

CHAPTER 4. SPATIAL VARIATIONS IN CANCER MORBIDITY

The previous chapters reported on spatial patterns and temporal trends in cancer mortality. However, cancer is not invariably fatal – indeed the survival rates for certain types of cancer are remarkably high. Mortality data therefore provide only a partial picture as they do not provide any information on those who have survived. This chapter therefore reports the analysis of morbidity data compiled by the National Cancer Registry. The first few sections of the chapter compares morbidity in Louth with that in other counties, whilst the final section looks at variations within Louth.

The data provided by the National Cancer Registry contains information on each new cancer diagnosed between 1994 and 1998. The National Cancer Registry Board was established in 1991 and registration began on 1st January, 1994.⁹ Data are not available for the period before 1994 nor, at the time of analysis, were they available for the period after 1998. Although the time period is too short to enable much to be said about temporal trends, the data provide a very rich source of information on the geographical variations in cancer incidence.

The data provided by the National Cancer Registry contains information on 104,192 tumours. However, it is possible for patients to develop more than one tumour, so some patients are recorded more than once. The analysis reported in this chapter therefore excludes the second (and any subsequent) tumours to avoid patients being ‘double counted’. It may therefore be regarded as an analysis of patients rather than of tumours. After excluding these additional tumours, the data contained information on 96,995 patients.

The Registry includes information on benign (non-invasive) tumours as well as malignant tumours (i.e. cancers). Patients with benign tumours were therefore excluded from the study, leaving a total of 85,474 cancer patients.

Each cancer patient is geocoded by the National Cancer Registry – i.e. each patient is assigned a code identifying the DED in which they are normally resident. This permits the geographical distribution to be analysed at both county and sub-county levels. However, the geocoding for patients added to the registry in 1998 was incomplete – i.e. some patients had been geocoded, but others had not. As there was no way of knowing whether the patients who had been geocoded could be regarded as typical of all patients registered in 1998, it was decided to exclude all patients registered in 1998 from the analysis. This reduces the total number of patients to 68,092.

A small number of patients (2.4 per cent) were not geocoded, so the total number of patients who could be mapped was 66,455 (34,868 males, 31,587 females). However, there are some doubts about the accuracy of the coding of some of these cases, so the total number of cases which can be analysed with confidence is slightly smaller (61,436). However, it is assumed that all cases are accurately assigned to the correct county, so the larger set (i.e. 66,455 cases) is analysed in the inter-county comparisons, but the smaller set is used for the analysis of variations within Louth in the final section of the chapter. (The implications of using the larger set for inter-county comparisons is assessed in Appendix B).

Does Co. Louth Have A High Crude Incidence Rate For Cancer?

The geocodes were used to allocate each patient to a county. A ‘crude’ incidence rate was then calculated for each county by dividing the average number of new patients each year (i.e. the total number 1994-1997

⁹ Walsh, P.M., Comber, H. and Gavin, A.T. (2001) *All-Ireland Cancer Statistics 1994-1996. A Joint Report Of incidence And Mortality For The Island Of Ireland*. National Cancer Registry (Ireland), Cork and Northern Ireland Cancer Registry, Belfast.

divided by 4) by the population at risk (i.e. the total population of the county as recorded in the 1996 census).

Table 8 shows the ‘crude’ incidence rates calculated for each county, expressed as new cases per 100,000 persons. The national rate was calculated at 484 per 100,000 for males and 432 per 100,000 for females. However, if the patients who were excluded because they could not be geocoded are included, the national incidence rates become 496 per 100,000 for males and 443 per 100,000 for females.

	Males		Females	
	Rate	Rank	Rate	Rank
Carlow	442	23	377	23
Dublin C.B.	612	3	587	1
Dublin Belgard	281	34	294	34
Dublin Fingal	313	33	314	33
Dun Laoghaire / Rathdown	565	9	531	2
Kildare	340	31	339	29
Kilkenny	422	27	352	27
Laois	469	21	415	18
Longford	519	13	475	8
Louth	483	17	452	12
Meath	399	28	375	25
Offaly	438	24	398	22
Westmeath	509	14	454	11
Wexford	446	22	375	24
Wicklow	487	15	408	19
Clare	438	25	335	30
Cork C.B.	567	8	504	4
Cork Co.	477	18	424	16
Kerry	590	4	500	6
Limerick C.B.	329	32	317	32
Limerick Co.	378	29	339	28
Tipperary N.R.	469	20	400	21
Tipperary S.R.	484	16	406	20
Waterford C.B.	438	26	446	14
Waterford Co.	534	12	460	9
Galway C.B.	350	30	334	31
Galway Co.	553	10	420	17
Leitrim	661	1	508	3
Mayo	577	7	449	13
Roscommon	625	2	460	10
Sligo	578	6	482	7
Cavan	584	5	503	5
Donegal	543	11	429	15
Monaghan	471	19	353	26
National	484		432	

Table 8. Mean Crude Cancer Incidence Rates (Per 100,000), 1994-1997.

The incidence rate for males (483 per 100,000) is almost identical to the national average, leaving Louth ranked 17th highest in the 34 counties examined, but the incidence rate for females (452 per 100,000) exceeds the national rate, making Louth the 12th ranked county. Louth does not fare too badly overall. However, the incidence rates reported in Table 8 take no account of variations in age composition. As with

crude death rates, crude incidence rates may consequently give a misleading impression. The following section therefore explores whether Louth has a high age standardised rate.

Does Co. Louth Have A High Standardised Incidence Ratio For Cancer?

Standardised incidence rates and ratios can be calculated in much the same way as standardised mortality rates and ratios. Standardised incidence rates express the results as new cases per 100,000, but (as noted above for crude rates) the figures may be slightly low because of the omission of the cases which could not be geocoded. Standardised ratios are calculated to have a mean of 100, irrespective of how many cases are missing, and are also more readily interpreted when comparing areas. Standardised incidence ratios were therefore calculated here by the direct method using the European Standard Population as the standard population. New cases in persons aged 75 or over were omitted for the purposes of the present analysis.

	Males		Females	
	Ratio	Rank	Ratio	Rank
Carlow	93.9	19	93.4	20
Dublin C.B.	121.0	1	118.7	1
Belgard	100.0	12	99.8	13
Fingal	106.4	5	107.3	5
Dun Laoghaire / Rathdown	116.9	3	117.7	2
Kildare	99.6	13	102.7	10
Kilkenny	80.8	33	80.2	31
Laois	87.5	29	101.5	11
Longford	84.3	30	105.2	8
Louth	104.4	6	106.5	7
Meath	92.8	21	96.0	19
Offaly	87.7	28	98.5	15
Westmeath	100.1	10	112.6	3
Wexford	88.3	26	83.3	28
Wicklow	114.8	4	98.1	16
Clare	83.8	31	75.5	33
Cork C.B.	118.2	2	112.5	4
Cork Co.	95.8	15	97.7	17
Kerry	102.1	7	103.5	9
Limerick C.B.	77.1	34	73.5	34
Limerick Co.	81.8	32	81.2	30
Tipperary N.R.	87.7	27	87.5	26
Tipperary S.R.	94.6	17	87.9	25
Waterford C.B.	100.0	11	106.9	6
Waterford Co.	95.6	16	98.6	14
Galway C.B.	91.8	22	100.5	12
Galway Co.	93.0	20	89.9	24
Leitrim	89.1	24	92.2	22
Mayo	96.1	14	91.8	23
Roscommon	93.9	18	82.4	29
Sligo	100.3	9	93.4	21
Cavan	100.4	8	96.8	18
Donegal	90.0	23	87.0	27
Monaghan	88.6	25	76.0	32

Table 9. Standardised Incidence Ratios (Per 100,000), 1994-1997.

Table 9 shows the standardised incidence ratios for each county in the Republic. Louth is ranked 6th for males with a standardised incidence ratio of 104.4. However, although higher than the national average, the excess morbidity for males in Louth between 1994 and 1997 is less than the excess mortality reported for 1970 to 1999 in Chapter 2. This may be due to differences between morbidity and mortality, but it may also reflect the fact that the morbidity and mortality data cover different time periods. The lower morbidity rates may therefore reflect an improving situation for males in Louth in the 1990s, as suggested by the temporal trends in mortality reported in Chapter 3.

The morbidity rate for females is very similar to that for mortality. The standardised incidence ratio for females is 106.5, the 7th highest in the state, whilst for mortality it was 106.4 and ranked 5th.

The standardised incidence ratios are mapped for males and females in Figure 13 and Figure 14 respectively. It will be noted that the patterns depicted in these two maps are quite different from the patterns of mortality shown in Figure 1 and Figure 2. There are of course some similarities: Dublin C.B. and Cork C.B. have persistently high ratios, but some areas that had low mortality over the past three decades emerge as areas of above average morbidity in Figure 13 and Figure 14 (e.g. South Dublin, Fingal, Westmeath and Kerry).

Counties west of the Shannon were generally identified as areas of low mortality in Figure 1 and Figure 2. Most of these are also identified as areas of low morbidity in Figure 13 and Figure 14, but perhaps the most striking feature in both morbidity maps is the band of low incidence counties stretching from Clare to Wexford. This band includes several high mortality areas, most notably Limerick C.B. Waterford C.B. (for males) and Carlow.

There are some interesting differences in the rates for males and females. Wicklow, Cavan and Sligo, for example, have high ratios for males, but below average ratios for females. On the other hand, Kildare Laois, Longford and Galway C.B. have high ratios for females, but below average ratios for males.

The differences between the mortality maps for 1970 to 1999 (Figure 1 and Figure 2) and the morbidity maps (Figure 13 and Figure 14) are intriguing. At least three possible explanations suggest themselves:

a) The two sets of data refer to different time periods. The mortality data refer to a 30-year period from 1970 to 1999, whereas the morbidity data refer only to 1994 to 1997. Some of the differences may reflect changes in the spatial distribution of cancer.

b) Differences between the patterns of cancer morbidity and cancer mortality may reflect spatial variations in survival – i.e. some areas of high morbidity might have low mortality rates if they had better survival rates. This could reflect differences in the treatment available in different areas. However, survival is more likely to be a function of the different mix of cancer types found in different areas. Non-melanoma skin cancer represents about one third of all cancers, but it has a very high survival rate. Areas with above average rates of non-melanoma skin cancer with therefore tend to have high overall morbidity rates, but this will not translate into high mortality rates. Lung cancer, on the other hand, is much less common but accounts for about one fifth of all cancer deaths. Areas with a high rate of lung cancer will therefore tend to have high cancer mortality rates, but not necessarily have high morbidity rates.

c) Either the mortality or the morbidity data may be more complete for some areas than for others. Whilst a possibility, this is not believed to be a significant factor.

Whatever the explanation may be, the main point to note at present is that Louth is amongst the worst counties with regard to both morbidity and mortality.

Standardised Incidence Ratios, Males

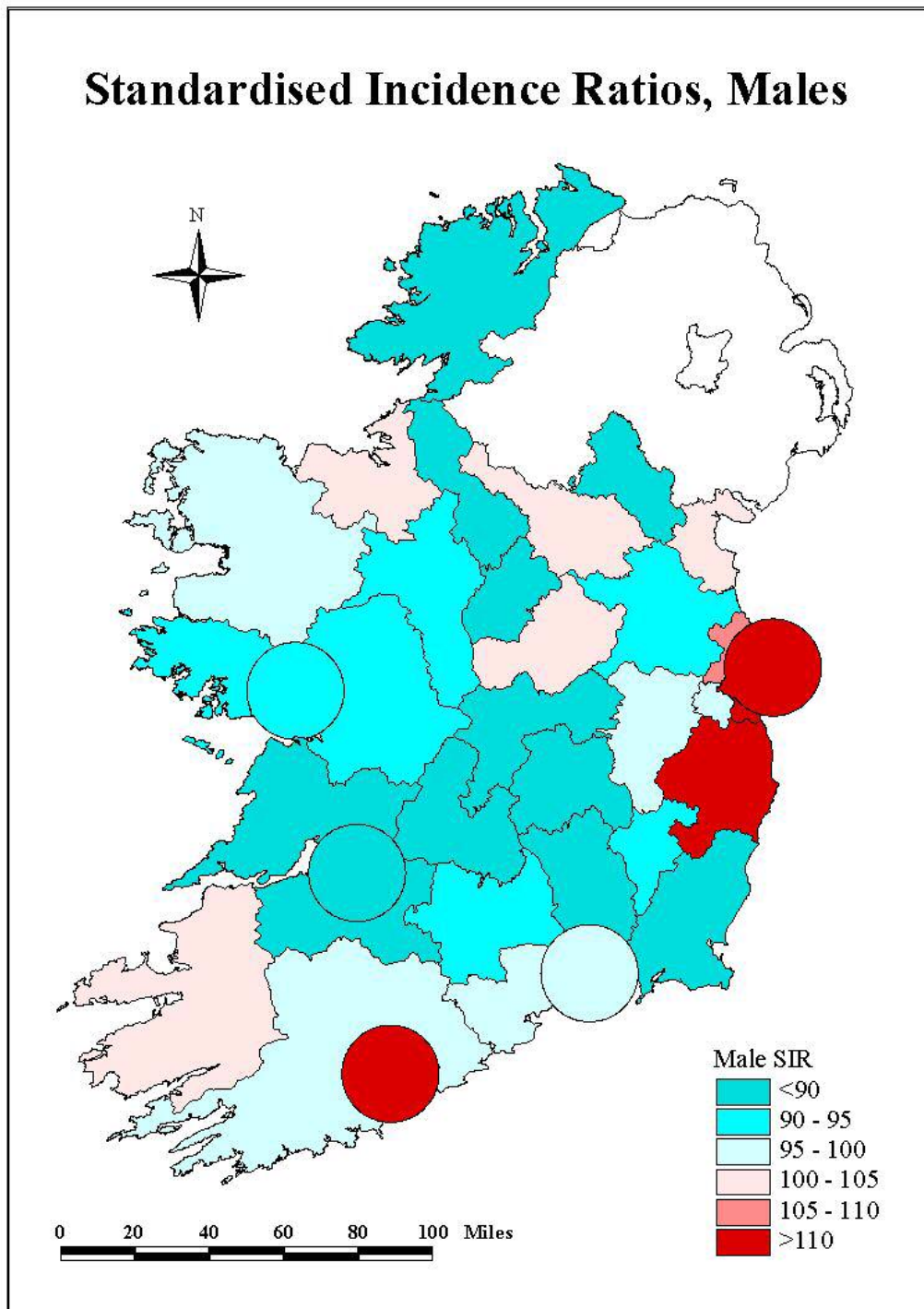


Figure 13. Standardised Incidence Ratios For Males Under 75, 1994-97.

Standardised Incidence Ratios, Females

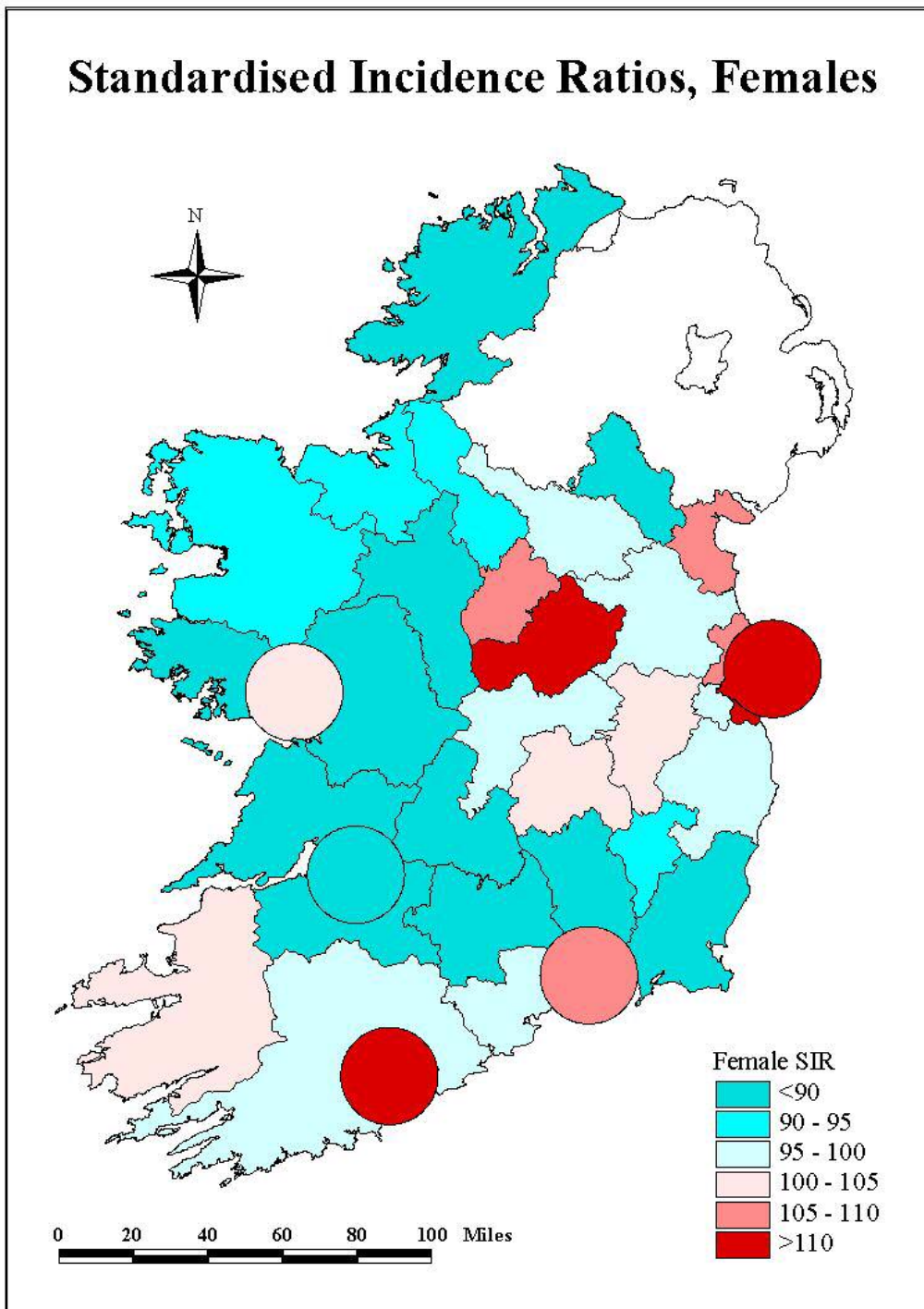


Figure 14. Standardised Incidence Ratios For Females Under 75, 1994-97.

Does Co. Louth Have A High Age Specific Incidence Rate At Every Age?

Louth has an above average age standardised incidence ratio for both males and females – i.e. there were more new cases of cancer in the period 1994 to 1997 in Louth than might be expected given the age composition of the population. The next question is whether the excess number of new cases is concentrated amongst people in particular age groups or whether people of all ages are adversely affected. To explore this, age specific incidence rates were calculated for each of the age groups examined previously.¹⁰

The age specific incidence rates for males and females are shown in Table 10. The male rates are much the same as the national average for the 5-14, 15-24, 35-44, and 45-54 age groups. They are lower for the 55-64 age group, but they are higher in Louth for all the other age groups. A similar sort of pattern may be observed for females, except that the Louth rate for females aged 55-64 is above the national average, but the rates for the 35-44 and 45-54 age groups are much the same or below the national average. Younger adult females (i.e. those aged 15-24 and 25-34 have above average incidence rates).

Age	Males		Females	
	Louth	National	Louth	National
0-4	30	19	24	16
5-14	9	11	6	9
15-24	21	22	38	20
25-34	64	53	85	69
35-44	117	117	187	212
45-54	372	370	500	510
55-64	1051	1140	1034	962
65-74	2988	2626	1807	1637
75 +	4857	4223	2495	2350

Table 10. Mean Age Specific Cancer Incidence Rates (Per 100,000), 1994-1997.

The patterns in the age specific incidence rates for 1994-1997 generally reflect the patterns in the age specific mortality rates for 1970-1999 as shown in Table 3. However, the male mortality rates were higher in Louth for all age groups, whereas the incidence rates for men aged 55-64 are below the national average. This would tend to support the conclusion drawn from Table 6 that the situation for males in Louth in these age groups improved between the 1970s and 1990s.

The patterns in the age specific incidence rates for females in Table 10 likewise tend to reflect the patterns in the age specific mortality rates in Table 3. The high incidence rate for 25-34 age group, paralleling the high mortality rate for the same age group, is especially disturbing given the young age of the women, and the fact that the mortality trends in Table 6 suggest that the situation is disimproving. Whilst the numbers are very small, the above average rate for 15-24 year olds is also disturbing.

Are There Spatial Variations In Cancer Morbidity Within County Louth?

The mortality data reported in Table 5 suggest that Drogheda and Dundalk have above average cancer

¹⁰ The data would permit age specific rates to be calculated for 5-year (or even 1-year) age groups, but 10-year age groups are retained for comparability with the mortality data discussed previously.

mortality rates, but that the rest of the county was more or less in line with the national average. However, these findings need to be treated with caution because of various limitations in the data. This section examines whether similar spatial variations are suggested by the morbidity data.

Standardised incidence ratios can be calculated for each DED in Louth, permitting in theory a much more detailed spatial breakdown than is possible from the mortality data. However, the ratios calculated for many DEDs with small populations are potentially misleading because of what is generally referred to as ‘the small numbers problem’ – i.e. one or two fewer or additional cancer cases in a DED may make a very large ‘percentage’ difference to the ratio. The maps of standardised incidence ratios for DEDs in County Louth consequently tend to display widely varying ratios in what would appear to be a haphazard pattern. Rather than cause unjustified concern amongst people who live in areas which, just by chance, happen to have high ratios, it is preferable to aggregate DEDs into a smaller number of areas with larger populations.¹¹



Figure 15. Analytical Areas In County Louth.

Seven areas, loosely based on the Urban and Rural Districts in County Louth, were defined for the purposes of analysis. Because the towns now extend beyond their original Urban District boundaries, St. Peter’s DED was added to the DEDs within Drogheda M.B. to form a ‘Greater Drogheda’ area and Dundalk Rural, Castletown and Haggardstown DEDs were added to those within Dundalk U.D. to form a ‘Greater Dundalk’ area. Although not an Urban District, a ‘Greater Ardee’ area was defined by joining Ardee Urban and Ardee Rural DEDs. Four predominantly rural areas were defined from the remaining DEDs. The

¹¹ There are other approaches which may be adopted, in particular a number of techniques based on Bayesian statistics, but they do not completely resolve the problems. The approach adopted here has the advantage of being simple to understand.

Cooley region contains the seven DEDs on the Cooley Peninsula, NorthWest Louth contains the remaining DEDs in the Dundalk Rural District plus Clonkeen and Talanstown DEDs, Mid Louth contains the remaining DEDs in Ardee No. 1 Rural District, and South Louth contains the remaining DEDs in the Louth Rural District. The boundaries of the seven areas are shown in Figure 15.

Standardised incidence ratios were calculated for each area using the direct method, standardizing to the European Standard Population. As noted previously, only cases which were confidently geocoded were used in this part of the analysis. The national age specific rates (as opposed to the Louth age specific rates) were used in the calculations as the age specific rates for the standard population, with the result that ratios higher than 100 indicate an incidence rate above the national average (but not necessarily higher than the Louth average). The standardised incidence ratios are shown in Table 11.

Area	Males	Females
Greater Drogheda	133.3	142.6
Greater Dundalk	104.7	97.5
Greater Ardee	83.2	100.6
Cooley	79.5	92.5
NorthWest Louth	104.1	85.6
Mid Louth	76.6	106.8
South Louth	94.6	99.5

Table 11. Standardised Incidence Ratios For Areas In Louth, 1994-97.

The Greater Drogheda area has the highest standardised incidence ratios for both males and females. Indeed, it is the only area which has an incidence rate substantially above the national average for both sexes. Greater Dundalk has an above average incidence for males but not females, although in both instances it is only slightly different from the national average. Greater Ardee is about average for females, but well below average for males. Cooley interestingly (given that it was concerns in this area that instigated this study) has a low incidence for both males and females. Northwest Louth has the third highest incidence for males, but has a very low incidence for females. The opposite is true for Mid Louth which has the second highest incidence for females, but a very low incidence for males. Finally the incidence in South Louth, despite its proximity to Greater Drogheda, is very close to the national average for and females, and below average for males.

Overall, the standardised incidence ratios suggest that cancer incidence in Louth in the mid-1990s was not particularly high, except in the Greater Drogheda area. However, the data would suggest that the incidence rates in Drogheda were about one third above the national average for males and almost one half above the national average for females. This, on the face of it, would suggest a very disturbing situation in Drogheda. However, although patients are geocoded by their home address, it is possible that the figures for Drogheda may in some way be inflated because it is the location of the largest hospital in the North Eastern Health Board Region. It is also possible that the population at risk, used in the denominator, may have been undercounted. If some of the Drogheda cases normally reside elsewhere in Louth, then the incidence rates for the other areas of Louth may be understated.

Given the concerns expressed about the possible influence of discharges from Sellafield, a second set of regions were defined. A coastal zone was defined as all DEDs which bordered on the sea, plus Ravensdale DED (which would otherwise have formed a 'region' on its own). The remaining DEDs form a contiguous inland zone. The location of these two zones is shown in Figure 16.



Figure 16. Coastal And Inland Zones In County Louth.

The standardised incidence ratios calculated for the two zones are shown in Table 12. It will be noted that the coastal zone has a higher incidence for both males and females. This would appear to support the contention that Sellafield may pose a risk to people in coastal areas. However, the coastal zone contains the Greater Drogheda area, which accounts for most of the excess morbidity. If the Greater Drogheda area is excluded from the coastal zone, then the coastal zone is found to have a similar incidence to the inland zone. This does not prove that Sellafield is not a factor – there is little reason to believe its effects would be confined to a narrow coastal strip – but the incidence rates do not provide any evidence to suggest that it is a factor.

Zone	Males	Females
Coastal	119.9	112.4
Inland	83.0	100.7

Table 12. Standardised Incidence Ratios For Zones In Louth, 1994-97.

Summary

Generally speaking the analysis of the morbidity data for the period 1994-1997 provided by the National Cancer Registry supports the conclusions based on the mortality data for 1970 to 1999. The ‘crude’ incidence rate for Louth, like the crude death rate was neither exceptionally high or low, but this is misleading because of the generally youthful nature of the Louth population. When the effects of age are taken into account, in the form of standardised incidence ratios, Louth fares worse. Louth has the 6th worst standardised incidence ratio for males and the 7th worst ratio for females in the country. However, the

amounts of excess morbidity are comparatively small - 4 per cent for males and 6 per cent for females.

The morbidity data also tend to support the conclusions from the mortality data that the higher risk of cancer in Louth is less pronounced amongst middle aged men and women than it is for both younger and older people of both sexes. The age specific incidence of cancer in middle aged men in Louth (i.e. those in the 45-54 and 55-64 age bands) is similar to or below the national average. Louth men in these age bands were found to have above average mortality in Chapter 2, but the age specific rates for these ages in Louth were also found to be declining much faster than the national average in Chapter 3, suggesting that the reduced risk in men in these ages has brought them into line with the national average. However, similar improvements do not appear to have occurred for older men in Louth, with the result that the age specific incidence rate for men in these ages remained higher in Louth than the national average.

The age specific incidence rates for middle aged women in Louth (i.e. in the 35-44 and 45-54 age bands) were similar to the national average, but the Louth rates were higher than the national average for both younger and older women.¹² This broadly corresponds to the findings based on mortality data in Chapter 2. Although the number of cases is much lower for younger women than for older women, the very high incidence for Louth women aged 15-24 and 25-34, relative to the rest of the country, coupled with the fact that mortality amongst women in these ages was found to be increasing in Louth at a time when it declined elsewhere, is a disturbing trend possibly suggesting a growing problem which is likely to intensify as the women in this cohort become older.

The morbidity data provided by the national Cancer Registry permits spatial variations in cancer to be examined at a larger scale (i.e. for smaller areas) than is possible using the published mortality data. However, the fact that the morbidity data are only available for 5 years, and the fact that a substantial number of cases had to be ignored because they could not be confidently geocoded, reduces the confidence which may currently be placed upon any conclusions which may be drawn. The morbidity data supports some of the conclusions based on mortality data in Chapters 2 and 3, but they also provides some contradictions. Dundalk was identified in Chapter 2 as an area of high mortality, but the morbidity data in this Chapter suggest that incidence rates for both males and females in Dundalk is not very different from the national average. The possibility that this might be attributed to an improving situation in Dundalk between the 1970s and 1990s is contradicted by the steep rise in mortality reported for the 1991-95 period in Table 7.

The morbidity data supports the conclusion that Drogheda has the highest rates of cancer in Louth. Indeed, the morbidity data suggest that Drogheda may be the only area in Louth with significantly high rates for both males and females. However, further research is required to establish whether the high morbidity rates are an accurate indication of increased risk or a statistical artefact generated by unidentified causes.

The morbidity data suggest that the incidence rates may be above average for either males or females in other parts of Louth, but where they are high for one sex they tend to be low for the other, with the result that it would appear that no other part of Louth is markedly out of line the national average overall. The Cooley peninsula has a low calculated incidence rate for both males and females.

¹² It should perhaps be noted that 'middle aged' women in these discussions are 10 years younger than 'middle aged' men.