treatment of lymphoma, by urban/rural status, deprivation stratum and diagnosis age: age/sex/casemix-adjusted models (or sex/casemix-adjusted models by age-group).

9.5 Lymphoma: comorbidity

Variation by urban/rural status

Broadly similar percentages of rural patients (19.9%) and urban patients (20.8%) had recorded known comorbidities (*Figure 9.5.1*), and there was no significant variation in comorbidity prevalence having adjusted for age and sex: relative risk (RR) 1.09 (95% CI 0.95-1.26) for urban v rural patients (*Figure 9.5.2*).

Variation by deprivation

The proportion of lymphoma patients known to have other clinically significant health conditions at or around the time of cancer diagnosis ranged 17-24% across the five deprivation strata (*Figure 9.5.1*), or 19-26% for males, 14-22% for females (*Figure 9.5.2*). There appeared to be quite a strong pattern of increase with increasing levels of deprivation: age/sex-adjusted RR 1.32 (95% CI 1.04-1.67) comparing the most with the least deprived stratum (*Table 9.5.1*, *Figure 9.5.3*).

Interaction between deprivation and urban/rural status

Urban cases showed some evidence of a stronger pattern of variation by deprivation (*Figure 9.5.1*) but the strength of the deprivation effect did not differ significantly between urban and rural cases, comparing the most with the least deprived strata: RR 1.44 (1.10-1.89) for urban cases v 1.11 (0.66-1.87) for rural cases (P=0.36 for difference) (*Table 9.5.1*).

Table 9.5.1 Influence of deprivation on comorbidity in lymphoma patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	*1.32	1.04-1.67		
Rural	1.11	0.66-1.87		
Urban	*1.44	1.10-1.89	0.92	0.36

Variation by age

Comorbidity percentages ranged 9-30% among the age-groups examined (*Figure 9.5.1*), or 11-33% for males, 7-26% for females (*Figure 9.5.2*) and showed quite a clear pattern of increase with increasing age, especially in males. Patients from the oldest group (75+) were about 80% more likely to have known comorbidities than those aged 45-54: sex-adjusted RR 1.79 (95% CI 1.42-2.26) (*Figure 9.5.3*). Comorbidity prevalence was also significantly high at ages 65-74, but lower at ages 15-44, compared with ages 55-64.

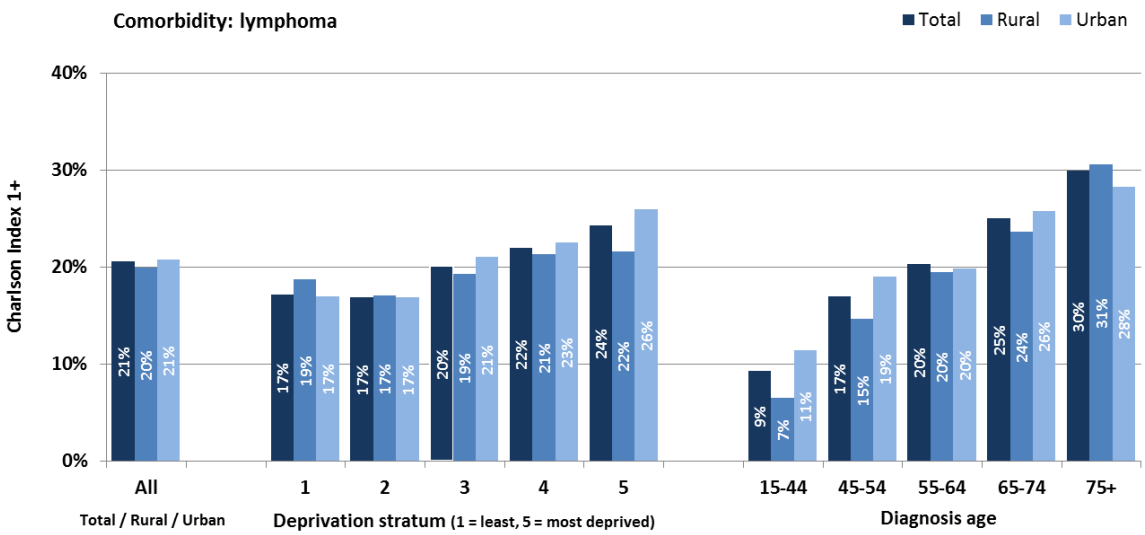


Figure 9.5.1 Comorbidity in lymphoma patients (sexes combined), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

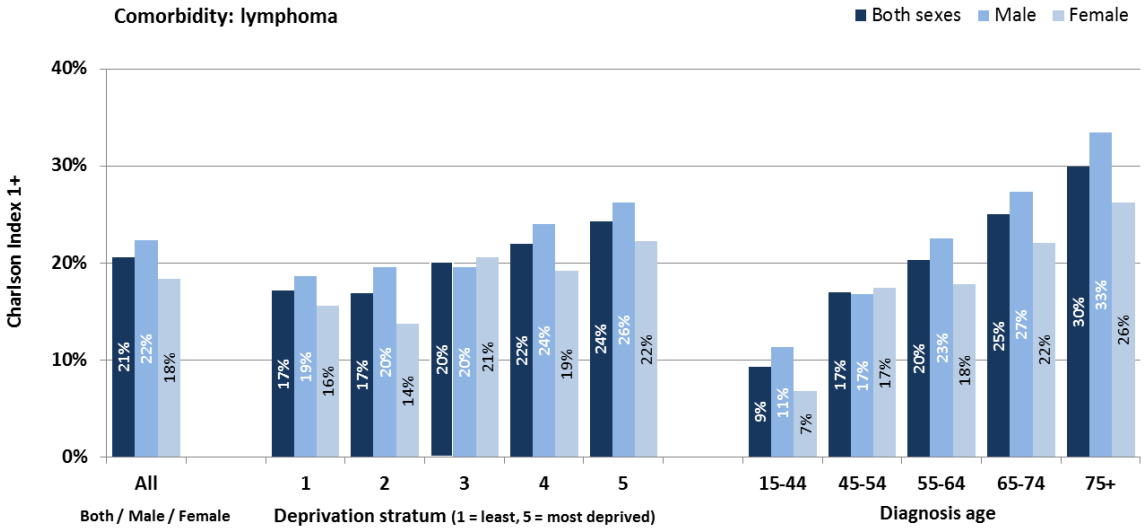


Figure 9.5.2 Comorbidity in lymphoma patients, 2008-2012, by sex, deprivation stratum and diagnosis age.

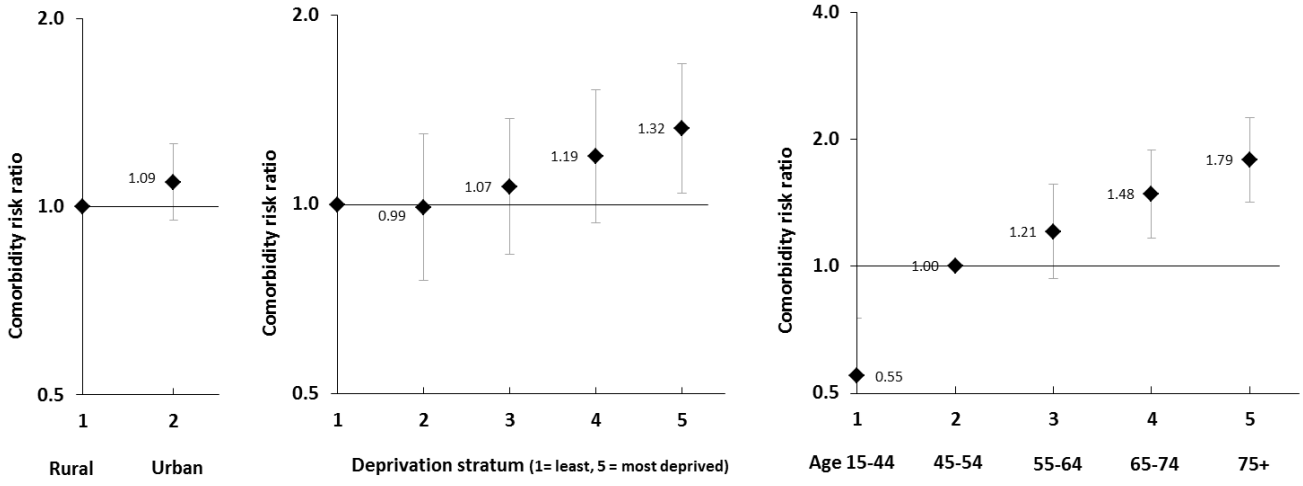


Figure 9.5.3 Risk ratios for comorbidity in lymphoma patients, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

10 LEUKAEMIA

Note: All leukaemias within ICD10 codes C91-C95 are included here, but some analyses are adjusted for casemix based on the five 3-digit ICD10 categories. Note, however, that finer distinction (for example acute versus chronic disease status) was not attempted for analyses in this report.

Key points

- *Incidence*
  - For the comparison between the most and least deprived stratum, rural males showed a 37% higher age-standardised incidence rate compared with a 22% lower rate for the same comparison in urban males (significant urban/rural difference in deprivation effect).
  - Incidence rates were about nine times higher for males and seven times higher for females at ages 75+ compared with 45-54.
- *Survival*
  - Survival was significantly poorer (age/sex-adjusted mortality hazard about four [4.3] times higher) at ages 75+ compared with 45-54, and also poorer at ages 65-74 and 15-44.

Table 10.k.1 Visual summary of the influence of urban status, deprivation and age on leukaemia in Ireland, 2008-2012: black arrows indicate significantly higher or lower incidence, survival, use of treatment or prevalence of comorbidity for urban (v. rural), most deprived (v. least deprived) and age 75+ (v. 45-54) groups; grey = no significant variation.*

	Incidence[a]	Survival[b]	Treatment[e]	Comorbidity[f]
Urban status	=	=	R↑ TC=	↓
Deprivation	M↓ F=	↓	T↑ R↑ C↑	↑
Older age	M↑ F↑	↓	T↓ R↓ C↓	↑

*For fuller key, see footnote to *Summary Tables 1-3* (*Key Points*, p. 2)

- *Treatment*
  - Patients aged 75+ were significantly less likely to have chemotherapy (-54% in relative terms), radiotherapy (-91%) or any treatment (-53%) compared with ages 45-54; this also applied to ages 65-74 and to radiotherapy at ages 55-64. The youngest patients (<45) were more likely to have radiotherapy, chemotherapy or any treatment.

- *Comorbidity*
  - Patients aged 75+ were twice as likely to have other recorded, significant health conditions compared with those aged 45-54; comorbidity prevalence was also higher at ages 65-74.

10. 1 Leukaemia: incidence

Variation by urban/rural status

Age-standardised incidence was very similar in both urban and rural populations – 14.6 and 14.4 cases per 100,000 males, 8.6 cases per 100,000 females (*Figures 10.1.1*); directly age-standardised rate ratios (DSRRs) for urban v rural incidence 0.99 (0.89-1.11) for males, 1.00 (0.87-1.15) for females (*Figure 10.1.2*).

Variation by deprivation

Age-standardised rates of leukaemia ranged 13-16 cases per 100,000 males and 8-9 cases per 100,000 females across the five deprivation strata, and there was only limited evidence that incidence of leukaemia was related to deprivation (*Figure 10.1.1*). Apart from a lower rate among males from deprivation stratum 4 compared with 1 (DSRR 0.81, 95% CI 0.68-0.96), variation across the deprivation strata was not statistically significant (*Figure 10.1.2*).

Interaction between deprivation and urban/rural status

However, for males, urban and rural populations showed significantly different patterns of incidence by deprivation: a significantly low rate ratio of 0.78 (95% CI 0.64-0.95) comparing the most with the least deprived urban populations versus 1.37 (0.95-1.97) for the same comparison among rural populations (P=0.009 for difference) (*Table 10.1.1*). For females, there was no significant influence of deprivation for either group and no significant heterogeneity of the deprivation effect (P=0.67).

Table 10.1.1 Influence of deprivation on leukaemia incidence, Ireland, 2008-2012: comparison of effect between urban and rural populations (age-standardised rate ratios)

	Males				Females			
	DSRR most v least deprived	95% CI	z	P	DSRR most v least deprived	95% CI	z	P
Total	0.86	0.72-1.02			0.90	0.73-1.11		
Rural	1.37	0.95-1.97			0.82	0.52-1.29		
Urban	0.78	0.64-0.95	2.63	*0.009	0.92	0.72-1.17	0.43	0.67

Variation by age

Male rates ranged from 3 to 102 cases and female rates from 3 to 46 cases per 100,000 between the youngest (15-44) and oldest (75+) age-groups examined, with a very strong pattern of increased incidence with age (*Figure 10.1.1*). In males, the rate in the oldest group (75+) was about nine times that in the 45-54 group (rate ratio 9.3, 95% CI 7.4-11.7); in females, about seven times (rate ratio 7.1, 5.5-9.3) (*Figure 10.1.2*). Rates at ages 55-64 and 65-74 were also significantly higher, while rates at age 15-44 were significantly lower, than at ages 45-54.

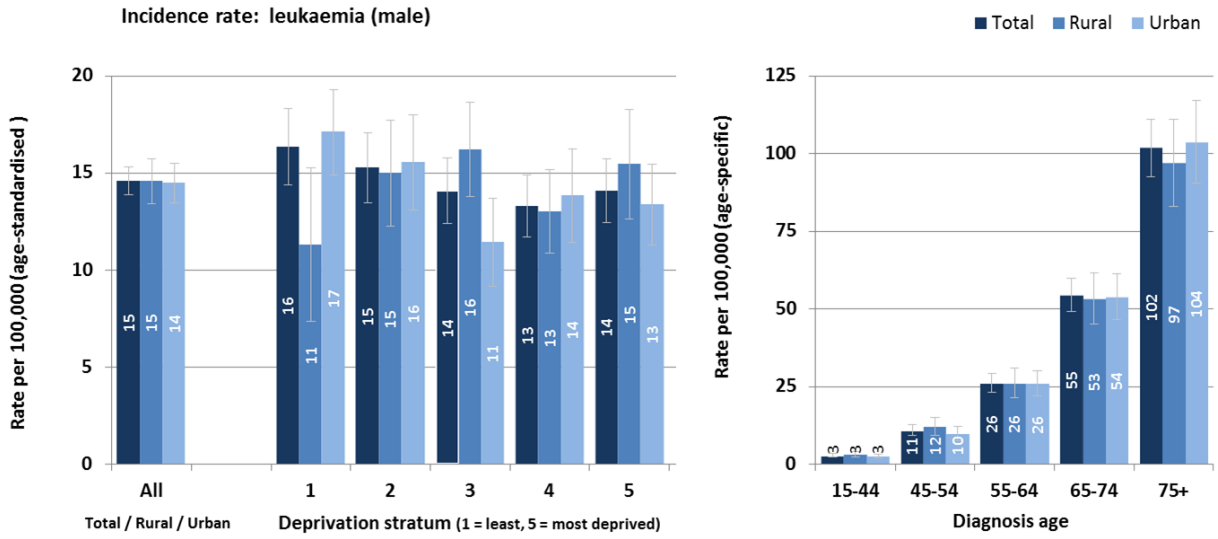


Figure 10.1.1(a) Incidence of leukaemia (male), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

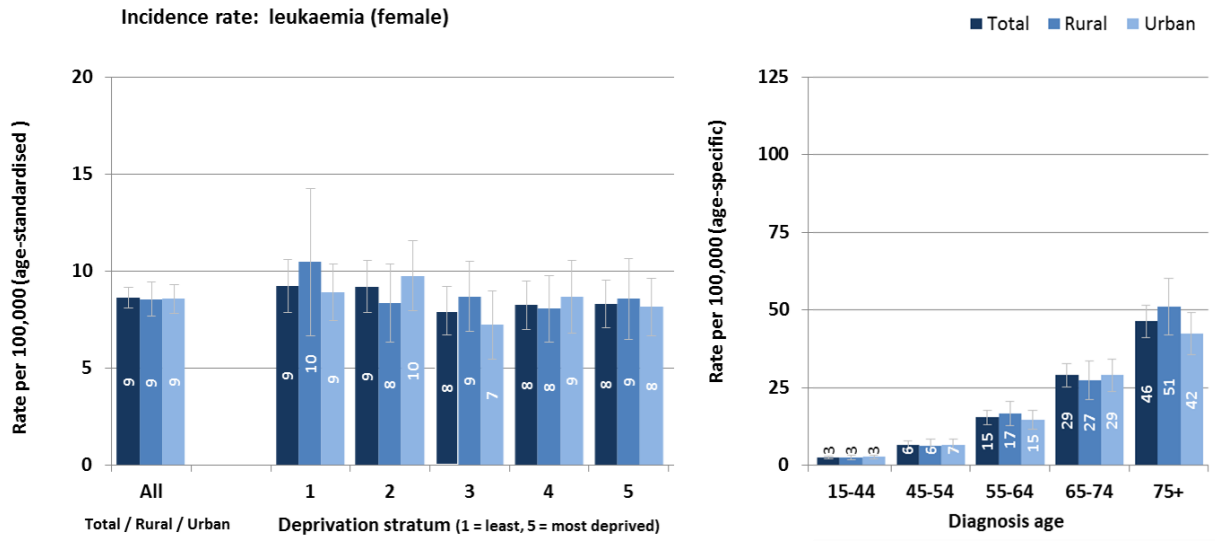


Figure 10.1.1(b) Incidence of leukaemia (female), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age. Note different scale for age-specific rates.

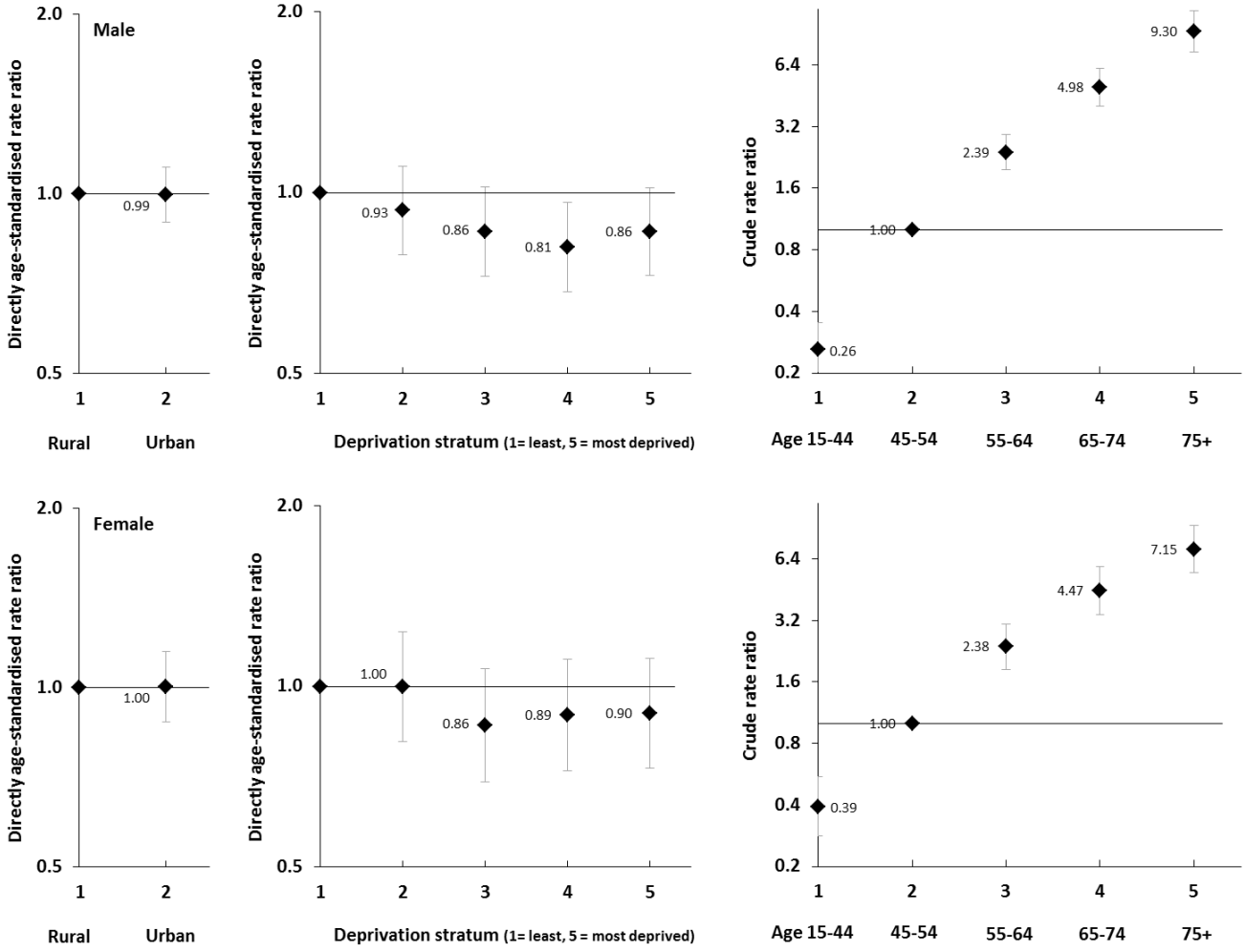


Figure 10.1.2 Rate ratios of leukaemia incidence, by urban/rural status, deprivation stratum and diagnosis age.

10.2 Leukaemia: cause-specific survival

Variation by urban/rural status

Five-year survival averaged 62% for rural cases and 59% for urban cases (*Figure 10.2.1*), but mortality hazards did not differ significantly: age/sex-adjusted hazard ratio (HR) 1.09 (0.93-1.28) for urban relative to rural cases, or 1.14 (0.97-1.33) after adjustment for casemix (*Figure 10.2.2*).

Variation by deprivation

Age-standardised five-year survival of leukaemia patients ranged 58-62% across the deprivation strata, apparently lowest in the most deprived group (*Figures 10.2.1 & 10.2.3*). However, Cox modelling adjusted for age and sex did not confirm any significant variation, comparing the most with the least deprived stratum: age/sex-adjusted HR 1.20 (95% CI 0.94-1.54) (*Table 10.2.1*), or 1.00 (0.78-1.28) after further adjustment for casemix (*Figure 10.2.2*).

Interaction between deprivation and urban/rural status

No significant variation of survival by deprivation status was confirmed among either urban or rural cases, and based on comparisons of the least with the most deprived strata there was no significant heterogeneity of the deprivation influence between urban and rural patients (P=0.51 for difference) (*Table 10.2.1*).

Table 10.2.1 Influence of deprivation on leukaemia survival, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted mortality hazard ratios)

	HR most v least deprived	95% CI	z	P
Total	1.20	0.94-1.54		
Rural	1.62	0.83-3.17		
Urban	1.23	0.92-1.64	0.66	0.51

Variation by age

Five-year survival varied 40-79% between different age-groups and was apparently highest in age-group 45-54 (*Figure 10.2.1*). Survival was significantly poorer at ages 75+ compared with 45-54: age/sex-adjusted HR 4.27 (95% CI 3.07-5.93), or 5.61 (4.02-7.82) after adjustment for casemix (*Figure 10.2.2*). Survival was also significantly poorer at ages 65-74 and, after adjustment for casemix, 55-64; poorer survival at ages 15-44 was not significant after adjustment for casemix.

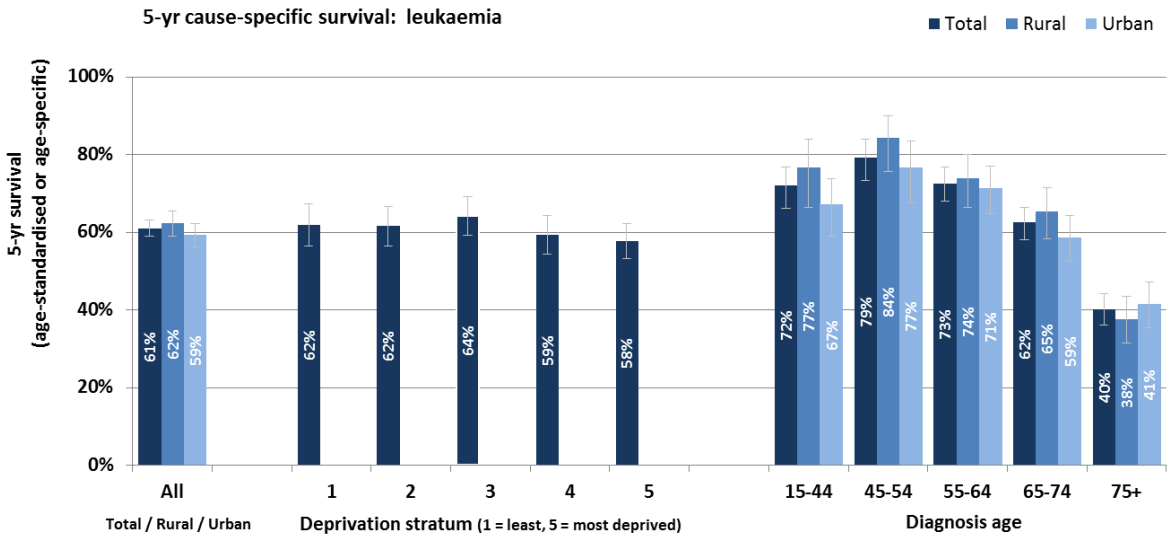


Figure 10.2.1 Cause-specific five-year survival of Irish leukaemia patients (hybrid period estimates 2009-2013), by urban/rural status, deprivation stratum and diagnosis age. Age-standardised survival for deprivation strata by urban/rural status could not be calculated because of insufficient numbers of cases in some subgroups.

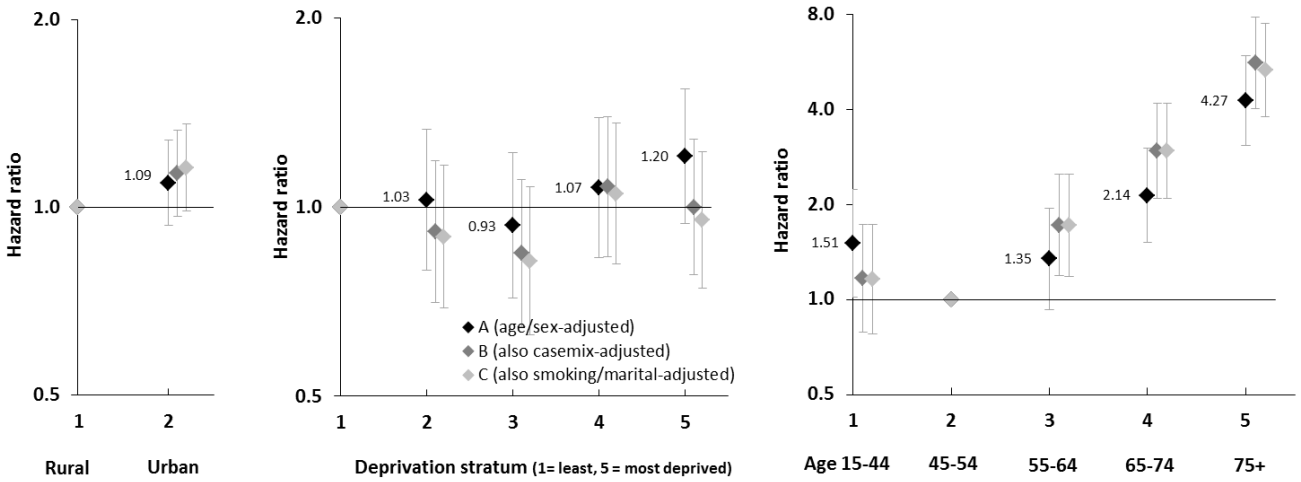


Figure 10.2.2 Mortality hazard ratios for leukaemia survival, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group) and fuller models.

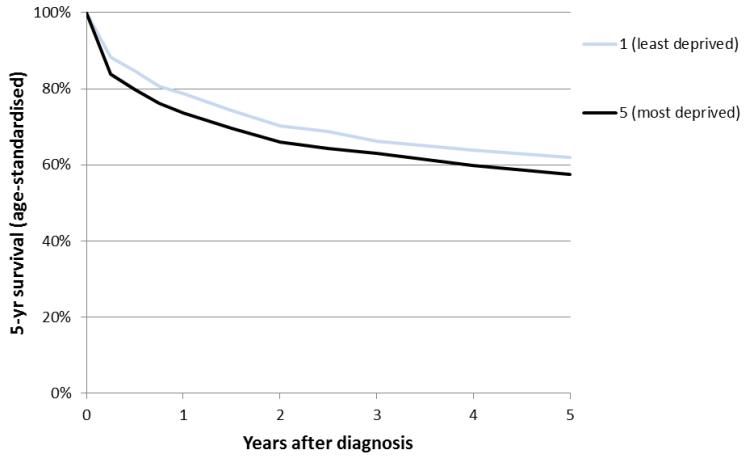


Figure 10.2.3 Cause-specific survival curves for leukaemia patients (hybrid period estimates 2009-2013): comparison of least and most deprived strata.

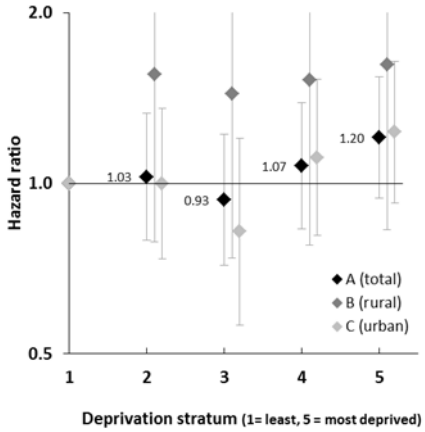


Figure 10.2.4 Mortality hazard ratios for leukaemia survival, by deprivation stratum: age/sex-adjusted models – all, rural and urban cases compared. See also *Table 10.2.1*.

10.3 Leukaemia: tumour-directed treatment

Note: Some patients with chronic leukaemia may not begin active treatment (i.e. other than diagnostic procedures or symptom-relieving therapies) until there is evidence of disease progression, thus initial treatment or treatment within a year following diagnosis may be categorised as 'no tumour-directed treatment' in the summary information below. Overall, only about half of all leukaemia patients had active treatment in the year following diagnosis.

Variation by urban/rural status

Variation in treatment between rural and urban cases was minor, based on unadjusted percentages: chemotherapy use ranged 49-51%, radiotherapy 3-4% and overall treatment 50-51% (*Figure 10.3.1*). In relative terms, use of radiotherapy appeared higher for urban cases, but this was based on small numbers of treated cases and was not statistically significant: age/sex/casemix-adjusted relative risk (RR) 1.41 (0.91-2.14) versus rural cases (*Figure 10.3.2*).

Variation by deprivation

The crude (unadjusted) proportion of leukaemia patients having any tumour-directed treatment ranged 47-51% between deprivation strata or 46-53% for chemotherapy and 3-5% for radiotherapy (*Figure 10.3.1*). There was some evidence that patients from deprivation strata 2-5 were more likely to have chemotherapy (the main treatment) or radiotherapy, compared with those from the least deprived stratum. However, these differences were not statistically significant (though almost so for chemotherapy and overall treatment): comparing stratum 5 with 1, age/sex/casemix-adjusted RR

1.12 (95% CI 0.99-1.25) for chemotherapy, 1.23 (0.60-2.52) for radiotherapy and 1.12 (0.99-1.26) for overall treatment (*Table 10.3.1*, *Figure 10.3.2*). As for lymphomas, the casemix-adjustments here are based on cell-type rather than acute/chronic disease status, and the latter might account for some of the treatment variation seen.

Interaction between deprivation and urban/rural status

A stronger influence of deprivation on chemotherapy use was seen for rural than for urban cases (*Table 10.3.1*): adjusted RRs 1.52 (1.16-1.99) and 1.01 (0.88-1.16) respectively, comparing stratum 5 v 1 (P=0.02 for difference in deprivation effect) (*Table 10.3.1*). This was also noted for overall treatment: RRs 1.53 (1.17-2.00) and 1.03 (0.90-1.17) (P=0.02). No significant difference in deprivation effects between rural and urban cases was seen for radiotherapy (P=0.75).

Table 10.3.1 Influence of deprivation on leukaemia treatment, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex/casemix-adjusted relative risks)

	Any treatment							
	RR most v least deprived	**95% CI**	**z**	**P**				
Total	1.12	0.99-1.26						
Rural	*1.53	1.17-2.00						
Urban	1.03	0.90-1.17	2.26	*0.02				
	Radiotherapy				**Chemotherapy**			
	RR most v least deprived	**95% CI**	**z**	**P**	**RR most v least deprived**	**95% CI**	**z**	**P**
Total	1.23	0.60-2.52			1.12	0.99-1.25		
Rural	*1.14	1.07-8.82			*1.52	1.16-1.99		
Urban	1.33	0.59-3.02	0.33	0.75	1.01	0.88-1.16	2.31	*0.02

Variation by age

Very marked variation in treatment was seen by age, with use of chemotherapy (range 26-85%), radiotherapy (1-19%) and overall treatment (27-86%) all falling progressively with increasing age (*Figure 10.3.1*). Compared with age-group 45-54, younger patients (15-44) were significantly more likely, and the oldest patients (65-74 and 75+) less likely, to have chemotherapy, radiotherapy or any treatment (*Figure 10.3.2*), having adjusted for sex and cell-type. Differences were particularly marked for age-group 75+ relative to 45-54: RR 0.46 (95% CI 0.40-0.54) for chemotherapy, 0.09 (0.04-0.24) for radiotherapy and 0.47 (0.41-0.55) for overall treatment. Radiotherapy use was also lower in age-group 55-64 than 45-54. The youngest patients (<45) were more likely to have radiotherapy, chemotherapy or any treatment.

As for variation by deprivation, variation in acute/chronic disease status might account for some of the age-related variation seen in treatment, i.e. beyond that accounted for by cell-type.

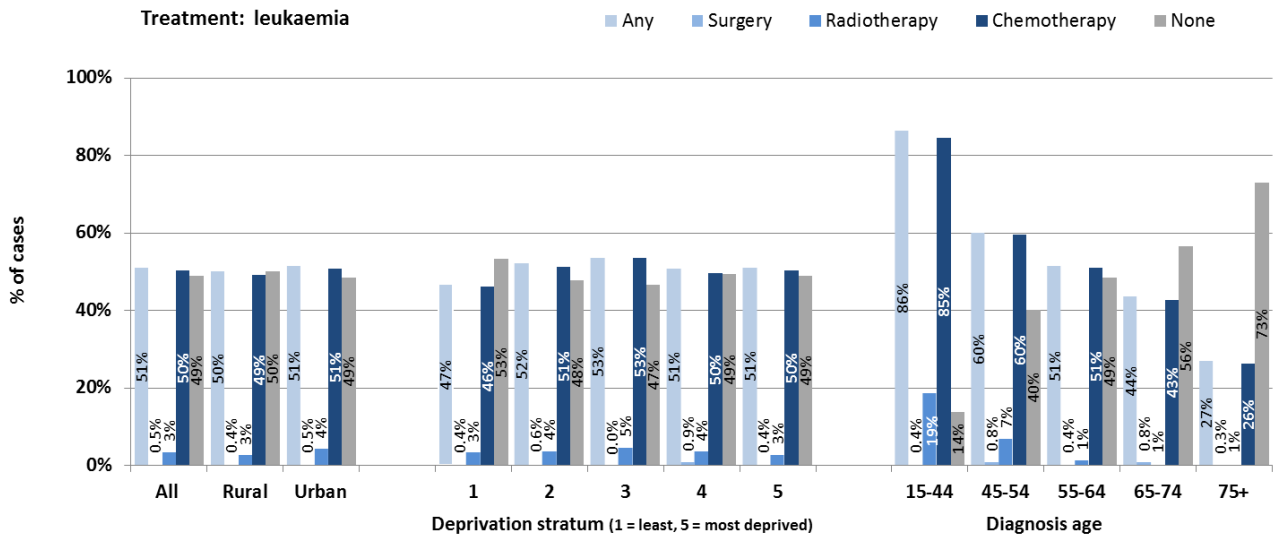


Figure 10.3.1 Treatment of leukaemia within a year of diagnosis, 2008-2012, by urban/rural status, deprivation stratum and age.

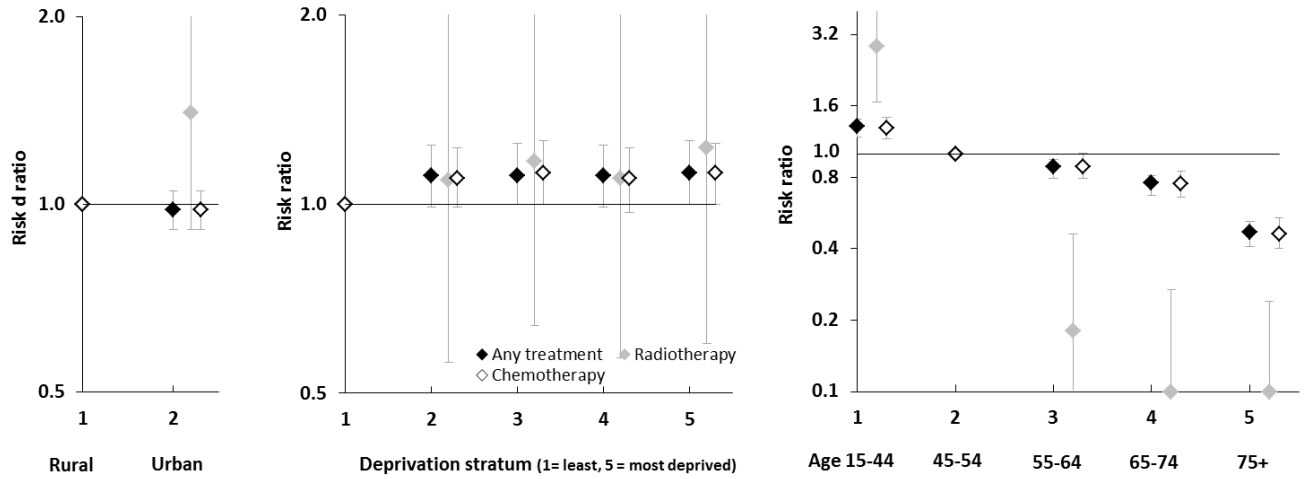


Figure 10.3.2 Risk ratios for treatment of leukaemia, by urban/rural status, deprivation stratum and diagnosis age: age/sex/casemix-adjusted models (or sex/casemix-adjusted models by age-group).

10.4 Leukaemia: comorbidity

Variation by urban/rural status

Rural patients appeared to have a higher prevalence of comorbidity (23%) than urban cases (19%), and this was also evident across all deprivation categories and most age-groups (Figure *10.4.1*). However, the overall variation was not statistically significant after adjustment for age and sex: relative risk (RR) 0.86 (95% CI 0.72-1.04) for urban v rural patients (*Figure 10.4.3*)

Variation by deprivation

The proportion of leukaemia patients with other clinically significant health conditions at or around the time of cancer diagnosis ranged 18-22% across the five deprivation strata (*Figure 10.5.1*), or 17-28% for males, 10-21% for females (*Figure 10.4.2*). No clear pattern of comorbidity prevalence by deprivation was evident from the unadjusted percentages. Models adjusted for age and sex did not confirm any significant variation: RR 1.14 (95% CI 0.84-1.55) comparing the most with the least deprived stratum (*Table 10.4.1*, *Figure 10.4.3*).

Interaction between deprivation and urban/rural status

Neither rural nor urban patients showed any significant variation by deprivation, and there was no significant difference between rural and urban patients in the pattern of comorbidity by deprivation (P=0.20), based on comparisons between the most and least deprived strata (*Table 10.4.1*).

Table 10.4.1 Influence of deprivation on comorbidity in leukaemia patients, Ireland, 2008-2012: comparison of effect between urban and rural populations (age/sex-adjusted relative risks)

	RR most v least deprived	95% CI	z	P
Total	1.14	0.84-1.55		
Rural	0.77	0.43-1.39		
Urban	1.18	0.81-1.72	1.28	0.20

Variation by age

Comorbidity percentages varied from 11 to 30% between the age-groups examined (*Figure 10.4.1*), or 11-32% for males, 10-28% for females (*Figure 10.4.2*). There was a fairly strong pattern of increasing comorbidity with increasing age, especially after age 64. Patients from the oldest group (75+) were twice as likely to have recorded comorbidities as those aged 45-54: sex-adjusted RR 2.04 (95% CI 1.38-3.00) (*Figure 10.4.3*). Comorbidity prevalence was also significantly higher at ages 65-74 compared with 45-54.

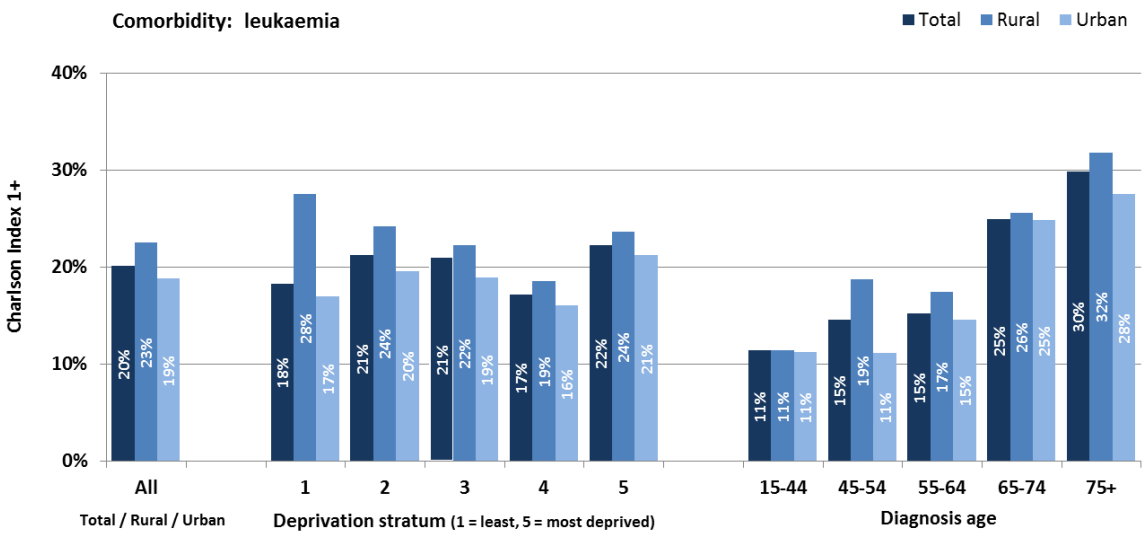


Figure 10.4.1 Comorbidity in leukaemia patients (sexes combined), 2008-2012, by urban/rural status, deprivation stratum and diagnosis age.

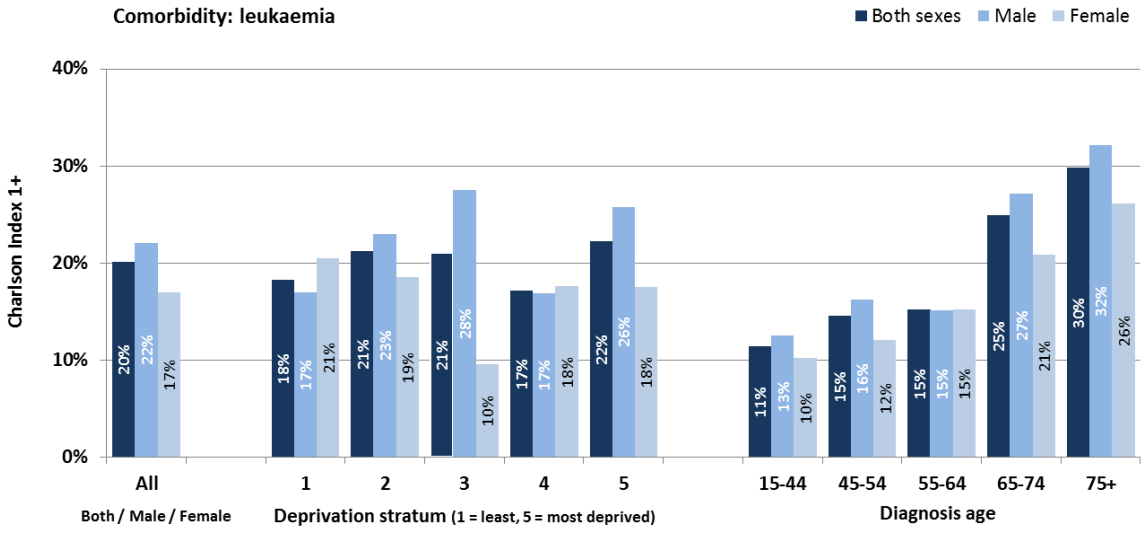


Figure 10.4.2 Comorbidity in leukaemia patients, 2008-2012, by sex, deprivation stratum and diagnosis age.

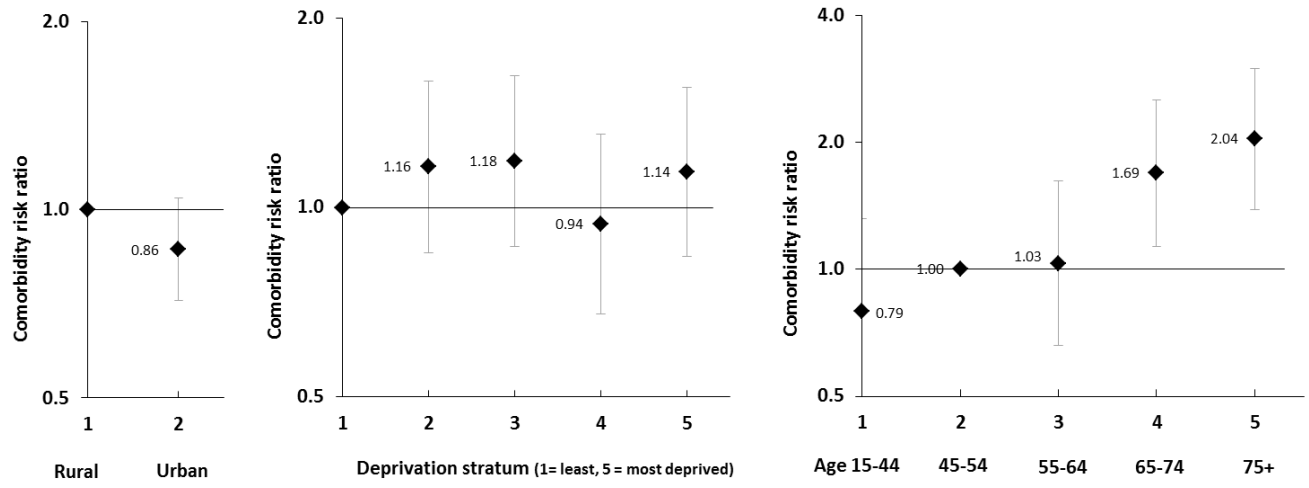


Figure 10.4.3 Risk ratios for comorbidity in leukaemia patients, by urban/rural status, deprivation stratum and diagnosis age: age/sex-adjusted models (or sex-adjusted models by age-group).

OVERVIEW / DISCUSSION

Key findings

This report has assessed inequalities by urban/rural status, deprivation, and age on incidence, survival, stage, treatment and comorbidity for cancer patients in Ireland during the years 2008-2012, using data collected by the National Cancer Registry (NCR). Strong patterns of inequality by deprivation and age have been documented for most of the measures examined, and the influence of age is particularly striking. These patterns were often applicable across a range of cancer types, although the patterns shown by different cancers could differ markedly or, for some cancers, the evidence was less strong. Variation by urban/rural status was less pronounced but some differences in deprivation effect were evident between urban and rural cases. For some measures or cancers (notably incidence of prostate cancer) significant differences in the direction or strength of deprivation effects were found between urban and rural cases.

Particularly notable (and statistically significant) findings included:

By urban/rural status:

- Higher cancer incidence in urban than in rural populations, overall and for six of the nine specific cancer types examined: stomach, lung, male colorectal, female breast and cervical cancers, and melanoma.
- A tendency towards lower proportions of patients treated in urban compared with rural populations.

By deprivation status:

- Higher incidence of cancer in more deprived populations, overall and for stomach, lung and cervical cancers, but the opposite trend (lower incidence in more deprived populations) for breast cancer and melanoma.
- Opposite patterns of incidence in relation to deprivation for urban and rural prostate cancer and male leukaemia patients (higher incidence in more deprived rural areas, but lower incidence in more deprived urban areas) and stronger patterns of increasing incidence with increased deprivation for lung cancer and male colorectal cancer.
- Lower survival of cancer patients from more deprived populations, overall and for six cancer types: stomach, colorectal, lung, breast and prostate cancers, and lymphoma.
- Lower proportions of early-stage or higher proportions of later-stage cancers among more deprived populations for stomach, breast and prostate cancers and melanoma.
- Lower proportions of patients surgically treated in more deprived populations, overall and for stomach, colorectal, lung, breast and prostate cancers.
- Higher prevalence of comorbidities (other serious health conditions) in cancer patients from more deprived populations, overall and for lung and breast cancers and lymphoma.

By age:

- Markedly higher incidence in the oldest patients, overall and for most major cancers, but weaker trends by age for breast and prostate cancers and the opposite pattern for cervical cancer.
- Markedly poorer cancer-specific survival among the oldest patients, overall and for all nine major cancers,
- Older patients for some cancers (notably melanoma, breast, cervical and prostate cancers) tended to present at more advanced stage, but the opposite pattern was seen for colorectal and lung cancers, which appeared to present at less advanced stage in the elderly.
- Substantially lower proportions of the oldest patients having active treatment for their cancer, overall and for all nine major cancers, with the exception of hormonal therapy for breast and prostate cancers (higher use in the elderly).
- Substantially higher prevalence of comorbidities among the oldest cancer patients, for all nine major cancers.

These findings are summarised and discussed further below, with reference to findings of other Irish or international studies, and further context or background is provided under a number of other headings (e.g. smoking status).

Cancer incidence

Incidence by urban/rural status

Age-standardised incidence for six of the nine cancer types examined (stomach, lung, melanoma, male colorectal, female breast and cervical), and for cancer as a whole, was significantly higher among urban populations (defined on the basis of average population density ≥1 person/hectare) than among rural populations (*Figure o.1*). For these cancers, urban rates were 13-38% higher, most notably for lung cancer (36-38% higher). For all cancers combined, urban rates were 10% (95% confidence interval 8-12%) higher for males and 11% (95% CI 8-12%) higher for females. For prostate cancer, lymphoma, leukaemia and female colorectal cancer there was no significant variation of incidence between urban and rural populations.

Incidence by deprivation status

Overall cancer incidence was slightly but significantly higher in the most deprived 20% of the population, by about 10% for males and 4% for females, having adjusted for age (*Figure o.2)*. Of the individual cancers examined, cervical, lung and stomach cancers showed strong patterns of increasing incidence with increasing deprivation, with age-standardised rates about 120%, 60% and 40% higher, respectively, in the most deprived compared with the least deprived fifth of the Irish population. Breast cancer and melanoma showed the opposite pattern, i.e. decreasing incidence with increasing deprivation, with age-standardised rates about 15% lower and 30% lower, respectively, in the most deprived populations. No clear patterns of incidence by deprivation were evident for colorectal or prostate cancers, lymphoma or leukaemia.

Interaction between deprivation and urban/rural status

For lung cancer and male colorectal cancer, urban populations showed a significantly stronger pattern of higher incidence in more deprived areas than seen in rural populations. For prostate cancer and male leukaemia, urban and rural populations showed opposite (and significantly different) patterns of deprivation influence on incidence, i.e. higher incidence in more deprived rural areas but lower incidence in more deprived urban areas. Otherwise, the pattern of deprivation influence on incidence was broadly similar for urban and rural populations.

Incidence by age

Cancer as a whole and almost all of the specific cancer types examined showed significantly higher incidence rates at older ages, based on comparisons between age-groups 75+ and 45-54 (or 85+ and 55-64 for prostate cancer) (*Figure o.3*). Overall incidence rates were about ten times higher for males and four times higher for females in the oldest group (compared with ages 45-54). For eight of the nine specific cancers examined, male rates were 1.6-15 times higher and female rates 1.4-13 times higher in the oldest group. The biggest differences (more than 10-fold) were seen for stomach cancer, lung cancer and male colorectal cancer. For breast and prostate cancers the difference was relatively modest (1.4-fold and 1.6-fold differences, respectively). Only cervical cancer showed a pattern of significantly lower rates (42% lower) in the oldest group.

Comments / Comparison with other studies

Variation of cancer incidence in relation to deprivation is well known, both internationally and within Ireland. Kogevinas et al. (1997) reviewed international findings on the influence of socioeconomic factors on cancer incidence, mortality and incidence. For cancer as a whole, that review noted higher incidence in more socioeconomically disadvantaged groups based on studies in England and Wales, Italy, Spain, Finland and Denmark, particularly of males, but the opposite trend in men in Colombia and no trend in Sweden or for women in Denmark and Colombia. Stomach, lung and cervical cancers showed quite strong and consistent trends internationally of higher incidence in more socioeconomically disadvantaged groups, while breast cancer, colon cancer and melanoma of skin showed the opposite pattern (though less consistent for colon cancer). Of the other cancers included in the current report, the international data on incidence of rectal and prostate cancers, lymphoma and leukaemia did not show clear-cut or consistent patterns by socioeconomic status (Kogevinas et al. 1997). These international findings match those found in this report, with the exception of colon and rectal cancers (no overall influence of deprivation on incidence was found here but we did not analyse colon and rectal cancers separately).

A previous NCR analysis, for the 1994-2003 cancer atlas (Carsin et al. 2009), found that incidence rates of all cancers (excluding non-melanoma skin) were significantly higher in the most compared with the least deprived group, by about 12% for males and 4% for females. Rates were also significantly elevated in the most deprived group for stomach cancer, male colorectal cancer, lung cancer and cervical cancer. In contrast, rates were significantly lower in the most deprived group for female breast cancer, melanoma of skin and prostate cancer. The patterns and the magnitude of the differences seen were quite similar to those seen in this current report, with the exception of colorectal and prostate cancers (no clear pattern by deprivation during 2008-2012).

The 1994-2003 atlas also compared cancer incidence in Ireland between three categories of urban/rural status: population densities <1 person/ha, 1-20 persons/ha and 20+ persons/ha. The latter (most urban) category had

significantly elevated rates, compared with the most rural category, for cancer as a whole, stomach cancer, male colorectal cancer, lung cancer, melanoma of skin, female breast cancer and cervical cancer, although no comparison was given for prostate cancer (Carsin et al. 2009). Rates of most or all of these cancers were also significantly elevated for the intermediate category of population density. Again, the findings matched quite closely with those presented in this report for 2008-2012 (comparing two broader urban/rural categories: 1+ v <1 person/ha).

A further NCR analysis (in collaboration with the Northern Ireland Cancer Registry) also looked, on an all-Ireland basis, variation of cancer incidence by population density and by two measures of socioeconomic status – unemployment and education (NCR/NICR 2011). Again, the findings were broadly consistent with the current study. A further all-Ireland analysis confirmed that, after adjustment for socioeconomic factors, urban/rural differences in incidence were still evident for the majority of cancers examined (Sharp et al. 2014). The latter study noted that differences between urban and rural populations in risk factors such as smoking, alcohol consumption, foreign holidays, or air pollution could, in part, contribute to urban/rural differences in incidence for some cancers, but the potential role of such factors was poorly understood.

The most clear-cut and well-known patterns of incidence are those by age, and these have been examined in many previous NCR reports. For most cancers, the patterns of incidence by age have probably changed little since the early years of data collection by the NCR, although rates may have increased or decreased depending on changes in underlying risk or in diagnostic activity. However, some changes in relative incidence across age-groups may be expected where screening or other early diagnosis interventions have targeted specific age groups. *Figure o.4* compares incidence by age for 1994-1998 and 2008-2012 using the five main age groups used elsewhere in this report. Overall, and for most individual cancers, the pattern of incidence by age has changed relatively little. Overall and for some cancers (e.g. melanoma, female lung cancer, lymphoma) rates have increased across the age-groups, while stomach cancer rates have fallen at all ages. Patterns, and changes over time, are more complex for some other cancers. For breast cancer, incidence at ages 45-54 and 55-64 have increased to a greater extent than at other ages, reflecting the introduction of population-based screening from about 2000 onwards, and this has produced a more level pattern of incidence across the three oldest age-groups than was the case in the 1990s. Most notably, for prostate cancer, widespread use of Prostate Specific Antigen (PSA) testing has shifted the incidence peak to ages 65-74 rather than the 85+ group in which incidence peaked in the 1990s.

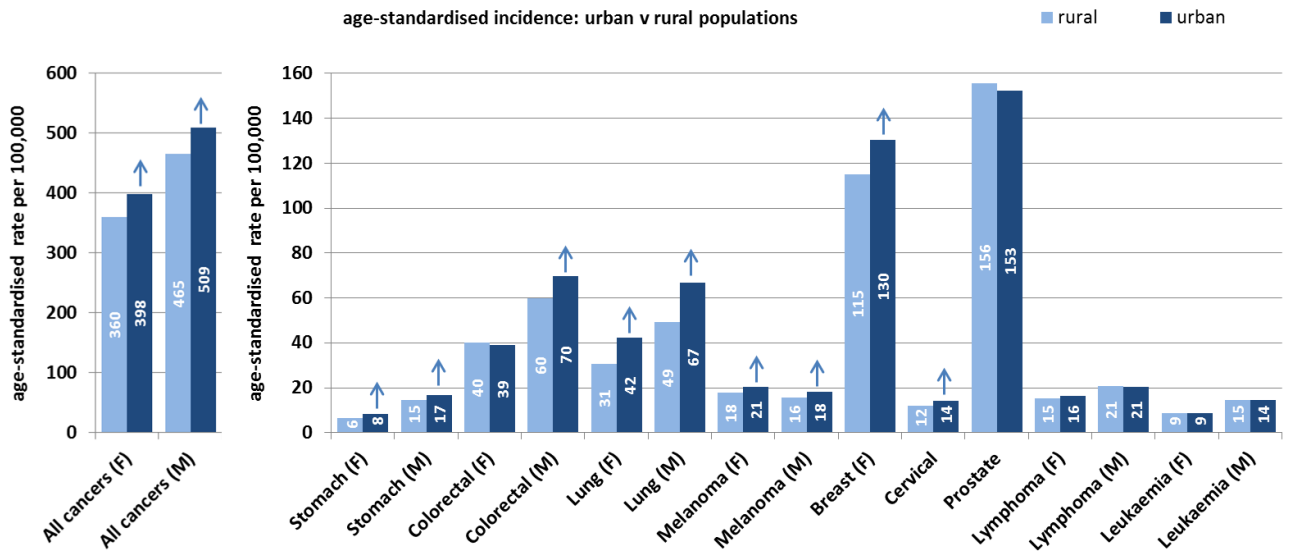


Figure o.1 Age-standardised cancer incidence, Ireland, 2008-2012: comparison between urban and rural populations. Arrows indicate significant differences. Note different scale for all-cancer graph.

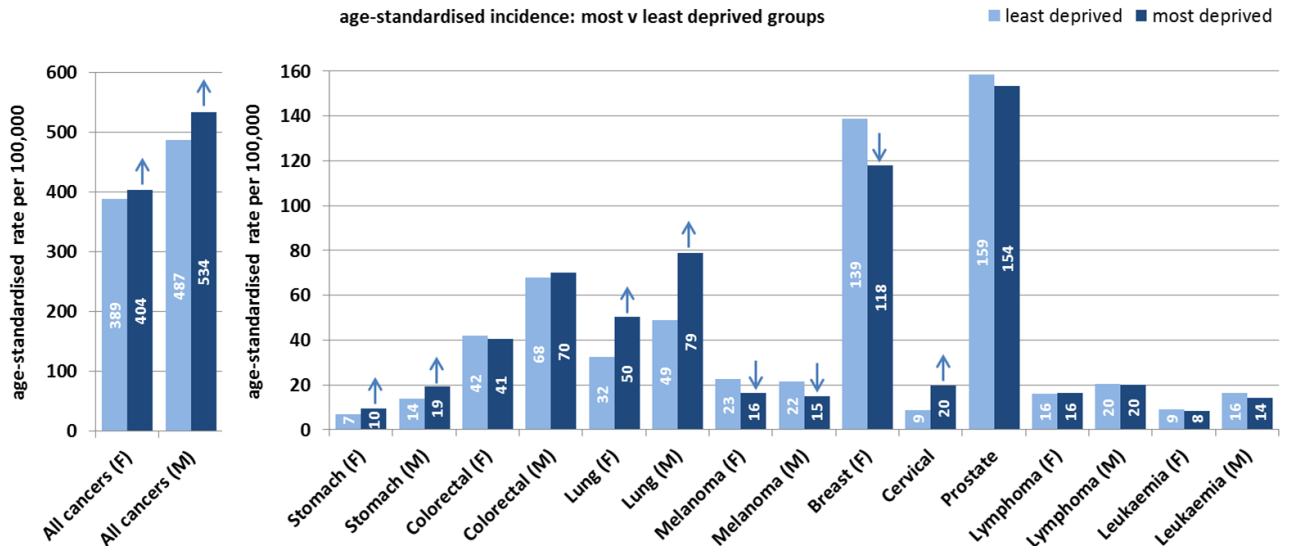


Figure o.2 Age-standardised cancer incidence, Ireland, 2008-2012: comparison between the most deprived and the least deprived 20% of the population. Arrows indicate significant differences. Note different scale for all-cancer graph.

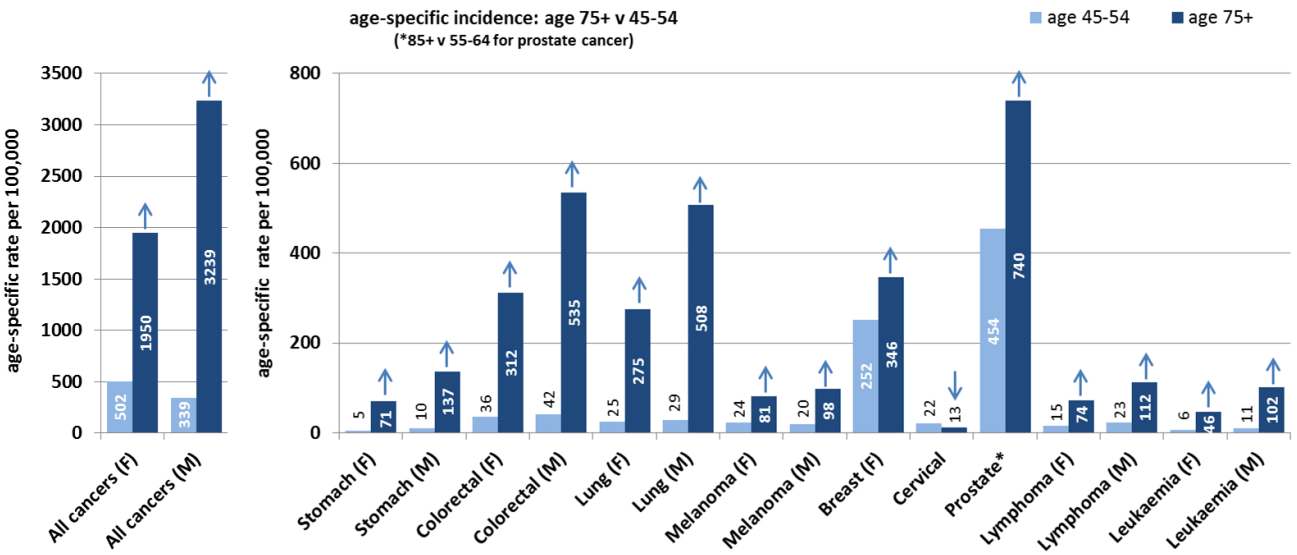


Figure o.3 Age-specific cancer incidence, Ireland, 2008-2012: age 75+ and 45-54 groups (or 85+ and 55-64 for prostate cancer). Arrows indicate significant differences. Note different scale for all-cancer graph.

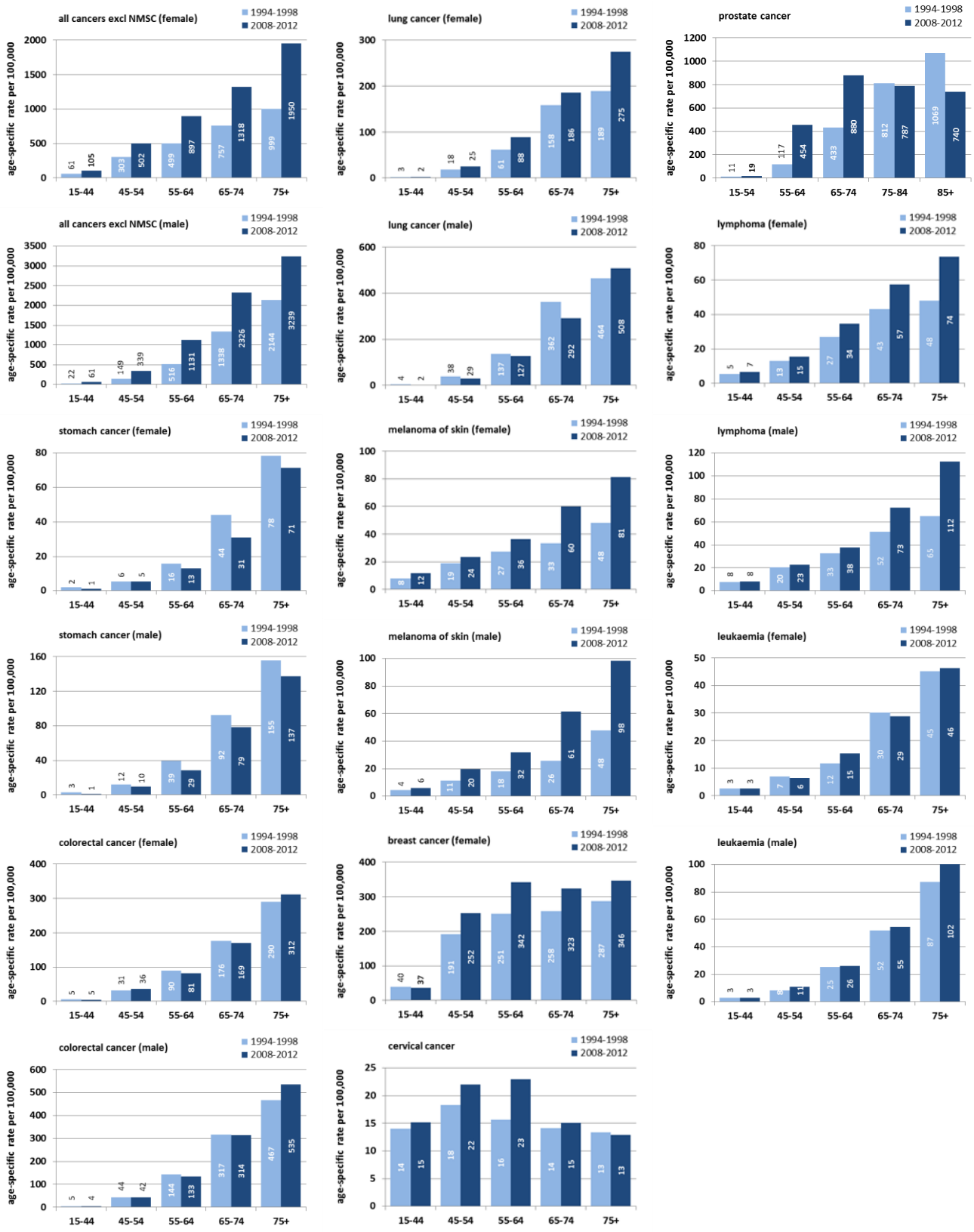


Figure o.4 Age-specific cancer incidence, Ireland, 1994-1998 compared with 2008-2012.

Cancer survival

A note on the use of cause-specific survival

It is important to re-emphasise that the survival outcome examined here is cause-specific survival, i.e. death directly attributed to the cancer involved (or to a cancer of unspecified sites or of a closely related site). Patients whose death was attributed to other causes were included in follow-up but censored at the point of death, i.e. their death was not included in the cancer-specific mortality outcome but the patients involved were included in the at-risk denominator up until their death. Total observed survival (i.e. all-cause survival) was not examined, as it would also include deaths attributable to non-cancer causes. Influences of deprivation and age on all-cause survival would possibly be even stronger than those seen for cancer-specific survival, given that non-cancer conditions are more common among older patients and those from more deprived areas. The influence of smoking on survival, and its role as a contributory or mediating factor in the influence of deprivation on survival, would probably also be stronger if all-cause survival was examined, as direct mortality from non-cancer illnesses caused by smoking might also be considerable.

Relative or net survival, i.e. survival expressed as a percentage of that expected in the general population of the same age and sex, was not examined, as correct calculation would require comparison with expected mortalities (life tables) specific to each deprivation stratum examined. Such life tables are not available in Ireland as they would require routine, ongoing geocoding of all deaths in order to assign each death to a deprivation category based on address at the time of death. Work assessing inequalities in cancer survival in the UK has largely used relative survival outcomes (Coleman et al.1999, Rachet et al. 2010) However, the conclusions of our Irish analyses should not be affected (unless the reliability of cause-of-death coding varied sufficiently by deprivation status, urban/rural status or age). One advantage of using relative survival would be that calculations of 'avoidable' deaths would be more straightforward to make – this has been done in the UK (e.g. Ellis et al. 2012).

Survival by urban/rural status

For all cancers combined, age-standardised survival was slightly but significantly lower among urban than among rural patients (*Figure o.5*), with mortality risk about 4% higher overall, 8% for males but no significant difference for females. However, these differences were no longer significant after adjustment for casemix (cancer type), which is also influenced by urban/rural status (e.g. lung cancer makes up a higher proportion of cancers in urban patients). Lung cancer survival was significantly higher in urban patients (mortality risk about 6% lower than for rural patients), but there was no difference after adjustment for stage. Otherwise urban/rural status did not significantly influence survival for the individual cancer types examined.

Survival by deprivation status

For all nine cancer types examined, and for cancers as a whole, there was evidence of poorer cancer-specific survival in patients from the most deprived compared with the least deprived areas (*Figure o.6*). This was not statistically significant for melanoma, cervical cancer or leukaemia, but for the other cancers examined the age/sex-adjusted mortality risk among cancer patients was between 19% and 54% higher among patients from the most deprived areas. The greatest inequality seen was for breast cancer, the lowest for stomach cancer and melanoma. For all cancers combined, the mortality risk was 39% higher in the most deprived compared with the least deprived areas, having adjusted for age and sex, or 27% higher if further adjusted for the cancer types involved (i.e. casemix may explain about a third of the survival variation by deprivation). Models adjusted for stage suggested that stage accounted for between one-fifth and two-fifths of the deprivation-related variation in survival for breast, cervical and prostate cancers but none of the variation for colorectal or lung cancers or lymphoma.

Interaction between deprivation and urban/rural status

For cancer as a whole and for male colorectal cancer, patients from urban areas showed a significantly stronger pattern of poorer survival in the most deprived areas. For other cancer types the influence of deprivation on survival was broadly similar (or differences could not be statistically confirmed) between urban and rural patients.

Survival by age

A very striking decline in average survival with increasing age was seen for all cancer types examined (see *Figure o.7* for comparisons of the oldest with younger patients), even though cancer-specific survival was the outcome (thus mortality risk from non-cancer causes, which increase rapidly with age, was excluded). Overall, patients aged 75+ years were about four (3.8) times more likely to die from their cancer than patients aged 45-54, or about three (2.9) times more likely if adjustment is made for cancer type. For females, the disparity in survival by age was particularly high (mortality risk 5.2 times higher in the oldest group, compared with 2.6 times for the oldest males). For specific cancer types, survival disparities between ages 75+ and 45-54 ranged from about a two-fold difference (for stomach, colorectal and lung cancers) to a five-/six-fold difference or more (for breast and prostate cancers and lymphoma). Models adjusted for age suggested that stage differences by age accounted for a substantial proportion (perhaps 30-70%) of the age-related

variation in survival for some cancers (breast, cervical, prostate, melanoma) but not for others (stomach, colorectal, lung cancers, lymphoma).

Comments / Comparison with other studies

Many international studies have examined the influence of socioeconomic factors on survival of cancer patients, using either area-based or individual-level data on a range of 'social indicators' such as education level, social class based on occupation, private v public health-funding status, income, or indices of deprivation based on combinations of factors. A review by Kogevinas et al. (1997) noted that differences in cancer survival by social class appear "remarkably general" and that "patients in low social classes had consistently poorer survival than those in high social classes". That review also concluded that the widest differences were noted for cancers with a good average prognosis, such as breast cancer, and that where relative mortality risks were estimated, they generally ranged between 1.0 and 1.5 (comparing more deprived with less deprived groups).

Some of the most comprehensive assessments of survival variation by deprivation across a range of cancer types have been undertaken in England and Wales by the Cancer Research UK Cancer Survival Group (e.g. Coleman et al. 1999, Rachet et al. 2010). Of 47 cancer types for which 1981-1990 survival data were compared across deprivation categories, 44 showed some evidence of lower survival in the most deprived groups (Coleman et al 1999). For cancers in common with this report, deprivation 'gaps' (absolute differences in 5-year, age-standardised relative survival between the least and most deprived groups) were seen for cancers of the colon (3%), rectum (5%), female breast (7%), cervix (4%), prostate (2%) and for melanoma of skin (7%), non-Hodgkin lymphoma (3%), Hodgkin lymphoma (8%) and leukaemia (5%) during 1986-1990. Differences were less clear for stomach and lung cancers, but the overall trend of declining survival across five deprivation categories was significant for lung cancer. Further work comparing three periods (1996-2000, 2001-2003 and 2004-2006) found only limited evidence, confined to one-year survival, that deprivation gaps in England were narrowing over time (Rachet et al. 2010)

Previous Irish analyses have also found significantly poorer survival in more deprived patient groups for lung cancer (NCR 2011) and breast cancer (NCR 2012, Walsh et al. 2014). For prostate cancer patients in Ireland, Burns et al. (2014) found that the survival was poorer in men of lower socioeconomic status but that the influence of socioeconomic status was more marked in patients treated in public than in private hospital settings. For childhood cancers in Ireland, no significant influence of deprivation on survival was confirmed, but for lymphoid leukaemias there were indications (a non-significant trend) of declining survival with increasing deprivation (Walsh et al. 2011).

Woods et al. (2006) reviewed factors that might contribute to socioeconomic inequalities in cancer survival, under three broad categories – tumour characteristics; patient characteristics; and health-care factors. The first category includes stage and biological characteristics of the tumour such as grade, morphological type, oestrogen-receptor status; of these, stage was the factor most often found to contribute to survival disparities by socioeconomic status. Of the patient factors considered, some (but rather limited) evidence was found for a role of comorbidities (other significant health conditions), and some studies have also proposed a role for patient nutritional factors or obesity. Psychosocial factors potentially also contribute, e.g. levels of social support (such as being married) and knowledge about health tend to be lower in more disadvantaged groups. Health-care factors, in particular inequalities in the treatment received by patients from different backgrounds, were considered by some studies to be an important contributor to socioeconomic differences in cancer survival in the US, but evidence from elsewhere was less clear. The review concluded that, although stage and access to optimal treatment were clearly important, the role of patient or system delays in diagnosis or treatment and of patient factors such as nutrition and health-seeking behaviours needed further study.

Survival variation by age seen in the present study is broadly in line with that seen internationally. A direct comparison of age-specific survival rates is possible between Ireland and Europe as a whole using findings of the EUROCARE-5 study (De Angelis 2014), which included data submitted by cancer registries across Europe, including NCR. For cancers as a whole and for the 'solid' tumours included in this report, the patterns of 5-year relative survival by age are quite similar (*Figure o.8*). Based on comparisons between ages 75+ and 45-54 (comparing cumulative mortality to 5 years), age-related inequalities in overall cancer survival appeared to be slightly more marked in Ireland overall and for prostate cancers. The opposite appeared to be true (i.e. less marked inequality by age in Ireland) for breast and, especially, cervical cancer and melanoma. For stomach, colorectal and lung cancers there was little difference in the pattern.

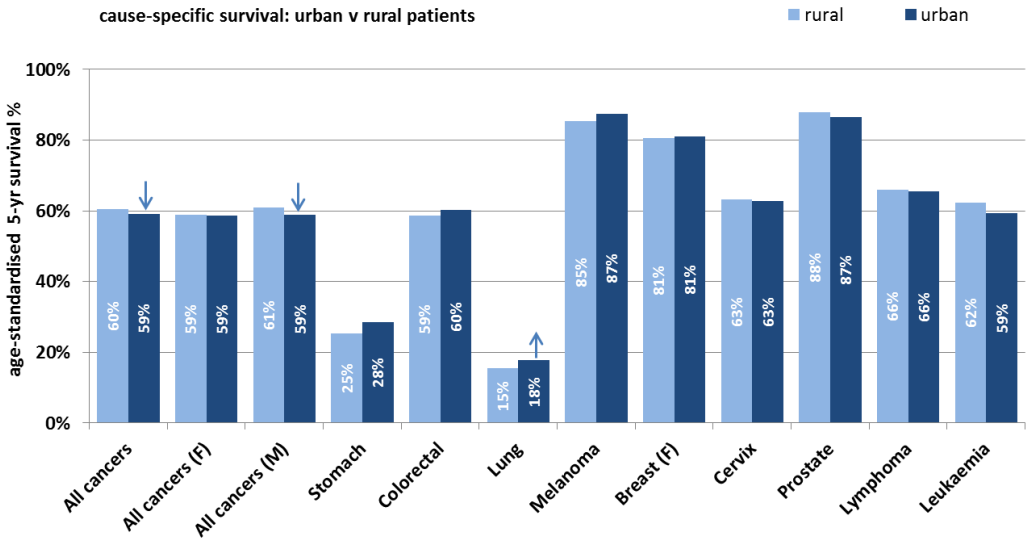


Figure o.5 Age-standardised cancer survival, Ireland, 2008-2012: comparison between urban and rural populations. Arrows indicate significant differences (after adjustment for age and sex). Survival for all cancers combined did not differ significantly after adjustment for cancer type.

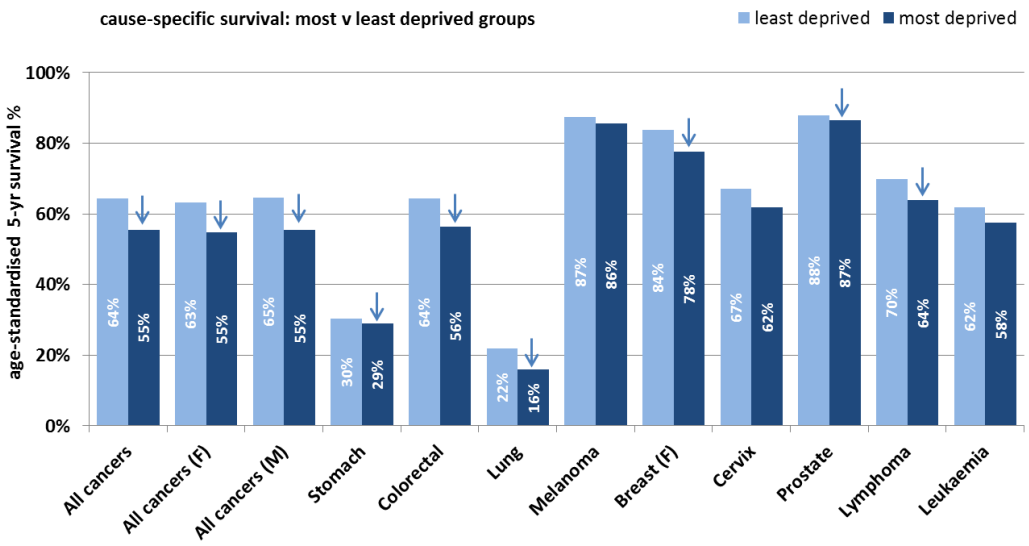


Figure o.6 Age-standardised cancer survival, Ireland, 2008-2012: comparison between the most deprived and the least deprived 20% of the population. Arrows indicate significant differences (adjusted for age and sex).

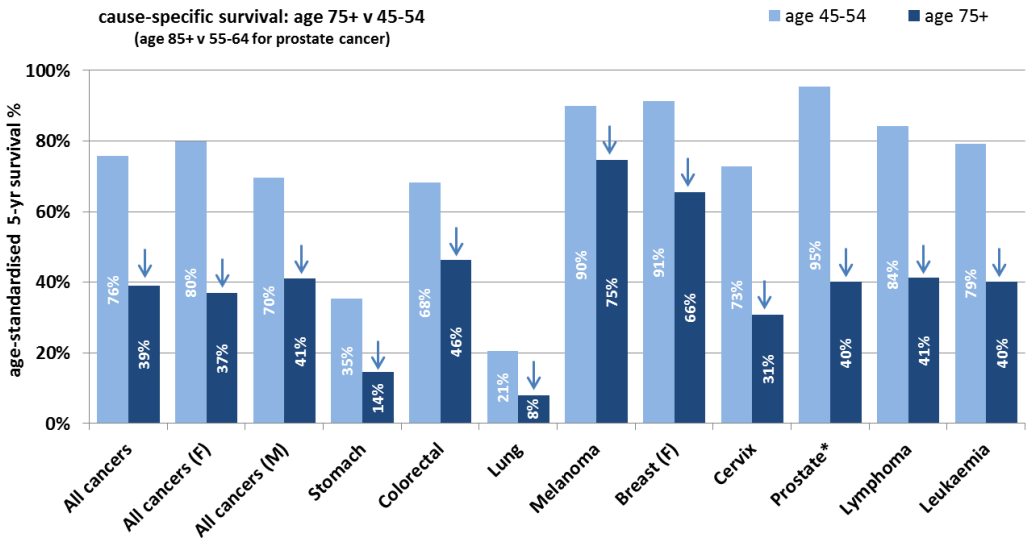


Figure o.7 Age-specific cancer survival, Ireland, 2008-2012: comparison between age 75+ and 45-54 groups (or 85+ and 55-64 for prostate cancer). Arrows indicate significant differences (adjusted for sex where relevant).

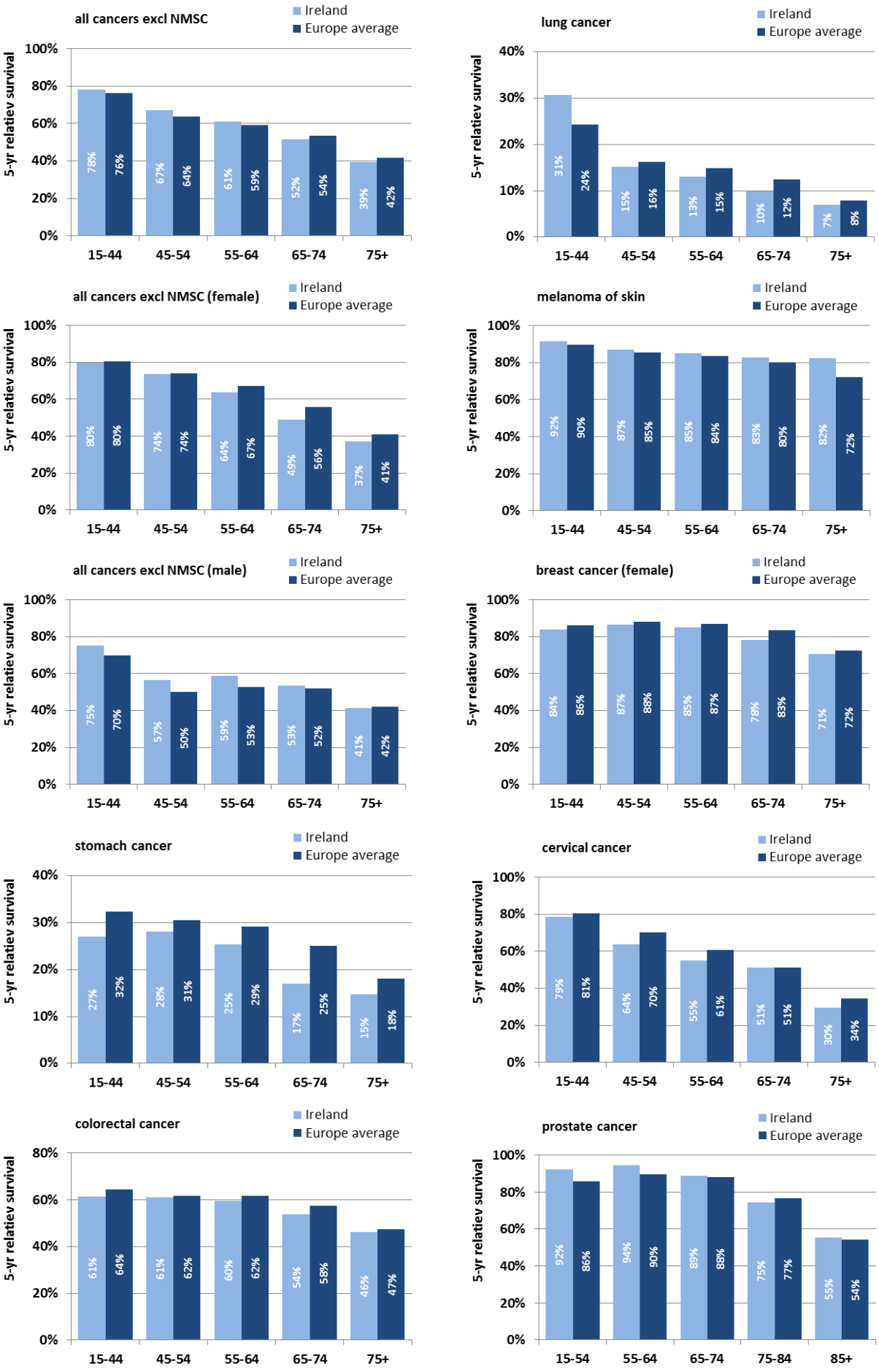


Figure o.8 Relative survival of cancer patients by age-group: comparison of Irish with European average survival from the EUROCARE-5 study, 2000-2007 (figures downloaded from: http://www.eurocare.it/Database/tabid/77/Default.aspx).

Cancer stage

Stage by urban/rural status

Urban patients with lung or breast cancer were significantly more likely to present at the least advanced stage (stage I), and less likely to present at an advanced stage (stage III), than rural patients, having adjusted for age and sex (*Figure o.9*). Urban patients with prostate cancer were more likely to present at the most advanced stage (stage IV). For other cancers examined, the stage breakdown of cases did not vary significantly between urban and rural cases.

Stage by deprivation

Patients from the most deprived areas were significantly less likely to present at an early stage for breast cancer (stage I) and prostate cancer (stage II), and more likely to present at an advanced stage for breast cancer (stage IV), prostate cancer (stages III and IV), stomach cancer (stage IV) and melanoma of skin (stage III), compared with patients from the least deprived areas (*Figure o.10*). For lymphoma, the most deprived group were significantly more likely to present at stage II. These findings are adjusted for age and sex.

Interaction between deprivation and urban/rural status

Influences of deprivation on the stage breakdown of cases differed significantly between urban and rural patients for stomach cancer (stages I, II and IV), colorectal cancer (stage IV) and lymphoma (stage III).

Stage by age

The influence of age on stage breakdown of cases was striking but was not consistent across cancer types, and two broad patterns were seen. For colorectal and lung cancers, the oldest patients were significantly more likely to present at an earlier stage (stage II colorectal, I lung) and less likely to present at an advanced stage (III and IV for both) (*Figure o.11*). In contrast, for melanoma, breast, cervical and prostate cancers, the oldest patients were less likely to present at early stages (stage I melanoma, I and II breast, I cervical, II prostate) and more likely to present at advanced stages (stage III melanoma, III and IV breast, IV cervical and IV prostate). Older patients with stomach cancer were less likely to present at stage II or III, those with lymphoma less likely to present at stage I.

Comments / Comparison with other studies

Variation of stage by deprivation, age or urban/rural status was not as clear-cut as variation by incidence or survival. In part, this may reflect the greater complexity of the data (and variable proportions of unstaged cases), but the findings of other studies have, likewise, not always been clear-cut. For example, Brewster et al. (2001), using Scottish Cancer Registry data, found “no evidence that patients from deprived communities were likely to present with more advanced disease for breast or colorectal cancer”; there waslimited evidence for such an effect in ovarian cancer, and the opposite effect was seen for lung cancer. On the other hand, many individual studies have noted a higher proportion of late-stage cases among more deprived patient groups (e.g. Clegg 2009, Schwarz et al. 2003, Wang et al. 2013). As noted earlier, when discussing survival findings, stage is widely perceived to be an important contributor to, or mediating factor in, the influence of deprivation or social class on survival of cancer patients, but its role is sometimes unclear or relatively modest (e.g. Kafasshian et al. 2003, Schrijvers et al. 1995).

Relevant previous Irish studies include that of Burns et al. (2012) on prostate cancer, which noted that men with the highest socioeconomic status and educational attainment were the most likely to avail of screening using the Prostate Specific Antigen (PSA) test. This would be consistent with the present report’s findings that later-stage prostate cancers made up a higher proportion of cases in more deprived patient groups. For breast cancer, Walsh et al. (2014) found that Irish patients from more deprived backgrounds were, likewise, more likely to present at advanced stage. For rectal cancer (Comber et al. 2016), patients from more deprived areas are more likely to present as emergency admissions to hospital and that this is associated in part with more advanced stage at diagnosis.

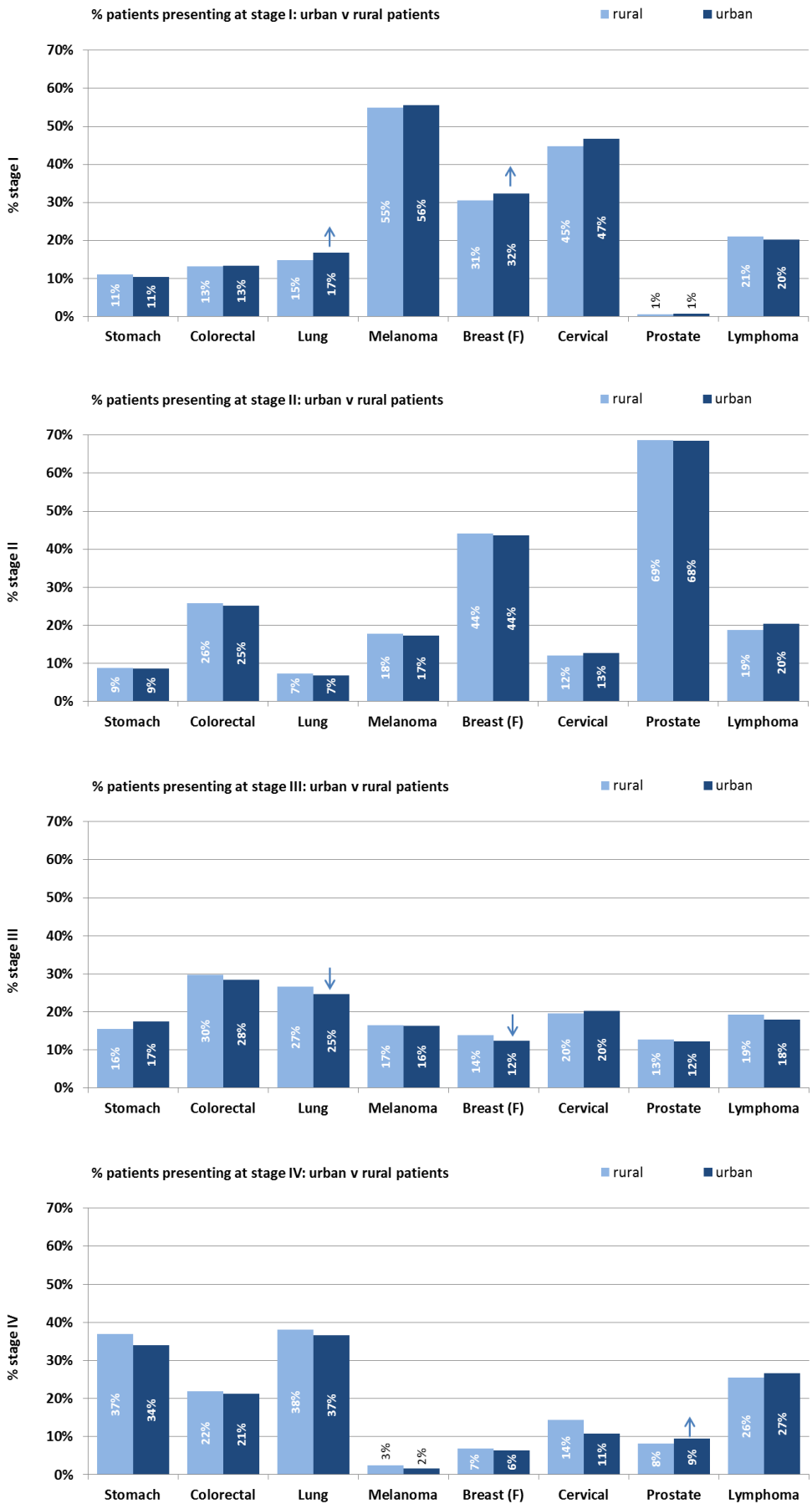


Figure o.9 Percentage of patients presenting at stages I-IV, Ireland, 2008-2012: comparison between urban and rural patients. Arrows indicate significant differences (adjusted for age and sex).

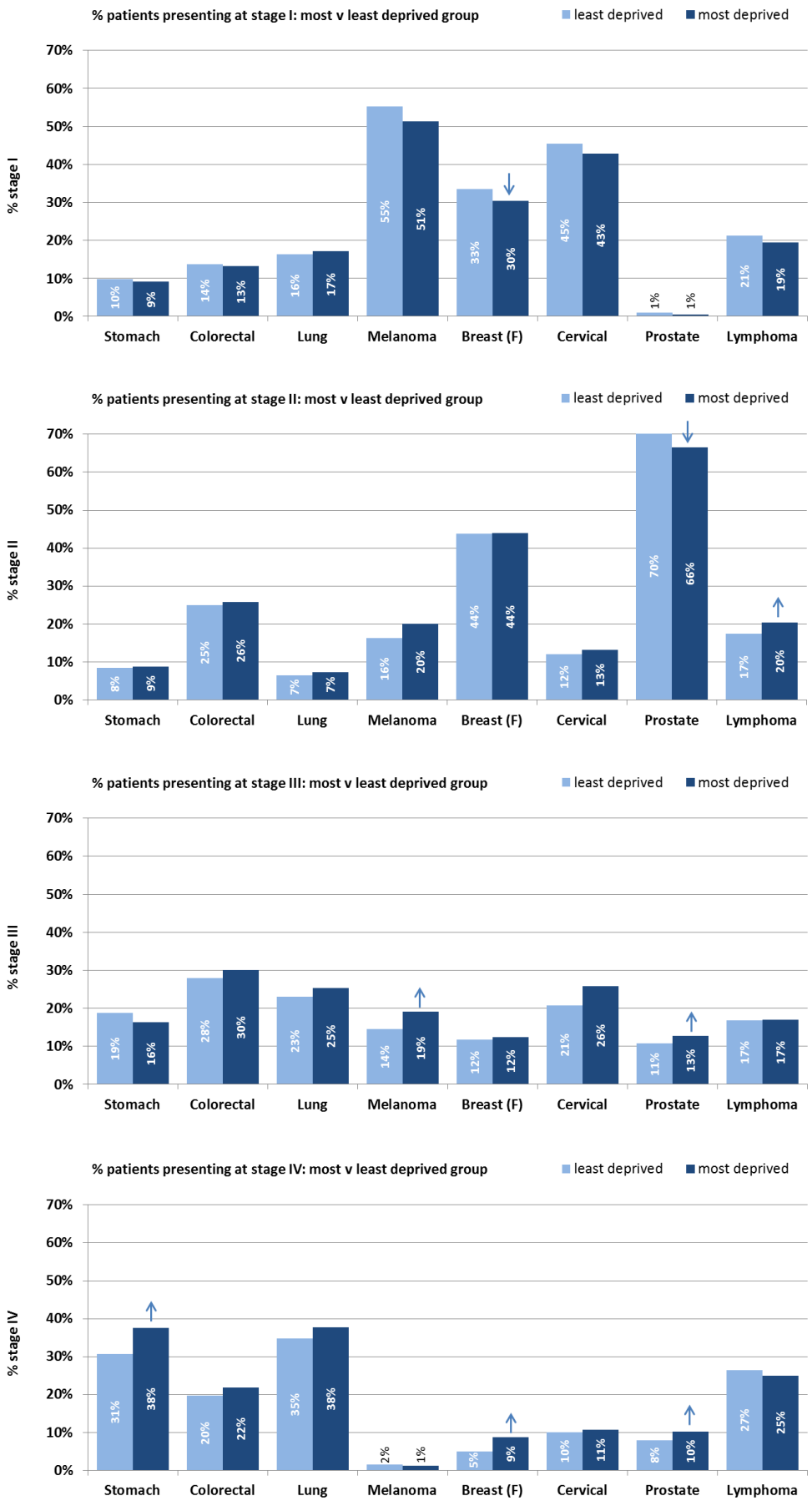


Figure o.10 Percentage of patients presenting at stages I-IV, Ireland, 2008-2012: comparison between the most deprived and the least deprived 20% of the population. Arrows indicate significant differences (adjusted for age and sex).

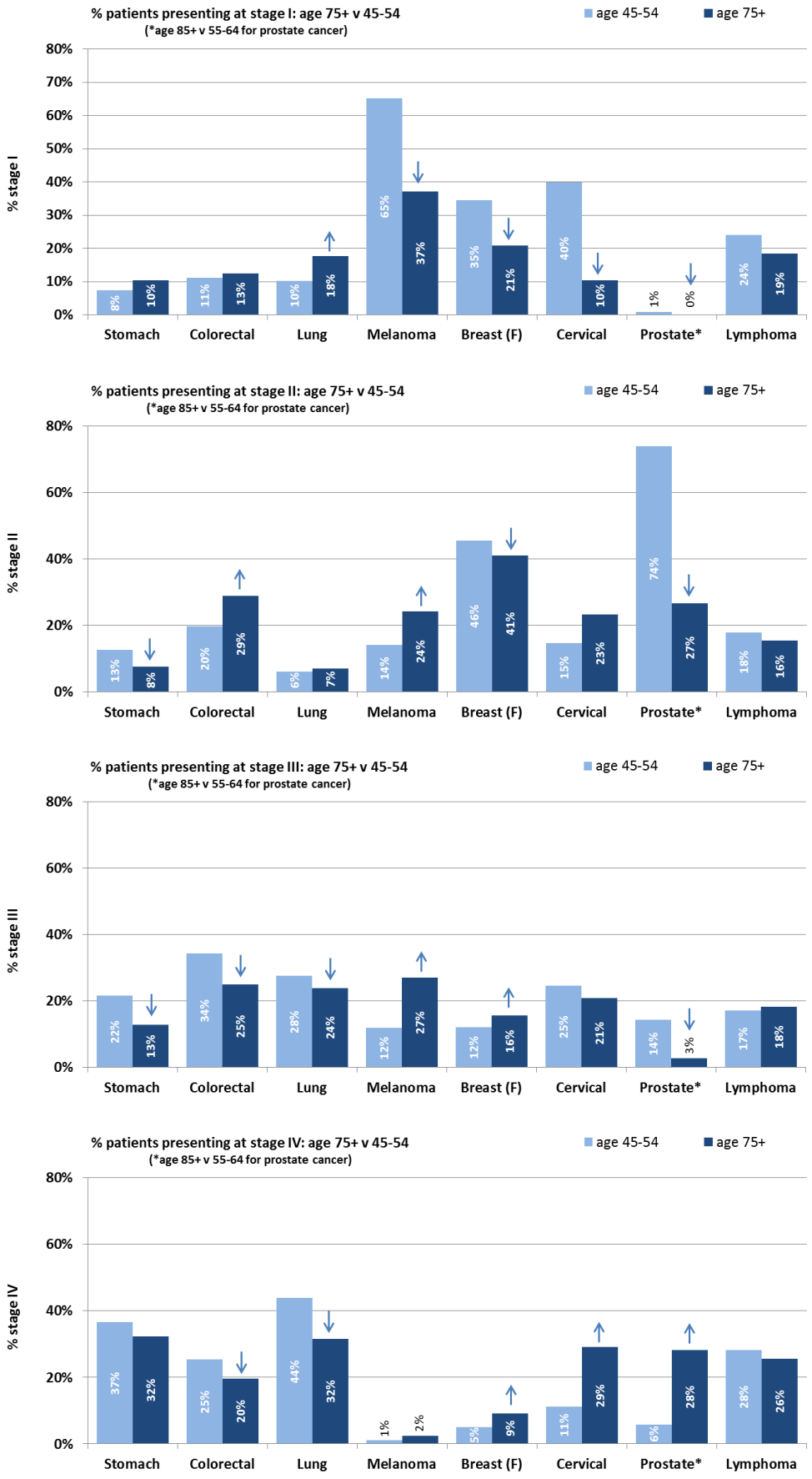


Figure o.11 Percentage of patients presenting at stages I-IV, Ireland, 2008-2012: comparison between age 75+ and 45-54 groups (or 85+ and 55-64 for prostate cancer). Arrows indicate significant differences (after adjustment, where relevant, for sex).

Cancer treatment

Treatment by urban/rural status

Urban patients were significantly less likely than rural patients to have any treatment for melanoma (-2% relative) and prostate cancer (-4%); tumour-directed surgery for colorectal cancer (-3%); radiotherapy for any cancer (-4%) and prostate cancer (-9%); and chemotherapy/immunotherapy for any cancer (-4%), colorectal cancer (-5%), melanoma (-26%) and breast cancer (-5%) (*Figure o.12*). However, urban patients were more likely to have surgery for prostate cancer (+12%). Urban patients were less likely to have hormonal treatment (not graphed) for any cancer (-13%), breast cancer (-8%) and prostate cancer (-18%).

Treatment by deprivation status

Patients from the most deprived populations were significantly less likely to have surgery for cancer, overall (-6% relative) and for stomach cancer (-13%), colorectal cancer (-4%), lung cancer (-7%), female breast cancer (-4%) and prostate cancer (-19%), compared with the least deprived group; and less likely to have any treatment for colorectal cancer (-4%) and lung cancer (-21%) (*Figure o.13*). Patients from the most deprived populations were significantly more likely to have hormonal treatment, overall (+27%) and for breast cancer (+11%) and prostate cancer (+61%); and also any treatment (+8%), radiotherapy (+12%) or chemotherapy (+95%) for prostate cancer.

Interaction between deprivation and urban/rural status

The influence of deprivation on treatment differed significantly between urban and rural patients for chemotherapy in breast cancer patients (stronger effect for rural patients), hormonal therapy in prostate cancer (stronger effect for urban patients), and chemotherapy in leukaemia (stronger effect for rural patients) – in each case, a higher proportion of patients in the most deprived group were treated.

Treatment by age

Very marked variation of treatment by age was seen, particularly in the use of chemotherapy, with (in general) a lower proportion of older patients having treatment (with the exception of hormonal treatment). For cancers as a whole, patients aged 75+ years were significantly less likely to have any treatment (-30% in relative terms), surgery (-21%), radiotherapy (-22%) or chemotherapy (-72%) than those aged 45-54 (*Figure o.14*). Across nine specific cancer types, use of any treatment was significantly lower in the oldest group for all (ranging from -4% for melanoma to -53% for leukaemia); use of surgery lower for eight cancers (-4% melanoma to -63% lung cancer); use of radiotherapy lower for six cancers (-43% lung cancer to -91% leukaemia); use of chemotherapy or immunotherapy lower for eight cancers (-31% lymphoma to -88% breast cancer); but use of hormonal treatment washigher for the oldest patients with breast cancer (+8%) and prostate cancer (+105%).

Comments / Comparison with other studies

A range of international studies have noted lower use of some treatment modalities in patients from more deprived backgrounds (e.g. Yu 2009, Aarts et al. 2010, 2012, Forrest et al. 2012). For lung cancer, for example, a review of studies noted that lower socioeconomic status was significantly associated with lower overall treatment and lower use of surgery and chemotherapy but not radiotherapy, and concluded that "these inequalities cannot be accounted for by socioeconomic differences in stage at presentation or by differences in health care system" (Forrest et al. 2012).

Previous NCR analyses have highlighted lower use of treatment in elderly patients with lung cancer (Mahmud et al. 2003, non-Hodgkin lymphoma (Cronin-Fenton et al. 2006), colorectal cancer (Carsin et al. 2008), and prostate cancer (de Camargo Cancela et al. 2013), among others. For non-Hodgkin lymphoma, it was noted that disparities by age in treatment of non-Hodgkin lymphoma in Ireland were greater than in the US. Some of the factors and difficulties involved in treatment decisions involving elderly cancer patients, and the importance of comprehensive geriatric assessment of such patients, are reviewed by Balducci & Extermann (2000), Blanco et al. (2015) and Given & Given (2008).

A comparison of treatment in relation to age between Ireland and the US is presented below (*Figures o.15-19*) for five major cancers (colorectal, lung, prostate and female breast cancers and melanoma of skin) over the diagnosis period 2008-2012. The comparisons use figures for invasive cancers downloaded from the American College of Surgeons' National Cancer Database (NCDB) website (http://oliver.facs.org/BMPub/). The age-groups involved could not be precisely matched but the relevant age-ranges are indicated. Of 16 combinations of cancer type and treatment modality examined, for more than half (10) the treatment figures for Irish patients showed stronger evidence of inequality by age than those for US patients, based on comparison of treatment percentages for age 75+ v 45-54 (Ireland) or 80+ v 50-59 (US). This also applied to overall treatment for all five cancers. However, for radiotherapy of colorectal (mainly rectal) cancer patients and hormone therapy of breast and prostate cancer patients, Irish patients showed less evidence of age inequality. Variation by age was broadly similar for radiotherapy in melanoma, chemotherapy in breast cancer and surgery in prostate cancer patients. There were also some notable differences in absolute treatment percentages between the Irish and US populations (particularly for prostate cancer), but these are not the focus of the current report.

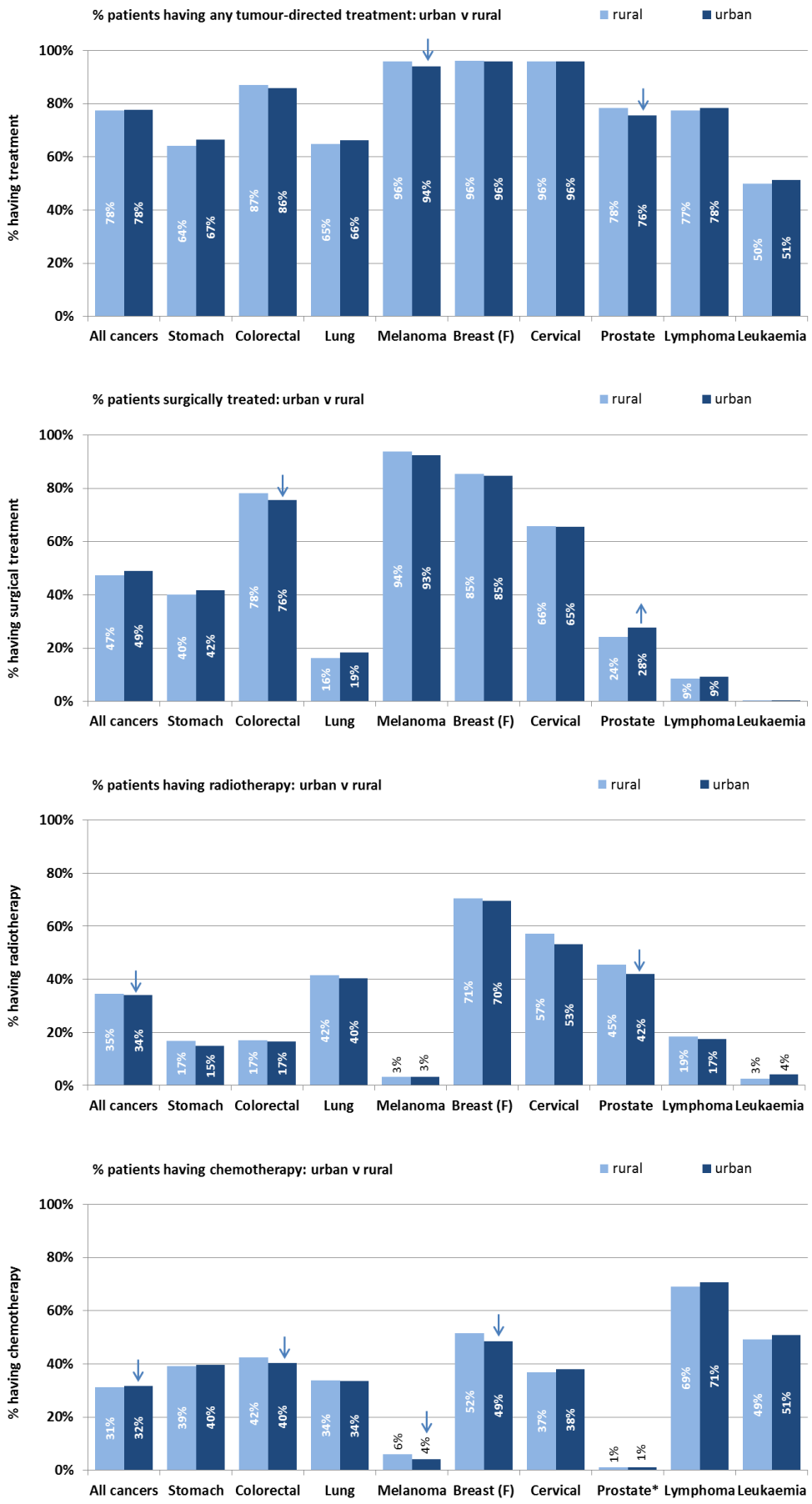


Figure o.12 Percentage of patients having tumour-directed treatment within a year of diagnosis, Ireland, 2008-2012: comparison between urban and rural populations. Arrows indicate significant differences (after adjustment for age and, where relevant, sex).

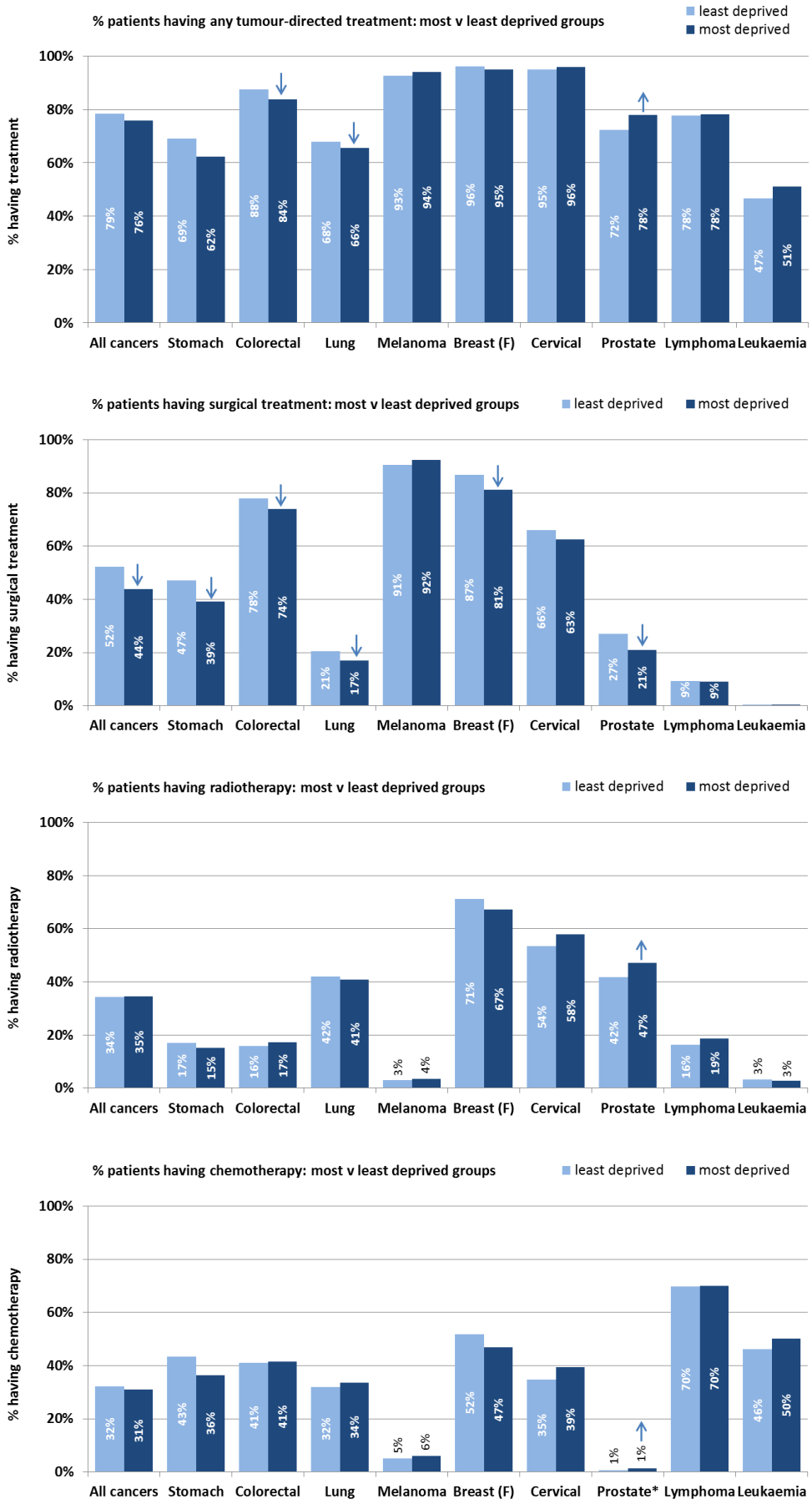


Figure o.13 Percentage of patients having tumour-directed treatment within a year of diagnosis, Ireland, 2008-2012: comparison between the most deprived and the least deprived 20% of the population. Arrows indicate significant differences (after adjustment for age and, where relevant, sex).

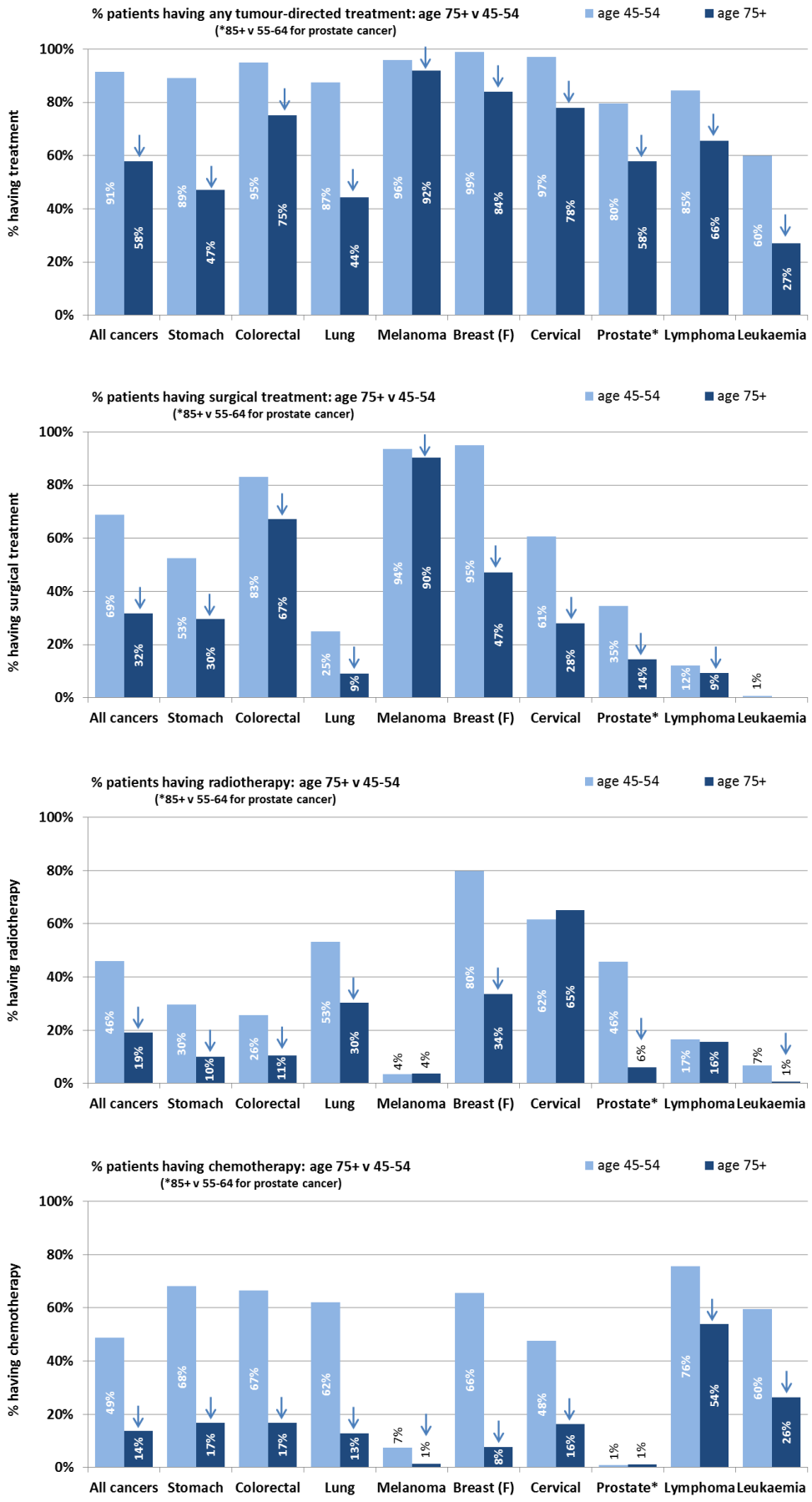


Figure o.14 Percentage of patients having tumour-directed treatment within a year of diagnosis, Ireland, 2008-2012: comparison between age 75+ and 45-54 groups (or 85+ and 55-64 for prostate cancer). Arrows indicate significant differences (adjusted for sex where relevant).

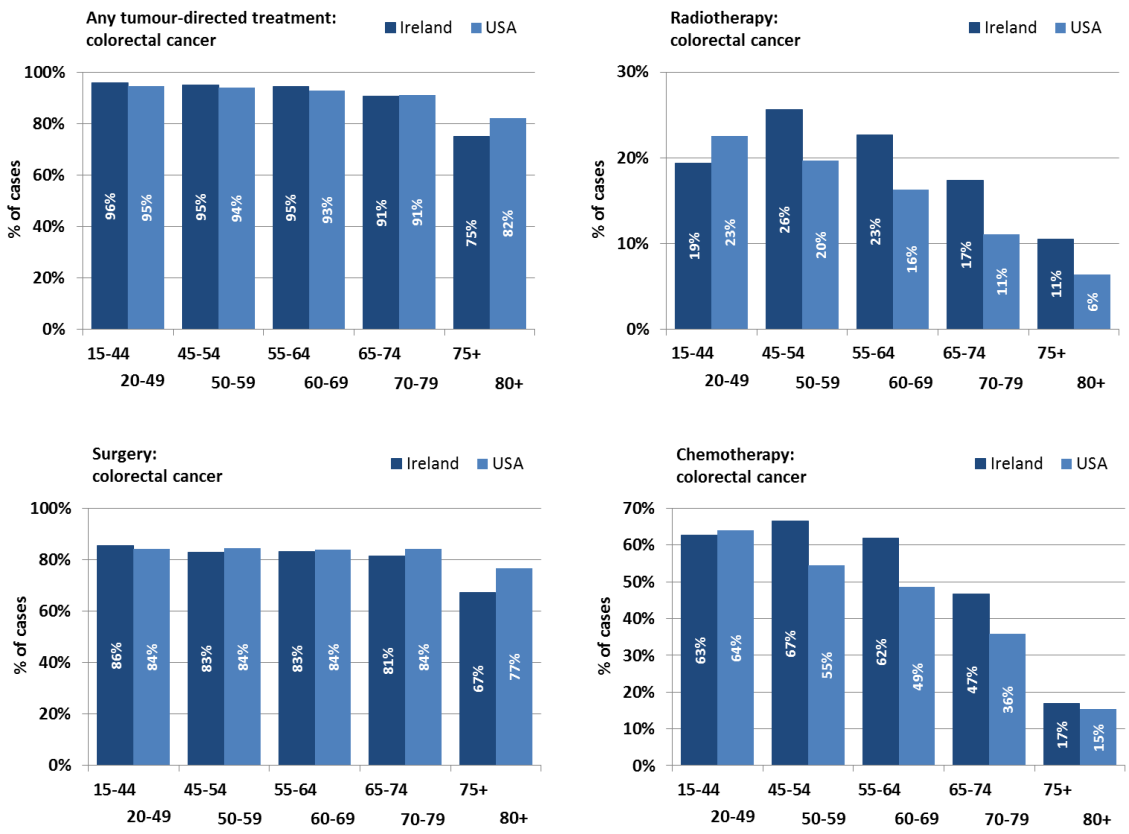


Figure o.15 Percentage of colorectal cancer patients, by age-group, having tumour-directed first-course treatment, Ireland (NCR) compared with the USA (National Cancer Database), 2008-2012. NCDB data for colon and rectum are combined.

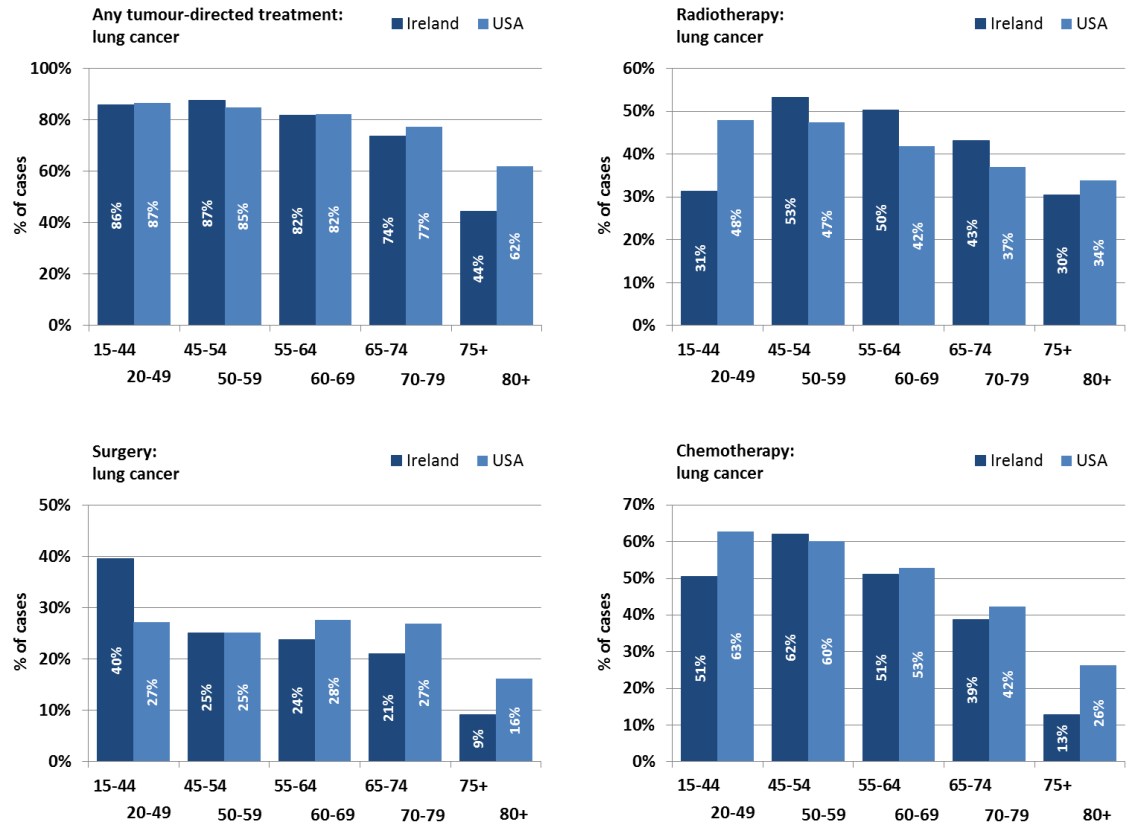


Figure o.16 Percentage of lung cancer patients, by age-group, having tumour-directed first-course treatment, Ireland (NCR) compared with the USA (National Cancer Database), 2008-2012. NCDB data for small-cell and non-small-cell lung cancers were combined to allow comparison with Irish data.

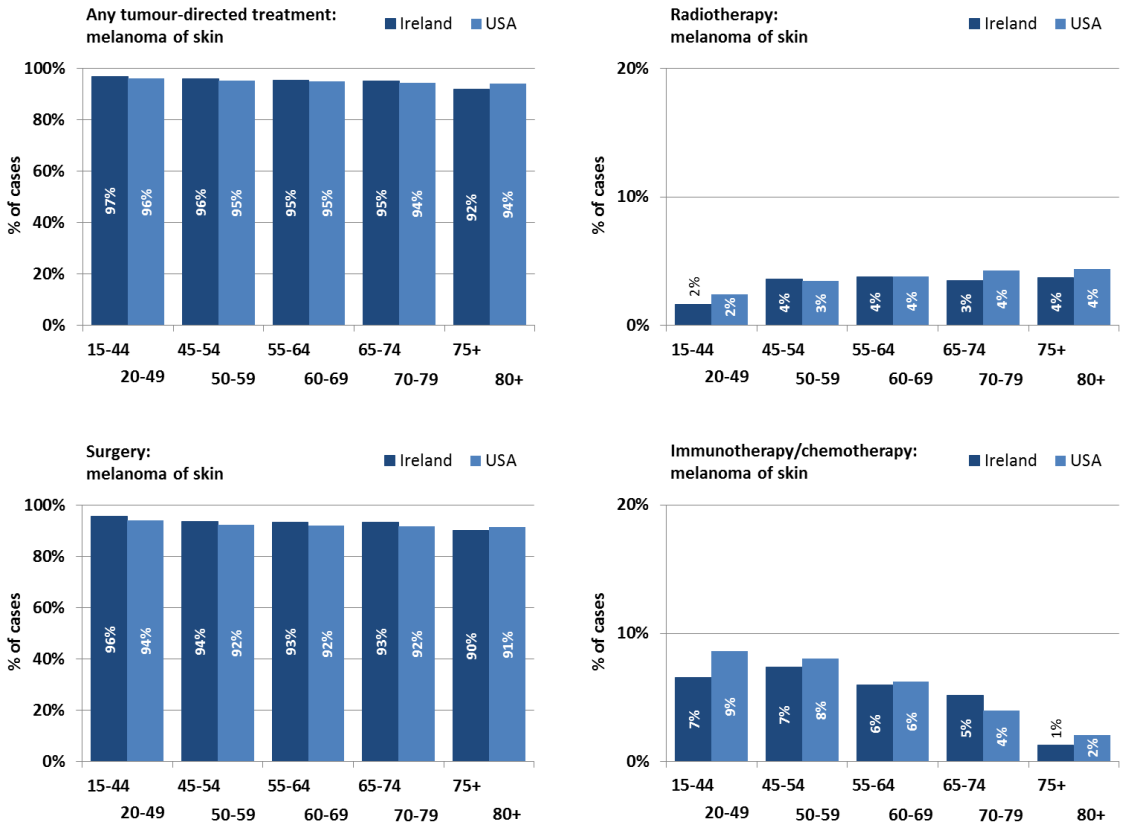


Figure o.17 Percentage of patients with melanoma of skin, by age-group, having tumour-directed first-course treatment, Ireland (NCR) compared with the USA (National Cancer Database), 2008-2012.

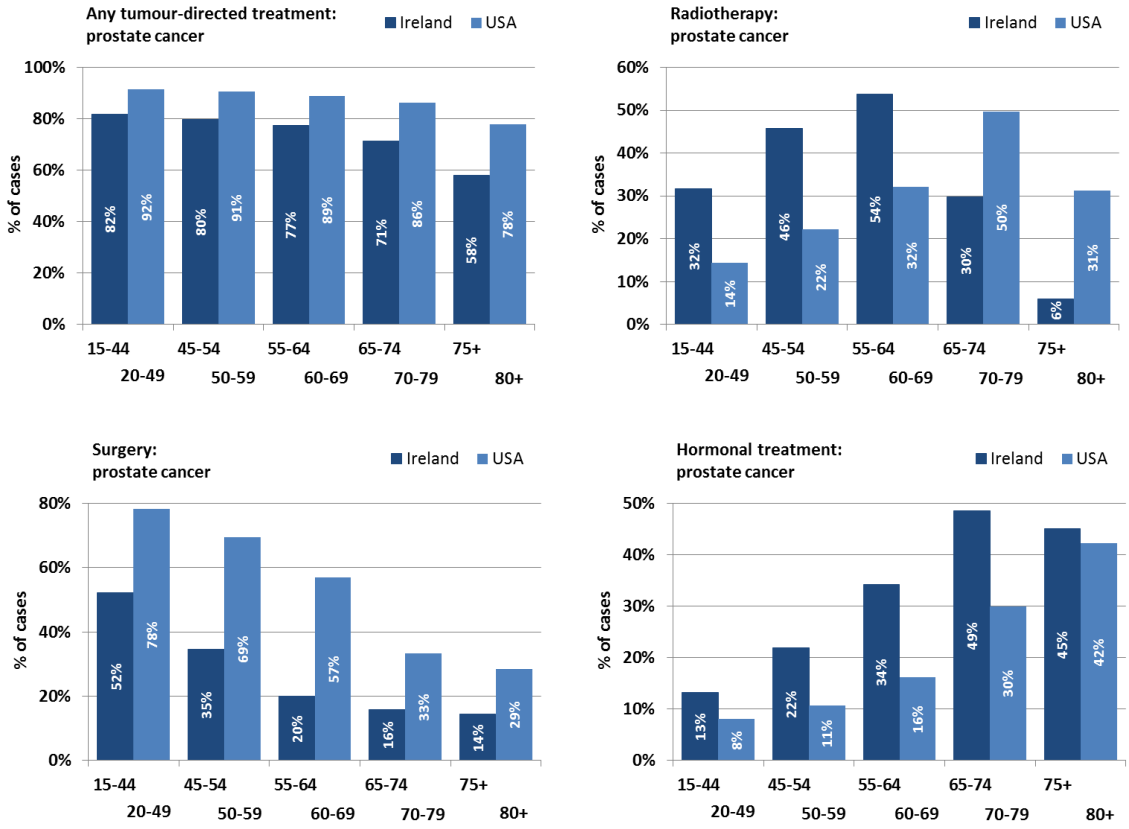


Figure o.18 Percentage of prostate cancer patients, by age-group, having tumour-directed first-course treatment, Ireland (NCR) compared with the USA (National Cancer Database), 2008-2012.

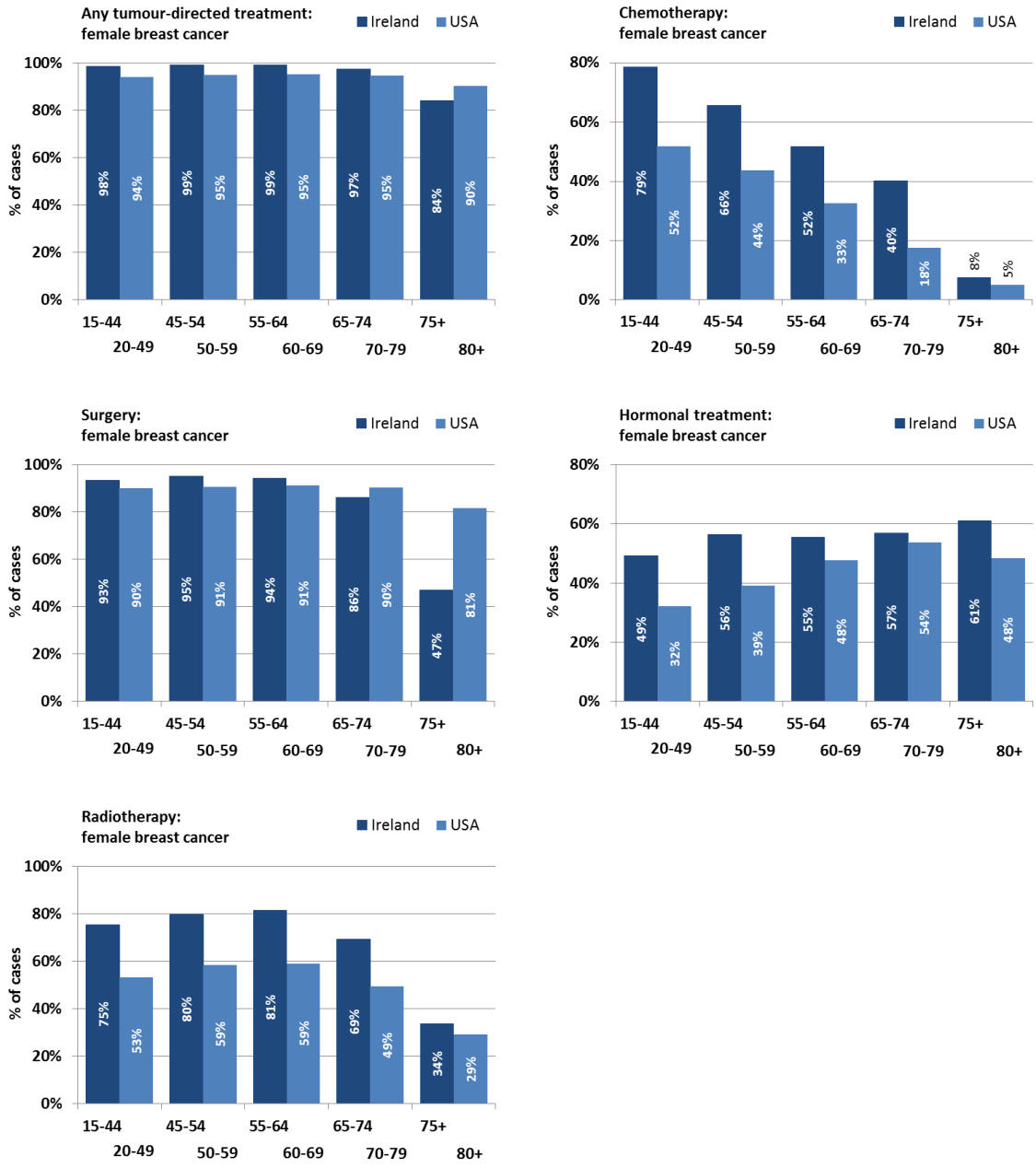


Figure o.19 Percentage of female breast cancer patients, by age-group, having tumour-directed first-course treatment, Ireland (NCR) compared with the USA (National Cancer Database), 2008-2012.

Comorbidity in cancer patients

Comorbidity by urban/rural status

Cancer patients (as a whole) from urban areas were slightly but significantly more likely (about 6% more likely having adjusted for age and sex) to have other significant health conditions than those from rural areas, for both males and females (*Figure o.20*). However, variation was not statistically significant for individual cancer types, and the all-cancer pattern was partly influenced by variation in cancer type between urban and rural patients.

Comorbidity by deprivation status

Cancer patients from the most deprived areas were significantly more likely to have serious non-cancer health conditions than those from the least deprived areas (*Figure o.21*): about 20% more likely in relative terms for cancer patients as a whole, or about 15% more likely for lung cancer, 40% more likely for breast cancer and 30% more likely for lymphoma patients (having adjusted for age and sex). Most other cancers examined showed broadly similar (but not statistically significant) patterns of variation by deprivation.

Interaction between deprivation and urban/rural status

For cancer patients as a whole (overall and for males), urban patients showed a significantly stronger pattern of higher levels of comorbidity in the most deprived group than seen for rural patients.

Comorbidity by age

Cancer as a whole and all individual cancers examined showed significantly higher prevalence of non-cancer comorbidities in the oldest patients compared with younger patients (*Figure o.22*). Overall, cancer patients from the oldest group (75+) were 150% more likely (i.e. 2.5 times as likely) to have serious comorbidities, compared with ages 45-54; or 35%-350% more likely for individual cancers, highest (250-350% more likely) for melanoma, cervical cancer, prostate cancer and breast cancer. Overall, 27% of cancer patients aged 75+ years had known serious comorbidities, based on hospital inpatient data, highest (33%) for cervical and lung cancer patients, lowest (15-17%) for melanoma and breast cancer patients, and higher for males (34%) than for females (24%).

Comments / Comparison with other studies

For the purposes of this report, we documented available data on comorbidity in cancer patients in relation to deprivation, urban/rural status and age. Considerable variation was seen, particularly in relation to deprivation and age, and these variations seem likely to contribute to the likelihood of patients receiving, continuing or responding well to treatment and, ultimately, to their likelihood of surviving their cancer. However, given the wide scope of the report and the range of cancers and outcomes examined, it proved impractical to incorporate comorbidity in the models we used.

Previous NCR studies have attempted to assess the possible role of comorbidity in explaining treatment or survival of cancer patients, but findings have generally been rather inconclusive. In part, this may reflect under-recording of relevant comorbidities in the data-source used (hospital in-patient records). Also, the information on treatment analysed has generally related only to initial receipt of treatment, and patients whose treatment was ended sooner than planned, because of comorbidities, would not have been taken account of. For breast cancer, for example, comorbidity did not contribute significantly to the model of survival by deprivation, whereas factors such as method of presentation, stage and region of residence played a greater role (Walsh et al. 2014).

There is much international evidence to indicate that comorbidities are more frequent among socioeconomically disadvantaged populations and in the elderly. Evidence of comorbidity's role in influencing treatment and survival tends to be less clear-cut, though some studies have indicated a moderate role, for some cancers at least. In one of the largest studies, in the Netherlands, Louwman et al. (2010) found levels of comorbidity about 50% higher in cancer patients with a lower socioeconomic status (SES), and the same broad pattern across a wide range of specific cancer types (as noted in the current report). Based on models of crude (overall) survival within one year of diagnosis, it was estimated that comorbidity accounted for about 23% of survival variation between low-SES and high-SES groups for males with colorectal cancer, 33% for females with colorectal cancer, 18% for female breast cancer, 22% for prostate cancer but none of the variation for lung cancer. For breast cancer in the USA, a range of studies have also found that comorbidities are associated with significantly reduced overall (all-cause) survival (e.g. Patnaik et al. 2011). A possible criticism of many such studies, however, might be that their use of all-cause rather than cancer-specific or relative survival might exaggerate the influence of comorbidities on cancer-related survival, especially for less-fatal cancers.

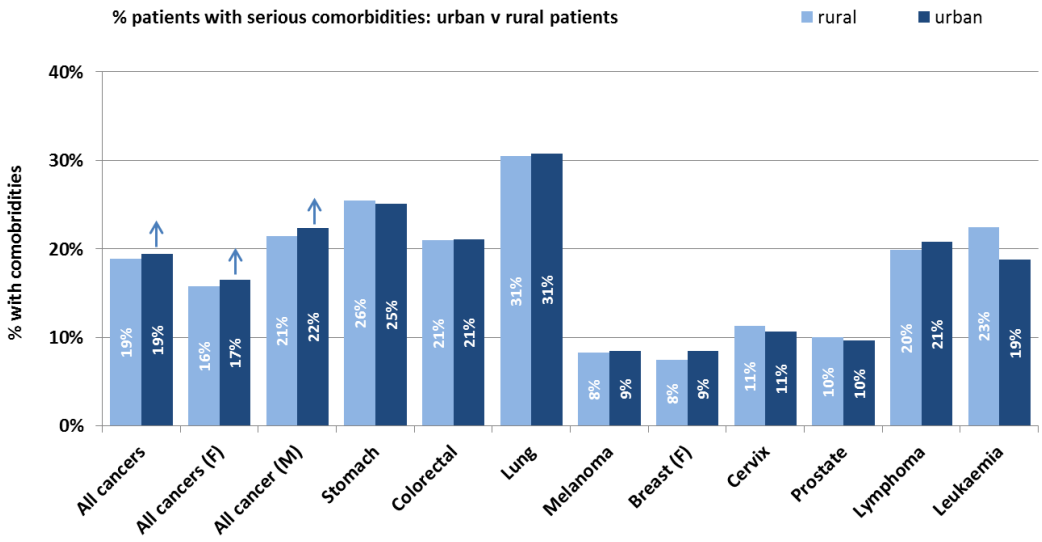


Figure o.20 Percentage of cancer patients having serious comorbidities around time of diagnosis, Ireland, 2008-2012: comparison between urban and rural patients. Arrows indicate significant differences (adjusted for sex where relevant).

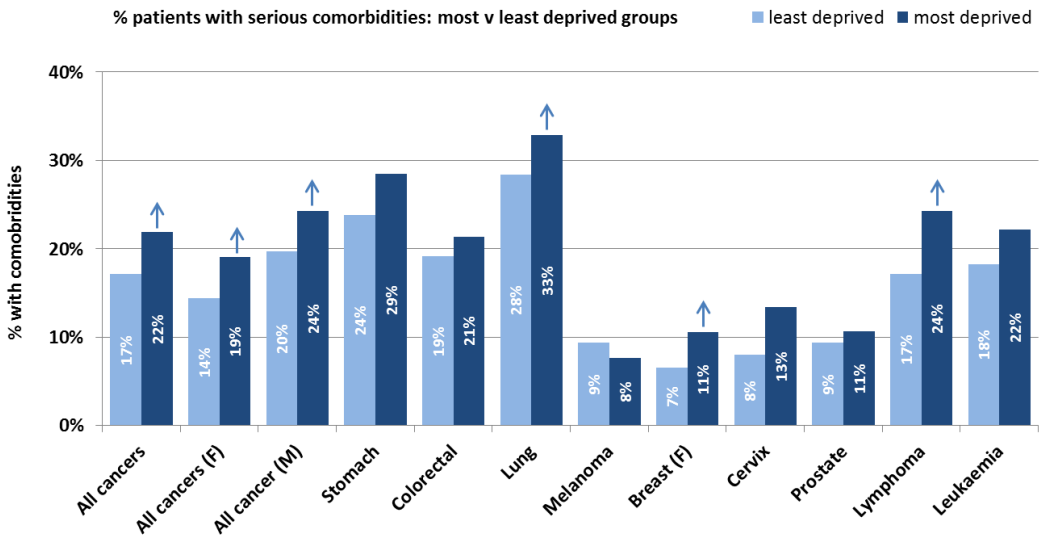


Figure o.21 Percentage of cancer patients having serious comorbidities, Ireland, 2008-2012: comparison between the most deprived and the least deprived 20% of the population. Arrows indicate significant differences (adjusted for age and sex).

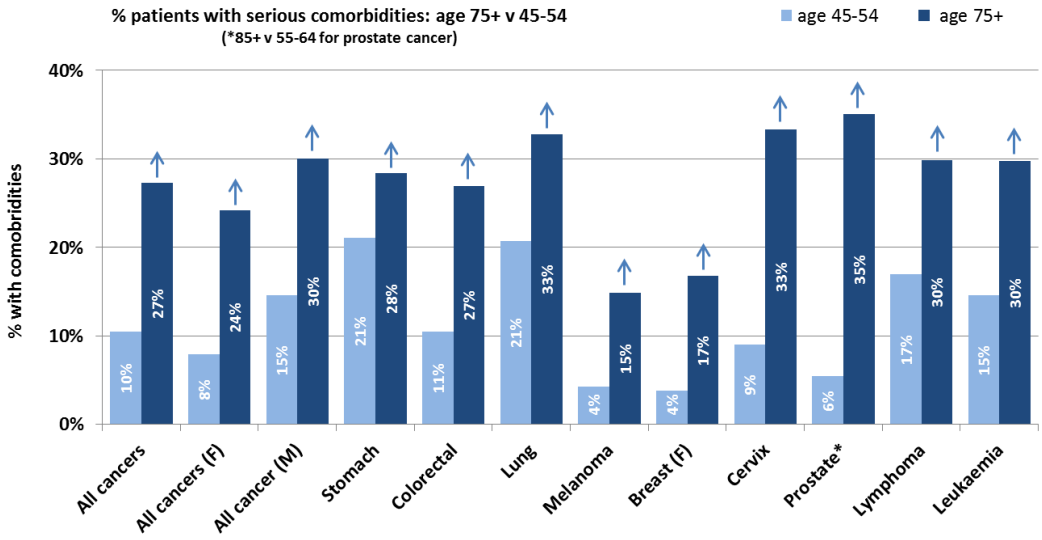


Figure o.22 Percentage of cancer patients having serious comorbidities, Ireland, 2008-2012: comparison between age-groups 75+ and 45-54 (85+ / 55-64 for prostate cancer). Arrows indicate significant differences (adjusted for sex where relevant).

Screen-detection status (breast cancer)

Screen-detection by urban/rural status

In the age-group (50-64) initially targeted by the national breast screening programme (BreastCheck), breast cancers in women from urban populations were slightly (7%) but significantly more likely to have presented through screening than in rural women. The per-population incidence rate of screen-detected breast cancers was also higher (by about 20%) in urban populations, reflecting a combination of higher screen-detected proportion and higher overall incidence of breast cancer in urban populations.

Screen-detection by deprivation status

The proportion of breast cancers at ages 50-64 that were screen-detected did not differ significantly by deprivation status, but the rate of screen-detected breast cancer was about 20% lower in the most deprived compared with the least deprived population group. This finding seems to reflect the overall influence of deprivation on breast cancer incidence more strongly than its influence on screening.

Comments / Comparison with other studies

Our findings in relation to screening are rather complex to interpret. They suggest that women from urban populations are slightly more likely to be diagnosed through screening, but that deprivation status did not significantly influence the likelihood of diagnosis through screening. Nevertheless, for both urban status and deprivation status, the per-population rate of screen-detected cancer differed quite markedly (rates 20% higher in urban than in rural populations, but 20% lower in the most compared with the least deprived populations). Influences of urban status and deprivation status on overall incidence, and possible interactions between urban and deprivation status, may be involved. Further work to explore urban and deprivation influences on screening, based on populations invited to screening (i.e. not just breast cancer patients), would be informative.

A range of international studies have found evidence of lower use of mammographic screening among women of lower socioeconomic status (SES). For example, in the region of the Netherlands covered by the Eindhoven Cancer Registry, the attendance rate (after invitation to screening) was 79% in the low-SES group, 85% in an intermediate group and 87% in the high-SES group (Aarts et al. 2011). It was suggested that this disparity in screening attendance contributed, in part, to the less favourable stage distribution seen for breast cancer in the low-SES group in that region.

Smoking status

Although smoking status was not a major focus of this report, it is strongly linked to deprivation status and can influence not only incidence of certain cancers but also, potentially, survival, treatment and comorbidity in a wider range of cancers (e.g. Sharp et al. 2014). When recorded in hospital notes, smoking status for each patient at the time of their first recorded cancer is coded by the National Cancer Registry. As well as contributing significantly to cancer risk (for some cancers in particular), smoking status among cancer patients may also independently have an adverse influence on survival, including cancer-specific survival (i.e. not just by increasing risk of dying from smoking-related non-cancer causes, e.g. chronic obstructive pulmonary disease). Part of the influence of smoking on cause-specific survival may be through an association with comorbidity, if smokers are more likely to have certain comorbid conditions and if patients with comorbidities are less likely to have effective treatment (or to respond to or complete their treatment). Smoking may also potentially interfere with certain treatments.

The recorded (minimum) prevalence of patients classed as “current smokers” was notably higher among patients from the most deprived quintile (20%) of the Irish population (*Table m.i* [*Methods* chapter] and *Figure o.23*). Overall, 25% of cancer patients from the most deprived group were known to be current smokers, compared with 14% of those from the least deprived stratum – equivalent to an 80% higher prevalence (in relative terms) in the most deprived group. This does not take into account differences in casemix, age or sex between deprivation groups, but similar patterns were evident for both sexes and for all individual cancer types examined (*Figure o.24*). Relative differences between the most and least deprived groups were highest for melanoma (current smoker prevalence 130% higher in the most deprived group) and lowest for lung cancer (current smoker prevalence 30% higher in the most deprived group). It should be noted, however, that substantial percentages of patients were of unknown smoking status and that the percentage of “unknowns” varied by cancer type. Thus the percentages shown here will be minima and may not be directly comparable across cancer types (for example, patients with lung cancer may be more likely to be questioned about their smoking status when admitted to hospital).

Differences in smoking prevalence between urban and rural patients were much less marked than differences by deprivation status (*Table m.i* [*Methods* chapter] and *Figure o.24*). Overall, 20% of urban patients were known to be current smokers, compared with 18% of rural patients, or a 13% higher prevalence of smoking among urban patients

(unadjusted for age, sex or casemix). Urban/rural differences were minor or absent for some cancer types but most of the nine specific cancers examined showed some evidence of higher smoking prevalence among urban patients.

In comparison with casemix (cancer type) and stage, the mediating or 'explanatory' role of smoking in relation to survival variation by deprivation or urban/rural status appeared to be lower i.e. a smaller proportion of the effect of deprivation or urban status on survival appeared to be accounted by smoking. The effect of adjusting for smoking status will depend both on the strength of smoking's influence on cancer-specific survival and the actual prevalence of smoking in the different groups compared. Although the effect of adjusting for smoking was fairly modest, a clear influence of smoking on cancer-specific survival was nevertheless evident from statistical models of survival for most of the cancer examined (*Table o.1*). For cancers as a whole, patients who were classified as current smokers at the time of diagnosis were about 20% more likely to die from their cancer than non-smokers, having adjusted for age, sex, cancer type and deprivation status. Most specific cancer types examined also showed significant negative influences of smoking on cancer survival. Survival differences between smokers and non-smokers would be even higher if all-cause (observed) survival were the outcome examined, reflecting additional deaths from smoking-related illnesses other than cancer. Only lymphoma showed any significant negative influence of former smoking status on survival.

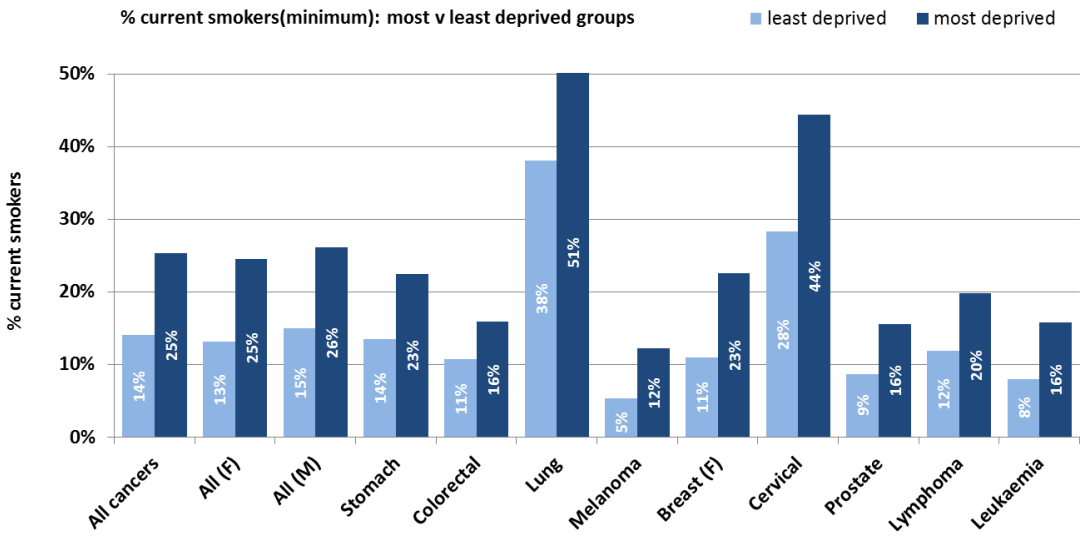


Figure o.23 Prevalence of smoking among cancer patients, Ireland 2008-2012: comparison between the most deprived and the least deprived 20% of the population.

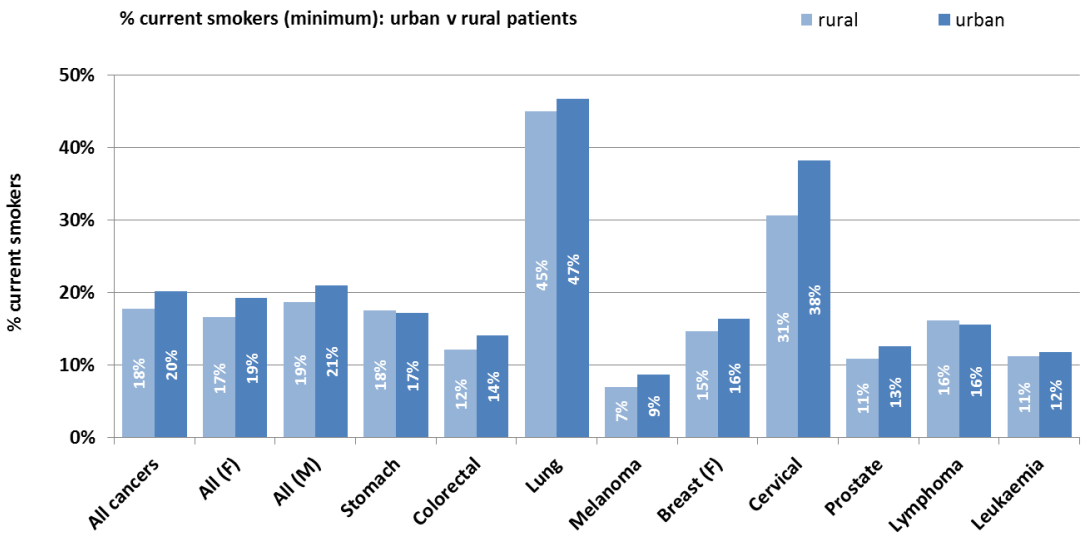


Figure o.24 Prevalence of smoking among cancer patients, Ireland 2008-2012: urban v rural comparison

Table o.1 Hazard ratios for the influence of smoking status on cancer-specific survival

Cancer type	Non-smokers	Current smokers		Ex- smokers	
	HR	HR	95% CI	HR	95% CI
All cancers[abd]	1.00	***1.22	1.17-1.26	0.98	0.94-1.02
All (male)[ad]	1.00	***1.22	1.15-1.28	0.98	0.92-1.03
All (female)[ad]	1.00	***1.23	1.16-1.29	0.99	0.93-1.05
Stomach[abc]	1.00	1.05	0.89-1.23	0.93	0.78-1.08
Colorectal[abce]	1.00	**1.21	1.08-1.35	1.00	0.90-1.11
Lung[abc]	1.00	**1.17	1.06-1.29	1.01	0.91-1.11
Melanoma[abc]	1.00	**1.69	1.16-2.43	0.92	0.60-1.40
Breast (F)[ace]	1.00	***1.40	1.17-1.67	1.08	0.88-1.31
Cervical[ac]	1.00	*1.41	1.03-1.92	1.33	0.85-2.07
Prostate[ac]	1.00	1.21	0.97-1.48	0.92	0.75-1.12
Lymphoma[abcd]	1.00	**1.47	1.16-1.84	*1.27	1.02-1.56
Leukaemia[abd]	1.00	1.04	0.79-1.37	1.23	0.95-1.57

[abcde]Adjusted for [a]age [stratified], deprivation, marital status, [b]sex, [c]stage [stratified], [d]cancer-type, [e]screen-detection status [stratified]

Conclusions / Further work

The findings in this report are, on the whole, not unexpected, and build on work previously done by the National Cancer Registry and internationally. Nevertheless, the patterns seen are quite stark when seen across a range of cancers and outcomes – in particular in relation to variation in cancer risk by deprivation status, variation in survival by deprivation and by age, and variation in treatment by age. These patterns point up striking inequalities that need to be targeted for improvement. This is a very complex area to tackle, however, given that we don't fully understand all the factors involved and how they interact. For example, serious health conditions other than cancer are more frequent in older or more socioeconomically deprived patients and can influence their treatment and survival– so survival variation may not simply be explained by some patient groups presenting at a later stage or receiving less treatment.

In a report of this scope, covering a range of cancer types, risk factors and outcomes, for practical reasons it was not possible to explore the findings in the depth that some previous NCR studies have attempted (e.g. Walsh et al. 2014 for breast cancer). However, we hope in future publications to use appropriate analytical methods (such as structural equation modelling) to explore and quantify the mediating or 'explanatory' role of particular factors (e.g. stage or comorbidity) that may be involved in the patterns of treatment or survival for particular cancers.

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- the Commission on Cancer of the American College of Surgeons for permission to quote treatment data downloaded from the NCDB (National Cancer Data Base) Public Benchmark Reports webpage (http://oliver.facs.org/BMPub/index.cfm; https://www.facs.org/quality%20programs/cancer/ncdb/publicaccess).

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