Appendix A – Related Cancer Council Queensland reports

Queensland Cancer Registry. *Cancer in Queensland: Incidence, Mortality, Survival and Prevalence 1982 to 2007*. QCR, Cancer Council Queensland and Queensland Health, June 2010 (www.cancerqld.org.au/pdf/qcr_report/).

Youlden DR, Cramb SM, Baade PD. *Current status of female breast cancer in Queensland: 1982 to 2006*. Viertel Centre for Research in Cancer Control, Cancer Council Queensland, April 2009 (www.cancerqld.org.au/pdf/breast_report.pdf).

Youlden DR, Cramb SM, Baade PD. *Current status of colorectal cancer in Queensland: 1982 to 2005*. Viertel Centre for Research in Cancer Control, Cancer Council Queensland, September 2008 (www.cancerqld.org.au/pdf/colorectal_report.pdf).

Youlden DR, Cramb SM, Baade PD. *Current status of lung cancer in Queensland: 1982 to 2004*. Viertel Centre for Research in Cancer Control, The Cancer Council Queensland, December 2007 (www.cancerqld.org.au/pdf/lung_report.pdf).

Baade PD, Steginga SK, Aitken JF. *Current status of prostate cancer in Queensland, 1982 to 2002*. Viertel Centre for Research in Cancer Control, Queensland Cancer Fund, October 2005 (www.cancerqld.org.au/downloads/prostate_report.pdf).

Baade P, Fritschi L, Aitken J. *Geographical differentials in cancer incidence and survival in Queensland: 1996-2002*. Viertel Centre for Research in Cancer Control, Queensland Cancer Fund, October 2005. (www.cancerqld.org.au/downloads/Geographical_differentials_report/).

Appendix B – Methods

Cancer classifications

Throughout this report the definitions of cancer type (Table B1) are the same as those currently used by the Queensland Cancer Registry, as shown in their annual report.[63] These definitions are based on the World Health Organization's International Classification of Diseases for Oncology, 3rd edition (ICD-O3).[64]

Table B1: Cancer ICD-O3 codes

Type of cancer	ICD-O3 code
All invasive cancers	C00-C80 (excluding C44 (M805-M811))
Oesophageal cancer	C15
Stomach cancer	C16
Colorectal cancer	C18-C20 and C218
Pancreatic cancer	C25
Lung cancer	C33-C34
Melanoma	C44 and M872-M879
Breast cancer	C50
Cervical cancer	C53
Uterine cancer	C54
Ovarian cancer	C56
Prostate cancer	C61
Kidney cancer	C64-C66 and C68
Bladder cancer	C67
Brain cancer	C70-C72
Thyroid cancer	C73
Non-Hodgkin lymphoma	M959, M967-M971
Leukaemia	M980-M994
Myeloma	M973

Data sources

Australian Bureau of Statistics (ABS)

Population data were obtained from the Australian Bureau of Statistics.[14,15] These data include estimated population counts by age group, sex, year and SLA of residence. Population data were primarily used in this report as the denominator for calculating rates and for age-standardisation.

De-identified unit record mortality data for all causes of death for Queensland residents were also obtained from the Australian Bureau of Statistics.[16] These data were used to calculate expected population mortality estimates for the relative survival models. Since some Queensland residents die interstate, permission was obtained from the Registrar of Births, Deaths and Marriages in every State and Territory in Australia to access these data.

Queensland Cancer Registry (QCR)

De-identified data on all cancers diagnosed among people living in Queensland during 1996 to 2007 were obtained from the QCR. Ethical approval to conduct this study was obtained from the Central Office Human Research Ethics Committee of Queensland Health (HREC/09/QHC/25). Approval to extract the data was obtained from the Chief Executive Officer – Centre for Health Care Improvement, Queensland Health, under delegation by the Director-General, Queensland Health.

The QCR is a population-based cancer registry that maintains a record of all cases of cancer diagnosed in Queensland since 1982, with data currently available to the end of 2007.[63] Cancer Council Queensland has managed the processing operations of the QCR on behalf of Queensland Health since October 2000.

Details of all cancers diagnosed in Queensland are legally required to be included in the QCR under the Public Health Act 2005. Notifications of patients with cancer are received from all public and private hospitals and nursing homes throughout the State. Queensland pathology laboratories are also required to provide copies of pathology reports for cancer specimens. Information regarding the deaths of people diagnosed with cancer is provided to the QCR by the Registrar of Births, Deaths and Marriages.

Further details about the QCR can be found in their annual report.[63]

Bayesian methods

Background

Bayesian methods make inferences from data using probability models. Rather than basing the analysis entirely on the observed data, Bayesian models utilise probability distributions for the variables included in the model. These distributions are called 'prior' distributions, and are generated using previous (or 'prior') knowledge about the variables in question, or the characteristics they are expected to have.

All probability distributions have parameters controlling their shape, such as the *mean* and *variance*. Unfortunately, when specifying the 'prior' distribution, there is often little or no information to guide what these distributions should look like.[13] Rather than give these parameters specific values, they can instead be given a distribution of values (called 'hyperprior' distributions) to reflect this uncertainty. This results in different levels, or hierarchies, of distributions governing the behaviour of the variables in the models. These are known as Bayesian hierarchical models.

In a spatial model, the underlying assumption is that neighbouring regions are more likely to share similar features than regions that are further apart. Hence the parameters of a region could be better estimated by using the data in that region, as well as incorporating information obtained from the neighbouring regions. These two sources of information are weighted by the populations in the regions, so that areas which have small populations will be subjected to greater neighbourhood 'smoothing' than areas with larger populations. A recommended way of modelling spatial variation is to include two random effects components – one which smooths the estimates towards their neighbours (spatial heterogeneity), and one which smooths the estimates towards the overall State average (uncorrelated heterogeneity).[21]

Development of the neighbourhood adjacency matrix

For this report, SLAs were defined as neighbours if they shared a common physical boundary, known as "Queen" adjacencies. This neighbourhood matrix was then manually adjusted to ensure all regions had at least one neighbour, even if the region was an island. In particular, most of the islands in far North Queensland were grouped together. Details of the neighbour groupings used for this report are available from the authors on request.

Models

The Bayesian models were run using WinBUGS[65] interfaced with Stata[66] (using the wb commands written by John Thompson, University of Leicester[67]). A burn-in period of 100,000 and 250,000 iterations was used initially for the incidence and survival models, respectively, with a subsequent 100,000 iterations run. Since the posterior distribution was simulated using Markov Chain Monte Carlo (MCMC) methods with Gibbs sampling, the value of each iteration depends on the previous one. To decrease autocorrelation every 10th iteration was kept, resulting in 10,000 iterations used to calculate the final estimates.

Convergence of the Bayesian models for each combination of cancer type and sex was assessed using visual examination of autocorrelation, trace and density plots,[68] as well as Geweke[69] diagnostics.

Incidence

Data were aggregated by sex and 5-year age groups (0-4, 5-9…, 80-84, 85+) and standardised against the Queensland population to calculate the indirectly standardised incidence ratio (SIR) for each SLA. These 'crude' SIR components (observed and expected cases) were then used in the Bayesian model. The Besag, York and Mollié (BYM) model was used, as this is the standard model used in disease mapping.[22]

The BYM model separates area-specific random effects into 2 components: one which takes into account the effects that vary in a structured manner (spatial or correlated heterogeneity), and one which models the effects that vary in an unstructured way between areas (uncorrelated heterogeneity).[70]

The model is:

$$y_i \sim \text{Poisson}(e_i\theta_i)$$

$$\log(\theta_i) = \alpha + u_i + v_i$$

where α is the overall level of relative risk, u_i are the correlated (spatial) heterogeneity and v_i are the unstructured random effects.[70] A normal distribution was assumed for the unstructured random effects, $(v_i \sim N(0, \tau_v^2))$ while the spatial component (u_i) was modelled with the intrinsic Gaussian conditional autoregressive (CAR) prior.

This model can be very sensitive to the choice of hyperprior distributions for the parameters controlling the variability of the area-specific random effect components (τ_u and τ_v), so sensitivity analyses were performed comparing Deviance Information Criterion (DIC) values, residuals, shrinkage and quantile-quantile plots. Results from these sensitivity analyses indicated an appropriate choice for hyperprior distributions were:

$$\tau_u \sim \text{Gamma}(0.1, 0.1)$$

$$\tau_v \sim \text{Gamma}(0.001, 0.001)$$

The median smoothed relative risk or modelled SIR (i.e. exponential($\alpha + u_i + v_i$)) for each SLA was classified into categories and mapped.

Survival

The number of expected deaths and person-time at risk for each SLA, gender, broad age group (0-49,50-69,70-89 years) and follow-up time (in one year intervals up to 5 years) were calculated using the strs command in Stata.[66] The relative survival model described by Dickman et al was used,[23] with additional random effects included.[24]

Input data required for this relative survival Bayesian model were the observed number of deaths, expected number of deaths (calculated from general population mortality data and representing deaths due to causes other than the cancer of interest) and person-time at risk for each SLA, gender, broad age group and follow-up time interval.

The model was specified as a generalised linear model with the number of deaths as the outcome d_{kji}, a Poisson distribution, link function log $(\mu_{kji} - d^*_{kji})$ and offset $\log(y_{kji})$. Excess hazard rates were assumed to be constant within each follow-up time.[23] Data were stratified by *k* broad age groups, *j* follow-up intervals and *i* SLAs.

$$d_{kji} \sim \text{Poisson}(\mu_{kji})$$

$$\log(\mu_{kji} - d^*_{kji}) = \log(y_{kji}) + \alpha_j + \text{x}\beta_k + u_i + v_i$$

where y_{kji} is person-time at risk in the *k*th age group, the *j*th follow up interval and the *i*th SLA, d^*_{kji} is the expected number of deaths due to causes other than the cancer of interest, α_j is the intercept (which varied by follow-up year), β_k is the coefficient of the predictor variable vector x (representing the broad age groups), v_i are the unstructured random effects between areas (which has a normal distribution: $v_i \sim N(0, \tau_v^2)$ and u_i are the spatial components modelled with the intrinsic Gaussian CAR prior. The model was run separately for males and females.

Sensitivity analyses for the hyperprior distributions on τ_u and τ_v were conducted, and the distributions chosen were:

$$\tau_u \sim \text{Gamma}(0.1, 0.01)$$

$$\tau_v \sim \text{Gamma}(0.1, 0.01)$$

The median smoothed relative excess risk or RER (i.e. exponential($u_i + v_i$)) was classified into categories and mapped.

Measures

Credible intervals

All estimates are calculated with some degree of imprecision. When using Bayesian methods, the level of precision is typically reported in terms of a credible interval, which specifies a range of values in which the true point estimate is expected to lie with a given level of probability. Although credible intervals of 70% to 80% are considered to provide adequate coverage,[71] for the purposes of this report it was decided to use more conservative 95% credible intervals, similar to other published research examining spatial variation in cancer outcomes.[24]

Geographic location risks

Cancers with significant overall variation had estimates of the risk calculated by broad rurality and socioeconomic categories compared against the Queensland average. First the smoothed 'observed' value for each SLA were calculated, and summed across the categories. These were divided by the sum of the expected values for each category to produce an SIR or RER. These observed and expected values were calculated for all 10,000 iterations output from the Bayesian modelling (every 10th iteration from 100,000 iterations), and the 95% credible intervals were calculated as the 2.5 and 97.5 percentiles.

An additional adjustment was made to the expected values to ensure that the sum of the expected values across Queensland equalled the total Queensland count (accounting for rounding of the modelled estimates).

Indirect standardisation

Refer to 'Standardised Incidence Ratio' below, which is calculated by indirect standardisation.

Number of preventable deaths

For cancers that had strong or moderate evidence of geographic variation, the number of deaths which could have been prevented if survival matched the Queensland average was calculated for the four rurality groups using the following formula:

Number of preventable deaths $= \text{dprev}_r = \text{dmod}_r - \text{dexp}_r$

Where $\mathbf{dmod}_r$ is the number of modelled deaths in the r[th] rurality group, and $\mathbf{dexp}_r$ is the number of expected deaths in that group.

The number of modelled deaths was calculated from the relative survival model for the i[th] SLA, k[th] age group and j[th] follow-up interval using the formula $\left(y_{kji} \times \exp\left(\alpha_j + x\beta_k + u_i + v_i\right)\right) + d^*_{kji}$. This value was calculated at each of the 10,000 MCMC iterations. Refer to "Survival" on page 83 for an explanation of each term in this formula.

The estimated number of modelled deaths μ_{kji} was obtained as the median of the 10,000 values. These were summed over age group and follow-up interval to provide the number of modelled deaths for each SLA.

Number of modelled deaths (by SLA) $= \mathbf{dmod}_i = \sum_{k,j} \mu_{kji}$

The expected number of deaths for each SLA was calculated by dividing the number of modelled deaths by the RER for that SLA.

Number of expected deaths (by SLA)

$$= \mathbf{dexp}_i = \frac{\mu_i}{\exp(u_i + v_i)} = \frac{\mu_i}{\mathrm{RER}}$$

The SLA-specific values of expected and modelled number of deaths were then summed across the (r = 1,..,4) rurality categories.

$$\mathbf{dmod}_r = \sum_{i \in R} \mathbf{dmod}_i$$

$$\mathbf{dexp}_r = \sum_{i \in R} \mathbf{dexp}_i$$

Person-time at risk

Person-time at risk measures the amount of time a cancer patient contributes to the analysis. It is calculated by taking the time between diagnosis and the date of death or 31st December 2007 (whichever is earlier, for those who are prevalent cases at some time between 1st January 1998 and the end of 2007).

Relative excess risk (RER)

The RER is also known as an excess hazard ratio, and represents whether the 'smoothed' estimate of excess mortality within five years of diagnosis in a particular SLA is higher or lower than the Queensland average. The RER is calculated in this report by taking the exponential of the sum of the spatial and unstructured random components from the relative survival model then multiplying by 100 (see page 83 for details on the relative survival model). A value of 100 represents the average mortality within five years of diagnosis for Queensland, so an RER value above 100 indicates a higher risk of dying within five years after diagnosis (and poorer survival) than the State, whereas an RER below 100 indicates a lower risk of dying (better survival) than Queensland as a whole.

Relative survival

Relative survival compares the survival of people who have a particular disease or condition against the expected survival of a comparable group from the general population, taking into account age, sex and year of diagnosis. The relative survival estimate can be interpreted as the percentage of cancer patients alive *x* years after diagnosis in the hypothetical situation where the cancer in question is the only possible cause of death.[72] Since this method requires information on whether the patient has died, and not the specific cause of death, relative survival is the preferred method for reporting cancer survival when using data from population-based cancer registries.[23]

Relative survival can be calculated using either period or cohort methods.[73] The period method was used as it is recognised as providing more up-to-date survival estimates.[73] Under the period method, the group of cancer patients included in the survival calculations are selected based on whether they are living with a diagnosis of cancer in the "at risk" period, which for this report is 1998-2007. In contrast, the cohort method is defined by the time of diagnosis. We included all patients diagnosed up to 31 December 2007.

Patients who were still alive at 31 December 2007 were considered censored. Persons with unknown age or aged 90 years and over at time of diagnosis have been excluded from the calculation of survival estimates. These cases represent 2% of all people diagnosed with cancer in Queensland during the study period. Other patients excluded were those whose cancer diagnosis was based on death certificate or autopsy only, or those with a survival time of zero days or less (1.2% of all cases).

Observed survival was calculated using a life table (or actuarial) method. Population expected survival was based on the Ederer II method[72] and calculated from Queensland all-cause mortality data.[16] Mortality

data were averaged over 1997-2002 and 2003-2007 to minimise the effects of year to year variation. The observed mortality, expected population mortality and person-time at risk were then input to the Bayesian relative survival model.

Rurality

Rurality was defined according to the SLA where the person was living at diagnosis. Categories of rurality in Queensland used throughout this report were defined using the ARIA+ (Accessibility/Remoteness Index for Australia plus) classification.[18]

The ARIA+ classification is an enhancement of the original ARIA classification, and defines remoteness on the basis of five categories: major city, inner regional, outer regional, remote and very remote (Figure D2). For the purposes of this report we have combined remote and very remote as the 'Remote' category. Full details of the differences between the ARIA+, ARIA and other geographic remoteness classifications have been described elsewhere.[74]

Socioeconomic status (SES)

Like rurality, socioeconomic status was defined according to the SLA where the person was living at diagnosis. Using the Socioeconomic Indexes for Areas (SEIFA) Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD) compiled by the Australian Bureau of Statistics,[19] SLAs in Queensland were ranked from the most disadvantaged to the most advantaged and then divided into quintiles (see Figure D3). The quintiles were labelled as follows: most advantaged, advantaged, middle SES, disadvantaged and most disadvantaged.

The IRSAD was based on a variety of data items available at the SLA level, such as the percentages of: people with high income; people who were unemployed; households paying cheap rental; households with no car; and households with broadband internet connection. Further details of the SEIFA indexes are reported elsewhere.[75]

Standardised Incidence Ratio (SIR)

The SIR allows for comparisons to be made between the incidence of cancer in a specific SLA and Queensland as a whole, adjusting for any differences in the population age-structures.

The crude SIR is calculated as:

$$\text{SIR} = \frac{\text{Observed number of cases}}{\text{Expected number of cases}} \times 100$$

where the expected number of cases

$$= \frac{\text{Queensland number of cases}}{\text{Queensland population}} \times 100$$

The expected number of cases were initially calculated separately for the age groups (0-4,5-9,10-14,...,80-84,85+), then summed over all age groups.

The smoothed SIR is calculated from the BYM model as the exponential of the sum of the overall level of relative risk, the spatial random components and the unstructured random components, multiplied by 100 (see page 82 for details on the incidence model).

A crude or smoothed SIR value of 100 represents the average incidence rate across Queensland. Therefore an SIR above 100 indicates higher incidence than the State average, whereas an SIR below 100 indicates a lower incidence compared to the Queensland average.

Statistical Local Area (SLA)

SLAs are part of the Australian Standard Geographic Classification (ASGC) used by the Australian Bureau of Statistics.[17] They correspond either to Local Government Areas (LGAs) or suburbs in larger LGAs (e.g. Brisbane City). In 2006 there were 478 SLAs in Queensland.[17]

Statistical local areas were mapped to the 2006 ASGC boundaries. For incidence and survival data (at the individual level), the suburb and postcode information were used to define the appropriate SLA classification. This classification was completed prior to extracting the data from the Queensland Cancer Registry. For the mortality data (used to calculate the expected mortality for relative survival), no information was available regarding suburb and postcode at death. Therefore an approximate SLA concordance developed by the ABS was used to map the SLA codes to the 2006 ASGC classification.

Cancer records that had missing or undefined SLAs (0.8% of all records between 1996 and 2007) were excluded from the analysis.

Tango's Maximised Excess Events Test (Tango's MEET)

Even though most maps show some evidence of geographic variation in outcomes, it is important to determine how likely it is that this variation reflects real differences, or merely random variation (or chance). Tango's Maximised Excess Events Test (Tango's MEET) is a test for overall clustering, which provides a measure of the significance of the variation.[20] There are multiple tests available (e.g. Besag-Newell's R, Moran's I, Oden's Ipop etc.), but Tango's MEET has been shown to perform well across a variety of datasets.[76]

Small p-values indicate there is variation throughout the State. Results were considered to have strong overall spatial variation if Tango's MEET was less than 0.01, and moderate overall spatial variation if Tango's MEET was between 0.05 and 0.01. Values between 0.05 and 0.10 were considered to provide only weak evidence for geographical variation, and those above 0.10 no evidence.

S+ code for Tango's MEET is available from: www.niph.go.jp/soshiki/gijutsu/download/index.html.

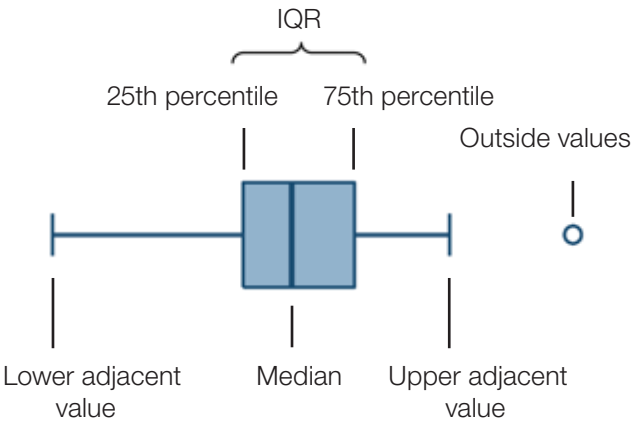
Statistical and spatial software

Bayesian analysis was undertaken in WinBUGS v1.4 (© 1996-2003 Imperial College and MRC, UK). Additional data analysis was performed using Stata software v11.0 (© 1984-2009 StataCorp, Texas) and R (v2.9.2; © 2009 The R Foundation for Statistical Computing). Neighbourhood matrices were generated using GeoDa v0.9.5-i (© 1998-2004 Luc Anselin and The Regents of the University of Illinois). Maps were generated using MapInfo Professional software v10.0 (© 2009 Pitney Bowes Software Inc.).

Map colours were based on those recommended by ColorBrewer (colorbrewer2.org) which were suitable for printing and classed as 'Colour-blind friendly'.

Distribution plot components

The distribution plots include the following specific components within each category of socioeconomic status or rurality:



25th percentile: The value below which 25% of all SLA-specific estimates fall.

Median: The middle value when all the SLA-specific estimates are arranged in ascending order.

75th percentile: The value above which 25% of all SLA-specific estimates fall.

IQR: The Interquartile range (IQR) is the 75th percentile value minus the 25th percentile value.

Lower adjacent value: The smallest estimate that is greater than or equal to the 25th percentile - 1.5 x IQR.

Upper adjacent value: The largest estimate that is less than or equal to the 75th percentile + 1.5 x IQR.

Outside values: These are any values greater than the upper adjacent value, or less than the lower adjacent value. These estimates can be considered outliers.

Appendix C – Incidence and survival rates

Table C1: Incidence by sex, Queensland, 1998-2007

	Males			Females		
Type of cancer	Count[a]	Rate[b,c]	Lifetime risk (1 in n)[d]	Count[a]	Rate[b,c]	Lifetime risk (1 in n)[d]
All invasive cancers	10,505	610.4	2	8,247	426.6	3
Oesophageal cancer	146	8.6	85	64	3.2	210
Stomach cancer	219	13.2	54	107	5.4	138
Colorectal cancer	1,341	78.1	10	1,087	55.8	13
Pancreatic cancer	194	11.5	62	171	8.6	84
Lung cancer	1,115	65.7	11	568	29.5	25
Melanoma	1,379	77.8	11	1,011	52.8	19
Breast cancer – females only	-	-	-	2,242	116.8	8
Cervical cancer	-	-	-	164	8.6	124
Uterine cancer	-	-	-	311	16.2	50
Ovarian cancer	-	-	-	212	11.0	75
Prostate cancer	2,522	147.2	5	-	-	-
Kidney cancer	312	17.9	43	188	9.7	77
Bladder cancer	503	30.5	23	157	8.0	87
Brain cancer	150	8.3	109	107	5.6	156
Thyroid cancer	77	4.2	227	222	11.7	97
Non-Hodgkin lymphoma	355	20.4	38	289	14.9	52
Leukaemia	308	17.9	45	209	10.8	76
Myeloma	119	7.1	102	91	4.7	152

a. Count is the average number diagnosed per year.
b. Rate is the average age-standardised rate per 100,000 population per year.
c. Rates are directly age-standardised to the Australian standard population (2001).
d. Lifetime risk is the risk of being diagnosed with the specific cancer by age 80.

Table C2: Five-year relative survival by sex, Queensland, 1998-2007

Type of cancer	Males [95% conf. int.][a]	Females [95% conf. int.][a]
All invasive cancers	62.9 [62.6,63.3]	68.9 [68.5,69.2]
Oesophageal cancer	18.3 [16.1,20.6]	20.1 [16.7,23.9]
Stomach cancer	25.9 [23.8,28.1]	28.4 [25.5,31.5]
Colorectal cancer	63.8 [62.7,64.9]	65.5 [64.4,66.7]
Pancreatic cancer	5.3 [4.3,6.5]	6.3 [5.2,7.7]
Lung cancer	11.5 [10.9,12.2]	15.1 [14.1,16.2]
Melanoma	92.6 [91.8,93.3]	95.5 [94.8,96.1]
Breast cancer – females only	-	87.9 [87.3,88.5]
Cervical cancer	-	75.4 [73.1,77.5]
Uterine cancer	-	82.2 [80.4,83.9]
Ovarian cancer	-	45.9 [43.5,48.3]
Prostate cancer	85.2 [84.4,86.0]	-
Kidney cancer	66.3 [64.1,68.4]	62.5 [59.8,65.1]
Bladder cancer	76.0 [74.3,77.7]	71.9 [68.9,74.6]
Brain cancer	22.8 [20.6,25.0]	23.6 [21.1,26.3]
Thyroid cancer	92.1 [88.9,94.7]	97.6 [96.5,98.6]
Non-Hodgkin lymphoma	64.4 [62.3,66.4]	66.1 [63.9,68.2]
Leukaemia	56.8 [54.7,58.9]	59.4 [56.9,61.8]
Myeloma	41.8 [38.3,45.3]	44.4 [40.5,48.4]

a. Conf. int. = confidence interval. The true value is likely to be within this range.

Notes: Relative survival calculated using the period method for persons aged 0-89 years at diagnosis. Data are for 'at risk' cases in the period 1998 - 2007.

Appendix D – Additional maps

Figure D1: Major Cities

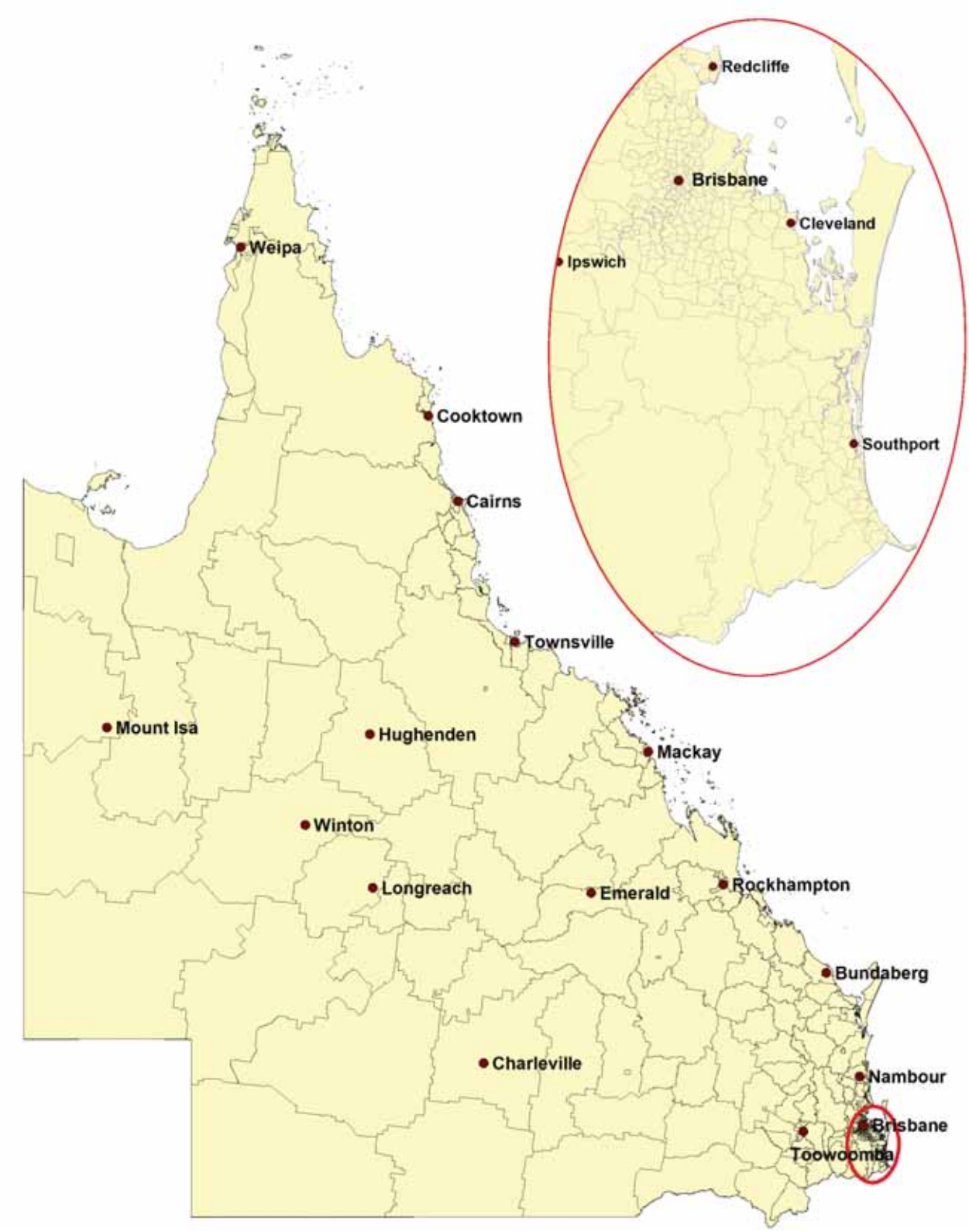


Figure D2: Rurality (ARIA+)

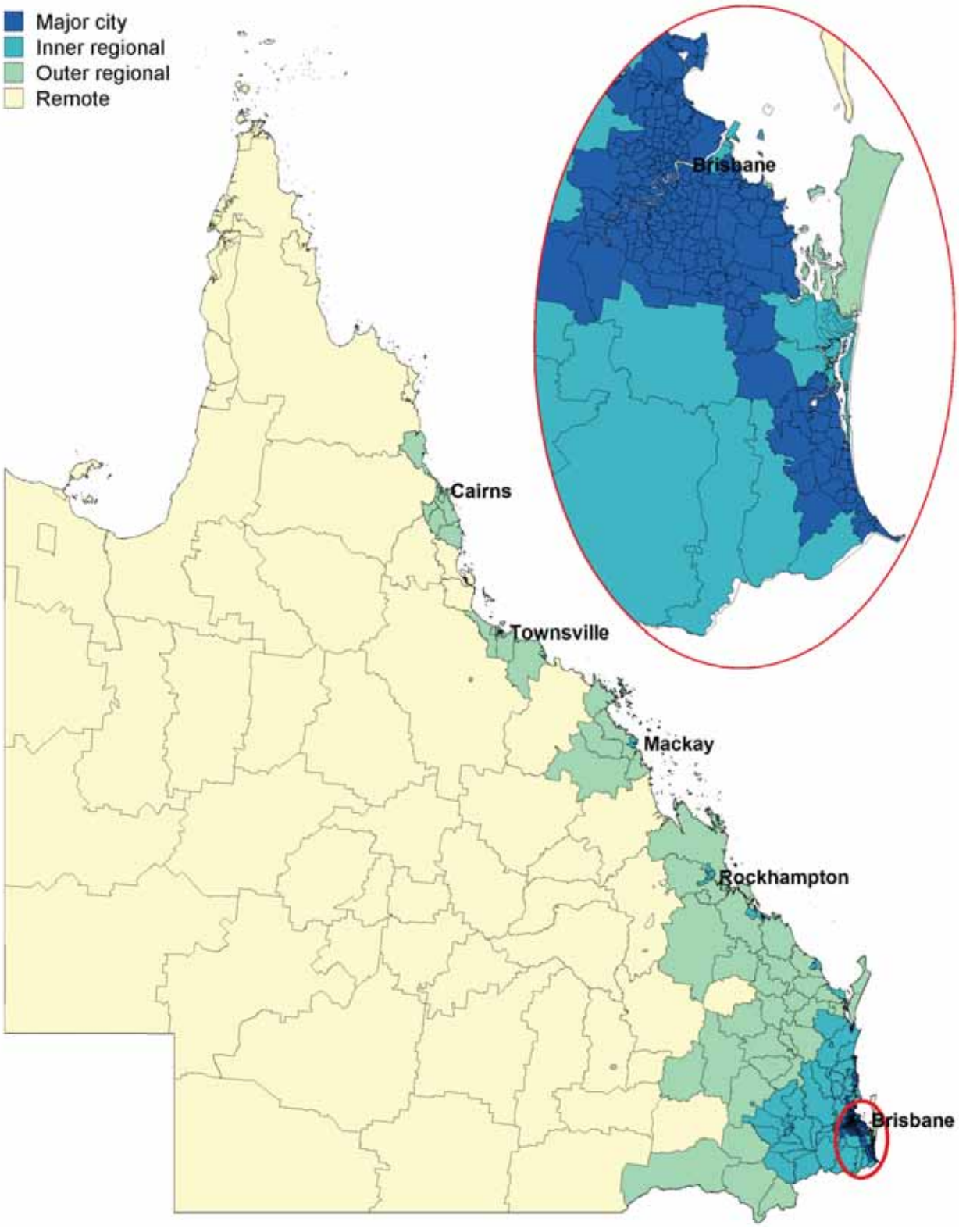
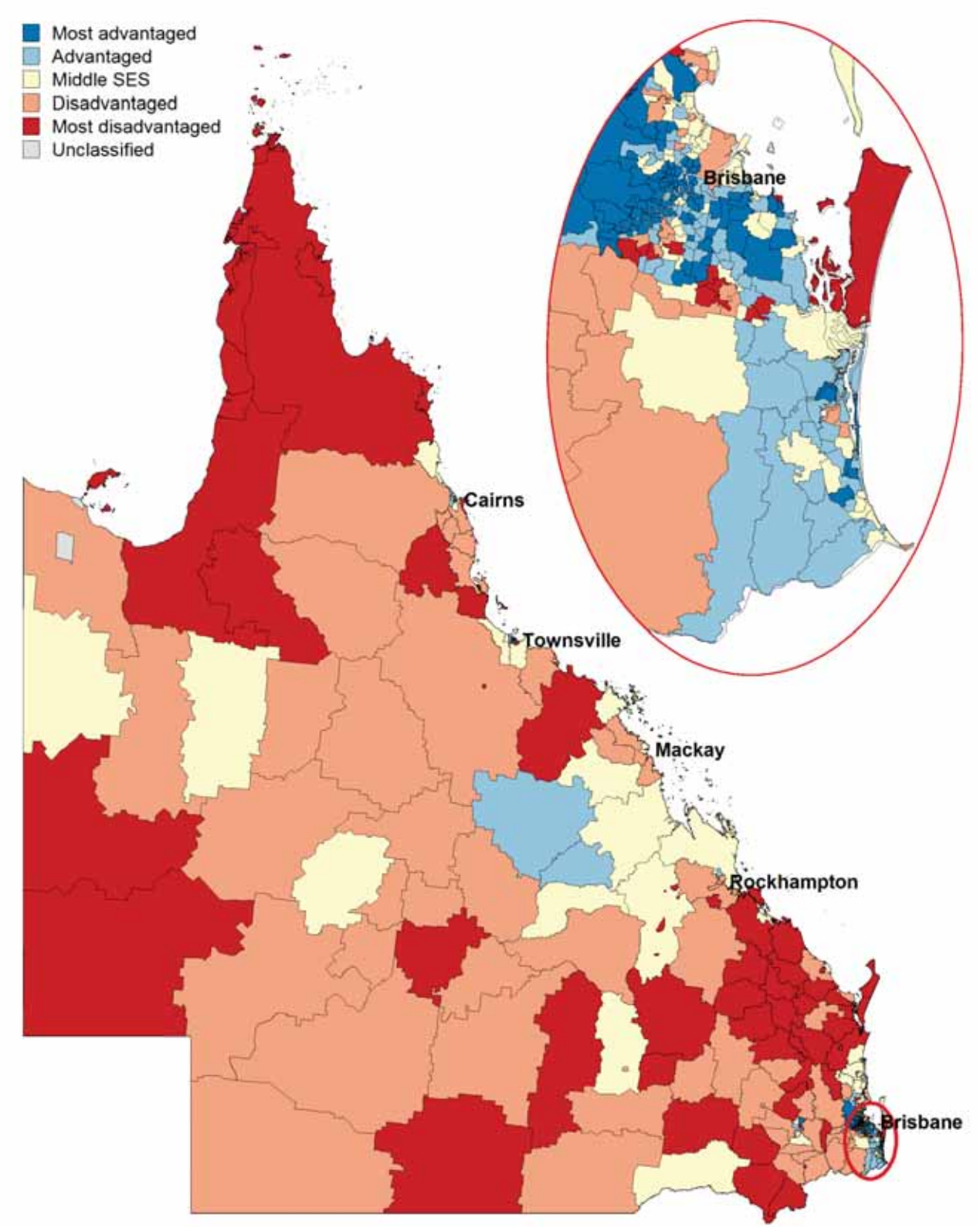


Figure D3: Socioeconomic status (SEIFA - IRSAD)



Appendix E – Geographic location risks

Table E1: Geographic location risks by rurality

		Smoothed SIR		Smoothed RER	
Cancer site	**Rurality**	**Males [95% CI]**	**Females [95% CI]**	**Males [95% CI]**	**Females [95% CI]**
All invasive cancers	Major city	100.4 [99.6,101.2]	102.0 [101.1,103.0]	95.5 [93.5,97.5]	96.4 [94.4,98.5]
	Inner regional	102.0 [100.8,103.3]	99.8 [98.4,101.3]	98.2 [95.4,101.1]	100.1 [97.1,103.4]
	Outer regional	98.5 [97.1,100.0]	94.5 [92.8,96.1]	111.5 [108.4,114.9]	111.2 [107.8,114.8]
	Remote	91.6 [89.1,94.2]	92.4 [89.5,95.5]	130.6 [125.3,136.2]	119.8 [114.5,125.6]
Oesophagus	Major city	95.2 [89.1,101.7]	-	-	-
	Inner regional	96.7 [88.7,104.9]	-	-	-
	Outer regional	115.3 [104.6,126.8]	-	-	-
	Remote	117.3 [102.4,133.8]	-	-	-
Stomach	Major city	-	-	94.9 [89.7,99.9]	-
	Inner regional	-	-	106.5 [98.9,114.9]	-
	Outer regional	-	-	109.2 [101.2,118.1]	-
	Remote	-	-	112.6 [99.8,128.5]	-
Colorectal	Major city	-	-	94.2 [91.1,97.5]	96.1 [92.4,100.2]
	Inner regional	-	-	103.3 [98.0,108.7]	102.8 [97.1,108.7]
	Outer regional	-	-	113.1 [107.6,119.1]	110.4 [103.9,117.4]
	Remote	-	-	116.9 [108.7,126.0]	112.0 [103.0,122.7]
Lung	Major city	96.7 [94.3,99.1]	104.9 [101.5,108.4]	95.1 [92.8,97.5]	95.6 [92.1,99.1]
	Inner regional	100.0 [96.3,103.8]	87.7 [83.1,92.3]	100.9 [97.0,104.8]	103.3 [97.7,109.3]
	Outer regional	105.9 [101.4,110.4]	98.5 [92.7,104.6]	111.3 [107.4,115.5]	112.2 [106.6,118.6]
	Remote	118.0 [110.1,126.8]	101.0 [91.5,111.6]	116.9 [111.0,123.4]	118.4 [109.3,129.3]
Melanoma	Major city	101.6 [99.3,103.8]	98.5 [96.0,100.9]	-	-
	Inner regional	102.8 [99.4,106.3]	108.1 [104.1,112.1]	-	-
	Outer regional	98.1 [94.3,102.0]	98.2 [94.0,102.6]	-	-
	Remote	77.5 [72.0,83.4]	88.5 [81.9,95.4]	-	-
Breast – females only	Major city	-	104.3 [102.6,106.1]	-	95.2 [90.4,99.8]
	Inner regional	-	98.9 [96.3,101.5]	-	104.8 [97.5,112.6]
	Outer regional	-	89.7 [86.9,92.6]	-	111.6 [103.9,120.2]
	Remote	-	85.5 [80.9,90.4]	-	114.1 [103.0,127.5]
Cervix	Major city	-	99.1 [93.2,105.2]	-	-
	Inner regional	-	92.6 [84.6,100.9]	-	-
	Outer regional	-	108.1 [98.0,119.0]	-	-
	Remote	-	115.0 [100.4,132.2]	-	-

Cancer site	Rurality	Smoothed SIR		Smoothed RER	
		Males [95% CI]	Females [95% CI]	Males [95% CI]	Females [95% CI]
Uterus	Major city	-	98.0 [93.7,102.5]	-	-
	Inner regional	-	103.8 [97.7,110.2]	-	-
	Outer regional	-	101.4 [94.2,109.1]	-	-
	Remote	-	102.6 [91.9,114.3]	-	-
Prostate	Major city	99.1 [97.4,100.7]	-	96.4 [91.7,101.0]	-
	Inner regional	106.3 [103.7,109.0]	-	100.5 [93.5,108.0]	-
	Outer regional	98.6 [95.7,101.6]	-	108.1 [100.3,116.2]	-
	Remote	86.1 [81.5,90.9]	-	117.7 [106.0,132.3]	-
Kidney	Major city	105.9 [101.3,110.6]	-	-	-
	Inner regional	97.4 [91.5,103.5]	-	-	-
	Outer regional	88.3 [81.9,95.3]	-	-	-
	Remote	85.1 [75.7,95.0]	-	-	-
Bladder	Major city	104.1 [100.6,107.9]	-	-	-
	Inner regional	98.7 [93.8,103.9]	-	-	-
	Outer regional	92.8 [87.3,98.7]	-	-	-
	Remote	81.9 [73.7,90.5]	-	-	-
Thyroid	Major city	-	103.9 [98.6,109.4]	-	-
	Inner regional	-	99.1 [91.8,106.7]	-	-
	Outer regional	-	89.7 [81.7,98.1]	-	-
	Remote	-	90.2 [78.7,103.1]	-	-
Non-Hodgkin lymphoma	Major city	101.8 [97.7,106.2]	105.0 [100.3,109.7]	95.4 [88.9,101.2]	93.5 [86.9,100.4]
	Inner regional	106.2 [100.4,112.7]	97.1 [91.2,103.3]	101.1 [92.4,110.3]	104.8 [94.5,116.1]
	Outer regional	90.3 [84.0,96.7]	88.3 [81.6,95.5]	112.6 [103.0,124.5]	122.2 [108.8,137.9]
	Remote	84.2 [75.3,94.1]	86.9 [77.5,97.3]	121.5 [106.1,142.9]	126.0 [108.6,148.7]
Leukaemia	Major city	99.9 [95.4,104.5]	101.3 [96.1,106.7]	94.7 [88.9,101.0]	-
	Inner regional	103.0 [96.9,109.6]	98.6 [91.4,106.2]	107.0 [97.3,118.5]	-
	Outer regional	98.8 [91.7,106.1]	98.4 [90.0,107.2]	109.8 [100.2,121.0]	-
	Remote	92.3 [82.4,102.6]	94.6 [82.8,107.2]	103.0 [89.2,117.3]	-

Note: Values are in comparison to the Queensland average, and are only shown for cancers which had a Tango's MEET p-value of <0.05.

Table E2: Geographic location risks by socioeconomic status

Cancer site	Socioeconomic	Smoothed SIR		Smoothed RER	
		Males [95% CI]	Females [95% CI]	Males [95% CI]	Females [95% CI]
All invasive cancers	Most advantaged	100.5 [98.9,102.1]	102.7 [101.0,104.4]	89.6 [86.9,92.4]	89.7 [86.8,92.5]
	Advantaged	98.1 [96.8,99.3]	100.6 [99.2,102.0]	94.5 [92.0,97.0]	96.4 [93.9,98.9]
	Middle SES	100.8 [99.6,101.9]	99.5 [98.3,100.8]	99.8 [97.3,102.3]	101.2 [98.7,103.8]
	Disadvantaged	99.5 [98.3,100.7]	97.8 [96.5,99.2]	104.6 [101.9,107.3]	105.2 [102.4,108.0]
	Most disadvantaged	101.9 [100.3,103.5]	100.9 [99.1,102.7]	111.8 [108.6,115.3]	107.2 [103.9,110.7]
Oesophagus	Most advantaged	91.7 [83.6,99.9]	-	-	-
	Advantaged	97.7 [91.0,105.0]	-	-	-
	Middle SES	102.7 [96.4,110.0]	-	-	-
	Disadvantaged	100.8 [93.7,108.1]	-	-	-
	Most disadvantaged	104.4 [96.0,113.9]	-	-	-
Stomach	Most advantaged	-	-	94.4 [87.5,101.0]	-
	Advantaged	-	-	93.5 [86.9,99.1]	-
	Middle SES	-	-	100.4 [95.1,105.9]	-
	Disadvantaged	-	-	104.8 [98.9,111.5]	-
	Most disadvantaged	-	-	107.2 [99.9,116.4]	-
Colorectal	Most advantaged	-	-	94.1 [89.9,98.3]	94.9 [90.0,99.8]
	Advantaged	-	-	94.6 [90.8,98.2]	96.2 [91.9,100.5]
	Middle SES	-	-	100.5 [96.9,104.2]	100.3 [96.3,104.5]
	Disadvantaged	-	-	105.4 [101.3,109.9]	104.0 [99.7,109.1]
	Most disadvantaged	-	-	104.8 [99.9,110.2]	105.5 [99.8,111.9]
Lung	Most advantaged	86.5 [82.4,90.6]	95.5 [90.2,101.0]	95.4 [92.0,98.8]	93.2 [88.2,97.8]
	Advantaged	89.8 [86.4,93.1]	100.2 [95.7,104.6]	96.4 [93.5,99.3]	96.5 [92.5,100.7]
	Middle SES	101.9 [98.7,105.3]	103.7 [99.5,108.0]	99.7 [96.9,102.5]	99.2 [95.2,103.2]
	Disadvantaged	105.5 [102.0,109.1]	98.7 [94.4,103.1]	103.1 [100.1,106.2]	105.2 [100.9,110.0]
	Most disadvantaged	114.8 [110.0,119.9]	99.3 [93.7,105.3]	103.1 [99.6,106.6]	105.5 [100.6,111.2]
Melanoma	Most advantaged	104.1 [100.3,108.1]	96.1 [92.4,100.1]	-	-
	Advantaged	101.6 [98.6,104.8]	98.4 [95.2,101.7]	-	-
	Middle SES	105.1 [102.2,108.1]	104.1 [100.9,107.3]	-	-
	Disadvantaged	94.0 [91.1,97.0]	98.3 [95.0,101.7]	-	-
	Most disadvantaged	93.2 [89.4,97.1]	102.0 [97.9,106.5]	-	-
Breast – females only	Most advantaged	-	109.5 [106.5,112.6]	-	89.4 [82.5,95.6]
	Advantaged	-	102.5 [100.1,104.9]	-	96.8 [91.4,102.0]
	Middle SES	-	99.0 [96.8,101.3]	-	103.5 [98.3,109.4]
	Disadvantaged	-	95.8 [93.5,98.2]	-	104.3 [98.6,110.6]
	Most disadvantaged	-	94.4 [91.3,97.4]	-	104.9 [97.9,112.6]
Cervix	Most advantaged	-	100.2 [92.2,108.7]	-	-
	Advantaged	-	98.6 [92.1,105.1]	-	-
	Middle SES	-	99.0 [92.9,105.6]	-	-
	Disadvantaged	-	101.5 [94.5,109.1]	-	-
	Most disadvantaged	-	101.7 [93.7,110.6]	-	-

Cancer site	Socioeconomic	Smoothed SIR		Smoothed RER	
		Males [95% CI]	Females [95% CI]	Males [95% CI]	Females [95% CI]
Uterus	Most advantaged	-	101.7 [95.4,108.2]	-	-
	Advantaged	-	95.1 [90.3,100.1]	-	-
	Middle SES	-	96.8 [92.1,101.6]	-	-
	Disadvantaged	-	103.4 [98.0,108.9]	-	-
	Most disadvantaged	-	106.8 [100.3,113.9]	-	-
Prostate	Most advantaged	105.4 [102.3,108.5]	-	96.6 [90.5,102.7]	-
	Advantaged	95.7 [93.4,98.1]	-	98.4 [92.7,103.7]	-
	Middle SES	99.8 [97.5,102.0]	-	99.7 [94.4,105.1]	-
	Disadvantaged	102.8 [100.5,105.2]	-	99.9 [94.1,105.7]	-
	Most disadvantaged	96.9 [93.9,99.9]	-	107.0 [99.8,115.1]	-
Kidney	Most advantaged	104.4 [97.9,111.0]	-	-	-
	Advantaged	102.4 [97.1,107.9]	-	-	-
	Middle SES	100.3 [95.2,105.4]	-	-	-
	Disadvantaged	96.9 [91.6,102.3]	-	-	-
	Most disadvantaged	96.7 [90.5,103.4]	-	-	-
Bladder	Most advantaged	100.0 [94.5,105.6]	-	-	-
	Advantaged	100.9 [96.3,105.6]	-	-	-
	Middle SES	101.3 [97.1,105.7]	-	-	-
	Disadvantaged	98.6 [94.3,103.3]	-	-	-
	Most disadvantaged	98.5 [93.1,104.3]	-	-	-
Thyroid	Most advantaged	-	111.4 [103.8,119.6]	-	-
	Advantaged	-	101.4 [95.7,107.4]	-	-
	Middle SES	-	92.6 [87.3,98.0]	-	-
	Disadvantaged	-	97.4 [91.4,104.0]	-	-
	Most disadvantaged	-	103.0 [95.3,111.4]	-	-
Non-Hodgkin lymphoma	Most advantaged	102.6 [96.5,109.3]	107.9 [101.5,114.8]	95.1 [87.1,102.4]	91.4 [82.9,99.9]
	Advantaged	100.9 [95.7,106.2]	102.4 [97.4,107.8]	95.7 [88.7,102.1]	92.7 [85.2,100.4]
	Middle SES	99.7 [95.0,104.7]	99.2 [94.3,104.1]	99.9 [93.6,106.3]	101.0 [94.2,108.2]
	Disadvantaged	95.9 [90.8,101.0]	95.5 [90.4,100.7]	107.3 [100.2,116.8]	110.4 [102.4,121.7]
	Most disadvantaged	103.5 [96.9,110.5]	96.9 [90.7,103.5]	100.5 [91.9,109.6]	106.3 [96.0,118.0]
Leukaemia	Most advantaged	104.9 [98.4,111.8]	105.0 [97.8,112.8]	91.3 [83.1,99.5]	-
	Advantaged	98.6 [93.5,103.8]	101.0 [95.3,107.2]	94.9 [88.7,101.6]	-
	Middle SES	97.8 [93.0,102.7]	97.4 [92.0,102.9]	101.1 [95.0,108.5]	-
	Disadvantaged	98.6 [93.3,104.0]	99.8 [93.8,106.2]	105.0 [97.7,114.1]	-
	Most disadvantaged	104.0 [97.5,111.1]	98.1 [90.9,105.7]	107.5 [98.2,118.8]	-

Note: Values are in comparison to the Queensland average, and are only shown for cancers which had a Tango's MEET p-value of <0.05.