RESEARCH COMMUNICATION

# Pancreatic Cancer Epidemiology and Survival in an Australian Population

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## Abstract

**South Australian registry data were used to explore age-standardised incidence and mortality rates and case survivals for pancreatic cancer during 1977 to 2006. Disease-specific survivals were investigated using Kaplan-Meier estimates and Cox proportional hazards regression. While annual incidence and mortality rates were relatively stable among males during 1983-2006, they were 14% and 17% lower respectively than for the 1977-82 baseline. A converse non-significant secular trend was suggested in females, in that incidence in 1989-2006 was 10% higher than in 1977-88, with a corresponding 9% increase in mortality. As a result, male to female incidence rate ratios decreased from 1.73:1 in 1977-82 to about 1.34:1 in 2001-06. One-year survival was 18.0% but this figure decreased to 3.6% at five years. Higher survivals were evident for more recent diagnostic periods, with one-year survival increasing from 14.3% in 1977-88 to 23.9% in 2001-06. Multivariable proportional hazards regression indicated that case fatality was higher in the older age groups and lower for neuroendocrine than other histology types, patients from high and mid-high than lower socio-economic areas, and for more recent diagnostic periods. The differences by diagnostic period, socio-economic status and histology type applied both to the age range less than 60 years and between 60 and 79 years, but were not evident in older patients. The divergent secular trends in incidence and mortality in males and females and associated decreases in male to female rate ratio are consistent with trends in the USA and likely reflect differences in historic tobacco smoking trends by sex. While survival at five years from diagnosis is still only about 5%, patients are living longer with more surviving one year or more, probably due to gains in treatment and potentially in diagnostic technology.**

**Key Words:** Pancreas cancer - incidence - mortality - survival - secular trends

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## Introduction

Pancreatic cancer is renowned for poor outcomes, with five-year survivals in Australia and North America approximating 5% and even poorer outcomes presenting in most populations (Faivre et al., 1998; CCCR, 2001; AIHW et al., 2008; Ries et al., 2008; Berrino, et al., 2009). The disease is often asymptomatic or associated with such vague and varied symptoms that suspicion is not raised and delays in diagnosis occur (Gullo et al., 2001). In the USA, only 8% of staged cases are reported to be localised at diagnosis, whereas 31% are found to have spread regionally and 61% to have distant metastases (Ries et al., 2008). Cancer of the pancreas is the sixth leading cause of cancer death in Australia, accounting for about 5% of these deaths (AIHW, 2007). There is a pressing need to find means of preventing this disease and improving clinical outcomes.

Recent data in Australia report secular trends as favourable in males, with age-standardised mortality rates reducing by about 20% in the 25 years since the late 1970s (AIHW, 2008). Although males are affected more often by the disease than females, there has been a contrasting 9% increase in mortality for females since the late 1970s (AIHW, 2008), with male-to-female mortality rate ratios declining from 1.72 to one to 1.17 to one. USA SEER data also point to a decreasing mortality in males over this period and an increase in females, with the mortality rate ratio declining from 1.55 to one to 1.35 to one (Ries et al., 2008). A similar pattern is not evident in Europe where trends have been more variable (Wood et al., 2006; Kota et al., 2008).

There appears to be potential for prevention in that tobacco smoking is an established risk factor with about 20% to 30% of pancreatic cancers being attributed to this cause in western populations (CCCR, 2001; Adami et al., 2002; Iodice et al., 2008; La Tore et al., 2009). In addition, it is thought that diets low in vegetable and fruit may contribute (CCCR, 2001; Chan, 2005). The evidence of higher pancreatic cancer rates in lower socio-economic

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areas and in Indigenous populations of Australia may reflect more frequent tobacco smoking, although diabetes and obesity are other risk factors that are more common in these groups (CCCR, 2001; Wang et al., 2003; Patel et al., 2005; Weiderpass et al., 2006; Pink B et al., 2008). Apart from these differences and differences by age and gender, pancreatic cancer rates vary little across socio-demographic groups in Australia (CCCR, 2001).

The present study is descriptive. It describes incidence and mortality trends using data from an Australian population-based registry. Reductions in smoking are thought to have accounted for reductions in lung cancer incidence in males and it is hoped that a parallel reduction in pancreatic cancer might be continuing, despite reported increases in prevalence of obesity and diabetes that may have a converse effect on risk (CCCR, 2001; Chittleborough et al., 2007; AIHW, 2008). Also, lung cancer incidence and mortality have increased in females potentially due to earlier increases in smoking (AIHW, 2008), but it is hoped that corresponding increases in pancreatic cancer incidence are no longer occurring because of recent declines in female smoking prevalence. Prevention of pancreatic cancer through tobacco control and potentially improvements in diet and reduced obesity is especially important, given the poor survival outcome. In the present study setting of South Australia, smoking prevalence has reduced to a comparatively low level by national standards, whereas obesity has increased to a comparatively high level (ABS, 2006). As a result, cancer trends in this setting may provide early indicators of effects of competing trends in these risk factors in Australia.

Although survivals from pancreatic cancer remain very low, marginal increases have been reported recently in Australia and North America, potentially reflecting increases in surgical management of localised disease (Linder et al., 2006; Baxter et al., 2007;AIHW et al., 2008; Ries et al., 2008). Surgery is the only means of cure, although only between 5% and 25% of patients would be amenable to this treatment, with or without adjuvant therapies (Neoptolemos et al., 2003; Boeck et al., 2007). Resection for localised disease has been linked to a long-term survival of about 25% (Ries et al., 2008). Apart from survival gains from advances in surgery, gains are also likely from gemcitabine chemotherapy for advanced disease, and potentially other adjuvant chemotherapies, although this may not yet be reflected in survival trends because routine use of adjuvant chemotherapy is a recent development (Neoptolemos et al., 2003; Boeck et al., 2007). The present study investigates differences in survival by socio-demographic characteristic and time period to identify patients at relative disadvantage and to determine whether secular advances in survival are taking place.

## Materials and Methods

*Data collection*

The South Australian Cancer Registry was used as the data source for this study. It has received statutory notifications of invasive pancreatic cancers since 1977. The Registry covers all regions of South Australia (one of eight Australian states and territories) and all invasive cancers diagnosed in residents except non-melanoma skin cancer. Its procedures have been described previously (SACR, 2000). Death data are collected through routine notifications, electronic searches of official State death records and the National Death Index at the Australian Institute of Health and Welfare, and from interstate registries (SACR, 2000). Under-ascertainment has been checked through active follow-up, and with deaths reported independently, and found to be minimal (SACR, 2000; Bonett et al., 1988).

The present study included 4,166 pancreatic cancers (ICD-O-3: C25) diagnosed between 1977 and 2006. They were mostly adenocarcinomas, although there was a small group of neuroendocrine cancers comprising islet cell carcinomas, glucagonomas, insulinomas, and other neuroendocrine cancers coded by histology according to a previous study of USA SEER data (i.e., ICD-O-3 histology codes: 81503; 81513; 81523; 81533; 81543 and 82403) (Yao et al., 2008). These neuroendocrine cancers were analysed separately to confirm prior evidence of better outcomes (Yao et al., 2008).

Socio-demographic descriptors included age at diagnosis; sex; region of residence, classified as 20 statistical sub-divisions and as metropolitan or non-metropolitan (SACR, 2000); country of birth (World Health Organization criteria) (Ferlay et al., 2001); Indigenous status (SACR, 2000); and relative socio-economic disadvantage, as inferred from residential postcode SEIFA index (ABS, 1998).

*Statistical analyses*

A de-identified file was extracted and analysed in-house under provisions of the South Australian Health Care Act 2008, employing STATA 9.2 software (StataCorp, 2005). Mean annual incidence and mortality rates were determined for five broad periods ( i.e., 1977-82, 1983-88, 1989-94, 1995-2000, and 2001-06) directly standardising by five-year age group (with an open-ended category from 85 years) to the 2001 Australian reference population (StataCorp, 2005; Armitage et al., 1987). Ninety-five per cent confidence limits were calculated assuming a Poisson distribution, as described previously (Dobson et al., 1991).

Rates were calculated by sex for all ages combined and for age categories under 50, 50-59, 60-69, 70-79, and 85 years or more respectively, to assist a visualisation of trends. Epidemiological differences between neuroendocrine and other histology types were explored using multiple logistic regression analysis (StataCorp, 2005; Armitage et al., 1987). All socio-demographic variables were entered as predictors, with backwards elimination of those where the fit of the model did not reduce as a consequence ($p>0.05$). Assumptions underlying the analysis, including an absence of co-linearity, were found to be satisfied.

Case survivals were calculated, with a date of censoring of live cases of December 31st, 2006. Kaplan-Meier product-limit estimates of disease-specific survival were calculated, treating deaths from other causes and people still alive at the end of 2006 as censored

**Table 1. Mean Annual Age-standardised (Australia, 2001) Pancreatic Cancer Incidence and Mortality Rates (95% Confidence Limits) per 100,000 South Australians by Sex and Calendar Year Period***

| Calendar year | 1977-82 | 1983-88 | 1989-94 | 1995-2000 | 2001-06 | Total |
|---|---|---|---|---|---|---|
| Incidence: | | | | | | |
| Males | [n=365] | [n=364] | [n=416] | [n=469] | [n=556] | [n=2,170] |
| | 13.3 [11.9,14.7] | 11.1 [10.0,12.4] | 11.3 [10.2,12.4] | 11.3 [10.3,12.3] | 11.6 [10.7,12.6] | 11.7 [11.2,12.2] |
| Females | [n=272] | [n=325] | [n=413] | [n=456] | [n=530] | [n=1,996] |
| | 7.67 [6.79,8.64] | 7.75 [6.93,8.64] | 8.50 [7.70,9.36] | 8.26 [7.52,9.05] | 8.66 [7.93,9.42] | 8.24 [7.88,8.61] |
| Persons | [n=637] | [n=689] | [n=829] | [n=925] | [n=1,086] | [n=4,166] |
| | 10.1 [9.33,10.9] | 9.28 [8.60,10.0] | 9.79[9.14,10.5] | 9.64 [9.02,10.3] | 10.1 [9.47,10.7] | 9.81 [9.52,10.1] |
| Mortality: | | | | | | |
| Males | [n=340] | [n=349] | [n=376] | [n=416] | [n=501] | [n=1,982] |
| | 12.6 [11.3,14.0] | 10.9 [9.82,12.2] | 10.3 [9.30,11.4] | 10.1 [9.12,11.1] | 10.5 [9.64,11.5] | 10.8 [10.3,11.3] |
| Females | [n=249] | [n=300] | [n=388] | [n=416] | [n=488] | [n=1,841] |
| | 7.02 [6.18,7.95] | 7.20 [6.41,8.06] | 7.97 [7.20,8.81] | 7.53 [6.82,8.29] | 7.81 [7.13,8.53] | 7.58 [7.23,7.93] |
| Persons | [n=589] | [n=649] | [n=764] | [n=832] | [n=989] | [n=3,823] |
| | 9.43 [8.69,10.2] | 8.84 [8.17,9.55] | 9.05 [8.42,9.71] | 8.66 [8.08,9.27] | 9.09 [8.53,9.67] | 9.02 [8.74,9.31] |

*Data source: South Australian Cancer Registry

observations (StataCorp, 2005; Armitage et al., 1987). Multivariable Cox proportional hazards regression also was undertaken to assess socio-demographic and histological predictors of survival from pancreatic cancer (StataCorp, 2005; Armitage et al., 1987).The regression analysis employed the same censoring criteria as for the Kaplan-Meier analyses. All predictor variables were entered into the analysis, with backwards elimination. Assumptions underlying the analysis, including proportionality and an absence of co-linearity, were found to be satisfied (StataCorp, 2005; Armitage et al., 1987).

Disease-specific survival was employed, not relative survival, because the life tables needed to undertake relative survival analyses were not available for many population sub-groups (SACR, 2000). Analyses have shown very similar survival estimates in South Australia, irrespective of relative survival or disease-specific survival method, such that the disease-specific survivals presented here are regarded as a good proxy for relative survival (SACR, 1997). This was confirmed by the similar percentage survivals for pancreatic cancers diagnosed in 1977-98, as indicated by relative survival and disease-specific survival respectively, which were: 15% and 15% at one year post diagnosis; 7% and 7% at two years; 4% and 4% at three years; 4% and 3% at four years; and 3% and 3% at five years.

## Results

*Age-standardised incidence and mortality trends*

Annual rates per 100,000 were consistently higher in males than females, the overall male-to-female rate ratio being 1.42 to one in 1977-2006 for both incidence and mortality (Table 1). Incidence ratios reduced over time from 1.73 to one in 1977-82 and 1.44 to one in 1983-88 to about 1.35 to one during 1989-2006.

These incidence trends were influenced by the relatively high annual incidence (95% confidence limits) per 100,000 males in 1977-82 of 13.25(11.93, 14.68), with a 14.5% lower combined figure of 11.33 (10.81, 11.86) following in 1983-2006 (Table 1). Little difference in incidence was observed in 1983-2006. Mortality rates per 100,000 males showed a similar pattern, in that following the 1977-82 rate of 12.62 (11.31, 14.03), there was a 17.0% lower combined figure of 10.47 (9.97, 10.99) for 1983-2006 and no clear trend between these periods (Table 1). In all five age-specific categories, the 1977-82 rate was the highest, both for incidence and mortality (note: data not shown).

Conversely, the annual incidence tended to be lower in females in 1977-88 than subsequently, although the difference did not achieve statistical significance ($p>0.05$) (Table 1). Specifically the incidence in 1977-88 was 7.71 (7.10, 8.35) compared with the 9.9% higher 8.47 (8.03, 8.93) in 1989-2006. Meanwhile the corresponding mortality rates were 7.11 (6.53, 7.73) and 7.77 (7.35, 8.21) respectively (Table 1). Differences were not consistent by age category, with three of the five age categories showing higher rates in 1989-2006, for both incidence and mortality, and two not doing so.

*Distribution by histology type*

Multiple logistic regression analysis indicated differences in ratios of neuroendocrine to other histology types by diagnostic period and age at diagnosis. For each successive five-year diagnostic period, the relative odds of neuroendocrine cancers increased on average by 15% (i.e., relative odds (95% confidence limits) of 1.15 (1.07, 1.23)). Also, using patients under 50 years of age as the reference category, the relative odds of neuroendocrine cancers were much lower at: 0.18 (0.08, 0.38) in 50-59 year olds; 0.15 (0.08, 0.28) in 60-69 year olds; 0.07 (0.03, 0.14) in 70-79 year olds; and 0.04 (0.01, 0.10) in those aged 80 years or more. Differences in histology type were not evident, however, by sex, region of residence (either classified as 20 statistical sub-divisions or as metropolitan or non-metropolitan), country of birth, Indigenous status or relative socio-economic disadvantage ($p>0.100$).

*Survivals*

Survivals ranged from 18.0% at one year from diagnosis to 3.6% at five years, 3.1% at 10 years and 3.0% at 15 years (Table 2).

Significant differences presented by:

• Age at diagnosis ($p<0.001$) – one-year survivals decreased with age from 26.3% for ages under 60 years

**Table 2. Percentage Survivals (± Standard Errors) from Pancreatic Cancer in South Australia by Socio-demographic Descriptor and Histology Type: 1977-2006****

| Years from diagnosis | | 1 | 2 | 3 | 4 | 5 | 10 | 15 | P value* |
|---|---|---|---|---|---|---|---|---|---|
| All cases (n=4,166) | 100 | 18.0 ±0.6 | 8.1±0.5 | 5.1±0.4 | 4.1±0.4 | 3.6±0.3 | 3.1±0.3 | 3.0±0.3 | |
| By age at diagnosis (yrs.): | | | | | | | | | |
| Under 60 [n=705] | 100 | 26.3±1.7 | 14.7±1.4 | 10.9±1.3 | 9.4±1.2 | 8.4±1.2 | 6.9±1.2 | 6.9±1.2 | |
| 60-69 [n=1,081] | 100 | 19.2±1.2 | 9.6±1.0 | 5.5±0.8 | 4.2±0.7 | 3.4±0.7 | 3.1±0.6 | 3.1±0.6 | p<0.001 |
| 70-79 [n=1,360] | 100 | 17.1±1.1 | 6.2±0.7 | 3.8±0.6 | 3.0±0.5 | 2.6±0.5 | 2.6±0.5 | 2.3±0.5 | |
| 80+ [n=1,020] | 100 | 12.0±1.1 | 4.5±0.7 | 2.0±0.5 | 2.0±0.5 | 1.7±0.5 | — | — | |
| By socio-economic status: | | | | | | | | | |
| Low [n=1,304] | 100 | 16.9±1.1 | 6.3±0.7 | 3.6±0.6 | 3.1±0.5 | 2.8±0.5 | 2.4±0.5 | 2.4±0.5 | |
| Mid-low [n=1,015] | 100 | 16.6±1.2 | 8.3±0.9 | 5.3±0.8 | 4.5±0.7 | 3.7±0.7 | 2.9±0.7 | 2.9±0.7 | |
| Mid-high [n=803] | 100 | 20.2±1.5 | 8.7±1.1 | 5.7±0.9 | 4.0±0.8 | 3.6±0.8 | 3.4±0.8 | 3.4±0.8 | p=0.042 |
| High [n=1,044] | 100 | 19.1±1.3 | 9.6±1.0 | 6.2±0.8 | 5.2±0.8 | 4.2±0.7 | 3.9±0.8 | 3.4±0.8 | |
| By place of residence: | | | | | | | | | |
| Metropolitan [n=3,130] | 100 | 18.4±0.7 | 8.7±0.5 | 5.5±0.5 | 4.5±0.4 | 3.9±0.4 | 3.4±0.4 | 3.3±0.4 | p=0.028 |
| Non-metro. [n=1,036] | 100 | 16.8±1.2 | 6.4±0.8 | 3.9±0.7 | 3.0±0.6 | 2.5±0.6 | 2.3±0.6 | 2.3±0.6 | |
| By histology type: | | | | | | | | | |
| Neuroendocrine [n=68] | 100 | 78.3±5.1 | 63.1±6.2 | 53.8±6.5 | 45.4±6.7 | 42.9±6.8 | 32.5±7.7 | 32.5±7.7 | p<0.001 |
| Other [n=4,098] | 100 | 17.0±0.6 | 7.2±0.4 | 4.2±0.4 | 3.4±0.3 | 2.9±0.3 | 2.6±0.3 | 2.5±0.3 | |
| By diagnostic period: | | | | | | | | | |
| 1977-82 [n=637] | 100 | 14.7±1.4 | 7.8±1.1 | 5.1±0.9 | 4.4±0.8 | 4.0±0.8 | 2.9±0.7 | 2.9±0.7 | |
| 1983-88 [n=689] | 100 | 14.0±1.3 | 5.4±0.9 | 3.2±0.7 | 2.7±0.7 | 2.5±0.6 | 2.3±0.6 | 2.0±0.6 | p<0.001 |
| 1989-94 [n=829] | 100 | 15.1±1.3 | 5.9±0.9 | 3.3±0.7 | 2.6±0.6 | 2.1±0.6 | 2.1±0.6 | 2.1±0.6 | |
| 1995-2000 [n=925] | 100 | 19.2±1.3 | 10.1±1.0 | 6.9±0.9 | 5.3±0.8 | 4.2±0.7 | 4.1±0.7 | — | |
| 2001-06 [n=1,086] | 100 | 23.9±1.4 | 9.7±1.1 | 5.6±0.9 | 4.9±1.0 | 4.9±1.0 | — | — | |

* Derived from Cox proportional hazards regression (see text); **Kaplan-Meier product limit estimates; Date of censoring of live cases: December 31st, 2006; Data source: South Australian Cancer Registry

to 12.0% for ages of 80 years and over

• Socio-economic status of residential postcode (p=0.042) – one-year survivals were 16.8% for low to mid-low status postcodes compared with 19.6% for mid-high to high status postcodes

• Metropolitan compared with non-metropolitan postcodes (p=0.028) – respective one-year survivals were 18.4% and 16.8%

• Histology type (p<0.001) – neuroendocrine tumours had a 78.3% one-year survival compared with a 17.0% corresponding survival for other types

• Diagnostic period (p<0.001) – one year survival increased from 14.7% in 1977-82 and 14.0% in 1983-88 to 23.9% in 2001-06.

Survivals did not vary by sex (p=0.580), country of birth (p=0.467), Indigenous status (p=0.285), or by non-metropolitan statistical sub-division (p=0.215), although a difference was suggested for metropolitan sub-divisions (p=0.018).

Multivariable proportional hazards regression analysis indicated that younger age at diagnosis, a neuroendocrine histology type, a mid-high to high socio-economic status, and a more recent diagnostic period were predictive of lower case fatality (Table 3). Neither sex, country of birth, Indigenous status or place of residence (metropolitan/non-metropolitan or statistical subdivision) were predictive in this multivariable model (p>0.100).

Interaction terms revealed differences in associations in old (80+ years) than younger age groups of survivals with histology type (p<0.001), high socio-economic status (p=0.005), and diagnosis in 1995-2000 (p=0.002) or 2001-06 (p=0.007) compared with earlier periods. Further analyses by age category confirmed that neuroendocrine histology type, higher socio-economic status, and a more recent diagnostic period were predictive of lower case fatality both in patients under 60 years of age and in 60-79 year olds, but not in patients aged 80 years or more (Table 4). While there was no indication of a lower case fatality for neuroendocrine tumous in patients aged 80 years or more, the number of these cancers was small (n=5) and the risk estimate very imprecise.

**Table 3. Relative Risk (95% Confidence Limits) of Death from Pancreatic Cancer in South Australia;1977-2006***

| Characteristic | Relative risk |
|---|---|
| Age at diagnosis (yrs.): | |
| Under 60 (reference) [n=705] | 1.00 |
| 60-69 [n=1,081] | 1.20 [1.08, 1.33] |
| 70-79 [n=1,360] | 1.35 [1.23, 1.49] |
| 80+ [n=1,020] | 1.73 [1.56, 1.92] |
| Histology type: | |
| Other (reference) [n=4,098] | 1.00 |
| Neuroendocrine [n=68] | 0.27 [0.19, 0.37] |
| Socio-economic status: | |
| Low/mid-low (ref) [n=2,319] | 1.00 |
| Mid-high [n=803] | 0.89 [0.82, 0.97] |
| High [n=1,044] | 0.90 [0.83, 0.97] |
| Diagnostic period: | |
| 1977-94 (reference) [n=2,155] | 1.00 |
| 1995-2000 [n=925] | 0.82 [0.76, 0.89] |
| 2001-06 n=1,086] | 0.73 [0.67, 0.79] |

* Cox proportional hazards regression analysis (see text), Data source: South Australian Cancer Registry.

## Discussion

Although the 14.5% lower incidence seen in males

**Table 4. Relative Risk (95% Confidence Limits) of Death from Pancreatic Cancer in South Australia by Age Category: (1977-2006)***

| Under 60 yrs. | | 60-79 yrs. | | 80+ yrs. | |
|---|---|---|---|---|---|
| Age at diagnosis (yrs): | | | | | |
| Under 50 [n=215] | 1.00 | 60-69 [n=1,081] | 1.00 | 80-84 [n=510] | 1.00 |
| 50-59 [n=490] | 1.07 [0.90,1.28] | 70-79 [n=1,360] | 1.13 [1.04,1.23] | 85+ [n=510] | 1.10 [0.96,1.25] |
| Socio-economic: | | | | | |
| Low/mid-low [n=424] | 1.00 | Low/mid-low [n=1,370] | 1.00 | Low/mid-low [n=525] | 1.00 |
| Mid-high [n=124] | 0.86 [0.69,1.06] | Mid-high [n=491] | 0.85 [0.77,0.95] | Mid-high [n=188] | 0.98 [0.82,1.17] |
| High [n=157] | 0.78 [0.63,0.95] | High [n=580] | 0.87 [0.78,0.96] | High [n=307] | 1.08 [0.93,1.25] |
| Histology: | | | | | |
| Other[n=672] | 1.00 | Other [n=2,411] | 1.00 | Other[n=1,015] | 1.00 |
| Neuro [n=33] | 0.22 [0.13,0.36] | Neuro [n=30] | 0.25[0.16,0.41] | Neuro [n=5] | 1.03 [0.43,2.49] |
| Diagnostic period: | | | | | |
| 1977-94 [n=378] | 1.00 | 1977-94 [n=1,318] | 1.00 | 1977-94 [n=459] | 1.00 |
| 1995-2000 [n=132] | 0.59 [0.48,0.73] | 1995-2000 [n=535] | 0.82 [0.74,0.91] | 1995-2000 [n=258] | 1.01 [0.86,1.18] |
| 2001-06 [n=195] | 0.58 [0.48,0.71] | 2001-06 [n=588] | 0.72[0.65,0.80] | 2001-06 [n=303] | 0.88 [0.75,1.02] |

*Cox proportional hazards regression analysis (see text), Data source: South Australian Cancer Registry; Neuro, Neuroendocrine

after 1977-82 is encouraging and consistent with other Australian and North American evidence (AIHW, 2008; Ries et al., 2008), there was little indication of a continuing drop in incidence during 1983-2006. Similarly, Australia-wide incidence per 100,000 males varied only marginally from 11.7 in 1983-88 to 11.2 in 2001-05 (AIHW, 2008). This may indicate that the benefits to be gained from declines in tobacco smoking have largely been obtained or that they are being offset by reverse trends in obesity, diabetes and potentially other risk factors (CCCR, 2001; Adami et al., 2002; Wang et al., 2003; Chan et al., 2005; Patel et al., 2005; Iodice et al., 2008; La Tore et al., 2009).

Meanwhile the suggestion of an increase in incidence in females is also consistent with other Australian and North American evidence (AIHW, 2008; Ries et al., 2008), although little change was observed during 1989-2006 in this study. Similarly the Australia-wide incidence per 100,000 was 8.8, both in 1995-2000 and 2001-05 (AIHW, 2008). This could mean that the upward pressures on incidence of historic increases in smoking prevalence are abating (CCCR, 2001).

Five-year survivals from pancreatic cancer are still dismally low at about 5%, except for neuroendocrine histology types where the figure approximates 43%. There is evidence of gains for all histology types collectively at one year from diagnosis, probably due to improvements in systemic chemotherapy for advanced disease, improved radiotherapy techniques for locally advanced disease and potentially improved diagnostic techniques, but the gains appear transitory, such that even among recently diagnosed cases, survival approximates 5% at five years from diagnosis. The lack of long term survival in this data set may be because the increased use of adjuvant fluorouracil, and more recently adjuvant gemcitabine chemotherapy, are recent changes in practice (Neoptolemos et al., 2003; Boeck et al., 2007). Other possible influences on survival could be increases in case load, which have been shown to affect margin status in other research (Neoptolemos et al., 2003). Further investigation is needed to explore this possibility.

The differences in survival by socio-economic status were statistically significant, although small in absolute terms. They were still suggested after 15 years of follow-up and are probably real and not a reflection of lead time and related artificial effects. Survival decreased markedly with increasing age at diagnosis, a trend seen with many other cancers (SACR, 2000), potentially due to the compromising effects on treatment planning and treatment response of age-related frailty and co-morbidity.

Notably the scale of secular gain in survival observed in the younger age ranges was not seen in patients aged 80 years or more at diagnosis. This could be due to a greater reluctance to offer surgical care or adjuvant chemotherapies to many of these older patients due to frailty and co-morbidity, such that treatment-related survival gains were not achieved. The lack of a socio-economic gradient in survival in old women, in contrast to that seen in younger patients, may also be due to age-related treatment compromises.

The higher survivals for neuroendocrine cancers, as compared with other histology types, have been observed in other studies (Yao et al., 2008). Since these cancers comprised a larger proportion of those in young patients, and were more common in the more recent diagnostic periods, they would have accentuated the higher survivals at a younger age and in more recently diagnosed patients. Multivariable regression analysis showed that these trends applied after adjusting for histology type, however, such that the differences in proportional contribution of neuroendocrine cancers would not be the full explanation.

In conclusion, the incidence of pancreatic cancer has reduced marginally in males over time, although very little since 1983. This may be due to trends in smoking. Survival has improved over time but this is only seen early after diagnosis, with 5 year survivals remaining essentially unchanged. This highlights the continued late diagnosis of pancreatic cancer in general and potentially the inability of systemic therapy to achieve control beyond one year, although gains in longer term survival may occur in the future as the uptake of adjuvant systemic therapy increases and becomes longer standing. Further research into screening techniques and improved community and professional education may allow earlier diagnosis and with this improvements in long-term survival.

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