Current status of
colorectal cancer
in Queensland, 1982 to 2005

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DISCLAIMER
This report is not intended to replace medical advice. The information and data contained in this report was the most recent available at the time of publication; however, data and published research are continually being updated. In light of these considerations, and where relevant, the authors recommend that readers of this publication seek the advice of their general practitioner or treating physician in relation to their individual situation.

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Executive Summary

The Cancer Council Queensland is dedicated to eliminating cancer and diminishing suffering from cancer through research, treatment, patient care and prevention and early detection.[1] Part of this commitment includes informing Queenslanders of the latest available data on cancer.

This report is the third in a series, following earlier publications on prostate cancer[2] and lung cancer,[3] and uses the most recent information released by the Queensland Cancer Registry[4] to comprehensively describe colorectal cancer incidence, mortality, survival and prevalence in Queensland. Comparisons against Australian and international data are presented where applicable.

Comment boxes throughout this report provide additional information to supplement the statistical information presented, offering more detail on recently published research into different aspects of the epidemiology of colorectal cancer.

Section 1 - Introduction

This section provides a description of the physiology of colorectal cancer, along with definitions of the different sites of colorectal cancer which will be examined in this report – right colon, left colon and rectum. An overview of the contents and limitations of this report is also included.

Section 2 - Risk Factors

A range of demographic, genetic and health-related behaviours can influence the development of colorectal cancer. Some of the main risk factors include older age, a family history of colorectal cancer, inherited and inflammatory diseases of the bowel, poor diet, lack of exercise and being overweight or obese. Based on a state-wide study of health risk behaviours for cancer,[5] it was estimated that around 88% of Queenslanders aged 20-75 years did not eat sufficient quantities of vegetables and 55% did not eat enough fruit, 41% were sedentary or insufficiently active, and over half (54%) were either overweight or obese.

Section 3 - Incidence

A total of 2601 cases of colorectal cancer were diagnosed in Queensland during 2005. Of these, 1430 (55%) were males and 1171 (45%) were females, corresponding to age-standardised incidence rates of 77 cases per 100,000 males and 56 cases per 100,000 females.

Between 2001 and 2005, colorectal cancer was the third most commonly diagnosed cancer in Queensland among males and second most commonly diagnosed cancer among females, accounting for 13% of all diagnoses for both sexes. Rectal cancer (37%) was the most common site for colorectal cancers diagnosed among males, followed by right colon (31%) and left colon (27%) cancers, while among females there were almost twice as many right colon cancers (42%) as left colon cancers (23%) with rectal cancers accounting for a further 29%.

Most colorectal cancers (93% for males and 92% for females) were diagnosed among people aged 50 years or older. Age-specific incidence rates peaked for males in the 80-84 age group (512 diagnoses per 100,000 per year) and among females in the 85 and over age group (391 diagnoses per 100,000 per year).

Australia's incidence rates of colorectal cancer were among the highest in the world for both males and females, while incidence rates for both males and females in Queensland were only slightly higher than the national average.

Although incidence rates for colorectal cancer are currently stable for males and decreasing slowly for females, the actual number of diagnoses increased by 154% among males and 105% among females between 1982 and 2005. This largely reflects a combination of population growth and the ageing of the population. Incidence rates were either decreasing or stable in each age group above 35 years, apart from increasing trends among 65-79 year olds for both males and females.

Section 4 - Survival

One-year relative survival for patients at risk from colorectal cancer in Queensland between 2000-2005 was 82% for both sexes, while 5-year relative survival was 66% for females compared to 65% for males. There have been considerable improvements in survival from colorectal cancer over time, with 5-year relative survival increasing from 47% for males and 48% for females since the early to mid 1980s.

The prognosis was slightly better for people diagnosed with colorectal cancer at a younger age, with 5-year relative survival of 67% for those aged 50-64 compared to 60% among those in the 80-89 age group at diagnosis. Only minor differences were detected in survival rates between cancers of the right colon, left colon and rectum.

Survival among colorectal cancer patients in Queensland is generally similar or better than reported survival rates elsewhere in Australia and internationally.

Section 5 - Mortality

Colorectal cancer was the third most common cause of cancer-related deaths among both sexes in Queensland (12% of all cancer deaths for males and 14% for females), with a total of 912 deaths in 2005. There were 525 deaths (58%) among males and 387 deaths (42%) among females, equating to age-standardised mortality rates of 29 and 18 per 100,000 respectively. Rectal cancers accounted for the greatest proportion of colorectal cancer deaths among males (37%), while deaths attributed to right colon cancers (38%) were most common among females.

The majority of colorectal cancer deaths (95%) occurred among people aged 50 years or older. Mortality rates continued to rise as age increased, reaching 292 deaths per 100,000 males and 259 deaths per 100,000 females in the 85 and over age group. Colorectal cancer was responsible for 12% of all cancer-related premature mortality among males (5260 years of life lost per year) and 13% among females (4280 years of life lost per year).

Mortality rates among both sexes in Queensland were similar to the corresponding national averages. From an international perspective, colorectal cancer mortality rates for both males and females in Australia were higher than the average among other developed countries.

Mortality rates for colorectal cancer have been trending downwards in Queensland for both sexes since the mid to late 1990s, decreasing by 2.2% per year on average for males since 1994 and 2.7% per year for females since 1997. The largest reductions in colorectal cancer mortality rates have been within the 50-64 age group. Decreasing mortality trends have also been observed in North America and in many European countries.

Section 6 - Prevalence

As at the end of 2005, there were 9580 males (527 per 100,000) and 8278 females (391 per 100,000) living in Queensland who had previously been diagnosed with colorectal cancer at some time during the previous 20 years. Just under half of these people had been diagnosed within the last 5 years (4719 males and 3733 females).

Prevalence rates for colorectal cancer have only grown slowly over the last decade, with the 5-year prevalence rate increasing by a total of 9% among males and 4% among females between the end of 1995 and the end of 2005. This small increase in prevalence rates primarily reflects ongoing improvements in survival offset by the recent decreases in incidence rates among both males and females.

Section 7 – Geographical areas and socio-economic status

Incidence rates of colorectal cancer were significantly lower for people living in remote areas of Queensland, with a relative risk about 20% below that of people living in major cities. There were also large differences in relative survival by accessibility/remoteness, with both males and females in inner regional and outer regional parts of the state experiencing significantly poorer survival following a diagnosis of colorectal cancer than people in major cities. Among males, the relative survival benefit was around 30% lower in inner regional and outer regional areas, while among females the corresponding difference in survival benefit was just over 20%. Geographical disparities in survival were also reflected in the mortality risk due to colorectal cancer. Males in inner regional and outer regional areas were more likely to die from colorectal cancer than those in major cities, recording increased mortality risks of 8% and 21%, with some evidence that females in outer regional areas also had a higher risk of dying from colorectal cancer compared to those in the major city category.

There was generally less variation in colorectal cancer by socioeconomic status. Males living in the most disadvantaged areas of Queensland had a 15% lower risk of being diagnosed with colorectal cancer compared to those in the middle socio-economic status group, while a similar (although non-significant) relationship was also observed among females. Survival from colorectal cancer tended to be higher among people living in more affluent locations and lower among the most disadvantaged sector of the population. For example, females from affluent areas exhibited a 20% relative survival benefit in relation to those of middle socio-economic status. There were no significant differences in colorectal cancer mortality by socio-economic status within Queensland, although males in both the most affluent and most disadvantaged areas tended to have a lower risk.

It should be noted that differences in the incidence of colorectal cancer by geographic area or socio-economic status are likely to be related to a range of factors including demographic characteristics, health-related behaviours, participation in screening programs and availability of diagnostic services.

Appendix A – Other sources of information

This section contains references to other related sources of information on cancer in Queensland as well as published relevant papers arising from research conducted by the Viertel Centre for Cancer Control. It also provides links to internet resources that provide information on colorectal cancer that is outside of the scope of this report (such as further information on patient support, advocacy, symptoms and treatment options).

Appendix B – Methodology

Definitions of cancer codes, risk factors, statistical methods and measures and geographic areas are provided, along with information on all data sources (including the Queensland Cancer Registry) that are used throughout this report.

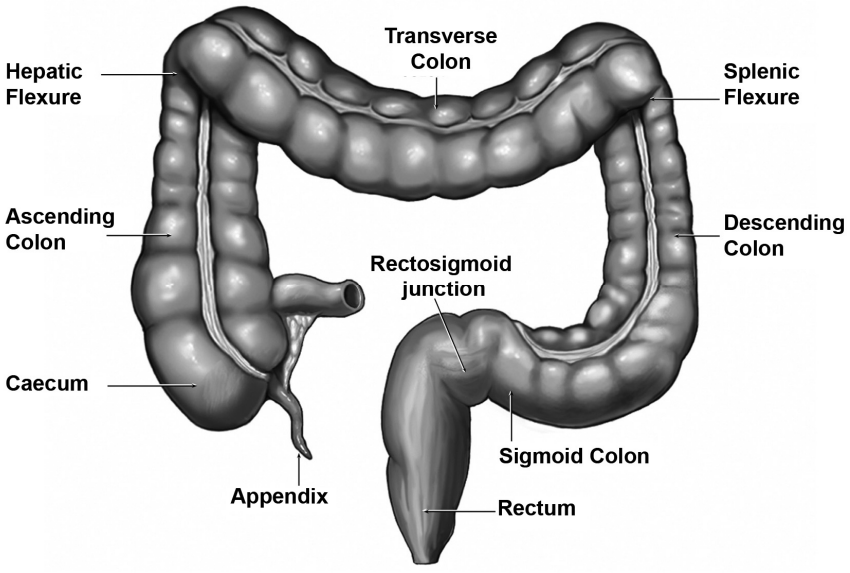
1 Introduction

1.1 What is colorectal cancer?

Colorectal cancer (also known as bowel cancer) is a major public health problem throughout the world, particularly in more developed regions such as Australia, New Zealand, Japan, North America and Europe.[6-8] It is one of eight types of cancer included in the Australian National Health Priority Area initiative, in recognition of the impact that colorectal cancer has on Australians and the potential for health gains through prevention and control.[9] Although colorectal cancer is one of the most common cancers worldwide, it is also considered to be one of the most preventable malignancies, due to the potential benefits of both lifestyle changes and screening to detect pre-cancerous growths.[10,11]

Colorectal cancers occur in the large intestine (or bowel), which is a muscular tube around 1.5 metres long and 6.5 centimetres in diameter, located in the abdomen (Figure 1.1). The functions of the large intestine include absorbing water and nutrients from food, and pushing wastes into the rectum to be excreted through the anus as faeces.[12]

Figure 1.1: Anatomy of the large intestine



Most colorectal cancers develop from adenomas (colonic polyps).[7,8] Adenomas are benign (non-cancerous) tumours that develop on the lining of the large intestine. They can vary in size from tiny nodules to large growths (up to 12 cm wide). Most adenomas don't cause symptoms, and only a small proportion become malignant,[6] although the potential for malignancy is greater among larger adenomas (i.e. more than 1 cm wide).[13] The process of an adenoma becoming malignant is a complex, multistage process[8] that can take many years.[14]

After a tumour becomes malignant, it may spread through the walls of the bowel and invade other areas of the body. Thus, as for most cancers, early detection and treatment of colorectal cancer may significantly improve survival.[6,7]

1.2 Are there different types of colorectal cancer?

Colorectal cancers can be further separated by site as follows: right colon (also known as proximal colon cancers, encompassing the caecum, ascending and transverse colon); left colon (or distal colon cancers, including the splenic flexure, descending and sigmoid colon); and rectal cancers (located in the rectosigmoid junction and rectum)[11,15] (Figure 1.1). These three colorectal cancer sites are distinct in their development and characteristics[16-18] (see Comment 2.2).

Colorectal cancers can also be grouped morphologically (based on what type of cell they occur in). Around 95% of colorectal cancers are adenocarcinomas, with the remaining 5% including mucinous carcinomas and adenosquamous carcinomas.[19]

Throughout this report, subtypes of colorectal cancer will be divided by site i.e. right and left colon cancers and rectal cancers. Colon cancers where the exact site was unknown are reported separately (where appropriate).

1.3 Purpose, structure and limitations of this report

1.3.1 Purpose

This report was designed to give a statistical overview of colorectal cancer in Queensland, primarily based on data from the Queensland Cancer Registry (QCR). The QCR maintains a record of all cases of cancer (excluding non-melanoma skin cancer) diagnosed in Queensland since 1982. At the time of publication of this report, the latest data available from the QCR was for the 2005 calendar year (see Appendix B for further details).[a]

A series of comment boxes throughout the report also provides background information from recently published scientific literature on the epidemiology of colorectal cancer and other related topics, including research conducted by the Viertel Centre for Research in Cancer Control (VCRCC) for the Cancer Council Queensland[20] (see Comment 2.4 and Appendix A).

1.3.2 Structure and contents

The main topics covered in this report include:

- how many people are diagnosed with colorectal cancer each year? (incidence);
- how long do people live after being diagnosed with colorectal cancer? (survival);
- how many people die from colorectal cancer? (mortality); and,
- how many people are still alive after being diagnosed with colorectal cancer? (prevalence).

For most of these topics, data were examined by sex, age group and type of colorectal cancer. Some of the results for colorectal cancer were compared to other types of cancer, and where possible, information for Queensland was also compared against interstate and international data.

In addition, the report describes some of the main risk factors for colorectal cancer (Chapter 2), the prevalence of these risk factors among the Queensland population, and how these behaviours change over time after people have been diagnosed with colorectal cancer.

[a] Note that as more years of data become available, most of the graphs in this report will be updated and placed on Queensland Cancer Statistics On-Line, an internet-based data dissemination system maintained by the Cancer Council Queensland (go to www.cancerqld.org.au/research/QCSOL.asp).

The final chapter (Chapter 7) details geographical and socio-demographic differences in colorectal cancer incidence, mortality and survival. Data were grouped by regions within Queensland, by accessibility and remoteness (using the ARIA+ index)[21], and by socio-economic status (using the socio-economic index for areas (SEIFA) index of relative socio-economic disadvantage)[22].

A list of other relevant sources of information is included at the end of the report (see Appendix A). Details of the data sources, definitions and statistical methods used throughout the report are contained in Appendix B.

Unless otherwise stated, estimates for Queensland were averaged over the 5-year period from 2001-2005 (a 5-year period was used to reduce the effects of random fluctuations from year to year). One exception to this is the final chapter on geographical and socio-demographic differences, where the analyses were based on a 10-year period (1996-2005) in order to allow sufficient numbers of colorectal cases or deaths within the smaller areas/subgroups.

As per usual reporting practices,[4] the data contained in this report relates solely to primary colorectal cancers. Cancers that originate in other parts of the body such as the breast or lungs and subsequently spread to the large intestine have been excluded.

1.3.3 Limitations

The information in this report does not include any adjustment for stage of cancer (a measure of how far the cancer has spread at the time of diagnosis). Data on staging are not routinely collected by the Queensland Cancer Registry, in line with the current practices adopted by most of the population-based cancer registries in Australia. The absence of information on cancer stage makes it difficult to distinguish between early/late diagnosis as a possible reason for any observed differences in colorectal cancer survival.

Non-melanoma skin cancers were not included in the comparisons of cancer types throughout this report. This is because non-melanoma skin cancers are not registered by the QCR (similar to the practice in most other cancer registries), since many are treated using techniques that preclude histological confirmation.

A detailed discussion of the various options for treating colorectal cancer is beyond the scope of this report.

2 Risk Factors

Increasing age is one of the greatest risk factors for colorectal cancer[8] (see Section 3.3). Other risk factors include:[6-8,10,23-26]

- family history of colorectal cancer
- lack of exercise
- obesity
- diabetes mellitus
- excessive alcohol consumption
- tobacco smoking
- unhealthy diet
- inflammatory bowel diseases
- inherited diseases (e.g. familial adenomatous polyposis, hereditary non-polyposis coli).

Comment 2.1 – Interpretation of information about risk factors for colorectal cancer

Colorectal cancer is caused by complex interactions between genetic and environmental factors that are yet to be fully understood.[24,27,28] These interactions make it difficult to determine the impact of individual risk factors. For instance, the effect of diet may be modified by a person's genes. In addition, multiple risk factors often occur together (such as poor diet, obesity and lack of exercise), which further complicates interpretation of the individual factors.[11]

Different research studies may produce conflicting evidence for the impact of a specific risk factor. This can be due to a range of reasons, including differences in study methodology, accuracy and completeness of data and socio-demographic characteristics of the study participants (such as cultural anomalies).[24] So as to provide the most reliable estimates available, the relative risks reported in this chapter have been based on meta-analyses of a large number of studies wherever possible; however, these estimates should still be interpreted with due caution.

2.1 Current evidence for risk factors

2.1.1 Family history and colorectal cancer

Studies from around the world over the past few decades have established that a family history of colorectal cancer among first-degree relatives (i.e. parents, siblings or children) more than doubles the risk of a person developing colorectal cancer themselves.[29,30] This family-related increase in colorectal cancer risk affects a considerable proportion of the population; for example, in the United States, it has been estimated that about 5% of people have at least one first-degree relative who has been diagnosed with colorectal cancer.[24]

The risk is generally greatest when the relative is diagnosed at a younger age (under 50 years old), if the relative has colon cancer rather than rectal cancer, when the affected relative is a sibling rather than a parent, and particularly if more than one relative has been diagnosed with colorectal cancer.[29,30] A person's risk of developing colorectal cancer also increases considerably if one of their immediate relatives is diagnosed with colorectal adenoma (which can be a precursor to colorectal cancer).[29]

2.1.2 Physical activity and colorectal cancer

People with an active lifestyle have been found to be at consistently decreased risk from colon cancer (about 30%-40% lower compared to those with a sedentary lifestyle).[11,17,31,32]

It is likely that several factors, rather than a single mechanism, are responsible for physical activity lowering the risk of colon cancer.[32] Some of the possible reasons why physical activity may protect against colon cancer include that it contributes to decreased insulin levels, lower body fat content, improved immune function, control of prostaglandin levels (a form of unsaturated fatty acids), regulation of bile acid and serum cholesterol, and decreased time for waste to pass through the bowel, each of which could inhibit the development of cancer.[11,31,32]

The benefits of physical activity in regard to colon cancer are influenced by the frequency, duration and intensity of exercise. Experts generally advise that between 3.5 to 4 hours of vigorous activity per week (the equivalent of about 45 minutes of vigorous activity on 5 days per week) is required to optimise protection against colon cancer.[11] At least an hour per day of moderate activity may also have some positive effect.[11] The type of activity could be important as well, with exercise due to both leisure and occupational activities reported to be useful in preventing colon cancer among males, while leisure-related activities appear to be more beneficial for females.[31]

Comment 2.2 – Do risk factors affect colorectal cancer sites differently?

Some risk factors for colorectal cancer appear to have different influences on the development of rectal, right and left colon cancers.[33,34] For instance, lack of physical activity appears to increase the risk of colon cancer more than rectal cancer.[35] Right colon cancers are more common among people in the older age groups, and are also more common among females[36,37] (see Comment 3.2).

Differences in molecular patterns between right and left colon cancers have been observed, which suggest they develop along different pathways.[18,38] This is probably due to the different features in these sites, including diverse blood supplies, acidity, metabolic processes, absorption mechanisms, muscular stretch abilities and neural control.[39]

2.1.3 Weight and colorectal cancer

Overweight or obese people are at higher risk of developing colon cancer.[40-42] A recent meta-analysis estimated that the relative risk of developing colon cancer was 24% higher for obese people compared to those in the normal weight range, with the risk being greater for males than females.[42] There also appears to be some evidence of a small increase in the risk of rectal cancer among obese people (about 13%),[42] although this relationship has been reported less consistently than for colon cancer.[41]

There are multiple pathways by which obesity may increase the risk of colorectal cancer. Weight generally reflects energy intake and expenditure, and the risk of developing colorectal cancer increases with total energy intake.[43] Obesity results in insulin resistance, which causes increased blood levels of insulin, glucose and fatty acids, all of which can promote colorectal cancer[44] (see Section 2.6). Obesity can result in chronic inflammation of the colonic mucosa, which increases cancer risk.[45] Certain genes associated with obesity have also been implicated in the development of colorectal cancer.[44]

2.1.4 Diet and colorectal cancer

It is difficult to quantify the exact effect that specific food items have on the risk of developing colorectal cancer. This is due to the large variety of nutrients, difficulties in accurately measuring consumption levels, and the complex interactions that occur between different foods, other lifestyle factors and genetics.[46] As a result, overall dietary patterns may be a better predictor of colorectal cancer than individual food items,[47] with a diet incorporating plenty of fruit and vegetables and restricting meat and salted, smoked or processed foods likely to decrease the risk of developing colorectal cancer.[48]

Although there is only limited evidence to date that increased consumption of fruit and vegetables reduces the risk of developing colorectal cancer,[19,45] there are multiple mechanisms via which fruit and vegetables could potentially protect against colorectal cancer.[19] Cruciferous vegetables (such as cabbages, broccoli and sprouts) contain phytochemicals which can inhibit the development of cancer.[49] The low energy density of fruit and vegetables, their high fibre content and some of the nutrients they contain, such as folate (which is thought to protect the lining of the colon from cancer), may also contribute to lowering the risk of colorectal cancer.[6,50,51] However, high doses of folate may increase the growth of already established colorectal cancers,[52] which may help to explain the lack of a consistent relationship between colorectal cancer and diets high in fruit and vegetables.

In contrast to the possible protective effect of fruit and vegetables, the prolonged consumption of red or processed meat is associated with an increased risk of developing colorectal cancer.[19,53-56] In particular, high consumption of red meat leads to a large increase in the risk of rectal cancer (by around 50%-70%).[53,55] There are several plausible mechanisms by which this may occur. For example, red and processed meats may contribute to the generation of potentially carcinogenic nitrous compounds in the colon.[19,57] Furthermore, when meat is cooked at high temperatures (such as barbecuing), compounds which cause cells to mutate and potentially become cancerous can be formed.[19,50]

2.1.5 Diabetes and colorectal cancer

Several large studies conducted during the last decade have reported a link between type 2 diabetes and colorectal cancer.[58-60] After adjusting for common factors between the two diseases, such as physical activity and obesity, type 2 diabetics have around a 30%-40% higher chance of developing colorectal cancer compared to people who don't have diabetes.[58] This result has generally been found to be fairly consistent for both sexes and by site (i.e. colon or rectum).[58] However, no association is evident between colorectal cancer and either type 1 diabetes or gestational diabetes.[59]

The increased risk of colorectal cancer among type 2 diabetics is mainly thought to be due to high levels of glucose (hyperglycaemia) and/or insulin (hyperinsulinaemia) in the blood, which could potentially aid the development of cancer.[61,62] Although the long-term treatment of diabetes with insulin is crucial to maintain wellness and quality of life,[59] there is some evidence that prolonged usage of insulin may also lead to an increased risk of colorectal cancer.[63]

2.1.6 Alcohol and colorectal cancer

There is growing evidence to suggest that excessive levels of alcohol consumption may lead to an increase in the risk of developing colorectal cancer.[19,64-67] For example, a recent meta-analysis found a 15% increase in the risk of both colon and rectum cancer for every 100g of pure alcohol (the equivalent of about 10 standard drinks) consumed per week.[64] A large study in Europe reported that people who drank more than 60g of alcohol per day (6 or more standard drinks) doubled their risk of developing colorectal cancer, compared to those with the lowest alcohol consumption (0.1-4.9g of alcohol per day).[65] There is some evidence that the association with colorectal cancer is greater for beer compared to other types of alcoholic drinks, and that alcohol-related cancer is more likely to affect the left colon and rectum rather than the right colon.[65,66]

The development of colorectal cancer as a result of alcohol consumption is likely to be triggered by one or more complex biological reactions, such as adverse changes in folate metabolism.[67,68] In particular, numerous studies have found that people (especially men) who have excessive alcohol intake combined with a diet that is low in folate have a 2- to 5-fold increase in their colorectal cancer risk.[67]

2.1.7 Smoking and colorectal cancer

Numerous studies around the world have examined the relationship between smoking and colorectal cancer.[69-74] Although some of the results have varied,[70,74] many contemporary studies with a sufficient follow-up period (35-40 years) have reported a significant association between colorectal cancer and smoking, with long-term, heavy smokers the most at risk.[69,71-73]

The importance of smoking as a risk factor for colorectal cancer is highlighted by estimates that between 10%-20% of colorectal cancer cases may be attributable to smoking,[69] and evidence has recently emerged that smokers are more likely to develop colorectal cancer at a younger age than non-smokers.[75,76]

Comment 2.3 – How can I limit my risk of developing colorectal cancer?

Although healthy lifestyle changes cannot guarantee that an individual won't develop colorectal cancer, a person's risk may be substantially reduced by following these guidelines:[6,19,77,78]

- Engage in moderate to vigorous physical activity for 30-60 minutes each day;
- Maintain your weight in the healthy body weight range;
- Limit alcohol consumption (especially relevant for women);
- Avoid tobacco smoking;
- Reduce dietary fat and limit consumption of red and processed meats; and,
- Eat a diet high in fibre, including fruit, vegetables and cereals.

2.2 Prevalence of selected risk factors for colorectal cancer in Queensland

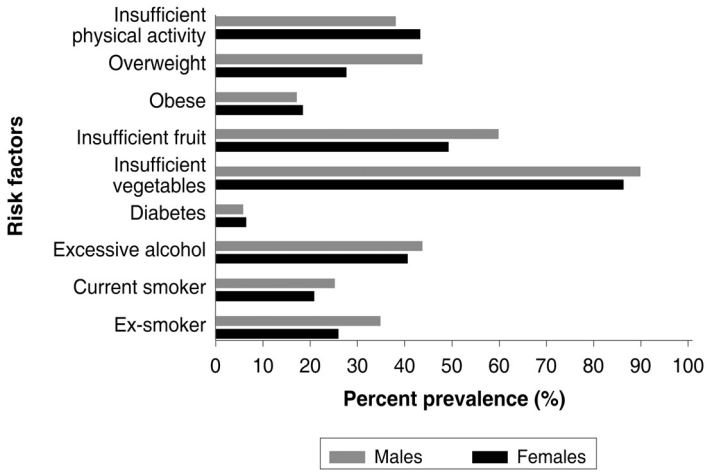
According to self-reported data from the Queensland Cancer Risk Study (see Appendix B), a greater proportion of males than females in Queensland engage in adverse health behaviours that may promote the development of colorectal cancer, with the exception of insufficient physical activity in which 38% of males did not perform a sufficient amount of physical activity compared to 43% of females (Figure 2.1). A large proportion of Queenslanders do not consume the recommended amounts of fruit (60% males, 49% females) or vegetables (90% males, 86% females).

The prevalence of risk factors for colorectal cancer also differs by age. Generally, younger people were more active, and less likely to have a high body mass or diabetes, than older people. However, they were also more likely to currently smoke, less likely to consume a healthy diet (i.e. younger people were less likely to eat an adequate amount of fruit and vegetables and ate more processed meats) and were more likely to consume excessive amounts of alcohol. In the 20-39 year age group, 52% of males and 46% of females drank too much alcohol. This reduced to 28% and 25% of males and females respectively, for those aged 60-75 years.[5]

Obesity in females rose from 15% of those aged 20-39 years to 21% of those aged 60-75 years. Similarly, obesity among males increased from 14% in the 20-39 age group to 19% among those aged 60-75 years. The proportion of self-reported diabetics in Queensland increased with age, with a greater proportion of elderly males having diabetes (14% compared to 11% of females aged 60-75 years). A greater proportion of males smoked across all age groups compared to females.

Within the 20-39 year age group, 34% of males and 27% of females were current smokers, while males and females aged 60-75 years had a smoking prevalence of 11% and 9%, respectively.[5]

Figure 2.1: Prevalence of selected potential risk factors for colorectal cancer by sex, Queensland, 2004



Data source: Queensland Cancer Risk Study.

Notes: For details about the definitions used for the above risk factors, see Appendix B.

Comment 2.4 – Does a diagnosis of colorectal cancer affect health risk behaviours?

The health behaviours of cancer survivors can influence the likelihood of the cancer recurring, the development of another cancer and/or the risk of other comorbid diseases such as heart disease and diabetes.[79]

A recent study of colorectal cancer survivors conducted by the Cancer Council Queensland found that a year after diagnosis they were less likely to be a current smoker, but more likely to be a high risk drinker or physically inactive compared to a matched sample of people from the general population.[80] Physical activity has been independently associated with improved quality of life among colorectal cancer patients,[81] and excess alcohol consumption may promote the development of colorectal and other cancers (see Section 2.7). Thus, these findings highlight how health behaviours change following a diagnosis of cancer, and the potential benefit of targeted health interventions for colorectal cancer survivors in particular.[80]

3 Incidence

The incidence of a disease measures how many people within a specified population are diagnosed with that disease in a given time period (typically the number of new cases per year), while the incidence rate expresses the same data in terms of a set population size (i.e. number of new cases per 100,000 population per year).

Incidence is an important measure for all types of cancer because it gives an indication as to how many people require intensive treatment and other short-term services immediately after diagnosis. Trends in the incidence rate are also a good way to monitor the effectiveness of current strategies to prevent colorectal cancer.

Comment 3.1 – Symptoms and diagnosis of colorectal cancer

The diagnosis of colorectal cancer is not straightforward,[82] as the disease is often accompanied by a range of non-specific symptoms.[83,84] Two of the more common (and most predictive) symptoms are the presence of blood in or on the stool and/or a change in bowel habits for an extended period of time.[23,83,85,86] Other more general symptoms may include abdominal pain, weight loss, vomiting, fatigue, and bloating.[23,85]

In most cases, colorectal cancer has already developed by the time these symptoms emerge.[23,87] This is borne out by research in Queensland, which has found that 90% of colorectal cancer patients experienced symptoms prior to diagnosis, compared to only 2% who were diagnosed solely via screening[85] (see Comment 3.4).

One of the keys to reducing the time that it takes to diagnose colorectal cancer is to improve awareness among patients of the significance of their symptoms.[84] Patients with rectal cancer tend to wait for longer after discovering their symptoms before they see a doctor compared to those with colon cancer, and changes in bowel habit also result in a longer delay period compared to other symptoms.[83-85] Conversely, the presence of more severe symptoms, such as abdominal pain, generally reduces the time to diagnosis.[84,85]

It is also possible that delays may be caused by medical practitioners, for reasons such as misdiagnosis, inadequate examination and uncertainty about referral guidelines.[84]

3.1 How many people are diagnosed with colorectal cancer in Queensland each year?

In 2005 there were 2601 colorectal cancers diagnosed among Queensland residents. More than half of these new colorectal cancer diagnoses were for males (1430 cases or 55%), with 1171 cases (45%) diagnosed among females. The corresponding age-standardised rates were 77 cases of colorectal cancer per 100,000 males and 56 cases per 100,000 females. As at 2005, males in Queensland were estimated to have a 1 in 18 chance of being diagnosed with colorectal cancer before the age of 75, while the equivalent risk for females was 1 in 26.[4]

Between 2001 and 2005, colorectal cancer was the third most common cancer diagnosed among males in Queensland (Figure 3.1), behind prostate cancer and melanoma, with an average of 1356 colorectal cancers diagnosed each year. This represented 13% of all new cancer diagnoses among Queensland males during that time period.

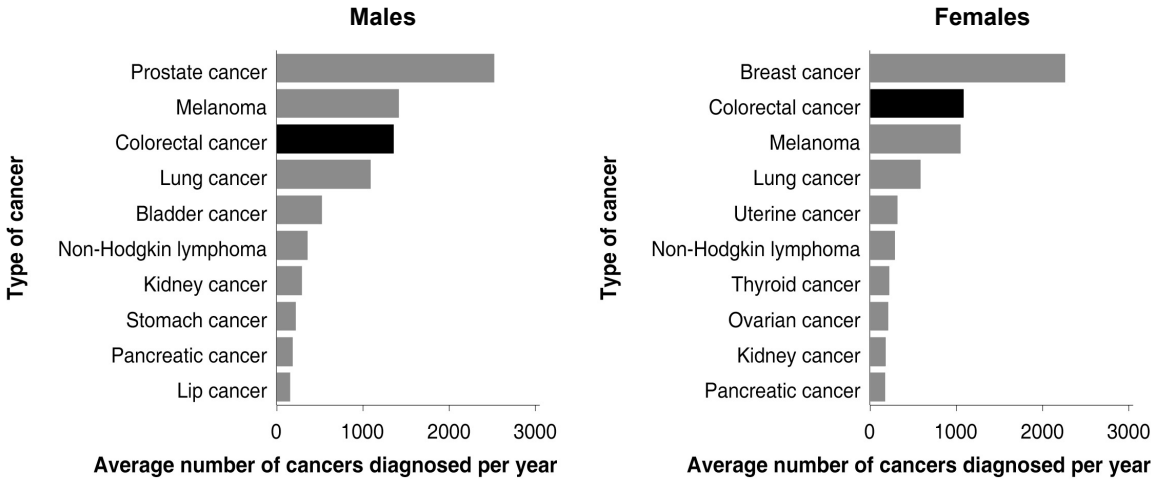
Colorectal cancer was the second most common cancer diagnosed among females, behind only breast cancer. There were an average of 1081 colorectal cancers diagnosed each year among females living in Queensland. Similarly to males, this represents 13% of all cancers diagnosed among females between 2001 and 2005.

Comment 3.2 – Why is colorectal cancer more common among males than females?

Males are generally more likely to develop both colorectal polyps and tumours than females.[88,89] However, this may not be true for each site – some studies have found that cancers of the right colon are more likely to occur among females, particularly in the older age groups.[88,89]

One possible reason why women have a lower risk of developing colorectal cancer may be that oestrogen has a protective effect against the development of polyps. Hormonal effects could also explain why older women are more prone to right colon cancers.[88] In addition, there is evidence that potential risk factors, such as insufficient exercise, poor diet and higher levels of alcohol consumption may affect males more than females.[89,90]

Figure 3.1: Average number of diagnoses per year for the most common types of cancer by sex, Queensland, 2001-2005



Data source: Queensland Cancer Registry.

3.2 What is the incidence of colorectal cancers diagnosed in Queensland by site?

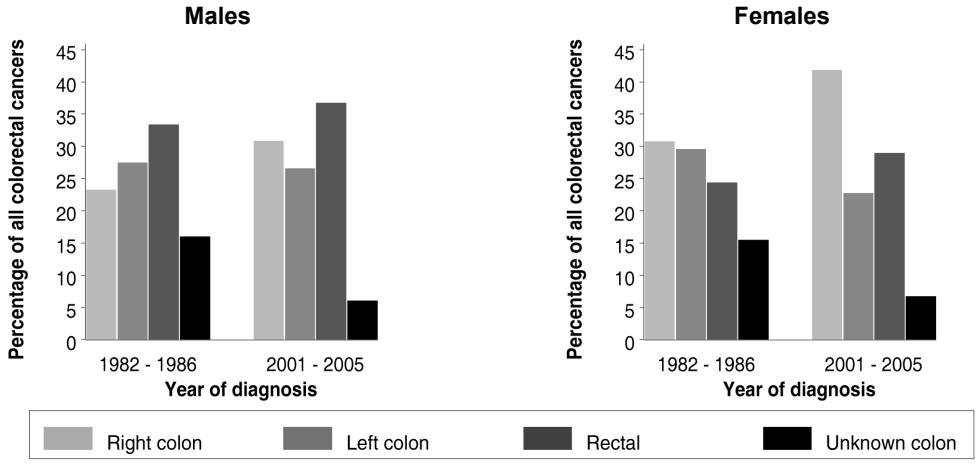
Rectal cancer (37%) was the most common type of colorectal cancer diagnosed among males in Queensland between 2001-2005. Males also experienced slightly more right than left colon cancers (31% and 27%, respectively). Among females there were almost twice as many diagnosed with right than left colon cancers (42% compared to 23% of all colorectal cancers diagnosed, respectively), while rectal cancer accounted for a further 29%.

The variation in the distribution of colorectal cancer site between males and females might be due to lifestyle differences, especially diet, and/or factors directly related to gender differences, such as hormonal influences.[16]

The proportion of colorectal cancers that were right colon cancers rose from 23% among males and 31% among females in Queensland between 1982-1986 to 31% and 42% respectively by 2001-2005 (Figure 3.2). Left colon cancers remained relatively stable among males (around 27% of all colorectal cancers) compared to a considerable decrease among females over this time period (29% in 1982-1986 compared to 23% in 2001-2005), while the proportion of rectal cancers increased among both males (from 33% to 37%) and females (from 24% to 29%).

It should be noted that interpretation of trends in the distribution of colorectal cancers by site is made difficult by the large decrease in the proportion of "unknown colon" cancers (that is, cancers of the colon for which the exact site has not been specified). The proportion of colorectal cancers in the "unknown colon" category more than halved between 1982-1986 and 2001-2005, from 16% to 6% among males and from 15% to 7% among females. This has possibly been due to advances in diagnostic capability through the use of better imaging techniques (e.g. colonoscopy) combined with improvements in data quality and coding practice over time. For example, improvements in diagnostic capability may have reduced the proportion of colorectal cancers that have metastasised prior to diagnosis, making identification of the exact site easier.

Figure 3.2: Change in distribution of colorectal cancer incidence by site and sex, Queensland, 1982-1986 and 2001-2005



Data source: Queensland Cancer Registry.

Note: Data are based on age-standardised incidence rates, and are expressed as the percentage of the total colorectal cancer incidence rate for each time period by males and females separately.

Comment 3.3 – Why has the distribution of colorectal cancer site changed over time?

The shift towards a higher proportion of colorectal cancers occurring in the right colon has also been reported in North America, Europe and Japan.[16,91,92] However, there are no clear explanations for this change in the distribution of colorectal cancers by anatomical site.[16]

One possible reason is improved diagnostic accuracy for cancers in the right colon over the last couple of decades[16] (which could also be related to the decline in the proportion of unknown colon cancers). Another possibility is that there has been a decrease in the incidence of left colon cancers as a result of improved detection of pre-cancerous polyps in the distal colon, resulting from the more widespread use of sigmoidoscopy (see Comment 3.5).[91,93] The ageing of the population is also likely to have played a role, due to the predominance of right colon cancers among older colorectal cancer patients.[91,92]

3.3 At what age are people diagnosed with colorectal cancer?

3.3.1 Most common types of cancer diagnosed by age group

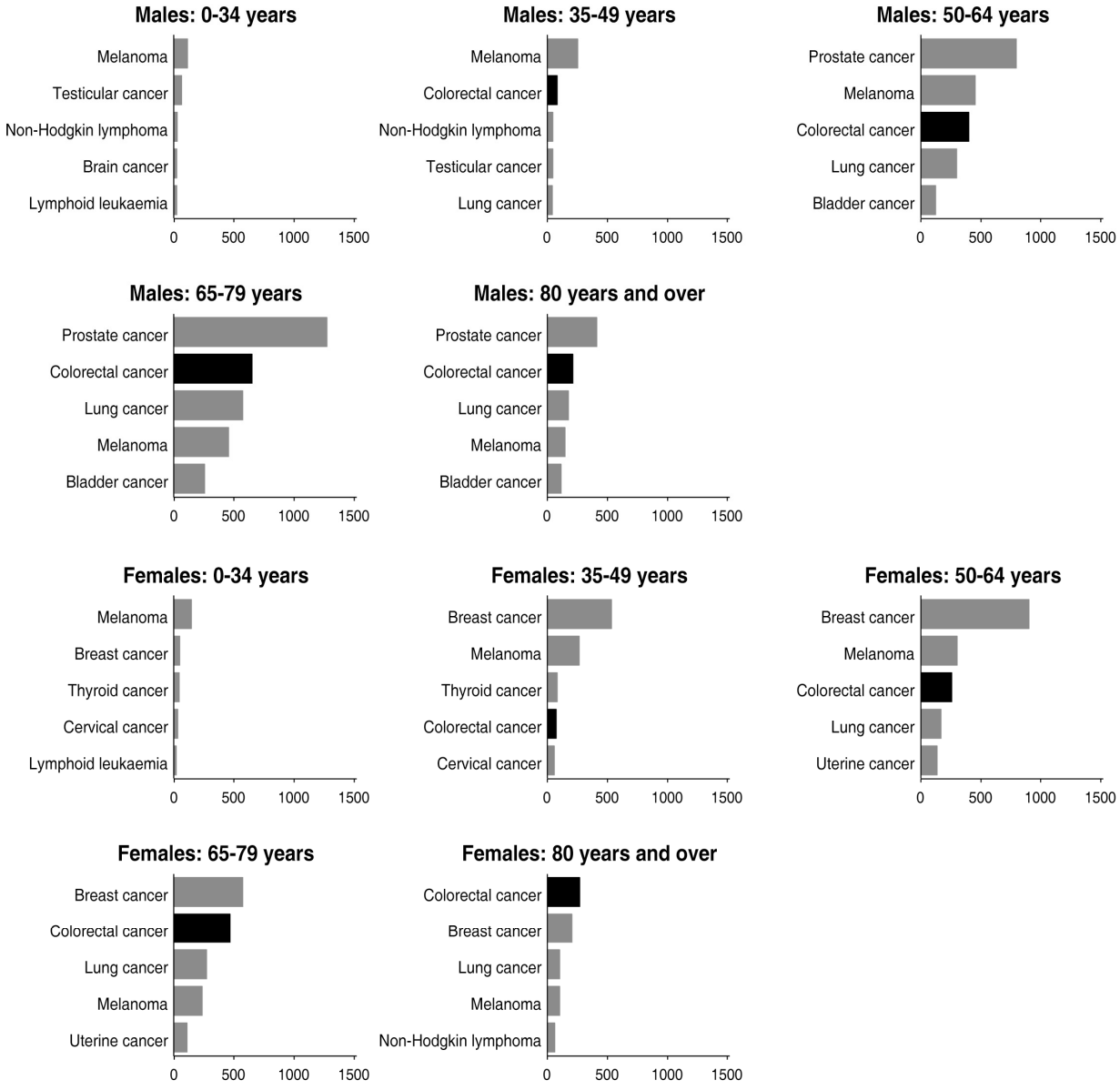
Colorectal cancer is uncommon among people younger than 35 years of age; only 3% of all cancers diagnosed in this age group in Queensland during 2001-2005 were colorectal cancers. The proportion of colorectal cancers generally increased with age: 7% of all cancers among

people aged 35-49 were colorectal cancers, 12% among people aged 50-64, and 16% among people aged 65 years and over.

Among males, colorectal cancer was the second most common cancer between the ages of 35-49 and those aged 65 years and over, and the third most common cancer within the 50-64 age group. Colorectal cancer increased in prominence for females as age increased, being the fourth most common cancer for females aged 35-49 years, the third most common cancer for those in the 50-64 age group, the second most common cancer for females aged 65-79 and the leading cancer in the 80 years and over age group (Figure 3.3).

Figure 3.3: Average number of diagnoses per year for the most common types of cancer by sex and age group, Queensland, 2001-2005

Note: For each of the following graphs, y-axis represents "Type of cancer" and x-axis represents "Average number of cancers diagnosed per year".



Data source: Queensland Cancer Registry.

Comment 3.4 – Population screening and the prevention of colorectal cancer

Population screening involves the organised, large-scale testing of the population for a specific disease. Screening allows for early detection of the disease before an individual starts displaying symptoms, and can thus significantly reduce both the incidence and mortality.[6,10,94] Randomised controlled trials have shown that participation in population screening within the target age group (typically people aged 50-69 years) decreases the incidence of colorectal cancer by around 20%[95] and mortality by about 25%.[96]

There are three main screening tools currently used for colorectal cancer:[6,10,14,94,97]

- *Faecal occult blood testing (FOBT)* – This test uses a chemical reaction to detect blood in or on the stool. Participants are provided with a testing kit to use at home. A faeces sample is smeared onto special paper and then returned to a medical laboratory for analysis. The FOBT does not diagnose bowel cancer, but the results will indicate whether further investigation is needed. If the test is positive, a colonoscopy is usually required to determine the cause of the bleeding. The National Bowel Cancer Screening Program in Australia is based on FOBT (see Comment 3.7).
- *Sigmoidoscopy* – Sigmoidoscopes are hollow, lighted tubes which are inserted through the anus. They can be rigid or flexible. A rigid sigmoidoscope is usually 25-30cm long and can be used by a medical practitioner to look for abnormalities in the rectum, while a flexible sigmoidoscope is longer (typically 60-75cm long) and more slender with a video camera attached to the end, allowing the rectum and left colon to be examined up to the splenic flexure. A mild laxative or enema is used prior to sigmoidoscopy to empty out the lower colon but sedation is not necessary. If a polyp or colorectal cancer is found during the procedure, a colonoscopy may be required to check the rest of the colon.
- *Colonoscopy* – A colonoscope is similar in design to a flexible sigmoidoscope, except that it is longer (1.2-1.6m). It is inserted through the anus and allows a doctor to view the lining of the rectum and the entire colon via a video camera on the tip of the colonoscope. A special diet to clean out the colon is necessary prior to a colonoscopy and the patient is sedated. If any abnormal tissue is found, a biopsy can be taken to determine whether the tissue is cancerous or benign. Colonoscopy is the most thorough screening test, but is also more invasive and expensive than either FOBT or sigmoidoscopy.[78]

Comment 3.5 – Barriers to screening for colorectal cancer

Despite the demonstrated advantages of colorectal screening, there are several barriers to widespread participation among the eligible population, including aversion to the preparation and/or screening process, lack of perceived benefit, fear of being diagnosed with cancer, cultural beliefs and attitudes, costs and accessibility.[6,98-100] Differences in attitudes towards colorectal cancer screening by sex may also help to explain why screening rates are generally higher among males, particularly for colonoscopy.[101-103]

In addition, whether a person is likely to be screened for colorectal cancer is often influenced by their perceived susceptibility to colorectal cancer. Some of the key elements shown to increase a person's perceived risk include a family history of colorectal cancer, personal history of bowel symptoms, knowing they have colorectal polyps or other types of cancer, poorer general health, and knowledge of colorectal cancer screening guidelines.[104,105]

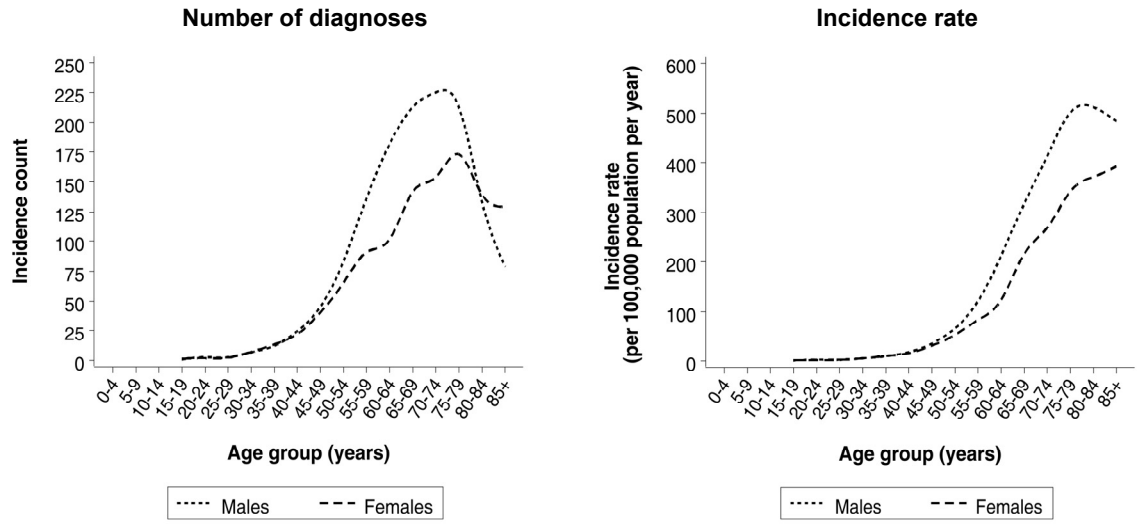
Importantly, a person's perceived risk is not always consistent with their true risk.[106] For example older people generally have a lower perception of colorectal cancer risk than younger people, despite the fact that the incidence of colorectal cancer increases with age.[104,105]

3.3.2 Age-specific incidence rates

The risk of being diagnosed with colorectal cancer is closely associated with increasing age,[8] although researchers have found that younger people tend to be diagnosed with more advanced disease.[107] Over 90% of all colorectal cancers (93% in males and 92% in females) diagnosed in Queensland were among people aged 50 years or older. Similar results have been reported in the United States, where 92% of colorectal cancers occurred in people aged 50 years or older.[107]

Colorectal cancer incidence counts and rates were similar for males and females under the age of 50, but among people over 50 years of age, males generally had higher age-specific counts and rates than females (Figure 3.4). The number of colorectal cancers diagnosed was highest in the 70-74 age group for males (average of 225 diagnoses per year) and for females aged 75-79 (average of 173 diagnoses per year). Incidence rates peaked in the 80-84 age group for males at 512 diagnoses per 100,000 males per year, and in the 85 and over age group for females at 391 diagnoses per 100,000 females per year.

Figure 3.4: Average age-specific incidence of colorectal cancer by sex, Queensland, 2001-2005



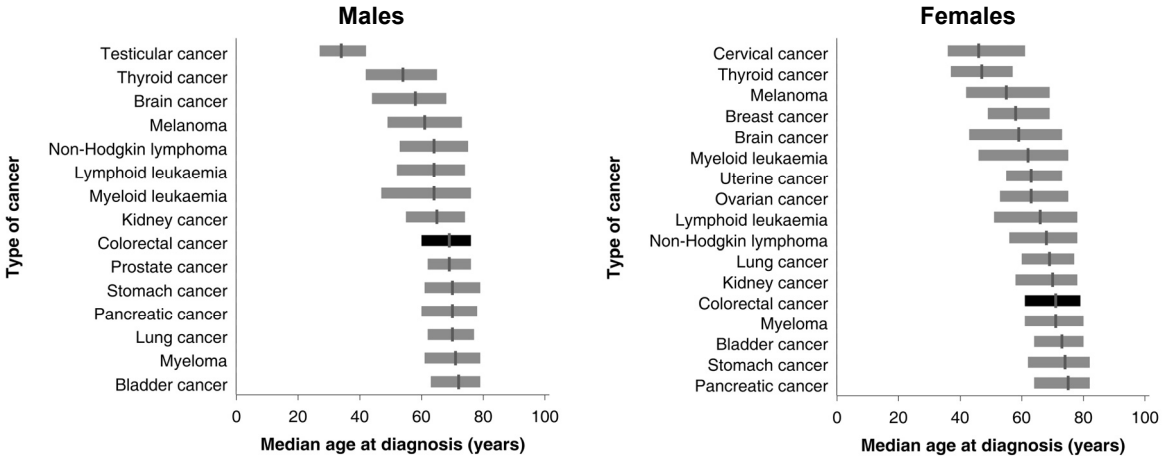
Data source: Queensland Cancer Registry.

3.3.3 Median age at diagnosis

Median age at diagnosis is the middle value - that is 50% of patients are diagnosed at an older age and 50% are diagnosed at a younger age compared to the median.

The median age at diagnosis for colorectal cancer in Queensland was 69 years for males and 71 years for females. This is considerably older than the median age at diagnosis for all cancers combined among females (64 years) and slightly older than the overall median age among males (67 years). Of the main types of cancer, testicular cancer (males), cervical cancer (females) and thyroid cancer all had a much younger median age at diagnosis compared to colorectal cancer. Stomach and pancreatic cancers among females and bladder cancer for both sexes had the highest median ages at diagnosis (Figure 3.5).

Figure 3.5: Median age at diagnosis for selected cancers by sex, Queensland, 2001-2005



Data source: Queensland Health and Queensland Cancer Registry.

Note: Vertical bar shows median age at diagnosis, with the corresponding interquartile range indicated by the shaded area.

Over the last twenty years the median age at diagnosis for colorectal cancer has increased by 3 years for both sexes, with males increasing from 66 years in 1982-1986 to 69 years in 2001-2005, and females increasing from 68 years to 71 years.

The median age for people diagnosed with rectal cancer (66 years for males, 68 years for females) was younger than for those diagnosed with left colon cancer (69 years for males, 70 years for females) or right colon cancer (71 years for males and 73 years for females).

3.3.4 Diagnoses by colorectal cancer site and age group

Rectal cancer was the most common site for colorectal cancer among both sexes in the younger age groups (46% for males and 40% for females aged 35-49 years). However, as age increased, right colon cancers became more prominent, accounting for 37% of all colorectal cancers diagnosed among males and 48% among females aged 80 years and over.

Similar results have been reported in the USA, where rectal cancers were relatively more common among people aged under 50 compared to those aged 50 and over (37% and 26% respectively), while a higher proportion of right colon cancers were diagnosed among older people (32% for those aged under 50 compared to 43% for those in the 50 and over age bracket).[107]

3.4 Are incidence rates for colorectal cancer different elsewhere?

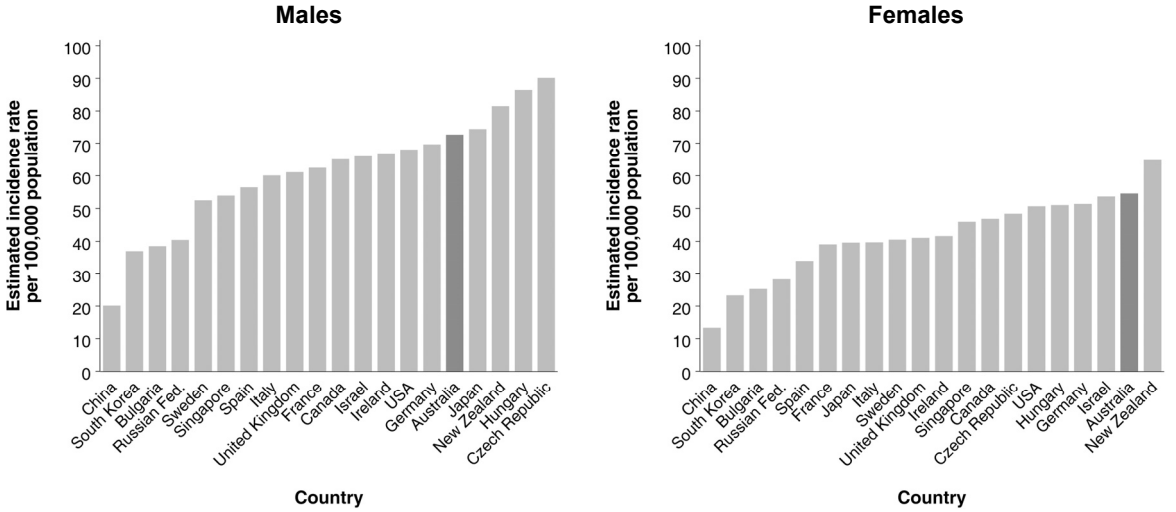
3.4.1 International comparisons for incidence

It was estimated that 1.02 million people were diagnosed with colorectal cancer worldwide during 2002.[108,109] This represented around 9% of all invasive cancers diagnosed throughout the world that year,[108,109] and was an increase of around 240,000 compared to the estimated number of colorectal cancers that occurred globally in 1990.[110] Colorectal cancer was more common among males (550,500 cases or 54%) than females, (472,700 cases or 46%).[108,109]

Colorectal cancer was the fourth most common cancer diagnosed among males worldwide, behind lung cancer, prostate cancer (more common in developed countries) and stomach cancer (particularly in developing countries). Among females, colorectal cancer was the third most frequently diagnosed cancer, behind breast cancer and cervical cancer (mostly in developing countries).[108]

There is a large amount of variation in the worldwide incidence of colorectal cancer, with more developed countries generally having far higher incidence rates compared to less developed countries[108,109] (see Comment 3.6). Australia had among the highest estimated colorectal cancer incidence rates for both males and females compared to other countries (Figure 3.6). By broad regions, the highest incidence rates for both sexes were in Australia/New Zealand, North America and Western Europe.[108,111] In contrast, colorectal cancer incidence rates were lowest throughout Africa and south-central Asia.[108,111]

Figure 3.6: Estimated age-standardised rate* of colorectal cancer incidence by sex for selected countries, 2002



Data source: GLOBOCAN 2002, International Agency for Research on Cancer (IARC).[111]

Notes: *Rates age-standardised to the Australian standard population (2001) using broad age groups.

Comment 3.6 – Why are there large differences in the incidence of colorectal cancer between more developed and less developed countries?

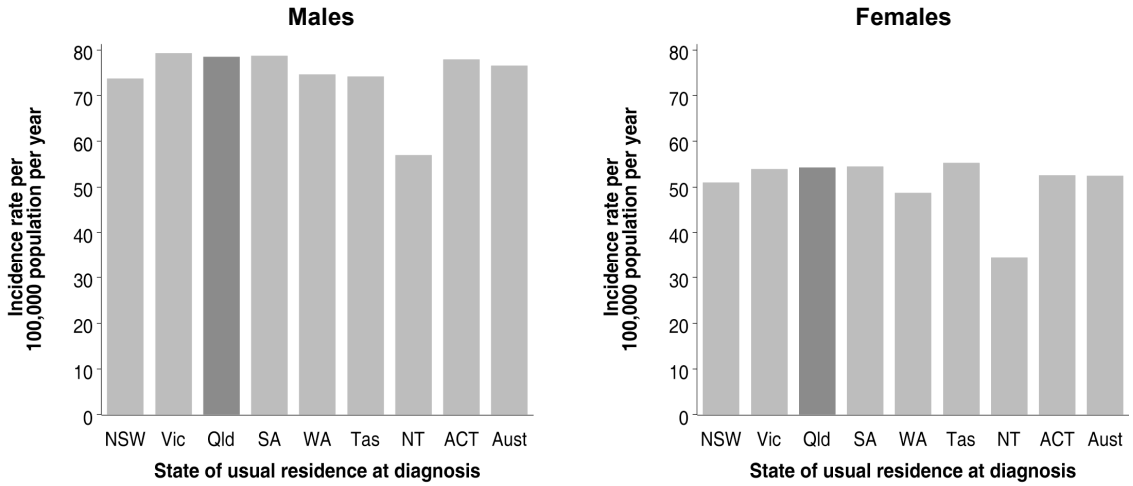
Differences in the incidence rates of colorectal cancer throughout the world, particularly the division between more developed and less developed countries, are strongly suggestive of the influence of dietary and other lifestyle factors on the development of colorectal cancer.[112] This is further evidenced by studies which have shown that the rates of colorectal cancer among migrants (and their descendents) who move from countries where colorectal cancer is less common to countries where it is more common tend to gradually converge with colorectal cancer rates in the host country.[113,114]

There are also large disparities between countries in the proportions of colon versus rectal cancers. In countries with higher incidence rates of colorectal cancer, the ratio of colon to rectal cancer is generally around 2:1, while in countries where colorectal cancer is less common the incidence rates of colon and rectal cancer are often similar.[108] There is some evidence to suggest that diet may effect the development of cancer in the colon and rectum differently, particularly among females.[115]

3.4.2 Interstate comparisons for incidence

Colorectal cancer incidence rates in Queensland between 2000 and 2004 for both males (78 cases per 100,000 males) and females (54 cases per 100,000 females) were slightly higher than the corresponding Australian averages of 76 cases per 100,000 males and 52 cases per 100,000 females (Figure 3.7). Most Australian states had fairly similar incidence rates, except for the Northern Territory, which had much lower rates for both sexes (57 and 35 per 100,000 for males and females respectively). This is possibly due to the significantly lower incidence rates of colorectal cancer that have been reported among Indigenous people[116] (see also Comment 7.4), who comprise over 30% of the population of the Northern Territory.[117]

Figure 3.7: Age-standardised rates* of colorectal cancer incidence per year by State/Territory and sex, Australia, 2000-2004



Data source: National Cancer Statistics Clearing House, Australian Institute of Health and Welfare (AIHW).[118]
Notes: *Rates age-standardised to the Australian standard population (2001).

Comment 3.7 – Colorectal cancer screening in Australia

Population screening for colorectal cancer is endorsed by the Cancer Council Australia, which has called for "*a high quality, well resourced national bowel cancer screening program capable of reaching 70% two-yearly participation of people over 50 years of age by 2012*."[10] Initial studies in Australia about the feasibility of colorectal cancer population screening found that it would be cost effective,[119,120] with an estimated reduction of around 250 deaths per year within the 55-69 age group based on biennial FOBT screening.[121] Research indicated that FOBT would achieve better participation rates compared to other types of testing, even when consumers were given a choice of screening method.[122]

The National Bowel Cancer Screening Program was implemented in Australia in August 2006.[6,10] Free screening using FOBT was offered to people who were either 55 or 65 years of age. The second phase of the program has been extended to include anyone turning 50, 55 or 65 years old between 2008 and 2010. Preliminary results indicate a participation rate of 34%, with better involvement for females (37%) compared to males (31%) and among 65 year olds (38%) compared to 55 year olds (32%).[123]

It is recognised that an extended population screening program will lead to increased demand for colonoscopy services for participants who return a positive FOBT,[124] which could potentially result in longer waiting times.[125] Plans are in place in Queensland to address this issue, by sharing the extra load on colonoscopy services between the public and private health systems.[124]

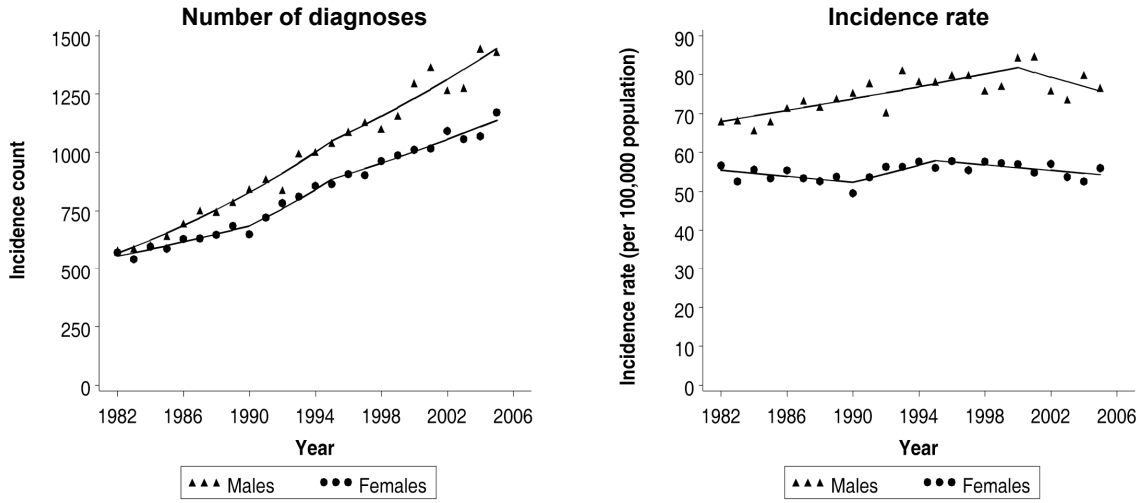
3.5 Have colorectal cancer incidence rates changed over time?

3.5.1 Incidence trends for Queensland by sex

In 1982 the number of colorectal cancers diagnosed among males and females in Queensland was very similar, with 580 and 570 diagnoses respectively (equating to age-standardised rates of 68 cases per 100,000 males and 57 cases per 100,000 females). However, the number of colorectal cancers has generally been growing faster among males compared to females since the early 1980s, with total increases of 154% and 105% respectively between 1982-2005 (Figure 3.8).

In contrast, incidence rates of colorectal cancer increased for males until 2000, but appear to have begun declining since then, while incidence rates for females have been decreasing slowly (by 0.6% per year) since 1995. Differences in the trends for counts versus rates of colorectal cancer incidence are mainly due to population growth and ageing (see Comment 3.8).

Figure 3.8: Trends in colorectal cancer incidence by sex, Queensland, 1982-2005



Linear trends (estimated average yearly percentage change, with 95% confidence intervals shown in brackets):

	Number of diagnoses	Incidence rate
Males	1982-1995 = +4.8% (+4.1%,+5.6%)	1982-2000 = +1.0% (+0.6%,+1.5%)
	1995-2005 = +3.2% (+2.4%,+4.1%)	2000-2005 = -1.5% (-3.8%,+0.8%)
Females	1982-1990 = +2.7% (+1.7%,+3.7%)	1982-1990 = -0.7% (-1.7%,+0.3%)
	1990-1995 = +5.2% (+2.7%,+7.9%)	1990-1995 = +2.1% (-0.5%,+4.7%)
	1995-2005 = +2.6% (+2.0%,+3.1%)	1995-2005 = -0.6% (-1.2%,-0.1%)

Data source: Queensland Cancer Registry.

Notes: Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, National Cancer Institute.[126]

3.5.2 Incidence trends for Queensland by age group and sex

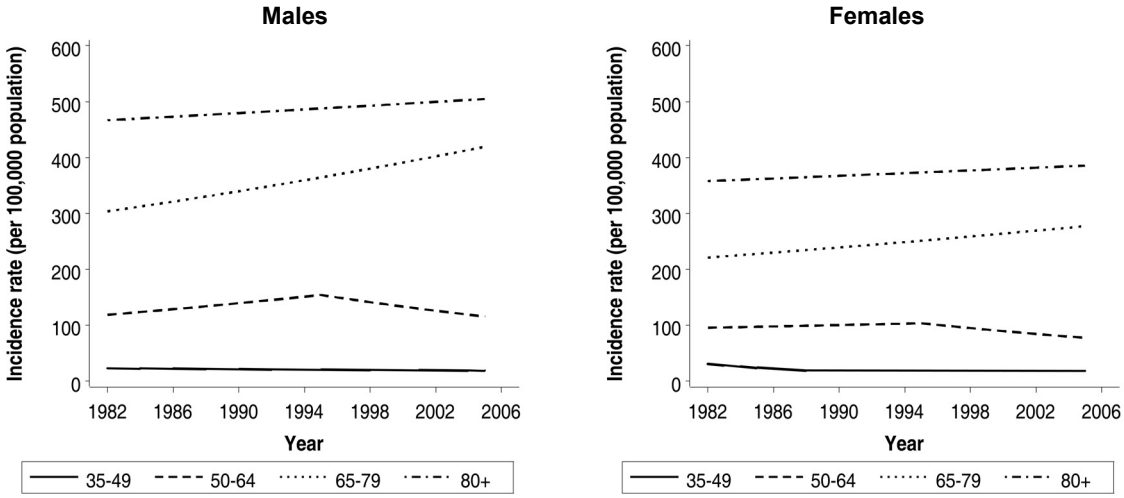
Recent trends in colorectal cancer incidence were either decreasing or stable for each age group above 35 years except those aged 65-79 years, where the trends were significantly increasing among both males and females (Figure 3.9). Among males aged 35-49 and 50-64 years, the incidence of colorectal cancer was decreasing by 0.8% and 2.9% per year respectively, although for those aged 50-64 years this trend started more recently (since 1995). In contrast, for males aged 65-79 years, the incidence rate was increasing by 1.4% per year (a total rise of 38% during 1982-2005), while rates remained relatively stable among males aged 80 years and over.

For females, there has been a decrease of 2.9% per year in the incidence rate among those aged 50-64 since 1995 (total decrease of 25%), while in the 65-79 age group rates have increased by

1.0% per year (a total of 25%) since 1982. Colorectal cancer incidence rates have remained fairly stable since at least the late 1980s among females aged either 35-49 years or 80 years and over.

Moderations in the incidence rate of colorectal cancer among the younger age groups have also been reported elsewhere in the world,[108] although rates appear to be rising among young adults (aged 20-40 years) in the United States, particularly for rectal cancer.[127]

Figure 3.9: Trends in colorectal cancer incidence by sex and age group (35 years and over)*, Queensland, 1982-2005



Linear trends (estimated average yearly percentage change, with 95% confidence intervals shown in brackets):

Males

35-49 years 1982-2005 = -0.8% (-1.6%,-0.1%)
50-64 years 1982-1995 = +2.0% (+0.8%,+3.3%)
1995-2005 = -2.9% (-4.3%,-1.4%)
65-79 years 1982-2005 = +1.4% (+1.1%,+1.8%)
80+ years 1982-2005 = +0.3% (-0.2%,+0.9%)

Females

35-49 years 1982-1988 = -7.6% (-12.7%,-2.2%)
1988-2005 = -0.3% (-1.3%,+0.8%)
50-64 years 1982-1995 = +0.6% (-0.5%,+1.8%)
1995-2005 = -2.9% (-4.3%,-1.4%)
65-79 years 1982-2005 = +1.0% (+0.7%,+1.3%)
80+ years 1982-2005 = +0.3% (-0.1%,+0.7%)

Data source: Queensland Cancer Registry.

Notes: *There were an insufficient number of cases to calculate incidence trends for persons aged 0-34 years.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, National Cancer Institute.[126]

Comment 3.8 – Why have colorectal cancer trends changed over time?

The risk of developing colorectal cancer is linked to a variety of genetic and behavioural factors (Chapter 2). Trends in the incidence of colorectal cancer are likely to be influenced by changes in the lifestyle risk factors at the population level.[128-130] For example, increases in the proportion of people who are classified as obese will probably increase colorectal cancer incidence.[128]

The widespread use of screening for colorectal cancer is also likely to impact on incidence rates in two different ways. Advances in the detection of colorectal cancer could lead to the diagnosis of tumours that may have remained undetected for some time, leading to increases in incidence rates at least in the short term. More importantly, the use of screening to detect and remove pre-cancerous polyps has the potential to substantially lower the incidence of colorectal cancer in the mid to long-term.[128-130]

Differences between trends in the counts and rates of colorectal cancer can largely be explained by population growth and ageing i.e. the number of colorectal cancer patients will continue to grow as the population expands and grows older, even if age-specific rates of colorectal cancer remain unchanged or slowly decrease.

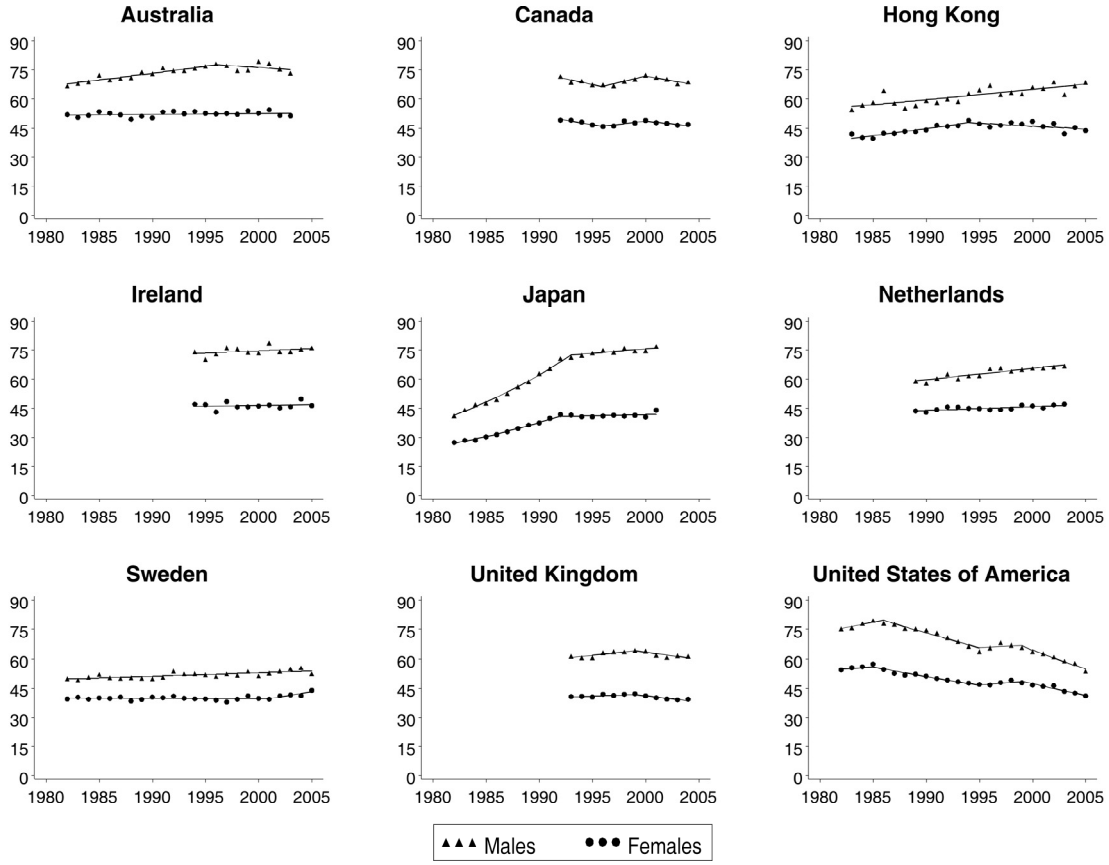
3.5.3 International incidence trends

The estimated number of colorectal cancer cases worldwide increased by 31% between 1990 and 2002 (37% increase for males and 24% increase for females).[108,110] However, after adjusting for population increases and ageing, age-standardised incidence rates of colorectal cancer increased only slightly (4%) among males during this period, and actually decreased among females by 5%.[108,110]

Trends in colorectal cancer incidence rates by sex for Australia were fairly similar to those reported for Queensland. There was an increase of 1.0% per year in colorectal cancer incidence rates among males in Australia between 1982-1996, followed by a non-significant decrease between 1996-2003, while incidence rates among females at the national level have remained stable since 1982 (Figure 3.10).

Figure 3.10: Recent national and international trends in colorectal cancer incidence by sex for selected countries/registry areas, 1982-2005*

Note: For each of the following graphs, y-axis represents "Incidence rate (per 100,000 population)" and x-axis represents "Year of diagnosis".



Data sources: Australian Institute of Health and Welfare,[131] Canadian Council of Cancer Registries,[132] Hong Kong Cancer Registry,[133] National Cancer Registry of Ireland,[134] National Cancer Center Japan,[135] Netherlands Cancer Registry,[136] National Board of Health and Welfare (Sweden),[137] Cancer Research UK,[138] National Cancer Institute (USA) SEER-9.[139]

Notes: * Data available from 1982-2005 for Sweden and USA, 1983-2005 for Hong Kong, 1982-2003 for Australia, 1982-2001 for Japan, 1992-2004 for Canada, 1993-2004 for the UK, 1994-2005 for Ireland and 1989-2003 for the Netherlands.
Hong Kong, Japan, Sweden and the UK included anal cancers in the data used.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, National Cancer Institute.[126]

There were large differences in the incidence rate trends between the other countries for which trend data are presented (Figure 3.10). In the USA and Canada, incidence rates have been dropping since the mid 1980s/early 1990s among both sexes, except for a short upturn during the mid-late 1990s.[b] Within the United Kingdom, incidence rates increased for males and were stable for females between 1993 to 1999, but have been decreasing since then. In contrast, incidence trends for Ireland, the Netherlands and Sweden were either stable or increasing slowly (by less than 1% per year) among both males and females. Stable or increasing incidence rate trends for colorectal cancer have also been reported in several other European countries,[108] including France,[141] Italy,[142] and Norway.[143]

Incidence rates are generally rising around Asia. There was a large increase in incidence rates between 1982 and the early 1990s in Japan (5.3% per year for males to 1993 and 4.3% per year for females to 1992), but since then the increase has slowed to 0.6% per year among males and rates have remained fairly stable among females. Incidence rates in Hong Kong have increased steadily among males, but have gradually declined among females since the mid-1990s. The incidence of colorectal cancer appears to be on the rise in several other Asian countries,[108] including China, South Korea and Singapore,[144,145] most likely reflecting their increasingly westernised lifestyle (particularly diet),[144-146] as well as possible interactions between lifestyle factors and the genetic characteristics of Asian populations.[144]

In 2005, the Australian Institute of Health and Welfare (AIHW) published a report on projections of cancer incidence in Australia up to 2011.[147] They have predicted that the incidence rates of colorectal cancer will remain stable for males, and continue to rise slowly for females. The actual number of new cases of colorectal cancer diagnosed among both males and females in Australia is expected to continue increasing, with a predicted rise of 33% among males and 30% among females between 2001 and 2011, mainly due to population growth within the older age groups.[147]

Comment 3.9 – Reducing the future burden of colorectal cancer

The best prospects for reducing the incidence of colorectal cancer are primary prevention (see Comment 2.2) and population screening (see Comment 3.4).[78,148] Despite evidence supporting the benefits of these activities, the widespread adoption of healthy lifestyle changes via public education takes time to achieve, and it is likely that rates of screening will remain relatively low until less invasive and more effective techniques can be developed.[78,148] It is expected that emerging methods such as virtual colonoscopy or the analysis of blood specimens for specific markers of colorectal cancer will improve the success of screening programs in the future, although further refinements are required.[149-151] Raising awareness among both medical practitioners and the general public that colorectal cancer can be prevented or detected early, along with improved screening processes, will also be crucial to ensuring that a large proportion of the at-risk population undergo regular testing.[78,100,152]

Another developing area of interest is the role of chemoprevention (i.e. the use of medications to prevent the development of colorectal cancer).[153,154] For example, studies in the United States have suggested that regularly taking non-steroidal anti-inflammatory drugs (such as aspirin) may reduce the risk of colorectal cancer by around 30%-40%.[154] However, the possible side effects of chemoprevention (including stomach ulcers, cardiovascular toxicity and stroke) mean its use is currently limited to those at highest risk, such as to prevent reoccurrence among people with a personal history of colorectal cancer.[78,153-155]

[b] The increase in colorectal cancer incidence rates in both the USA and Canada during the mid-late 1990s coincided with the mandatory addition of folic acid to uncooked cereal grains in both of these countries. It is therefore feasible that the observed rise in the incidence of colorectal cancer may have resulted from the effect of folic acid accelerating the growth of pre-existing cancerous cells.[140]

4 Survival

Survival is the length of time a person remains alive after being diagnosed with colorectal cancer. The crude survival rate is the proportion of people diagnosed with colorectal cancer who remain alive after a given length of time, such as 1 year. Relative survival divides the crude survival rate by the expected survival rate of the general population, and is usually expressed as a percentage. A relative survival estimate of 100% suggests that colorectal cancer patients have the same survival expectations as the general population (see Appendix B for more details).

Comment 4.1 – What are the main factors that influence colorectal cancer survival?

By far the most important prognostic factor for colorectal cancer is tumour stage, in particular whether the cancer has spread to the lymph nodes or beyond.[156-159] Patients with less advanced colorectal cancer have significantly improved survival.

Other patient and clinical-related factors which may be associated with better survival include:

- female gender[159-161]
- middle aged at diagnosis (50-69 years)[161-163]
- tumour not obstructing bowel[159]
- absence of comorbid diseases[162]
- lower grade of tumour (well-differentiated)[162,163]
- absence of certain molecular/genetic mutations[164,165]

In contrast, there is emerging evidence that some of the risk factors for colorectal cancer may also be detrimental to survival. Reduced physical activity,[166,167] diets containing large amounts of red meat and fat,[168] increased weight,[167,169] diabetes,[170] and smoking[171] have all been associated with reduced survival, although mainly among colon cancer patients rather than those with rectal cancer.

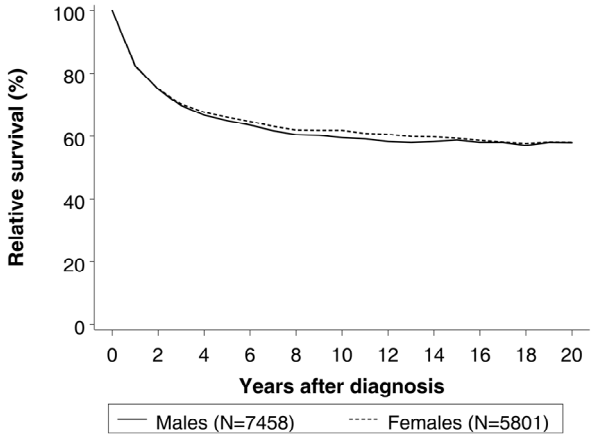
4.1 How long do people in Queensland survive after being diagnosed with colorectal cancer?

4.1.1 Survival by sex

Survival for colorectal cancer patients in Queensland who were “at risk” (see Appendix B) during the period 2000-2005 was similar for males and females (Figure 4.1). One-year relative survival was 82% for both sexes, 5-year relative survival was 65% for males and 66% for females, 10-year relative survival was slightly lower for males compared to females (60% and 62% respectively, although the difference was non-significant), and 20-year relative survival was 58% for both sexes.

As shown in Figure 4.1, most of the excess mortality experienced by colorectal cancer patients occurs in the first few years following diagnosis, after which relative survival continues to decrease slowly. This observation is consistent with results reported elsewhere. For example, a study from The Netherlands found that the ongoing prognosis for colorectal cancer patients generally improved with each year that they survived, and those who survived for around 10-15 years had little excess mortality compared to the general population.[172]

Figure 4.1: Relative survival from colorectal cancer by sex, Queensland, 2000-2005



Data source: Queensland Cancer Registry.

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 2000-2005.
"N" is the initial number of "at risk" cases by sex.

Comment 4.2 – Issues facing survivors of colorectal cancer

The quality of life for survivors of colorectal cancer may be affected by both the treatment they receive and the after-effects of the disease itself.[173] While longer term survivors of colorectal cancer generally report a relatively high quality of life compared to people in the general population of a similar age, issues such as fatigue, bowel problems (frequent bowel movements, diarrhoea or constipation), depression and sexual functioning can pose persistent problems.[173-175]

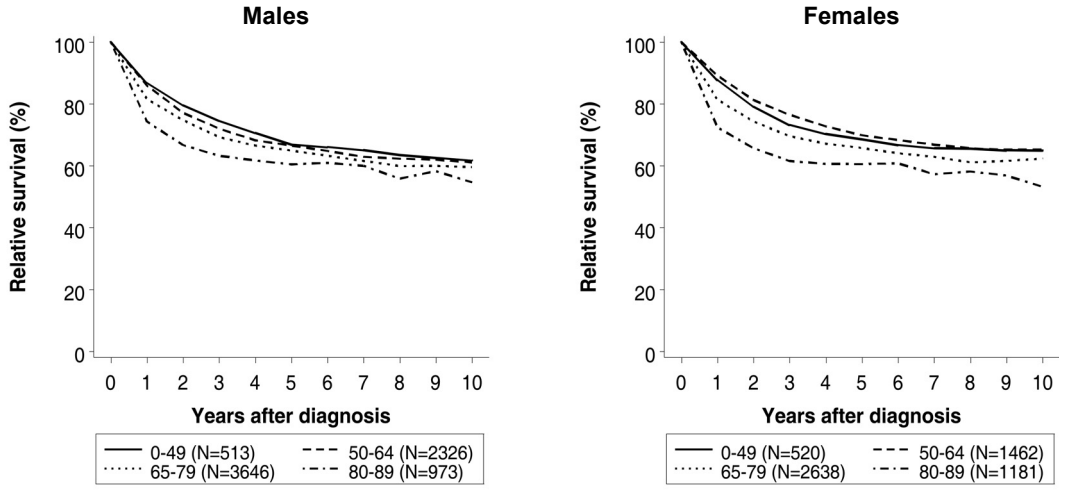
The presence of a stoma has usually been seen as an unfavourable outcome for colorectal cancer patients. However, according to a comprehensive review of the literature, it remains unclear whether a permanent colostomy significantly affects overall quality of life as reported by patients.[176] This possibly reflects a greater appreciation of being alive among survivors.[176]

Colorectal cancer patients also have an increased risk of developing subsequent primary cancers at various other sites as well as recurrence of colorectal cancer,[177,178] which can compromise both physical and mental well-being.[175]

4.1.2 Survival by age group

Survival rates from colorectal cancer tended to decrease as age at diagnosis grew older, with differences in survival by age group more evident among females (Figure 4.2). For males with colorectal cancer at risk between 2000-2005, 5-year relative survival was similar among the 0-49, 50-64 and 65-79 age groups (67%, 67% and 65% respectively), but dropped to 60% among those aged 80-89 years at diagnosis. Similarly, 5-year relative survival was 69% for females aged 0-49 and 70% for those in the 50-64 age bracket, but then decreased to 66% among females aged 65-79 years and 61% within the 80-89 age group.

Figure 4.2: Relative survival from colorectal cancer by age group and sex, Queensland, 2000-2005



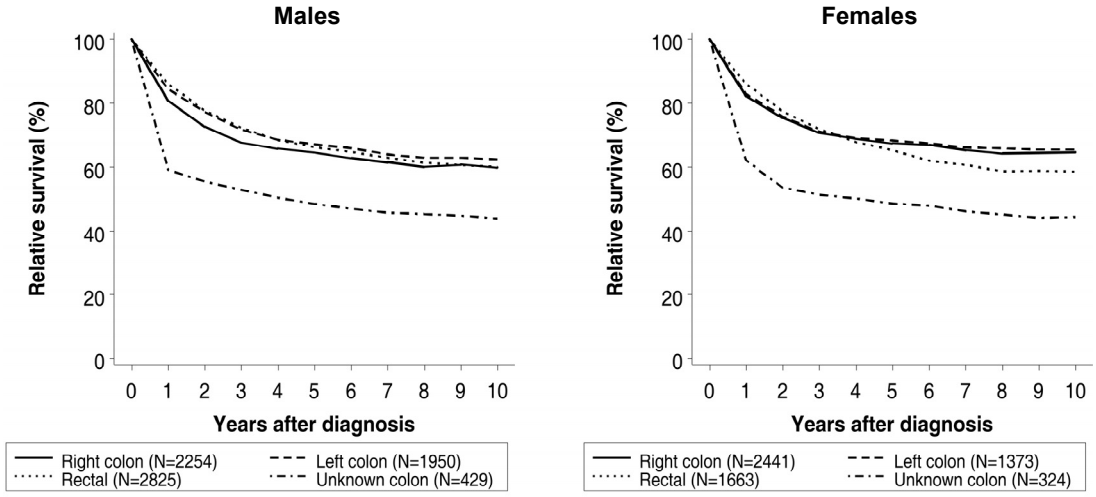
Data source: Queensland Cancer Registry.

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 2000-2005.
"N" is the initial number of "at risk" cases within each age group by sex.

4.1.3 Survival by colorectal cancer site

There were no significant differences in 5-year relative survival rates for cancers of the right colon (64%), cancers of left colon (67%) and rectal cancers (66%) among males (Figure 4.3). A similar consistency in 5-year survival rates by site was also observed among females, with survival rates of 67%, 68% and 65% for the right colon, left colon and rectum respectively. However, 10-year relative survival for rectal cancers among females was poorer than for either the right or left colon. Both males and females experienced significantly worse 5-year relative survival for unknown colon cancers (48% for both sexes) compared to the other colorectal sites. It is possible that a substantial proportion of unknown colon cancers have metastasised, resulting in poorer survival.

Figure 4.3: Relative survival from colorectal cancer by site and sex, Queensland, 2000-2005



Data source: Queensland Cancer Registry.

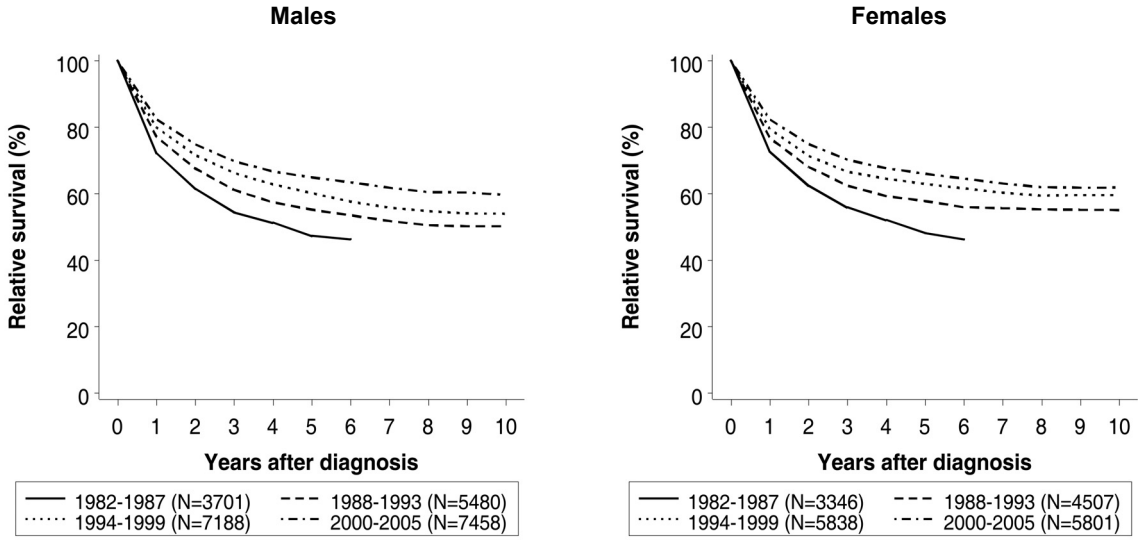
Notes: Relative survival calculated using the period method, for persons aged 0-89 years at diagnosis.
Data are for "at risk" cases in the period 2000-2005.
"N" is the initial number of "at risk" cases within each morphology group by sex.

4.1.4 Survival by 'at risk' time period

For both sexes, relative survival for colorectal cancer patients in Queensland has improved significantly for each consecutive time period since the early 1980s, with 5-year relative survival increasing from 47% for males and 48% for females during 1982-1987 to 65% for males and 66% for females for those at risk between 2000-2005 (Figure 4.4).

Survival for patients with colorectal cancer in Australia,[179] North America[180,181] and throughout Europe (particularly Eastern Europe)[182] has also shown considerable improvement over the last two or three decades (see Comment 4.3).

Figure 4.4: Relative survival from colorectal cancer by 'at risk' time period and sex, Queensland, 1982-2005



Data source: Queensland Cancer Registry.

Notes: Relative survival calculated using the period method, for persons aged 0-89 years at diagnosis.
The same person can contribute to different follow-up years after diagnosis across the various 'at risk' time periods.
"N" is the initial number of "at risk" cases within each time period by sex.

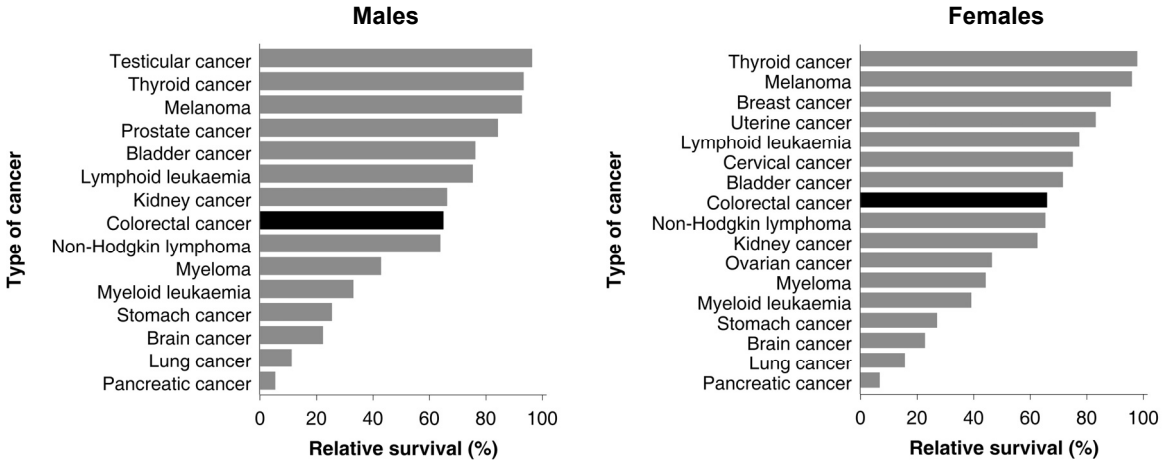
Comment 4.3 – Why has survival from colorectal cancer improved?

There have been major advances in the treatment of colorectal cancer over the last 10 to 20 years, particularly in regard to new surgical techniques, the implementation of improved chemotherapy regimes and more effective use of adjunct therapies (e.g. chemotherapy and radiotherapy).[78,183,184] The continuing development of targeted therapies based on specific patient and tumour characteristics holds the promise of further improvements in survival for people diagnosed with colorectal cancer,[78,183] including those with more advanced disease.[185]

4.2 How does survival from colorectal cancer compare with other cancers?

Five-year relative survival for people with colorectal cancer between 2000-2005 was around the average compared to people with other types of cancer (Figure 4.5). Cancers with the lowest 5-year relative survival included pancreatic cancer (5% for males, 7% for females), lung cancer (11% for males, 16% for females) and brain cancer (22% and 23% in males and females, respectively). In contrast, 5-year relative survival was high for thyroid cancer (93% for males and 98% for females), melanoma (93% for males and 96% for females), testicular cancer (96%) and female breast cancer (88%).

Figure 4.5: 5-year relative survival for selected cancers by sex, Queensland, 2000-2005



Data source: Queensland Cancer Registry and Queensland Health.

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 2000-2005.

Comment 4.4 – Does follow-up of colorectal cancer patients improve survival?

Despite advances in treatment, about 8% of colorectal cancer patients develop a new primary tumour within 4 years of diagnosis and approximately one-third of patients who undergo surgery eventually die from recurrent disease.[6] Thus, colorectal cancer patients are usually screened more frequently and have regular medical check-ups in the years following curative surgery, with the aim of detecting early recurrences or new tumours at a treatable stage.[6]

Although there is still some debate over the merit of intensive follow-up, overall survival rates are generally higher among colorectal cancer patients who have ongoing medical surveillance.[186-188] Apart from the possibility of increasing survival, comprehensive follow-up can also provide other benefits including psychological support, identification and treatment of complications and motivation for improved health behaviours.[187-189]

4.3 Is survival for colorectal cancer different elsewhere?

4.3.1 Interstate comparisons for survival

The latest available estimates for Australia relate to people who were diagnosed between 1992-1997. For cancer of the colon, 5-year relative survival was 58% among males and 59% among females, while 5-year relative survival for cancer of the rectum was 57% among males and 61% among females (Table 4.1).[179] However, given the improvement in colorectal cancer survival in Queensland over time (see Section 4.1.4), these national estimates are likely to underestimate current survival rates.

Most of the reported differences in colorectal cancer survival estimates by State/Territory were not statistically significant, although survival rates did appear to be lower among both males and females in South Australia and the Northern Territory (Table 4.1). However, direct comparison of survival rates between the States and Territories within Australia is made difficult by differing methodologies (i.e. period versus cohort method), variations in the age ranges considered, estimates being published separately for colon and rectal cancers in some States, as well as differences in the time period being considered (see Appendix B).

Table 4.1: 5-year relative survival[a] for colorectal cancer by State/Territory and sex

State/Territory	Years	Method	Ages	Cancer definition	5-year survival (%) (95% confidence interval)	
					Males	Females
Queensland	2000-2005	Period	0-89	Colorectal	64.9 (63.6-66.1)	65.9 (64.5-67.3)
New South Wales	1999-2003	Multi-year cohort	15-89	Colorectal	64.7 (63.0-65.9)	64.6 (63.1-66.1)
Victoria	2000-2004	Period	All ages	Colon	63 (60-65)	63 (60-65)
				Rectum/anus	61 (58-64)	66 (62-70)
South Australia	1977-2003	Cohort	All ages	Colon	55.4 (54.6-56.2)	55.2 (54.5-55.9)
				Rectum/anus	55.2 (54.2-56.2)	57.9 (56.9-58.9)
Western Australia	1998-2002	N.S.	15+	Colorectal	61.5 (59.1-63.8)	63.4 (60.9-66.0)
Northern Territory[b]	1991-2001	Cohort	N.S.	Colorectal	53 (45-62)	58 (47-68)
Australia – Total	**1992-1997**	**Cohort**	**0-99**	**Colon**	**58.3 (57.4-59.3)**	**58.7 (57.7-59.6)**
				Rectum/anus	**56.6 (55.5-57.8)**	**60.6 (59.2-61.9)**

Data sources:Queensland Health and Queensland Cancer Fund; Cancer Institute NSW;[190] The Cancer Council Victoria;[191] South Australian Cancer Registry;[192] Western Australian Cancer Registry;[193] Northern Territory;[194] and the Australian Institute of Health and Welfare.[195]

Notes: a. For further details on survival calculations and interpretation, see Appendix B.
b. Northern Territory data were only for the non-Indigenous population.
N.S. = not stated.
Recent data on colorectal cancer survival were not available for Tasmania or the Australian Capital Territory.

4.3.2 International comparisons for survival

Variations in colorectal cancer survival between countries may be influenced by a number of factors, including differences in the data collection and/or statistical analysis methodologies used;[196] therefore, international survival should be interpreted with these limitations in mind (see also Appendix B).

In the United States, 5-year relative survival for colorectal cancer between 1996-2003 was estimated at 65% for males and 64% for females,[197] while in Canada over the period 2001-2003 5-year relative survival was fairly similar, at 62% for males and 63% for females.[198]

Colorectal cancer survival was generally lower throughout Europe, with the average 5-year relative survival during between 2000-2002 estimated to be 56% for males and females combined.[182] Of the European countries for which survival estimates were available, colorectal cancer survival was highest in Switzerland (64%), Spain (62%), Germany and Belgium (both 61%), and lowest in the Czech Republic (45%), Poland (46%) and England (52%).[182]

5 Mortality

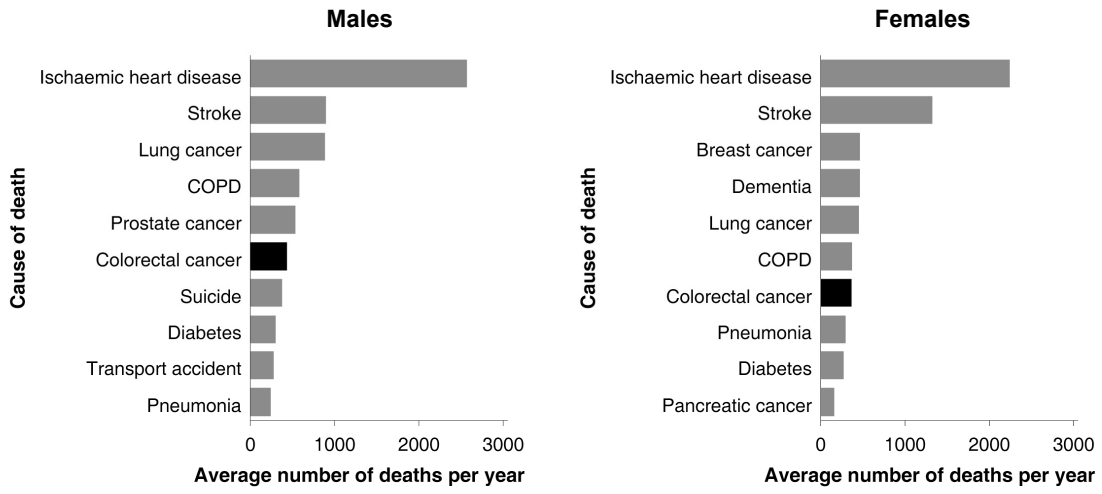
Mortality measures how many people in a population die from a specific disease over a given time period. Similarly to incidence, mortality can either be expressed as a number (i.e. the number of deaths due to colorectal cancer per year) or as a rate (i.e. the number of deaths due to colorectal cancer per 100,000 population per year).

5.1 How many people die from colorectal cancer in Queensland each year?

In 2005, 912 Queensland residents died from colorectal cancer. There were more colorectal cancer deaths among males (525 deaths or 58%) than females (387 deaths or 42%), corresponding to age-standardised mortality rates of 29 per 100,000 males and 18 per 100,000 females. Males in Queensland had a risk of 1 in 53 of dying from colorectal cancer before the age of 75, while for females the risk was 1 in 99.[4]

Between 2001 and 2005, colorectal cancer was the sixth most common individual cause of death for males and the seventh most common for females in Queensland (representing 3% of all deaths in both sexes), behind ischaemic heart disease (21% of male deaths, 20% of female deaths), stroke (7% of male deaths, 12% of female deaths), lung cancer (7% of male deaths) and breast cancer (4% of female deaths) (Figure 5.1). Colorectal cancer was most prominent as a cause of mortality among people aged 50-64 years, being the third and fourth most common cause of death for males and females in that age group respectively.

Figure 5.1: Average number of deaths per year for the most common causes of death by sex, Queensland, 2001-2005

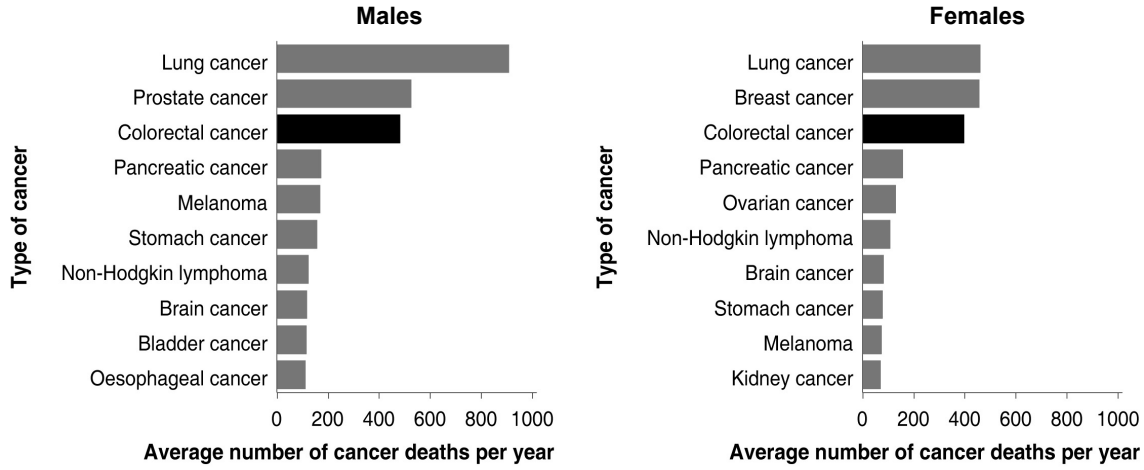


Data source: Australian Bureau of Statistics.[199]

Note: COPD = chronic obstructive pulmonary disease.
ICD-10 codes used to define each condition were based on those used by ABS[200] and AIHW.[201]

All cancers combined were responsible for 31% of male mortality and 26% of female mortality in Queensland. As shown in Figure 5.2, colorectal cancer was the third most common cause of cancer-related mortality for males (12% of all cancer deaths) and females (14% of all cancer deaths), behind lung cancer (23% of cancer deaths for males and 16% for females), prostate cancer (13% of male cancer deaths) and breast cancer (16% of female cancer deaths).

Figure 5.2: Average number of deaths per year for the most common types of cancer by sex, Queensland, 2001-2005



Data source: Queensland Cancer Registry.

Comment 5.1 – Mortality:incidence ratios for colorectal cancer

The mortality rate to incidence rate (MR:IR) ratio, also known as the case fatality ratio, is calculated by comparing the mortality rate to the incidence rate for a particular disease over a given time period. It provides a measure of the severity of a disease - the closer the MR:IR ratio value is to 1, the more likely a person is to die from that disease once they have been diagnosed.

In Queensland, the MR:IR ratio for colorectal cancer between 2001-2005 was 0.37 for males and 0.36 for females, reflecting the moderate survival rates of colorectal cancer patients (see Chapter 4). In comparison, the MR:IR ratio for melanoma in Queensland was 0.10 due to the high survival rate for melanoma patients, while the MR:IR for lung cancer was 0.82 which is indicative of the poor prognosis associated with lung cancer.

Internationally there were large variations in the MR:IR ratio for colorectal cancer, ranging from 0.35 for males and 0.34 for females in North America to 0.89 for males and 0.88 for females in Africa.[109] This disparity most likely arises from differences in access to screening and treatment for cancer between more developed and less developed countries.[202]

5.2 What is the distribution of colorectal cancer deaths in Queensland by site?

Rectal cancers caused the greatest proportion of colorectal cancer deaths among males (37%), followed by right colon cancers (30%), left colon cancers (24%) and unknown colon cancers (9%). This contrasted with the mortality distribution by site among females, where more deaths were attributed to right colon cancers (38%), followed by rectal cancers (29%), left colon cancers (22%) and unknown colon cancers (11%).

For both sexes, the MR:IR ratio (see Comment 5.1) was highest for unknown colon cancers (0.60 among males and 0.58 among females), resulting from the lower survival among patients diagnosed with unknown colon cancers in relation to the other sites of colorectal cancer (see Section 4.1.3). For comparison, the MR:IR ratios for cancers of the right colon, left colon and rectum varied between 0.32 to 0.36 among both males and females.

5.3 At what age do people die from colorectal cancer?

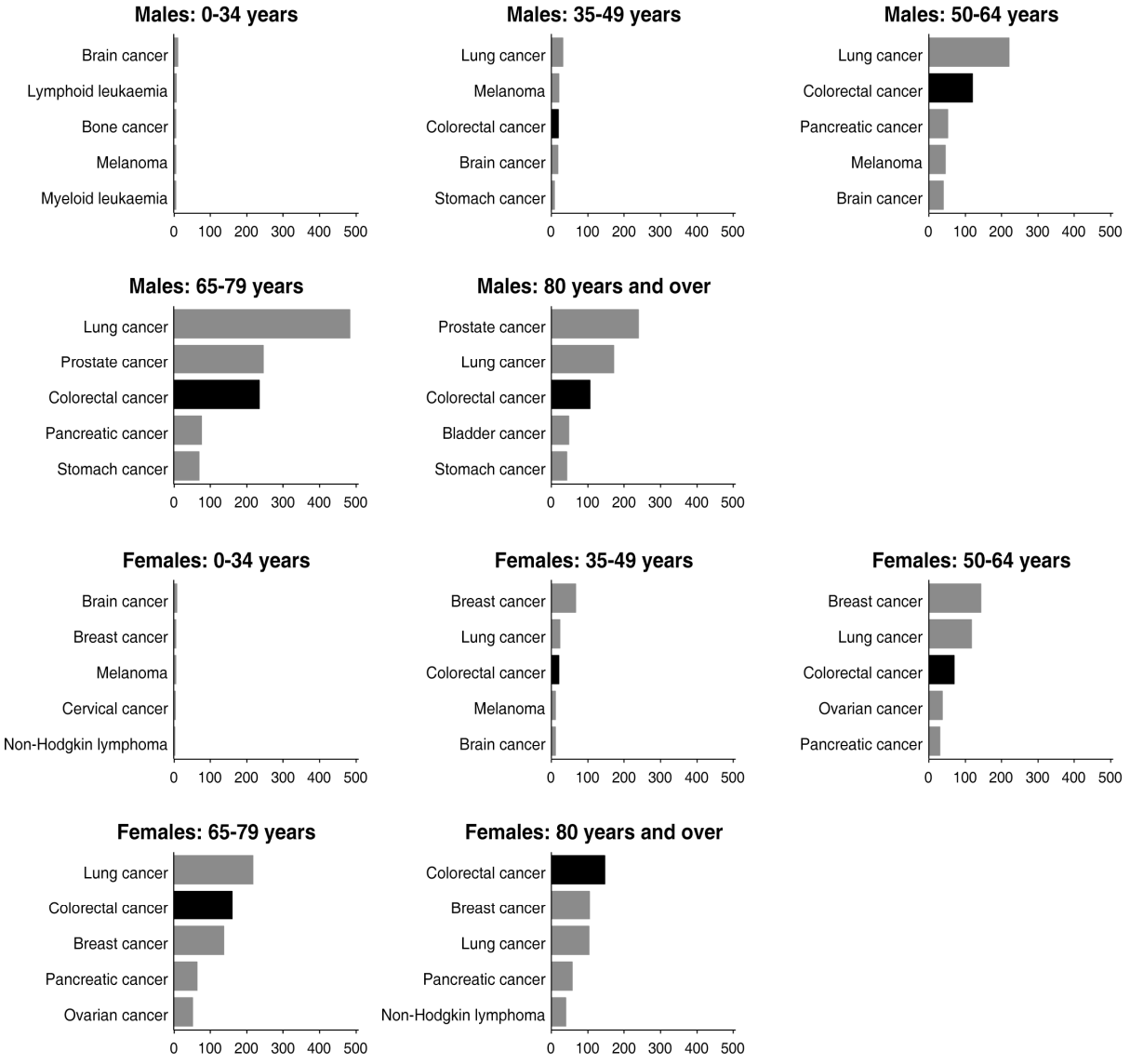
5.3.1 Most common types of cancer deaths by age group

Colorectal cancer was either the second or third most common cause of cancer-related deaths for both males and females in each age group 35 years and over, accounting for between 10%-15% of all cancer deaths in each of the age-sex cohorts (Figure 5.3). The exception was among females aged 80 years and over, where colorectal cancer (17%) was the most common cause of all cancer deaths.

Mortality due to colorectal cancer was far less prominent among persons aged younger than 35 years, causing less than 4% of all cancer-related deaths.

Figure 5.3: Average number of deaths per year for the most common types of cancer by sex and age group, Queensland, 2001-2005

Note: For each of the following graphs, y-axis represents "Type of cancer" and x-axis represents "Average number of cancer deaths per year".



Data source: Queensland Cancer Registry.

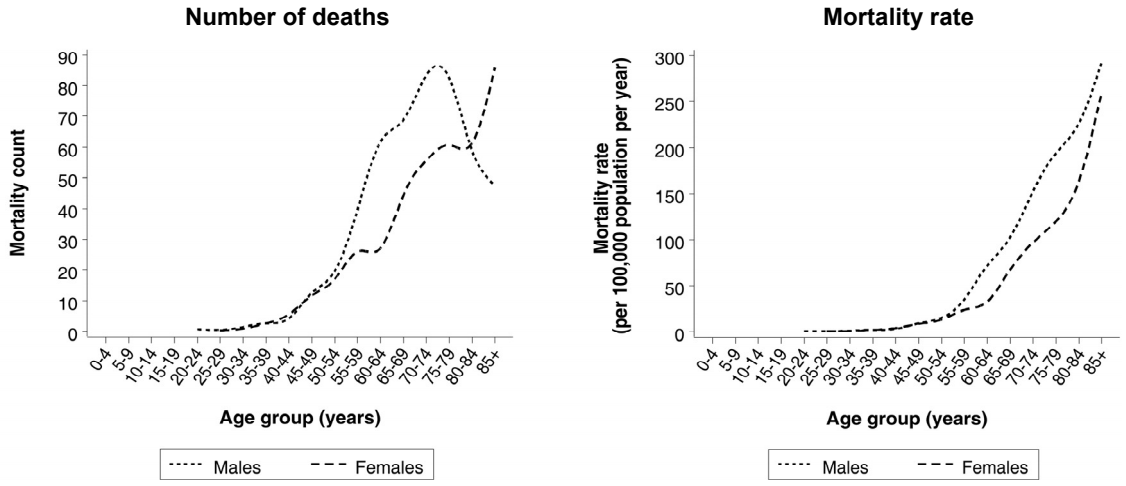
Comment 5.2 – Do people with colorectal cancer always die specifically from colorectal cancer?

A substantial proportion of people with colorectal cancer die from other causes, such as cardiovascular diseases, respiratory diseases or diabetes.[203,204] For example, a recent study by the Cancer Council Queensland found that 16% of deaths among colorectal cancer patients were due to causes other than cancer, and the risk of non-cancer mortality among people with colorectal cancer was 37% higher compared to the general population.[203] However, most of the excess mortality risk associated with non-cancer causes of death occurs during the first year after diagnosis, after which the non-cancer mortality risk for colorectal cancer patients decreases to the same level as people without cancer.[203]

5.3.2 Age-specific mortality rates

Most colorectal cancer deaths in Queensland (95%) occurred among people aged 50 years or older. The number of deaths due to colorectal cancer peaked within the 70-74 age group for males (83 deaths per year), while among females the number of deaths (86 per year) was highest in the 85 and over age group (Figure 5.4). Colorectal cancer mortality rates continued to rise as age increased, with an average of 292 deaths per 100,000 males and 259 deaths per 100,000 females among those aged 85 years and over.

Figure 5.4: Average age-specific mortality for colorectal cancer by sex, Queensland, 2001-2005



Data source: Queensland Cancer Registry.

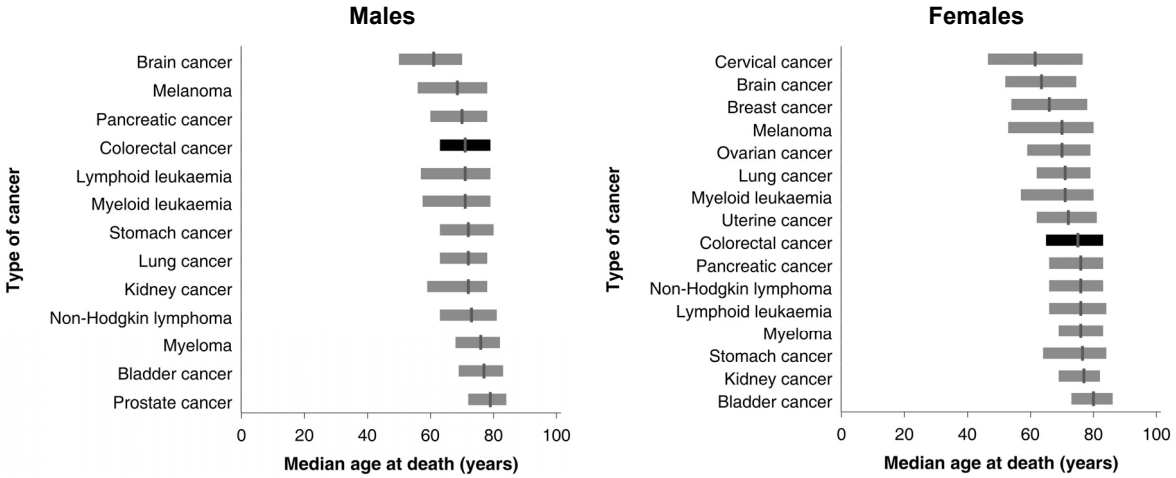
5.3.3 Median age at death

The median age at death for Queenslanders who died from colorectal cancer was 71 years for males and 75 years for females (Figure 5.5). This was marginally younger than the median age for all cancer deaths among males (72 years) but slightly older than the median age for all cancer deaths among females (73 years).

When compared against other types of cancer, the median age at death for colorectal cancer among males was considerably older than for deaths due to brain cancer (61 years), but younger than deaths related to prostate cancer (79 years), bladder cancer (77 years) or myeloma (76 years). Among females, cancers associated with a younger median age at death included cervical (62 years), brain (64 years) and breast cancer (66 years), while deaths due to bladder cancer had a considerably older median age (80 years).

There were minor differences in the median age at death by site of colorectal cancer. Rectal cancer had a lower median age at death (69 years) among males compared to either right or left colon cancers (both 72 years), while among females the median ages at death for right colon, left colon and rectal cancers were 75.5, 73 and 74 years respectively.

Figure 5.5: Median age at death for selected cancers by sex, Queensland, 2001-2005



Data source: Queensland Cancer Registry and Queensland Health.

Note: Vertical bar shows median age at death, with the corresponding interquartile range indicated by the shaded area.

Between 1982-1986 and 2001-2005 the median age at death increased by 2 years for males (from 69 to 71 years) and 4 years for females (from 71 to 75 years), most likely as a result of increases in the median age at diagnosis (see Section 3.3.3) combined with improvements in survival for colorectal cancer since the early 1980s (see Section 4.1.4).

Median age at death increased by at least 4 years from 1982-1986 to 2001-2005 for both males and females with either right or left colon cancers. The greatest improvement occurred among females who died from right colon cancers, with the median age at death increasing from 69 years to 75.5 years. In contrast, median age at death among males with rectal cancer remained constant over this time period, and only increased by 2 years (from 72 to 74 years) among females.

5.3.4 Deaths by colorectal cancer site and age group

Rectal cancers caused the greatest proportion of colorectal cancer deaths for males aged 35-79 years (49% among those aged 35-49 years, 43% among 50-64 year olds and 36% for those in the 65-79 age group), while among males aged 80 years and over right colon cancers caused slightly more colorectal cancer deaths (32%) than rectal cancers (29%).

For females, rectal cancers were responsible for the most number of colorectal cancer deaths in the 35-49 age group (39%), but right colon cancers were the most prominent cause of death among females aged 50 years and over, causing 36% of colorectal deaths in the 50-64 age group, 40% in the 65-79 age group and 37% among females aged 80 years or more.

5.4 How much premature mortality is caused by colorectal cancer in Queensland?

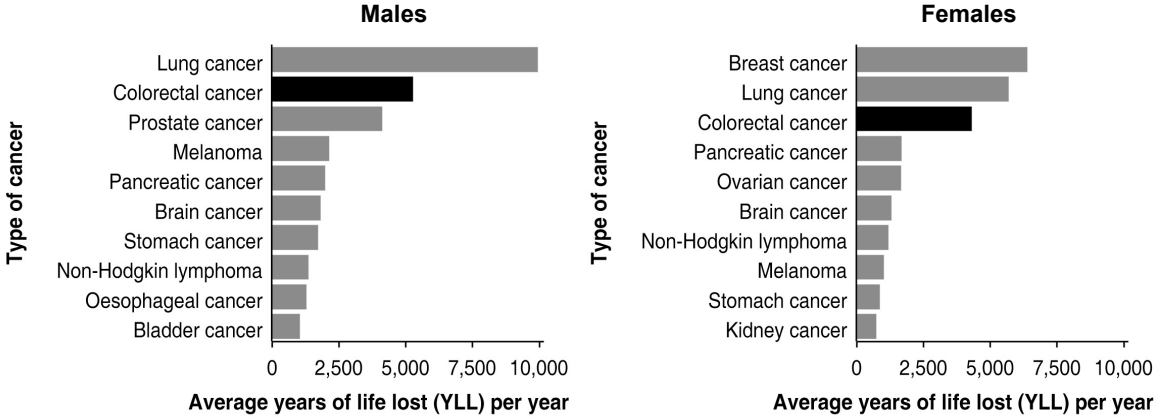
Premature mortality measures how much of their "expected" lifetime a person loses when they die. The calculation of premature mortality is influenced by both the number of deaths and the age at which people die from a particular disease. It is expressed in terms of years of life lost (YLL). For further details, see Appendix B.

5.4.1 Premature mortality by type of cancer

All cancers combined accounted for about one-third of total premature mortality among both males (32%) and females (34%) in Queensland between 2001 and 2005, with colorectal cancer causing around 4% of total premature mortality within both sexes. This is consistent with the findings of a recent national report on the burden of disease and injury, in which colorectal cancer was estimated to have caused a total of 51,700 YLL (4% of all YLL) throughout Australia during 2003.[205]

Colorectal cancer was responsible for a relatively large amount of cancer-related premature mortality (Figure 5.6), reflecting the proportion of all cancer-related deaths due to colorectal cancer (see Section 5.1). Among males, colorectal cancer caused the second highest amount of cancer-related premature mortality (12% or 5,260 YLL per year), behind lung cancer (24%, 9,930 YLL per year), while among females, colorectal cancer ranked third (13%, 4,280 YLL per year), behind breast cancer (19%, 6,380 YLL per year) and lung cancer (17%, 5,670 YLL per year).

Figure 5.6: Average years of life lost per year for selected types of cancer by sex, Queensland, 2001-2005



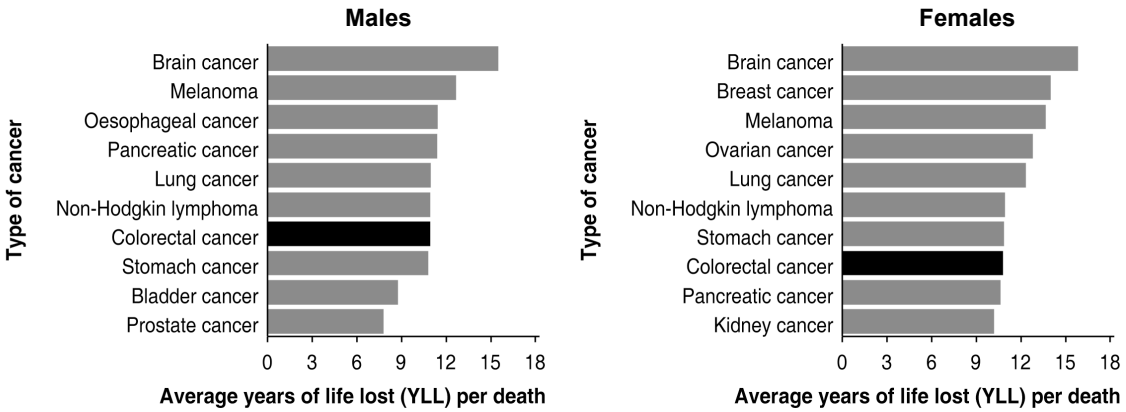
Data source: Queensland Cancer Registry.

Notes: 1. Only cancers with an average of at least 100 deaths per year for males and 60 deaths per year for females are shown.
2. YLL was calculated using life expectancy data from the 2003 Australian Burden of Disease study,[205] based on 3% discounting with no age weighting.

The amount of life expectancy lost per person for those who died from colorectal cancer was similar between the sexes, with 10.9 YLL per death for males compared to 10.8 YLL per death among females. The YLL per death from colorectal cancer was similar to the average for all cancers combined (10.8 YLL per death) among males, but was somewhat less than the average for females (11.9 YLL per death).

Of the major types of cancer, brain cancer (15.5 YLL per death for males and 15.8 YLL per death for females), female breast cancer (14.0 YLL per death) and melanoma (12.6 YLL per death for males and 13.6 YLL per death for females) caused the greatest amount of premature mortality per death (Figure 5.7).

Figure 5.7: Average years of life lost per death for selected types of cancer by sex, Queensland, 2001-2005



Data source: Queensland Cancer Registry.

Notes: 1. Only cancers with an average of at least 100 deaths per year for males and 60 deaths per year for females are shown.
2. YLL was calculated using life expectancy data from the 2003 Australian Burden of Disease study,[205] based on 3% discounting with no age weighting.

5.4.2 Premature mortality by site of colorectal cancer

Rectal cancer caused 39% of the premature mortality due to colorectal cancer among males (2,040 YLL per year), followed by right colon cancer (29%, 1,520 YLL per year). For females, right colon cancer was the most common cause of premature mortality (37%, 1,570 YLL per year), with rectal cancer second (31%, 1,310 YLL per year). Left colon cancer accounted for a further 24% of premature mortality from colorectal cancer among both males and females (1,270 and 1,030 YLL per year, respectively).

Rectal cancer was also responsible for the greatest number of years of life lost per death among males, with an average of 11.6 YLL per death, while left colon and right colon cancers resulted in 10.8 and 10.6 YLL per death, respectively. Premature mortality was generally higher for females with left colon cancer or rectal cancer (11.6 and 11.3 YLL per death, respectively), while females who died from right colon cancer had an average of 10.5 YLL per death.

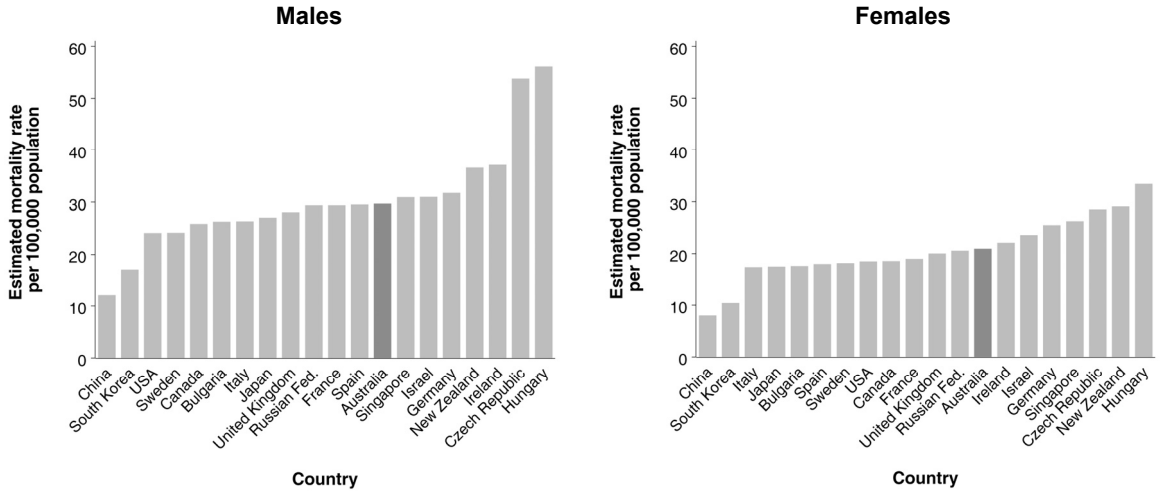
5.5 Are mortality rates for colorectal cancer different elsewhere?

5.5.1 International comparisons for mortality

In 2002 there were an estimated 529,000 deaths caused by colorectal cancer internationally, corresponding to 8% of all cancer deaths, with more deaths due to colorectal cancer among males (278,000 or 53%) than among females (251,000 or 47%).[108] Colorectal cancer was the fourth highest cause of cancer-related mortality among males, after lung, stomach and liver cancers, and ranked fifth among females behind breast, lung, cervical and stomach cancers.[108]

Based on 2002 estimates, age-standardised colorectal cancer mortality rates among both males and females in Australia were higher than the respective averages for more developed countries. Mortality rates due to colorectal cancer were generally highest in Australia/New Zealand and throughout Europe for both sexes (Figure 5.8), while the regions with the lowest age-adjusted mortality rates were South Central Asia and Middle Africa.[111]

Figure 5.8: Estimated age-standardised rate* of colorectal cancer mortality by sex for selected countries, 2002



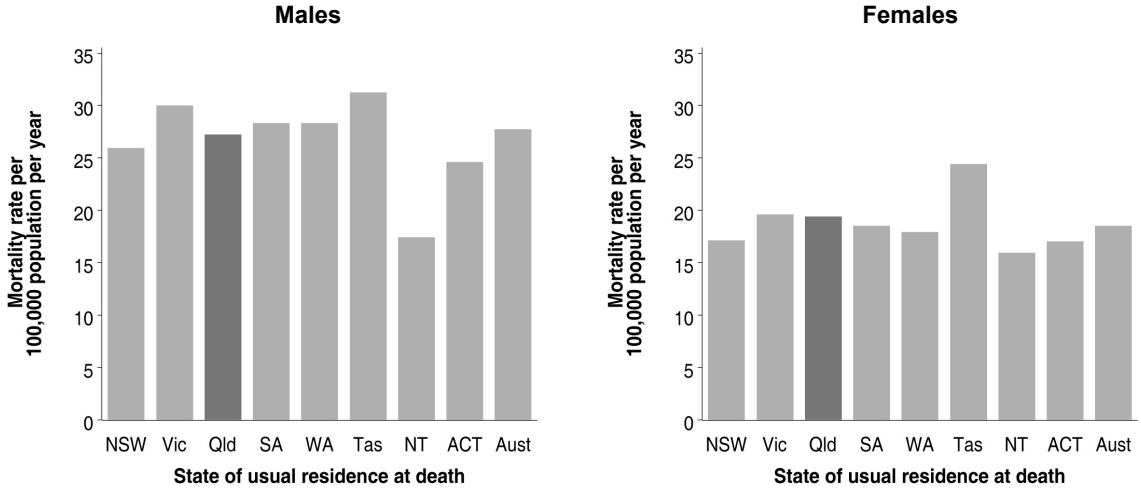
Data source: GLOBOCAN 2002, International Agency for Research on Cancer (IARC).[111]

Notes: *Rates age-standardised to the Australian standard population (2001) in broad age groups.

5.5.2 Interstate comparisons for mortality

The average annual mortality rates for colorectal cancer among both males and females in Queensland (27 deaths per 100,000 males and 19 deaths per 100,000 females) were similar to the corresponding Australian averages (28 deaths per 100,000 males and 19 deaths per 100,000 females), as shown in Figure 5.9. Tasmania had the highest mortality rates (particularly for females), with 31 deaths per 100,000 males and 24 deaths per 100,000 females. In contrast, the Northern Territory had the lowest colorectal cancer mortality rates for both sexes (17 deaths per 100,000 males and 16 deaths per 100,000 females).

Figure 5.9: Age-standardised rates* of colorectal cancer mortality per year by State/Territory and sex, Australia, 2000-2004



Data source: Australian Institute of Health and Welfare (AIHW).[206]

Notes: *Rates age-standardised to the Australian standard population (2001).

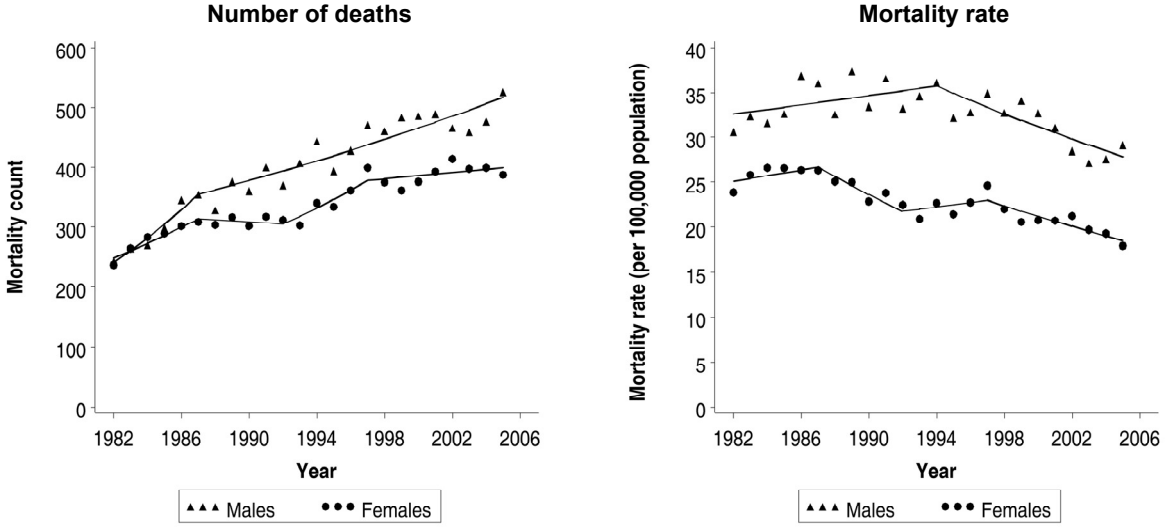
5.6 Have colorectal cancer mortality rates changed over time?

5.6.1 Mortality trends for Queensland

Recent trends in the mortality rate of colorectal cancer in Queensland have been decreasing for both males and females (Figure 5.10). Colorectal cancer mortality rates have declined for males in Queensland by 2.2% per year since 1994 (a total decrease of 22% between 1994-2005), while there has been a net decrease of 31% in the mortality rate for females since 1987 (despite a small increase during the mid-1990s).

Even though colorectal cancer mortality rates are decreasing, there has been an overall rise in the actual number of colorectal cancer deaths, due to population growth and ageing. The number of males dying from colorectal cancer has more than doubled (total increase of 114%) between 1982-2005. Trends in the number of colorectal cancer deaths among females have been more variable, with significant increases between 1982-1987 and 1992-1997, but more recently the number of deaths per year has remained reasonably stable (a non-significant increase of 0.7% per year since 1997).

Figure 5.10: Trends in colorectal cancer mortality by sex, Queensland, 1982-2005



Linear trends (estimated average yearly percentage change, with 95% confidence intervals shown in brackets):

Number of deaths

Males 1982-1987 = +8.0% (+3.5%,+12.8%)
1987-2005 = +2.1% (+1.6%,+2.6%)

Females 1982-1987 = +4.7% (+2.0%,+7.6%)
1987-1992 = -0.6% (-4.0%,+3.0%)
1992-1997 = +4.4% (+0.9%,+8.0%)
1997-2005 = +0.7% (-0.4%,+1.8%)

Mortality rate

Males 1982-1994 = +0.8% (-0.4%,+1.9%)
1994-2005 = -2.2% (-3.3%,-1.2%)

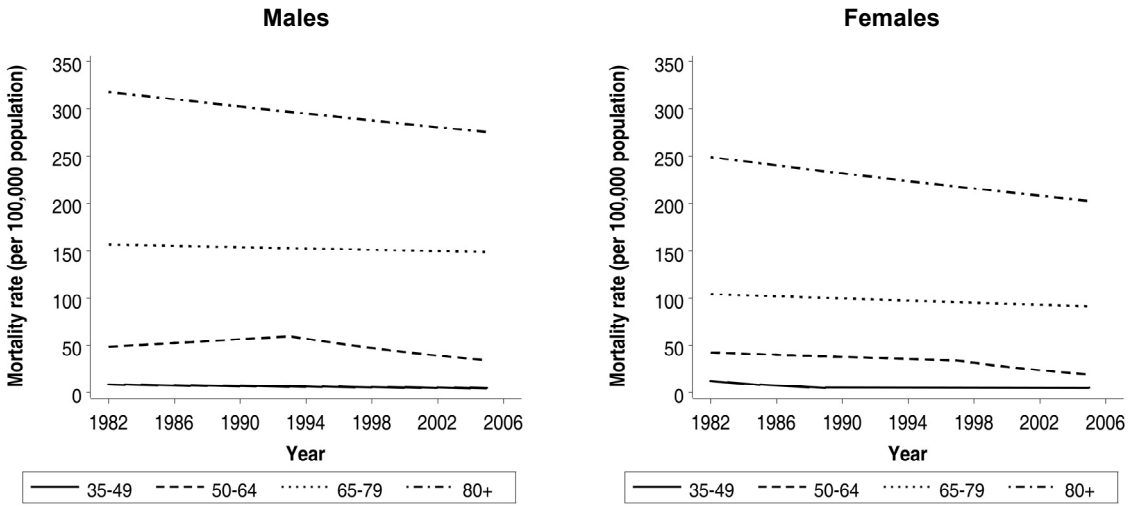
Females 1982-1987 = +1.3% (-1.5%,+4.1%)
1987-1992 = -4.0% (-7.4%,-0.4%)
1992-1997 = +1.1% (-2.4%,+4.7%)
1997-2005 = -2.7% (-3.8%,-1.6%)

Data source: Queensland Cancer Registry.

Notes: Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, National Cancer Institute.[126]

The largest reductions in colorectal cancer mortality rates have been within the 50-64 age group for both males and females, with decreases of 4.6% per year since 1993 (total decrease of 43%) and 7.1% since 1997 (total decrease of 56% since 1982) respectively. There were also significantly decreasing trends in the mortality rate for males aged 35-49 and females aged 65 years and over, while mortality rates were relatively stable among males aged 65 years and over and females aged 35-49 years (Figure 5.11).

Figure 5.11: Trends in colorectal cancer mortality by sex and age group (35 years and over)*, Queensland, 1982-2005



Linear trends (estimated average yearly percentage change, with 95% confidence intervals shown in brackets):

Males		Females	
35-49 years	1982-2005 = -2.5% (-4.1%,-0.9%)	**35-49 years**	1982-1989 = -11.7% (-19.3%,-3.4%)
			1989-2005 = -0.3% (-2.7%,+2.2%)
50-64 years	1982-1993 = +1.9% (-0.8%,+4.7%)	**50-64 years**	1982-1997 = -1.5% (-2.4%,-0.5%)
	1993-2005 = -4.6% (-6.6%,-2.6%)		1997-2005 = -7.1% (-9.4%,-4.7%)
65-79 years	1982-2005 = -0.2% (-0.7%,+0.3%)	**65-79 years**	1982-2005 = -0.6% (-1.0%,-0.1%)
80+ years	1982-2005 = -0.6% (-1.4%,+0.2%)	**80+ years**	1982-2005 = -0.9% (-1.4%,-0.4%)

Data source: Queensland Cancer Registry.

Notes: * There were an insufficient number of deaths to calculate mortality trends for persons aged 0-34 years.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, National Cancer Institute.[126]

5.6.2 International mortality trends

Trends in colorectal cancer mortality rates between 1982 and 2005 for 24 selected countries, including Australia, are displayed in Figure 5.12. Of the countries shown, the most recent colorectal cancer mortality trends by sex can be summarised into the following six general patterns:

- decreasing for both sexes e.g. Australia, Canada, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Sweden, United Kingdom, United States;
- decreasing for males and stable for females e.g. Israel;
- stable for males and decreasing for females e.g. Hungary, Singapore;
- increasing for males and decreasing for females e.g. Argentina, Spain;
- increasing for males and stable for females e.g. China, Ukraine; and,
- increasing for both sexes e.g. Bulgaria, Hong Kong, Mexico, Russian Federation, South Korea;

The largest decreases among males were recorded in Australia (-4.8% per year between 1997-2003), Israel (-3.9% per year between 1995-2003) and the United States (-3.7% per year between 2001-2005). In contrast, the largest annual increases for male colorectal cancer mortality rates were in Hong Kong (+7.5% per year from 1997-2005) and South Korea (+6.7% per year between 1996-2005). Among females, reductions in colorectal cancer mortality rates were greatest in the United States (-4.0% per year between 2001-2005) and Australia (-3.5% per year between 1998-2003), while the largest rises were occurring in South Korea (+4.9% per year between 1996-2005) and Bulgaria (+3.8% per year between 1995-2004).

Figure 5.12: Recent national and international trends in colorectal cancer mortality by sex for selected countries, 1982 to 2005*

Note: For each of the following graphs, y-axis represents "Mortality rate (per 100,000 population)" and x-axis represents "Year of death".

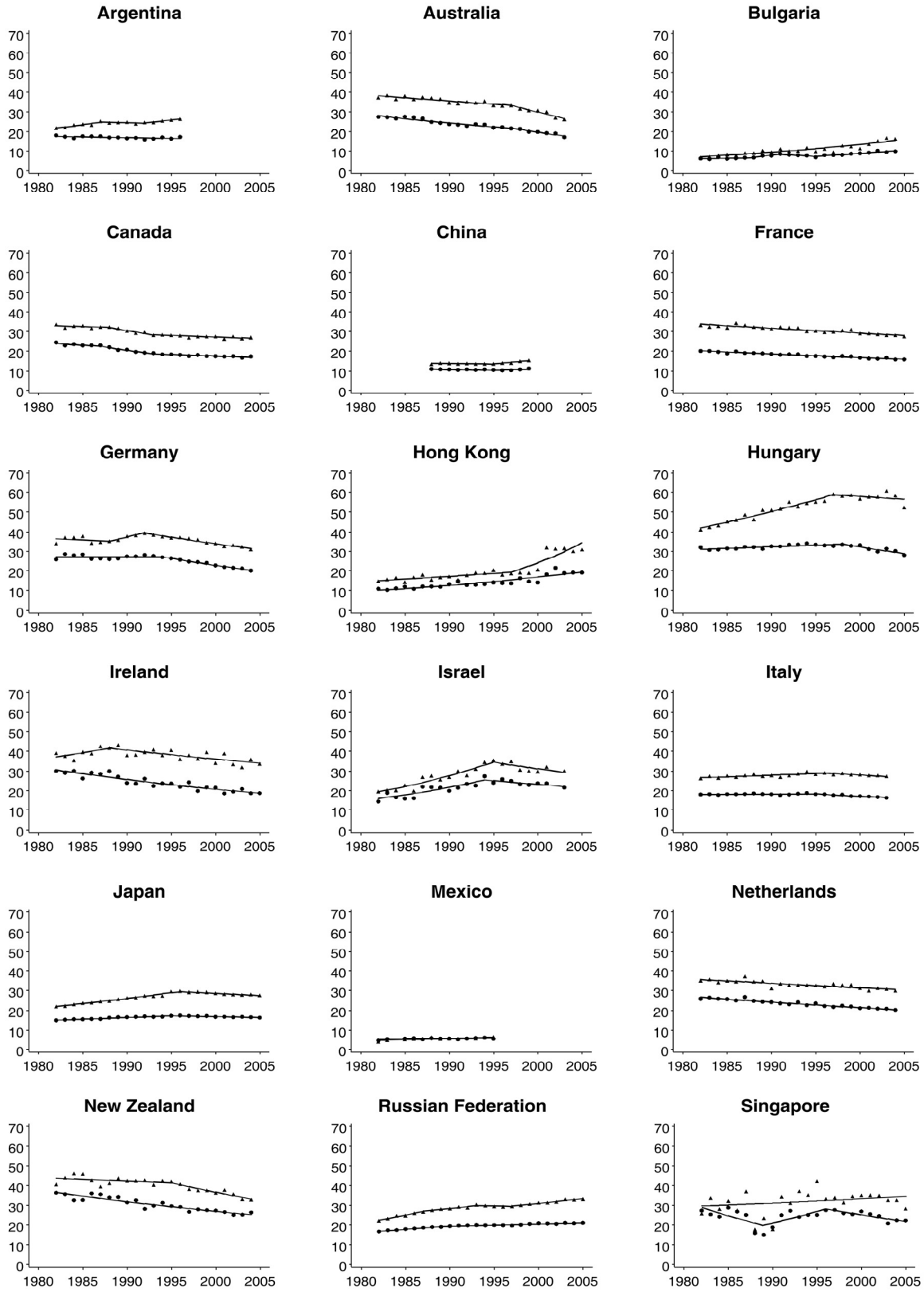
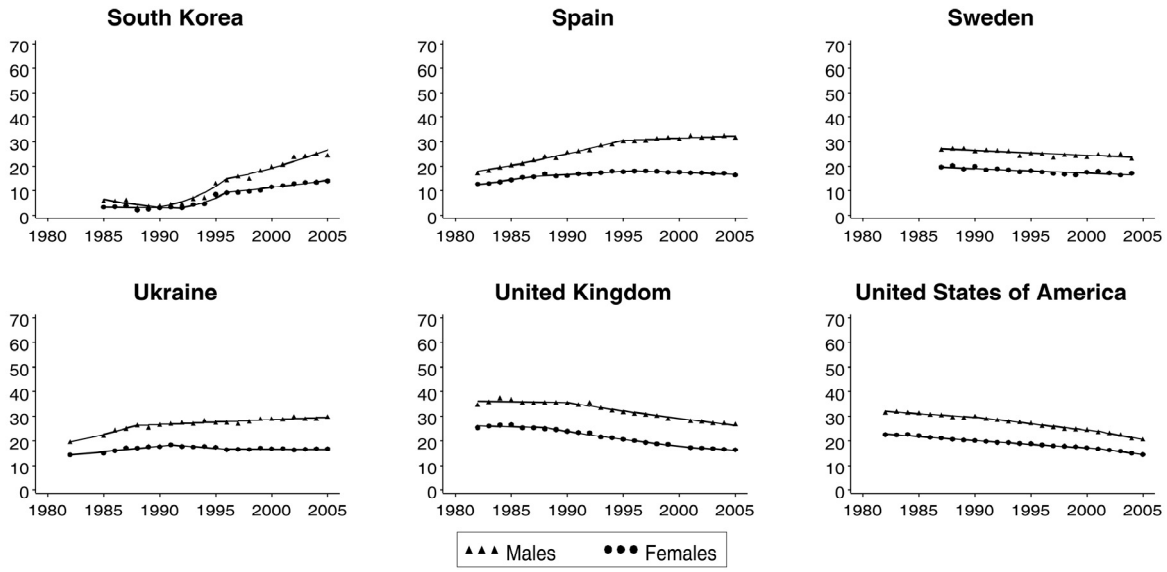


Figure 5.12 (*cont.*) Recent national and international trends in colorectal cancer mortality by sex for selected countries, 1982 to 2005*

Note: For each of the following graphs, y-axis represents "Mortality rate (per 100,000 population)" and x-axis represents "Year of death".



Data source: World Health Organization (WHO) [207]

Notes: * Colorectal cancer mortality rates available from 1982 to 2005 for France, Hong Kong, Hungary, Ireland, Japan, Russia, Singapore, Spain, Ukraine, the United Kingdom and the United States; from 1982 to 2004 for Bulgaria, Canada, Germany, the Netherlands, and New Zealand; from 1982 to 2003 for Australia, Israel and Italy; from 1985 to 2005 for South Korea; from 1987 to 2004 for Sweden; from 1982 to 1996 for Argentina; from 1982 to 1995 for Mexico; and from 1988 to 1999 for China.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, National Cancer Institute.[126]

Decreasing trends in colorectal cancer mortality rates among both sexes have been observed in most European countries since the early to mid-1990s, with the exception of some Eastern European and Mediterranean countries. This has resulted in a convergence of colorectal cancer mortality trends throughout Europe. If current trends are maintained, it is likely that colorectal cancer mortality rates will continue to fall throughout Europe in the immediate future.[208]

Comment 5.3 – What factors influence colorectal cancer mortality trends?

Trends in colorectal cancer mortality are influenced by both incidence and survival. For example, the widespread decline in colorectal cancer mortality rates, particularly throughout North America and most of Europe, can most likely be attributed to earlier detection combined with favourable lifestyle changes and improved treatment.[208]

Data modelling conducted in the United States suggests that under an optimistic scenario (i.e. increasing the use of population screening and chemotherapy while further decreasing the prevalence of risk factors) existing colorectal cancer mortality rates could potentially halve by the year 2020.[209] However, future trends in colorectal cancer mortality will depend on how successfully current interventions are employed, along with the development of new prevention, screening and treatment options.[209]

6 Prevalence

Whereas incidence measures how many people are diagnosed with a certain disease over a given time period (usually one year), the prevalence of a disease is a measure of how many people are still alive having been previously diagnosed with that disease.

Limited duration prevalence includes all the people alive on a given date who had a diagnosis of the disease within a certain timeframe. For instance, 5-year prevalence would include those diagnosed with the disease between 1st January 2001 and 31st December 2005 who were still alive at the end of that period. Prevalence can be expressed as either a count or a rate (e.g. per 100,000 population). Appendix B contains further information on the prevalence calculations used in this report.

The different measures of limited duration prevalence presented here (i.e. 1-year, 5-year, 10-year, 15-year and 20-year prevalence) are valuable for informing health care planners, oncology practitioners and providers of other support services of the likely short-, medium- and longer-term requirements of people diagnosed with colorectal cancer.

Comment 6.1 – The relationship between incidence, survival and prevalence

Prevalence is related to both incidence and survival. Therefore, the prevalence of colorectal cancer tends to be higher than most other types of cancer, due to its high incidence (see Section 3.1) combined with the moderate survival of colorectal cancer patients (see Section 4.1).[108] In contrast, despite the high incidence of lung cancer, it has relatively low prevalence (particularly for longer-term prevalence), due to the poor survival of lung cancer patients.

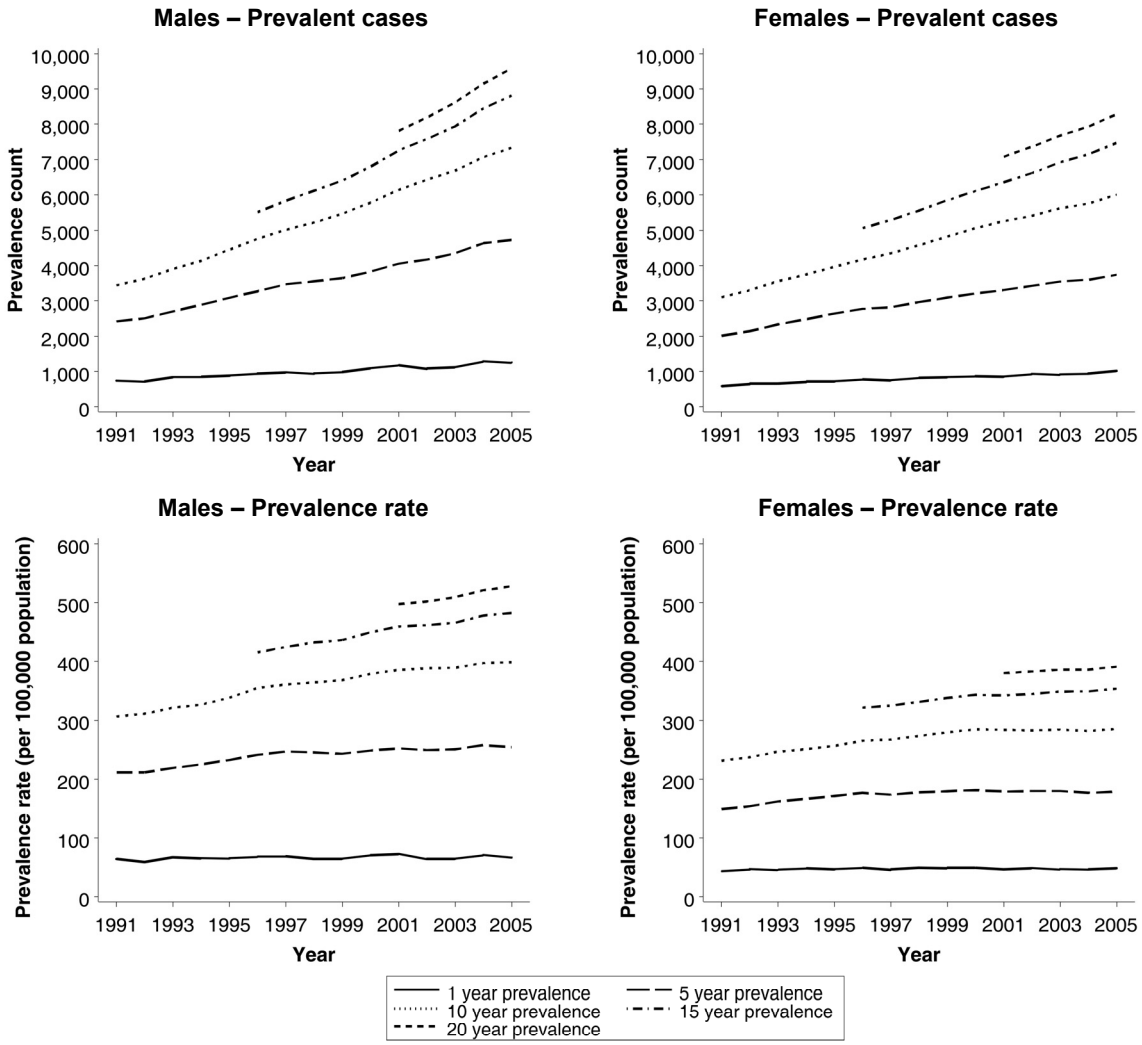
6.1 How many people living in Queensland have been diagnosed with colorectal cancer?

As at the end of 2005, there were 4,719 males (254 per 100,000) and 3,733 females (178 per 100,000) living in Queensland who had been diagnosed with colorectal cancer since the start of 2001 (i.e. 5-year prevalence). In regard to longer-term prevalence, 9,580 males (527 per 100,000) and 8,278 females (391 per 100,000) living in Queensland at the end of 2005 had been diagnosed with colorectal cancer at some time during the previous 20 years.

About three-quarters of the 20-year prevalent colorectal cancer cases had been diagnosed within the last 10 years (76% for males and 72% for females), while just under half had been diagnosed within the last 5 years (49% for males and 45% for females). This reflects the on-going growth in incidence counts over the last 20 years (see Section 3.5) as well as the moderate long-term survival associated with colorectal cancer (see Section 4.1).

Although mid- and longer-term prevalence counts have been increasing sharply for males in Queensland, prevalence rates have generally shown only modest growth over the last decade (Figure 6.1). This is because increases in prevalence counts for colorectal cancer are primarily caused by population growth and ageing, while prevalence rates adjust for both of these factors (see Comment 3.8). For example, the 5-year prevalence rate for males increased by 9% between the end of 1995 and the end of 2005, while the corresponding prevalence counts increased by 53%. A similar pattern was also evident for females, with rises of 4% and 42% in the 5-year prevalence rates and counts, respectively, between 1995 and 2005.

Figure 6.1: Trends in the limited duration prevalence of colorectal cancer (counts and rates) by sex, Queensland, 1991-2005



Data source: Queensland Cancer Registry.

Notes: Prevalence data are as at 31st December of the year shown.
Rates age-standardised to the Australian standard population (2001).

Comment 6.2 – The economic burden of colorectal cancer in Australia

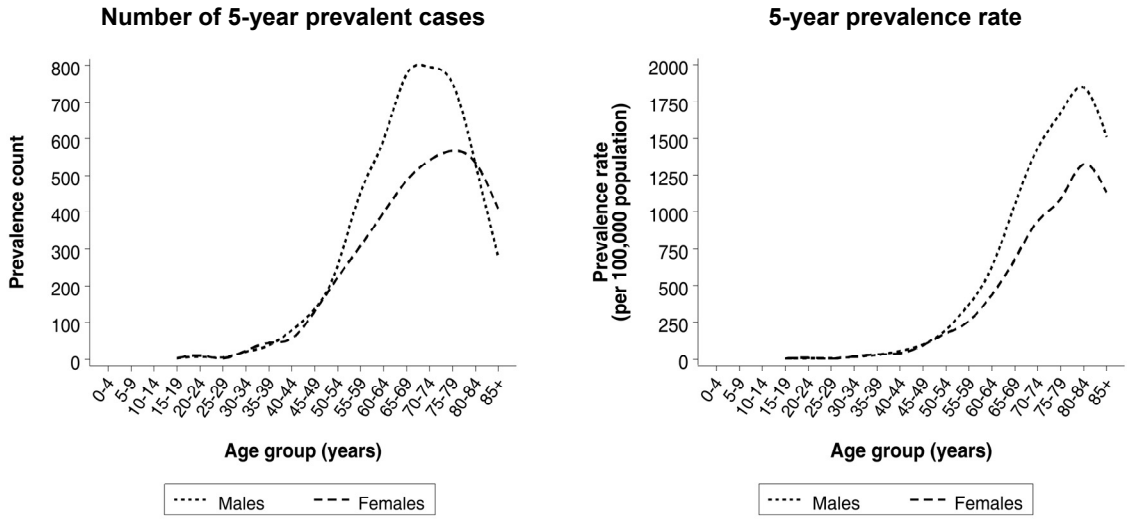
The Australian Institute of Health and Welfare (AIHW) estimated that in the 2000-2001 financial year, the lifetime treatment cost of a person diagnosed with colorectal cancer was over $18,200 per patient. This was much lower than the average cost per patient of leukaemia ($51,200) or brain cancer ($40,700), but substantially higher than either melanoma ($3,300) or breast cancer ($11,900).[210]

A total of $235 million was spent on colorectal cancer during 2000-2001, representing 8% of the total expenditure on cancer care.[210] It was the most expensive cancer for females aged 65 years and over, the second most expensive cancer for males in the 25-64 age group, and the third most expensive cancer for females aged 25-64 and males aged 65 years and over. Colorectal cancer was responsible for around 25,000 hospital admissions worth $188 million, the highest total cost of inpatient hospital care for any type of cancer.[210]

6.2 Does the prevalence of colorectal cancer vary by age group?

There was a sharp increase in the prevalence of colorectal cancer between the ages of 40 and 70 (Figure 6.2). Five-year prevalence counts for colorectal cancer in Queensland as at the end of 2005 peaked for males in the 70-74 age group (795 prevalent cases) and for females aged 75-79 years (566 prevalent cases), while 5-year prevalence rates were highest in the 80-84 age group for both sexes (1,847 per 100,000 males and 1,323 per 100,000 females). This contrasted with 5-year prevalence rates of less than 31 per 100,000 among people aged under 40 years.

Figure 6.2: Age-specific 5-year prevalence of colorectal cancer by sex, Queensland, 2005



Data source: Queensland Cancer Registry.

Notes: Prevalence data are as at 31st December 2005.

6.3 What types of colorectal cancer are people living with?

In terms of 5-year prevalence, the most common site for colorectal cancer among males living in Queensland was rectal cancer (1,876 prevalent cases at the end of 2005, 40%), compared to 1,378 (29%) and 1,291 (27%) males who had been diagnosed with right colon or left colon cancer respectively. The most prevalent site for colorectal cancer among females between 2001-2005 was right colon cancer (1,598 cases or 43%), followed by rectal cancer (1,103 cases or 30%) and left colon cancer (872 cases or 23%). Unknown colon cancers only accounted for 4% of the 5-year prevalence of colorectal cancer within both sexes.

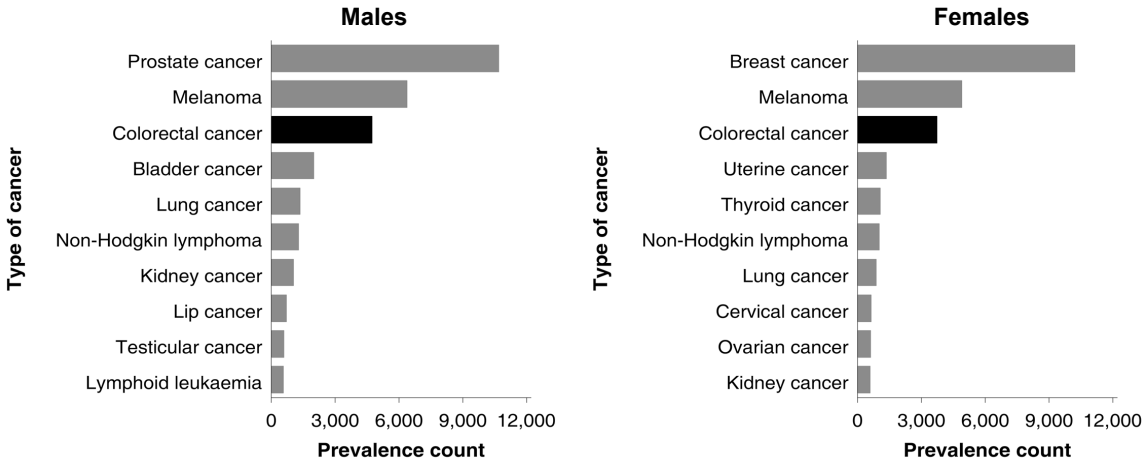
6.4 How does the 5-year prevalence of colorectal cancer compare with other cancers?

As at the end of 2005, there were a total of 35,389 males and 29,949 females who were living in Queensland following a diagnosis of cancer within the previous 5 years.

Colorectal cancer was the third most prevalent type of cancer in Queensland for both males and females (Figure 6.3), accounting for 13% (4,723 cases) and 12% (3,736 cases) respectively of all 5-year cancer prevalence by sex. Among males, the two most prevalent cancers were prostate cancer (10,702 cases or 30%) and melanoma (6,378 cases or 18%), while among females, breast cancer (10,211 cases or 34%), and melanoma (4,903 cases or 16%) were the most prevalent types of cancer.

Colorectal cancer also ranked third among both males and females for 20-year cancer prevalence in Queensland (data not shown).

Figure 6.3: 5-year prevalence counts for the most prevalent types of cancer by sex, Queensland, 2005



Data source: Queensland Cancer Registry and Queensland Health.

Notes: Prevalence data are as at 31st December 2005.

7 Geographical areas and socio-economic status

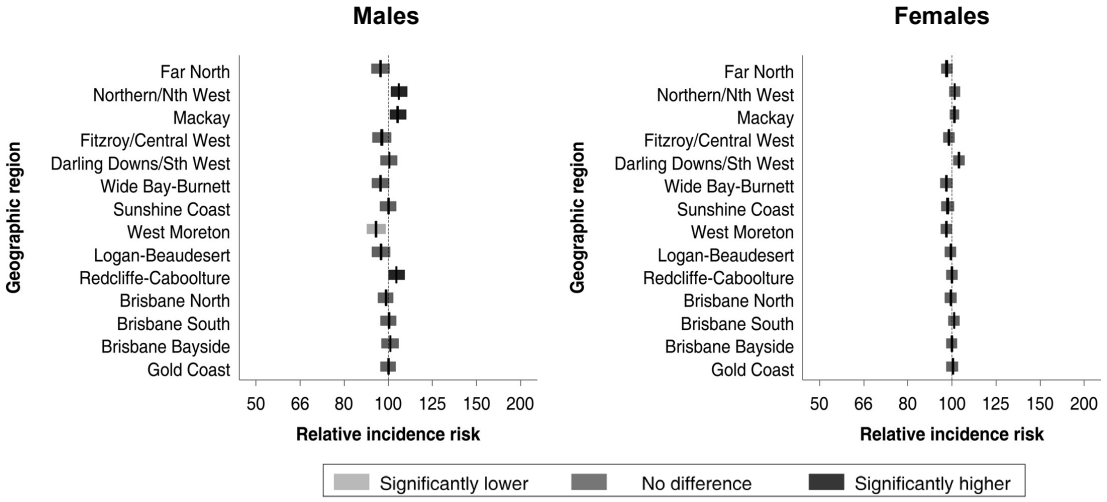
An understanding of differences in colorectal cancer data by geographic region, accessibility/ remoteness, or socio-economic status is important when planning the allocation of health resources and services (see Appendix B for further details on the definitions used for these characteristics). This information may also be useful for researchers as a starting point for more detailed studies into the possible causes of any differences in cancer incidence or survival.

7.1 Are there differences in colorectal cancer incidence within Queensland?

7.1.1 Colorectal cancer incidence by geographic region

There were small, but significant, differences in colorectal cancer incidence in Queensland for males (Figure 7.1). In the ten years from 1996-2005, the risk of being diagnosed with colorectal cancer was significantly lower than the Queensland average for males in the West Moreton area (6% lower), while the incidence risk was higher for males residing in Northern/North-West (6% higher), Mackay (5% higher) and Redcliffe-Caboolture areas (4% higher). There were no significant differences in colorectal cancer incidence by geographical region among females living in Queensland.

Figure 7.1: Relative risk of colorectal cancer incidence by geographic region and sex, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

Notes:
1. Geographic regions were based on place of usual residence at time of diagnosis.
2. Relative incidence risk was expressed in comparison to the Queensland average (i.e. relative incidence risk = 100 for Queensland average).
3. The vertical bar for each region shows the estimated relative risk, with the corresponding 95% confidence interval indicated by the shaded area.
4. Relative risk estimates have been "shrunk" to adjust for small area variations.

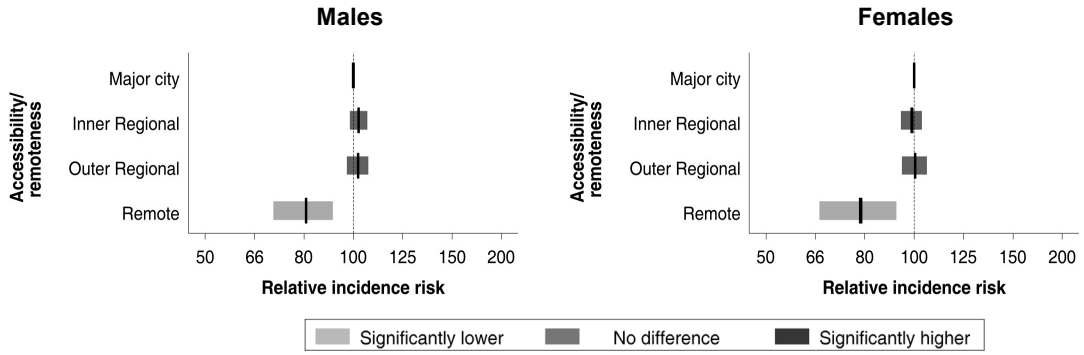
Statistical test results for overall geographic variation: **Males** Z=2.67, p=0.019.
Females Z=1.73, p=0.108.

7.1.2 Colorectal cancer incidence by accessibility/remoteness

People living in remote areas of Queensland around 20% less likely to be diagnosed with colorectal cancer compared to those living in major cities (Figure 7.2). A similar pattern was observed by accessibility/remoteness in an earlier Cancer Council Queensland report that examined geographical variation in colorectal cancer incidence within Queensland, although the differences failed to reach statistical signficance.[211]

National data shows that, among both males and females, incidence rates for colorectal cancer tend to be higher in inner regional and outer regional areas of Australia, while incidence rates were significantly lower in very remote parts of the country.[123] Results from the United States also suggest that colorectal cancer incidence rates were lower in rural areas compared to metropolitan centres, particularly among males.[212]

Figure 7.2: Relative risk of colorectal cancer incidence by accessibility/remoteness, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

Notes:
1. Accessibility/remoteness categories were based on place of usual residence at time of diagnosis.
2. Accessibility/remoteness was defined using the ARIA+ index (see Appendix B).
3. Relative incidence risk was expressed in comparison to the reference category of 'Major city' (i.e. relative incidence risk = 100 for 'Major city').
4. The vertical bar for each ARIA+ category shows the estimated relative risk, with the corresponding 95% confidence interval indicated by the shaded area.

Statistical test results for overall geographic variation: **Males** Chi-sq=15.51, df=3, p=0.001.
Females Chi-sq=9.31, df=3, p=0.025.

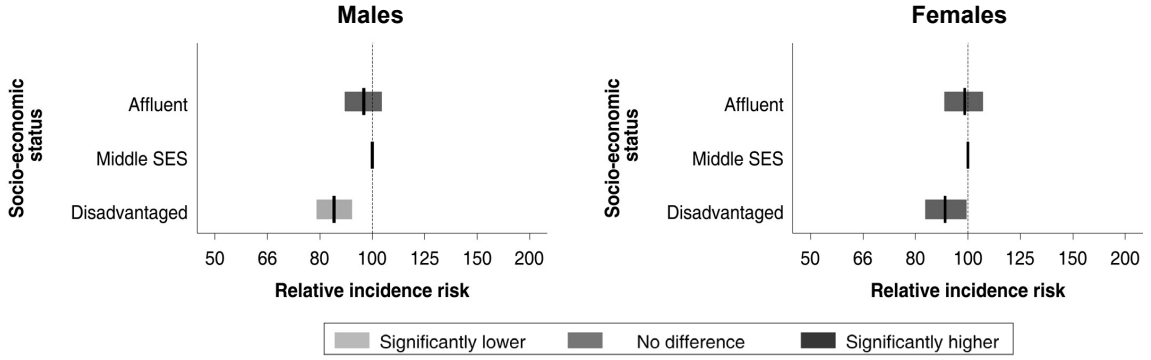
Comment 7.1 – Possible causes of variation in the incidence of colorectal cancer by rurality or socio-economic status

Any differences in the incidence rates of colorectal cancer by geographical area or socio-economic status are likely to be related to a range of factors, including disparities in demographic characteristics, preventive behaviours, screening rates and the availability of diagnostic services.[212,213] However, it can be difficult to disentangle the effects of these various factors. In particular, the introduction of population-based screening for colorectal cancer within a specific area may initially increase incidence rates, before leading to a decrease in the longer term.[214]

7.1.3 Colorectal cancer incidence by socio-economic status

Males living in the most disadvantaged areas of Queensland had a 15% lower risk of being diagnosed with colorectal cancer compared to those in the middle socio-economic status category (Figure 7.3). While there were no statistically significant differences in the risk of colorectal cancer incidence by socio-economic status for females, those living in the most disadvantaged areas of the state also tended to be at lower risk of developing colorectal cancer.

Figure 7.3: Relative risk of colorectal cancer incidence by socio-economic status, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

Notes:
1. Socio-economic status categories were based on place of usual residence at time of diagnosis.
2. Socio-economic status was defined using the SEIFA index of economic disadvantage (see Appendix B).
3. Relative incidence risk was expressed in comparison to the reference category of 'Middle SES' (i.e. relative incidence risk = 100 for 'Middle SES').
4. The vertical bar for each SEIFA category shows the estimated relative risk, with the corresponding 95% confidence interval indicated by the shaded area.

Statistical test results for overall geographic variation: **Males** Chi-sq=17.73, df=2, p<0.001.
Females Chi-sq=4.61, df=2, p=0.100.

These results differ from an earlier Cancer Council Queensland report, which found that colorectal cancer incidence rates were highest in the most affluent parts of the state, while there was little difference between the middle and disadvantaged socio-economic status categories.[211] Variations between the two reports are likely to be due to minor differences in the methodologies used.

Although there is no consistent pattern in the incidence of colorectal cancer by socio-economic status throughout the world,[215-217] there is evidence that gradients in incidence rates by social class have been weakening within some countries over recent years.[216,217]

Comment 7.2 – Are there differences in colorectal cancer screening participation rates by rurality or socio-economic status?

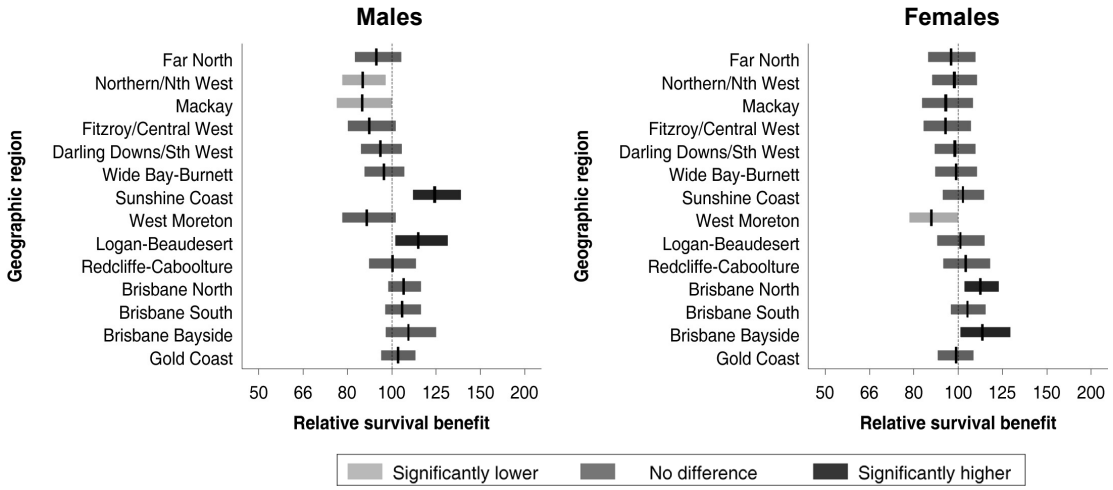
Prior to the implementation of the national bowel cancer screening program, research in Queensland found no difference in the intent to participate in colorectal cancer screening by either rurality or socio-economic status.[218] However, preliminary results from the national program indicate that participation rates have been highest among those in inner regional areas (37%) and lowest among people living in remote (23%) or very remote (14%) parts of Australia.[123] There was also a slight decline in participation as socio-economic disadvantage increased, with participation rates of 36% in the least disadvantaged quintile and 31% in the most disadvantaged quintile.[123]

7.2 Are there differences in colorectal cancer survival within Queensland?

7.2.1 Colorectal cancer survival by geographic region

Queensland residents experienced significant variation in colorectal cancer survival by geographic region between 1996-2005. Survival was poorer for males in the Northern/North West and Mackay regions compared to the State average (13% lower relative survival), while males living in the Sunshine Coast and Logan-Beaudesert regions experienced improved survival (relative survival 24% and 15% higher than the State average, respectively). Females in both Brisbane North and Brisbane Bayside regions also had improved survival, with a relative survival 12% and 14% higher than the State average, respectively, while females in the West Moreton region had poorer survival with 12% lower relative survival (Figure 7.4).

Figure 7.4: Relative benefit of 5-year survival for colorectal cancer by geographic region, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

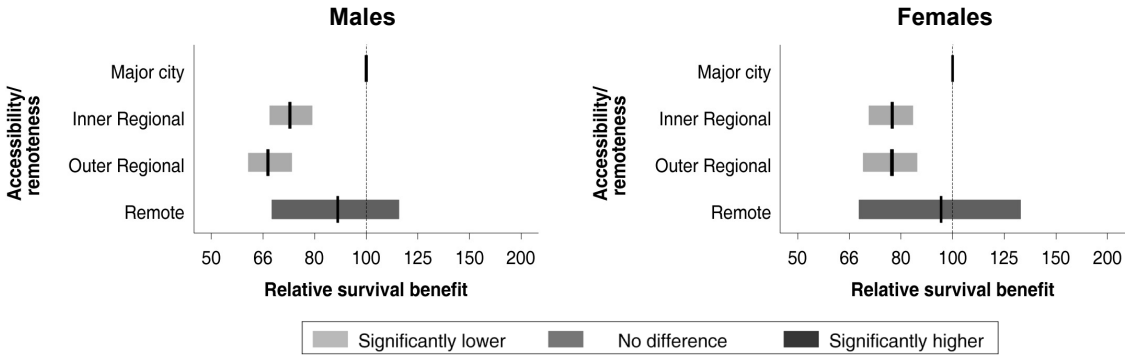
Notes:
1. Relative survival calculated using the period approach, for persons aged 0-89 years at diagnosis.
2. Data are for 'at risk' cases in the period 1996-2005.
3. Geographic regions were based on place of usual residence at time of diagnosis.
4. 5-year relative survival benefit was expressed in comparison to the Queensland average (i.e. relative survival benefit = 100 for Queensland average).
5. Vertical bar shows the estimated relative benefit, with the corresponding 95% confidence interval indicated by the shaded area.
6. Relative benefit estimates have been 'shrunk' to adjust for small area variations.

Statistical test results for overall geographic variation: **Males** Z=3.09, p=0.009.
Females Z=3.13, p=0.008.

7.2.2 Colorectal cancer survival by accessibility/remoteness

Five-year relative survival from colorectal cancer for both males and females living in inner regional and outer regional areas of Queensland was significantly poorer compared to their major city counterparts (Figure 7.5). Relative survival among males from inner regional and outer regional areas was 27% and 33% lower than major city residents respectively, while relative survival among females living in either inner regional or outer regional parts of Queensland was 22% lower compared to those in major cities. There were no significant differences in survival for people living in remote areas compared to major cities, although there is large uncertainty associated with these estimates due to the small numbers of colorectal cancer cases in remote areas.

Figure 7.5: Relative benefit of 5-year survival for colorectal cancer by accessibility/remoteness, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

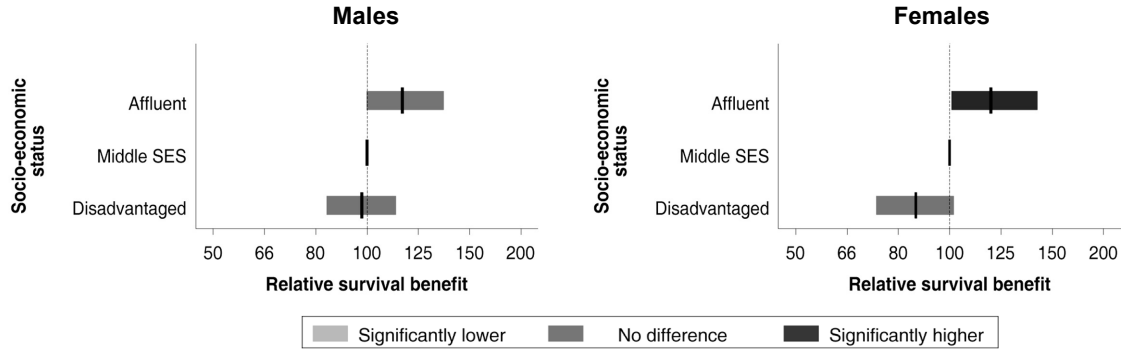
Notes:
1. Relative survival calculated using the period approach, for persons aged 0-89 years at diagnosis.
2. Data are for 'at risk' cases in the period 1996-2005.
3. Accessibility/remoteness categories were based on place of usual residence at time of diagnosis.
4. Accessibility/remoteness was defined using the ARIA+ index (see Appendix B).
5. 5-year relative survival benefit was expressed in comparison to the to the reference category of 'Major city' (i.e. relative survival benefit = 100 for 'Major city').
6. Vertical bar shows the estimated relative benefit, with the corresponding 95% confidence interval indicated by the shaded area.

Statistical test results for overall geographic variation: **Males** Chi-sq=95.99, df=3, p<0.001. **Females** Chi-sq=42.19, df=3, p<0.001.

7.2.3 Colorectal cancer survival by socio-economic status

Female colorectal cancer patients living in more affluent areas had a relative survival benefit 20% higher when compared to females from areas of middle socio-economic status, while those from disadvantaged areas tended to have poorer survival (Figure 7.6). A similar pattern for colorectal survival by socio-economic status was also observed among males in Queensland, although the differences were not as large and failed to reach statistical significance.

Figure 7.6: Relative benefit of 5-year survival for colorectal cancer by socio-economic status, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

Notes:
1. Relative survival calculated using the period approach, for persons aged 0-89 years at diagnosis.
2. Data are for 'at risk' cases in the period 1996-2005.
3. Socio-economic status categories were based on place of usual residence at time of diagnosis.
4. Socio-economic status was defined using the SEIFA index of economic disadvantage (see Appendix B).
5. 5-year relative survival benefit was expressed in comparison to the reference category of 'Middle SES' (i.e. relative survival benefit = 100 for 'Middle SES').
6. Vertical bar shows the estimated relative benefit, with the corresponding 95% confidence interval indicated by the shaded area.

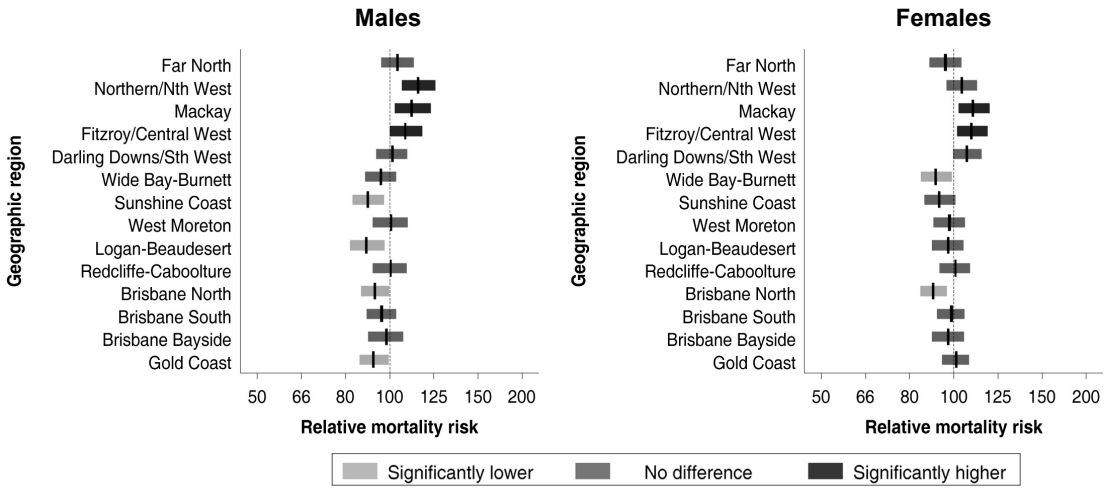
Statistical test results for overall geographic variation: **Males** Chi-sq=4.18, df=2, p=0.124. **Females** Chi-sq=7.81, df=2, p=0.020.

7.3 Are there differences in colorectal cancer mortality within Queensland?

7.3.1 Colorectal cancer mortality by geographic region

Among males in Queensland, the relative risk of dying from colorectal cancer was higher in the Northern/North-West (16% higher), Mackay (12% higher) and Fitzroy/Central West (9% higher) regions, while the Logan-Beaudesert (11% lower), Sunshine Coast (10% lower), Brisbane North and Gold Coast (both 7% lower) regions had a decreased risk of colorectal cancer mortality compared to the state average (Figure 7.7). A similar pattern was observed throughout the state for females, with an increased risk of colorectal cancer mortality among females in the Mackay (11% higher) and Fitzroy/Central West (10% higher) regions, but a decreased risk in the Brisbane North (9% lower) and Wide Bay-Burnett (8% lower) regions.

Figure 7.7: Relative risk of colorectal cancer mortality by geographic region, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

Notes:
1. Geographic regions were based on place of usual residence at time of diagnosis.
2. Relative mortality risk was expressed in comparison to the Queensland average (i.e. relative mortality risk = 100 for Queensland average).
3. Vertical bar shows the estimated relative risk, with the corresponding 95% confidence interval indicated by the shaded area.
4. Relative risk estimates have been 'shrunk' to adjust for small area variations.

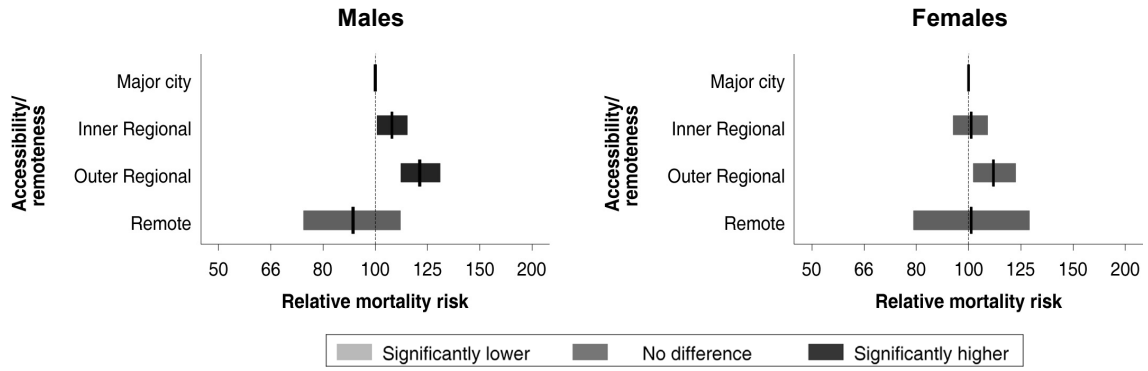
Statistical test results for overall geographic variation: **Males** Z=3.00, p=0.010. **Females** Z=2.35, p=0.035.

7.3.2 Colorectal cancer mortality by accessibility/remoteness

Males in inner and outer regional areas were more likely to die from colorectal cancer than those in major cities, with increased risks of 8% and 21%, respectively (Figure 7.8). Although the overall variation in colorectal cancer mortality by remoteness of residence among females was not significant, those in outer regional areas had a higher risk of dying compared to those in the major city category. These results are in line with the inequalities in survival reported by accessibility/ remoteness (see Section 7.2.2).

At the national level, colorectal cancer mortality rates were significantly higher among both sexes in inner regional and outer regional areas, and significantly lower among males in very remote parts of Australia.[123]

Figure 7.8: Relative risk of colorectal cancer mortality by accessibility/remoteness, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

Notes:
1. Accessibility/remoteness categories were based on place of usual residence at time of diagnosis.
2. Accessibility/remoteness was defined using the ARIA+ index (see Appendix B).
3. Relative incidence risk was expressed in comparison to the reference category of 'Major city' (i.e. relative incidence risk = 100 for 'Major city').
4. Vertical bar shows the estimated relative risk, with the corresponding 95% confidence interval indicated by the shaded area.

Statistical test results for overall geographic variation:
Males Chi-sq=25.69, df=3, p<0.001.
Females Chi-sq=6.04, df=3, p=0.110.

Comment 7.3 – Issues affecting the survival of colorectal cancer patients living in rural/remote areas or socio-economically disadvantaged areas

Geographic inequalities in survival for patients diagnosed with colorectal cancer have been reported in several Australian states, with people living in rural/regional areas generally experiencing poorer outcomes.[211,219,220] Results from Australia[221] and overseas[222-224] demonstrate that colorectal cancer survival rates also tend to be moderately lower among deprived populations compared to the most affluent.

In response to these findings, the Cancer Council Queensland is planning a study to investigate what could be causing inequalities in colorectal cancer survival throughout the state. Potential causes of the observed survival inequalities are complex, and may encompass:

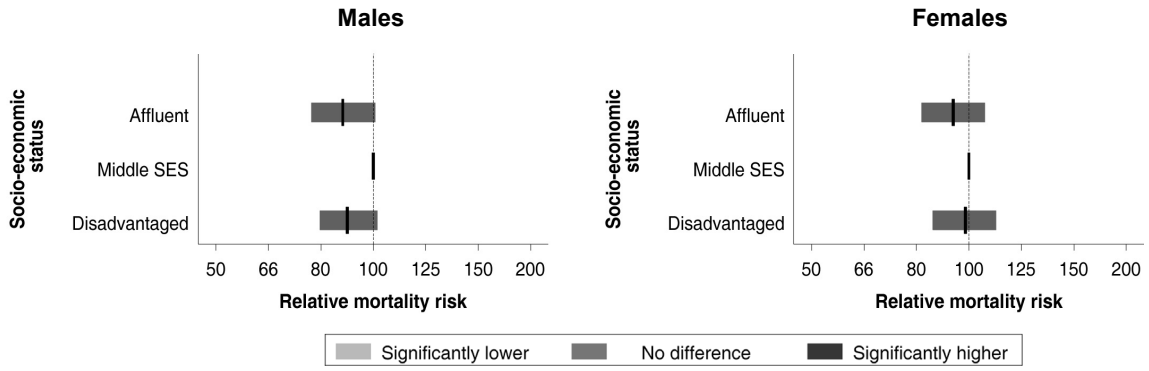
- tumour characteristics, particularly stage at diagnosis;[225-227]
- patient characteristics, such as health-related behaviours, race and comorbid diseases;[226-228] and
- access to and quality of medical services.[227-231]

For example, rural residence and lower levels of education have both been associated with increased delay to diagnosis for colorectal cancer,[84] which may result in more advanced stage at diagnosis.

7.3.3 Colorectal cancer mortality by socio-economic status

There were no differences in colorectal cancer mortality by socio-economic status in Queensland (Figure 7.9), although males in both the most affluent and the most disadvantaged areas of the state tended to have a lower risk of mortality from colorectal cancer.

Figure 7.9: Relative risk of colorectal cancer mortality by socio-economic status, Queensland, 1996-2005



Data source: Queensland Cancer Registry.

Notes:
1. Socio-economic status categories were based on place of usual residence at time of diagnosis.
2. Socio-economic status was defined using the SEIFA index of economic disadvantage (see Appendix B).
3. Relative incidence risk was expressed in comparison to the reference category of 'Middle SES' (i.e. relative incidence risk = 100 for 'Middle SES').
4. Vertical bar shows the estimated relative risk, with the corresponding 95% confidence interval indicated by the shaded area.

Statistical test results for overall geographic variation:
Males Chi-sq=6.08, df=2, p=0.048.
Females Chi-sq=0.85, df=2, p=0.655.

Comment 7.4 – Colorectal cancer among Indigenous Australians

Despite limitations regarding the completeness of information about cancer for Indigenous Australians, available data indicates that incidence rates of colorectal cancer are considerably lower among Indigenous Australians compared to non-Indigenous people.[232,233] For example, the age-standardised incidence rate of colorectal cancer in rural and remote Indigenous communities in Queensland was only 20% of that expected in the general population among males and 40% among females, although these results need to be interpreted with some caution as they may reflect competing causes of deaths, as well as a lack of diagnostic services for cancer for Indigenous people.[233] It should also be noted that incidence rate ratios for colorectal cancer were higher for younger compared to older Indigenous people, consistent with generation-related exposure to various risk factors such as diet and physical activity.[232]

Once diagnosed with colorectal cancer, there is evidence that Indigenous Australians tend to have poorer survival than their non-Indigenous counterparts.[194] More generally, a study in Queensland which matched Indigenous and non-Indigenous patients by type of cancer, age, sex, year of diagnosis and place of residence, found that Indigenous people were around 50% more likely to die from their cancer.[234] The reasons for differences in cancer survival by Indigenous status are not yet fully known. Factors that help to explain some of the disparity in survival for Indigenous cancer patients include being diagnosed at a later stage, being less likely to receive adequate treatment (perhaps due to cultural, language and socio-economic barriers) and having a higher prevalence of comorbidities compared to the general population.[232,234]

Appendix A – Other sources of information

A.1 Related publications on cancer in Queensland

Queensland Cancer Registry, 2008. *Cancer in Queensland: Incidence and Mortality, 1982 to 2005*. QCR, The Cancer Council Queensland and Queensland Health. (www.health.qld.gov.au/hic/qcr2005/1982-2005.pdf)

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

Wills R, Dinh M, Khor S, Coory M, 2007. *Mortality and incidence trends for leading cancers in Queensland, 1982 to 2004*. Queensland Health, Information Circular 76. (www.health.qld.gov.au/publications/infocirc/info76.pdf)

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

Baade P, Fritschi L, Aitken J, 2005. *Geographical differentials in cancer incidence and survival in Queensland: 1996-2002*. Viertel Centre for Research in Cancer Control, Queensland Cancer Fund. (www.cancerqld.org.au/downloads/Geographical%20differentials%20report.pdf)

Youlden D, Baade P, Coory M, 2005. *Cancer Survival in Queensland, 2002*. Queensland Health and Queensland Cancer Fund. (www.qldcancer.com.au/pdf/research/survival.asp.pdf)

Cancer Council Queensland, 2008. *Queensland Cancer Statistics On-Line*. Viertel Centre for Research in Cancer Control, CCQ. (www.cancerqld.org.au/research/QCSOL.asp).

A.2 Published papers from the Queensland Colorectal Cancer Quality of Life Study

Lynch BM, Youlden D, Fritschi L, et al., 2008. Self-reported information on the diagnosis of colorectal cancer was reliable but not necessarily valid. *J Clin Epidemiol*, 61(5):498-504.

Hawkes AL, Lynch BM, Youlden DR, et al., 2008. Health behaviors of Australian colorectal cancer survivors, compared with noncancer population controls. *Support Care Cancer* [in press].

Lynch BM, Steginga SK, Hawkes AL, et al., 2008. Describing and predicting psychological distress after colorectal cancer. *Cancer*, 112(6):1363-1370.

Lynch BM, Cerin E, Newman B, et al., 2007. Physical activity, activity change, and their correlates in a population-based sample of colorectal cancer survivors. *Ann Behav Med*, 34(2):135-143.

Lynch BM, Cerin E, Owen N, et al., 2007. Associations of leisure-time physical activity with quality of life in a large, population-based sample of colorectal cancer survivors. *Cancer Causes Control*, 18(7):735-742.

Lynch BM, Baade P, Fritschi L, et al., 2007. Modes of presentation and pathways to diagnosis of colorectal cancer in Queensland. *Med J Aust*, 186(6):288-291.

Lynch BM, Owen N, Newman B, et al., 2006. Reliability of a measure of prediagnosis physical activity for cancer survivors. *Med Sci Sports Exerc*, 38(4):715-719.

A.3 Published papers from the Queensland Cancer Risk Study

Hausdorf K, Rogers C, Whiteman D, et al., 2008. Rating access to health care: Are there differences according to geographical region? *Aust NZ J Public Health*, 32(3):246-249.

Carrière P, Baade P, Newman B, et al., 2007. Cancer screening in Queensland men. *Med J Aust*, 186(8):404-407.

Lawler SP, Kvaskoff M, DiSipio T, et al., 2006. Solaria use in Queensland, Australia. *Aust N Z J Public Health*, 30(5):479-482.

DiSipio T, Rogers C, Newman B, et al., 2006. The Queensland Cancer Risk Study: behavioural risk factor results. *Aust N Z J Public Health*, 30(4):375-382.

A.4 Internet resources

The internet resources listed below are intended to provide additional information to complement this report. Information contained on some of these websites may not be specifically endorsed by the Cancer Council Queensland, and should not take the place of medical advice. Instead, readers are encouraged to discuss any specific issues with their medical practitioner.

- *Cancer Council Queensland* (www.cancerqld.org.au) and *Cancer Council Australia* (www.cancer.org.au)
  These organisations provide support, education and resource material for cancer patients, their families and the broader community. (Australia)

- *Queensland Health* (www.health.qld.gov.au/bowelcancer) and *Commonwealth Department of Health and Ageing* (www.cancerscreening.gov.au)
  Information about colorectal cancer screening programs in Queensland and Australia. (Australia)

- *Health Insite* (http://www.healthinsite.gov.au/topics/Bowel_Cancer)
  Provides links to Australian websites with additional information on colorectal cancer. (Australia)

- *Cancer Voices Australia* (www.cancervoicesaustralia.org.au)
  A national network providing a forum for people affected by cancer, with the aim of advocating for improved services and care. (Australia)

- *National Health and Medical Research Council* (www.nhmrc.gov.au/publications/synopses/cp106/_files/cp106.pdf)
  Clinical practice guidelines for the prevention, early detection and management of colorectal cancer. (Australia)

- *American Cancer Society* (www.cancer.org)
  Information on risk factors, prevention and treatment options for a range of cancers. Also includes up to date information on the latest research into cancer. (United States)

Appendix B – Methods

B.1 Colorectal cancer classifications

The definitions for type of cancer that are used throughout this report are consistent with those currently used by the Queensland Cancer Registry in their annual report.[4] These definitions are based on the World Health Organization's International Classification of Diseases for Oncology, 3rd edition (ICD-O3).[235] Colorectal cancer was defined as the ICD-O3 codes C18-C20, C218.

Colorectal cancer site groupings were defined based on advice received from the Queensland Cancer Registry, and are detailed in Table B.1.

Table B.1: Definitions used for colorectal cancer site groups

Site	ICD-O3 code
Right colon cancer	C180-C184
Left colon cancer	C185-C187
Unknown colon cancer	C188-C189
Rectal cancer	C19-C20, C218

B.2 Data sources

Australian Bureau of Statistics (ABS)

Estimated resident population data were obtained from the Australian Bureau of Statistics.[236] These data include estimated population counts by age group, sex, year and geographical area of residence. Population data were primarily used in this report as the denominator for calculating rates and for age-standardisation (see Appendix B.4).

De-identified unit record mortality data for all causes of death for Queensland residents were also purchased from the Australian Bureau of Statistics.[199] Permission was required from the Registrar of Births, Deaths and Marriages in every State and Territory in Australia to access these data, since some Queensland residents die interstate.

Note that cancer mortality data are available from both the Australian Bureau of Statistics and the Queensland Cancer Registry. Differences in coding practices and residential criteria can result in slight differences in the counts and rates calculated from these two data sources.

Australian Institute of Health and Welfare (AIHW)

National and interstate colorectal cancer incidence data for the period 2000-2004 were published on-line by the Australian Institute of Health and Welfare.[118] Corresponding colorectal cancer mortality data were obtained from the State and Territories General Record of Incidence of Mortality (GRIM) books.[206] The State and Territories GRIM books are available on request from the AIHW, and include information on cause of death, year of registration of death, age group, sex and State/Territory of usual residence.

Incidence trend data for Australia were also sourced from the AIWH, via the online Australian Cancer Incidence and Mortality (ACIM) books.[131] These are interactive spreadsheets containing incidence data from 1982 to 2003 and mortality data from 1968 to 2005 by age and sex for major types of cancer.

Canadian Council of Cancer Registries (CCCR)

Incidence trends for Canada were sourced from the Canadian Council of Cancer Registries and downloaded from the on-line surveillance data provided by the Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada.[132] The CCCR is a collaboration of the 13 Canadian provincial and territorial cancer registries and the Health Statistics Division of Statistics Canada, and collects information on all cancers diagnosed throughout the country. Aggregated data by type of cancer, age group, sex and incidence year were available between 1992-2004.

Cancer Research UK

Cancer Research UK is a dedicated cancer research charity located in the United Kingdom. Their website includes the latest cancer statistics for the UK.[138] Aggregated data to calculate incidence trends for colorectal cancer in the UK from 1993 to 2004, including year of diagnosis, age group and sex, were obtained on request from the Statistical Information team at Cancer Research UK.

Hong Kong Cancer Registry

The Hong Kong Cancer Registry is a population-based cancer registry which has collected cancer incidence data since 1963.[133] Although notification is not compulsory, published data are now estimated to be almost complete. Aggregated data by type of cancer, age group, sex and incidence year were available between 1983-2005.

National Board of Health and Welfare (Sweden)

The National Board of Health and Welfare is a Swedish government agency established in 1968. Its responsibilities include administration of health data such as the national cancer register, which has collected all primary diagnoses of cancer since 1958. Aggregated incidence count data (by sex and age group) for 1982 to 2005 were obtained from their online statistical databases.[137]

National Cancer Centre (Japan)

Data on cancer incidence in Japan were estimated by the Centre for Cancer Control and Information Services, National Cancer Centre, using information collected by a network of population-based cancer registries. National estimates were available from 1975 to 2001.[135] There are currently fifteen cancer registries in Japan, but only those registries with data of sufficient quality (including Miyagi, Yamagata, Kanagawa, Niigata, Fukui, Shiga, Osaka, Okayama, Saga and Nagasaki) were used in the national incidence calculations.[237] Together, these 10 registries cover 24% of Japan's population.

National Cancer Institute (United States)

The Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute is a principal source of cancer incidence and survival data in the United States.[139] Incidence trend data from SEER were available from 1975 to 2005 for nine cancer registry areas: the states of Connecticut, Iowa, New Mexico, Utah, and Hawaii, the metropolitan areas of Detroit, San Francisco-Oakland and Atlanta in addition to the 13-county Seattle-Puget Sound area. These SEER-9 cancer registries cover approximately 10% of the population in the USA.[238] Another eight registries have been added more recently, but have not been included in the incidence trend data shown in this report.

National Cancer Registry of Ireland (NCRI)

The National Cancer Registry of Ireland collects population-based cancer statistics throughout the Republic of Ireland. A de-identified unit record dataset can be downloaded from the NCRI website,[134] which contains details on the type of cancer, year of diagnosis, age group and sex for cancer incidence data between 1994 to 2005.

Netherlands Cancer Registry

The Netherlands Cancer Registry was established in 1989 and provides incidence data on a national level. Data is compiled from nine regional Comprehensive Cancer Centres. Tables of aggregated cancer incidence data were available on-line for the years 1989 to 2003.[136]

Queensland Cancer Registry (QCR)

The majority of data on colorectal cancer in Queensland reported in this publication was acquired directly from the Queensland Cancer Registry (QCR) after obtaining all necessary approvals in accordance with the *Public Health Act 2005*. The data files provided by the QCR were either confidentialised or aggregated so that no individuals could be identified from the data.

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 2005.[4] The 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. Queensland pathology laboratories are also required to provide copies of pathology reports for cancer specimens. Information regarding the deaths of people with cancer is provided to the QCR from the Registrar of Births, Deaths and Marriages.

Further details about the QCR can be found in their annual data report.[4]

Queensland Cancer Risk Study (QCRS)

The QCRS was a state-wide survey conducted between February and November 2004 by the Queensland Cancer Fund (now called Cancer Council Queensland). It examined self-reported cancer risk factors, knowledge and attitudes as well as screening activity for 9,419 people aged 20-75 years who responded to a computer-assisted telephone interview. Definitions of the risk factors relevant to this report are given in Appendix B.3. Further information on the survey methodology is available in the Queensland Cancer Risk Study report.[5]

Note that self-reported data is unlikely to be as accurate as measured data, particularly for medical conditions. For example, Australian research has found that half of the people with diabetes have not been diagnosed.[239] The relatively low overall response rate of 46% may also limit the representativeness of the results to the entire Queensland population

Queensland Health

Information on median age at death and diagnosis and de-identified data at the whole of State level required for survival and prevalence calculations for cancers other than colorectal cancer were provided by the Health Statistics Centre, Queensland Health. (Note that this information could not be derived from the extract supplied by the QCR, which only contained data on colorectal cancer - see above).

World Health Organization (WHO)

Mortality and population data used for calculating international trends in colorectal cancer deaths were extracted from the WHO mortality database.[207] Data were available by cause of death, year of death, age group and sex. Records were selected when the death was coded to colorectal cancer, using the ninth and tenth revisions of the International Classification of Disease. For countries where anal cancers were excluded, ICD9 = 153, 1540, 1541 and ICD10 = C18-C20; and for countries where anal cancers were included, ICD9 = 153-154 and ICD10 = C18-C21.

Colorectal cancer mortality trends were calculated from the WHO data between 1982 to 2005 for 24 selected countries (including Australia) which had sufficient quality and quantity of information (although the years of data available varied between countries). The selected countries averaged

at least 200 deaths due to colorectal cancer per year for each sex, and at least 80% of all deaths were registered. The exception was China, where the WHO mortality data were from a sample of less than 10% of all deaths (from selected urban and rural areas).

Recent international colorectal cancer incidence and mortality rates were also sourced through the WHO. Data were obtained from the GLOBOCAN 2002 database, which is administered by the WHO International Agency for Research on Cancer (IARC).[111] This database contains estimates of incidence, mortality and prevalence as at 2002 by cancer site, broad age group and sex for many countries. The quality of the data for each country mainly depends on the coverage of the cancer registry and mortality data (i.e. entire population or selected regions), and the recency of the data used to calculate the 2002 estimates.

B.3 Definitions of risk factors for colorectal cancer

Alcohol consumption

Alcohol consumption guidelines are based on the Dietary Guidelines for Australian Adults, which recommend no more than 2 standard drinks/day for males and 1 standard drink/day for females.[240]

Diabetes

People were classified as having diabetes if they answered 'yes' to the question: "Has a doctor ever told you that you have or had diabetes/high blood sugar?". This question was only administered by mail to a sub-sample of the telephone respondents (around 2650 people).

Fruit and vegetable consumption

Insufficient fruit consumption was defined as usually having less than 2 serves of fruit each day, and insufficient vegetable consumption was defined as usually having less than 5 serves of vegetables each day.

Physical activity

National guidelines recommend the accumulation of the equivalent of at least 150 minutes of moderate-intensity activity per week, which is considered the minimum level of physical activity to confer a health benefit.[241] Respondents were categorised as being either inactive (0 minutes per week), insufficiently active (1 – 149 minutes per week) or sufficiently active (150 minutes or more per week).

To calculate the time spent in activity each week, activities were classified as moderate activity (e.g. gentle swimming, social tennis, golf, etc) or vigorous activity (e.g. jogging, cycling, aerobics, competitive tennis, etc). The total time spent in physical activity was then the sum of walking, moderate activity, and vigorous activity (weighted by 2). Those classified as either sedentary or insufficiently active were combined to give the prevalence of insufficient physical activity.

Overweight and obesity

The body mass index (BMI) of an individual is calculated as weight in kilograms divided by the square of height in metres. Overweight is defined as BMI between 25 and 29.99 kg/m^2, while obesity is defined as BMI greater than or equal to 30 kg/m^2.

Smoking status

Smoking status was originally defined as 5 categories: life-long non-smokers (those who have never smoked at least 100 cigarettes in their lifetime), current daily smokers, current intermittent smokers (smoke on some days), recent quitters (quit smoking <12 months ago) and long-term ex-smokers (quit smoking 12 months ago or longer).[242] These were re-classified into 3 groups: current smoker, ex-smoker and never smoker. The current smoker category included daily and intermittent smokers, while ex-smokers were composed of recent quitters and long-term ex-smokers.

B.4 Methods and measures

Most of the data analysis contained in this report was performed using SAS software v9.1 (© 2002-2003 SAS Institute Inc. SAS).[243] Shrunken estimates were modelled using SAS software v8.2 (© 1999-2001 SAS Institute Inc. SAS),[244] and the yearly percentage changes for incidence and mortality trends were calculated using Joinpoint software v3.0.[126]

Age-standardised rates

Age-standardised rates attempt to adjust for variation in age structures in different populations (either different geographical areas or the same population across time). There are two methods of age-standardisation – direct and indirect.

Directly standardised rates were used for comparing incidence or mortality rates across states or countries and for calculating incidence, mortality or prevalence trends. The method involves applying age-specific rates from the population of interest (e.g. Queensland) to a standard population, which in this report was the Australian Standard Population 2001 (see below), unless otherwise specified.

Indirect standardisation was used for calculating incidence and mortality rates in the chapter on geographical differences (Chapter 6). This approach was used because the age-specific rates may be less stable when the population of interest is smaller e.g. in the Northern/North-West area. Using this method, the age-specific rates for the standard population (Queensland) were applied to the population of interest. The standardised incidence or mortality rate was then derived by dividing the observed count by the expected value that was calculated in the previous step. These indirectly standardised rates were then used to compute the relative risk of incidence or mortality (see below).

Five-year age groups up to 85 years and over were used for all of the age-standardisation, except for the data obtained from GLOBOCAN 2002, where only broad age groups were available (i.e. 0-14 years, 15-44 years, 45-54 years, 55-64 years, 65+ years).

Australian Standard Population (2001)

The standard population currently used for direct age-standardisation within Australia is the 2001 Australian estimated resident population, based on data collected in the 2001 national census by the Australian Bureau of Statistics.[245]

Confidence intervals

All estimates are calculated with some degree of imprecision. The level of accuracy is typically reported in terms of a confidence interval, which specifies a range of values in which the true data point is expected to occur with a given level of certainty. For example, a 5-year survival rate may be estimated as 64.9% with a 95% confidence interval of 63.6%-66.2%. This means that there is a 95% probability that the true survival rate will be somewhere between 63.6% and 66.2%.

Due to the intended non-statistical audience of this report, confidence intervals have generally not been included on graphs. However, detailed data tables (which include the confidence intervals), are available from the authors on request (see contact details at the front of the report).

Incidence

The incidence of a particular disease (e.g. colorectal cancer) is the number of new cases diagnosed in a specified population during a given time period (usually one year). Incidence is also commonly expressed as a rate (e.g. per 100,000 population). Since the risk of most cancers varies with age, it is common practice to age-standardise incidence rates to allow for more valid comparisons between populations (see “Age-standardised rates”).

Mortality

Mortality measures the number of deaths caused by a given condition (e.g. colorectal cancer) within a specified population over a defined time period (usually one year). Similar to incidence, mortality can also be expressed as a rate (per 100,000 population), and these rates are often age-standardised to account for variation in the age structures of different populations (see "Age-standardised rates").

Premature mortality

Premature mortality (measured by years of life lost, or YLL) is based on how much of their "expected" lifetime a person loses when they die. For example, a person who dies from colorectal cancer at 40 years of age would lose a greater number of years of (expected) life than a person who dies from colorectal cancer at age 70.

The calculation of premature mortality in this report was based on the average YLL per death by age group and sex that were used in the 2003 Australian Burden of Disease and Injury study (using a 3% discount rate and no age weighting).[205] This information was then applied to mortality data from the Queensland Cancer Registry to ascertain the total YLL per year and the average YLL per death by type of cancer and by the specific colorectal cancer sites.

Prevalence

Although incidence is an important measure when describing the short-term impact of colorectal cancer, it only describes the number of newly diagnosed cancers. People who had been diagnosed previously are not included in incidence counts for subsequent years, even though they may still be alive and require continuing medical treatment and support.

Health care planners and cancer support personnel need to know how many people remain alive following a diagnosis of colorectal cancer. Prevalence is one measure that can provide this information. The prevalence of colorectal cancer represents the number of people who had a diagnosis of colorectal cancer in the past and are still alive at a specified point in time.

Prevalence is impacted by both the number of new cancers (incidence) and the length of time patients survive after being diagnosed. Even though two types of cancer might have similar incidence, if one cancer has low survival rates and another cancer has higher survival rates, then the prevalence of the second cancer will be greater.

In this report we have presented "limited duration" prevalence, which counts cases who remain alive at a given time point (e.g. 31st December 2005) as prevalent when they were diagnosed within a specific time period. Limited duration prevalence estimates for colorectal cancer were presented for 1-, 5-, 10-, 15- and 20-year time periods. Note that persons diagnosed with cancer before 1982 (when the Queensland Cancer Registry began operating) were not included in any prevalence estimates. For example, 20-year limited duration prevalence for colorectal cancer could not be calculated for Queensland prior to the end of 2001.

Relative risk of incidence or mortality

Geographical differences in incidence and mortality were assessed using age-adjusted Poisson models. In each model the age-specific counts of incidence or mortality over a ten year period from 1996-2005 were regressed against age group and geographical area (both as categorical variables). Modelling was performed separately for males and females. A log-link function was used in the Poisson models, with the offset variable being the log of the age-specific population. Relative risks for incidence or mortality were then calculated by taking the exponential of the regression parameter estimate for the geographical categories, and corresponding 95% confidence intervals were obtained from the standard error of the parameter estimate.

A further adjustment was made to the relative risk estimates for geographic regions (14 areas) to take into account the possible effects of small numbers (see "Shrunken estimates"). This adjustment was not considered appropriate for the analyses by remoteness/accessibility (four categories) or socio-economic status (three categories).

Relative risks that were significantly greater than 100 indicate an increased risk of colorectal cancer diagnosis or death compared to the reference group, and values significantly less than 100 suggest a reduced risk of diagnosis or death.

Assessment of the overall effect of the geographical differences was made by calculating the difference in model deviance between the full model (including age and geographical area) and the age model alone. This difference in deviance was then compared to the chi-squared statistic with the appropriate degrees of freedom.

Shrunken estimates

Despite combining ten years of data to increase the number of cases or deaths of colorectal cancer available for analysis in each geographical area, the numbers were still small in some areas, particularly in the more rural and remote regions. This can make the relative risk estimates for incidence, mortality or survival unstable and the resulting interpretation difficult.

To overcome this problem, a mathematical method known as the Empirical Bayes (EB) method was used to make allowance for small numbers when looking at the variation across geographical regions. The method "shrinks" the estimates for each region towards the state average. The degree of "shrinkage" generally increases as the area-specific counts become smaller.

A detailed description of the EB method is available in a Cancer Council New South Wales report on cancer incidence, mortality and survival by Area Health Services[246] and a related research paper.[247]

Survival

Survival time is defined as the length of time between when a person is diagnosed with a disease and when they die. However, since the eventual survival time of everyone diagnosed with cancer is not known (for example they may still be alive), statistical adjustments are required to take into account those unknown or "censored" survival times.

In this report, relative survival was used to estimate the proportion of people who survived for different lengths of time. 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 method does not require knowledge of the specific cause of death, only knowledge of whether the patient has died. Relative survival is the most commonly presented measure of cancer survival when using data from population-based cancer registries.[248]

Patients who were still alive at 31st December 2005 were considered censored. Persons aged 90 years and over at time of diagnosis have been excluded from the calculation of survival estimates, in order to minimise misclassification of deaths due to colorectal cancer, as specifying the exact cause of death is more difficult amongst the very elderly. Patients whose cancer diagnosis was based on death certificate or autopsy only have also been excluded, as well as those with a survival time of zero days or less.

Relative survival estimates can be calculated using either the period or cohort methods.[249] The period method has been used throughout this report. Although previous cancer survival estimates for Queensland have been based on the more traditional cohort method,[250] the period approach is gaining popularity and is recognised as providing more up-to-date survival estimates.[251]

A suite of computer programs developed by Paul Dickman from the Karolinska Institutet in Sweden[252] were used to generate the relative survival estimates. These programs use a life table (or actuarial) method for calculating observed survival. This approach involves dividing the total period being studied into a series of discrete time intervals. Survival probabilities were calculated for each of these intervals, and then multiplied together to produce the observed survival estimate. Expected survival (based on total Queensland mortality data obtained from the Australian Bureau of Statistics[199]) was calculated based on the Ederer II method.[253] Three-year averages for

expected survival were used to minimise the effects of year to year variation. Relative survival was then obtained from the ratio of observed survival to expected survival.

Note that differences in survival within Queensland, throughout Australia and internationally need to be interpreted with caution. It is possible that differences may be real; for example there may be a higher proportion of colorectal cancers diagnosed at a more advanced stage in some areas or variation in access to medical care or the use of treatments. However, there are also a range of other reasons that may artificially alter survival times, such as differing data collection, coding or statistical practices.[196,250]

Survival benefit

Modelling of the variation in relative survival estimates within Queensland was performed with a generalised linear model using exact survival times and a Poisson assumption (with logarithmic link and offset).[248] Models were fitted separately for males and females and were adjusted for age. Geographical and socio-demographic differences in survival were expressed in terms of a survival benefit (along with 95% confidence intervals), based on survival estimates up to and including 5-year survival.

A further adjustment was made to the survival benefit estimates by geographic region (14 areas) to take into account the possible effects of small numbers (see "Shrunken estimates"). This adjustment was not considered appropriate for the analyses by remoteness/accessibility (four categories) or socio-economic status (three categories).

A survival benefit significantly greater than 100 corresponds to improved survival compared to the reference group, while a survival benefit significantly less than 100 indicates poorer survival. Note that geographical differences in survival benefit within Queensland were based on the place of diagnosis, not the place of death.

Yearly percentage change (YPC)

The YPC is the yearly increase or decrease in incidence or mortality trends over the specified period, expressed as a percentage. Negative YPC values describe a decreasing trend and positive YPC values describe an increasing trend. A trend is taken to be statistically significant if the 95% confidence interval does not include zero.

YPC values in this report were calculated using a statistical method called joinpoint analysis, with software developed by the Statistical Research and Applications Branch of the National Cancer Institute.[126] The joinpoint method evaluates changing trends (in terms of both direction and magnitude) over successive segments of time. A joinpoint is the point at which the linear segment changes significantly.

The analysis begins with the assumption of constant change over time (i.e. no joinpoint). Up to three joinpoints were tested in each model, depending on the number of years of data available and the stability of the yearly estimates. The trend line with the fewest joinpoints which provided the best fit to the observed data, based on Monte Carlo permutation tests,[126] was selected.

B.5 Geographical and socio-demographic areas

Three area-based measures were analysed in this report: geographic region (14 areas), accessibility/remoteness (four categories) and socio-economic status (three categories). Each of these measures were defined to cover Queensland completely and without overlap, and were based on the person's place of usual residence when they were diagnosed with colorectal cancer.

Statistical local areas (SLAs) were the building blocks used to create the area-based groupings. SLAs are part of the Australian Standard Geographic Classification used by the Australian Bureau of Statistics.[254] They correspond either to Local Government Areas (LGAs) or suburbs in larger LGAs (e.g. Brisbane City). In 2005 there were 481 SLAs in Queensland.[254] For each of the area definitions, the data from the relevant SLAs in a specific category were first combined, and then all

analyses were undertaken on the combined data. Colorectal cancer records that had missing or undefined SLAs (about 0.4% of all records between 1996 and 2005) were excluded from the analysis.

Geographic region

The geographic regions include 14 distinct areas that cover Queensland (see Figure B.1). These areas correspond closely to the Health Service Districts that were previously used by Queensland Health (with some Districts aggregated).

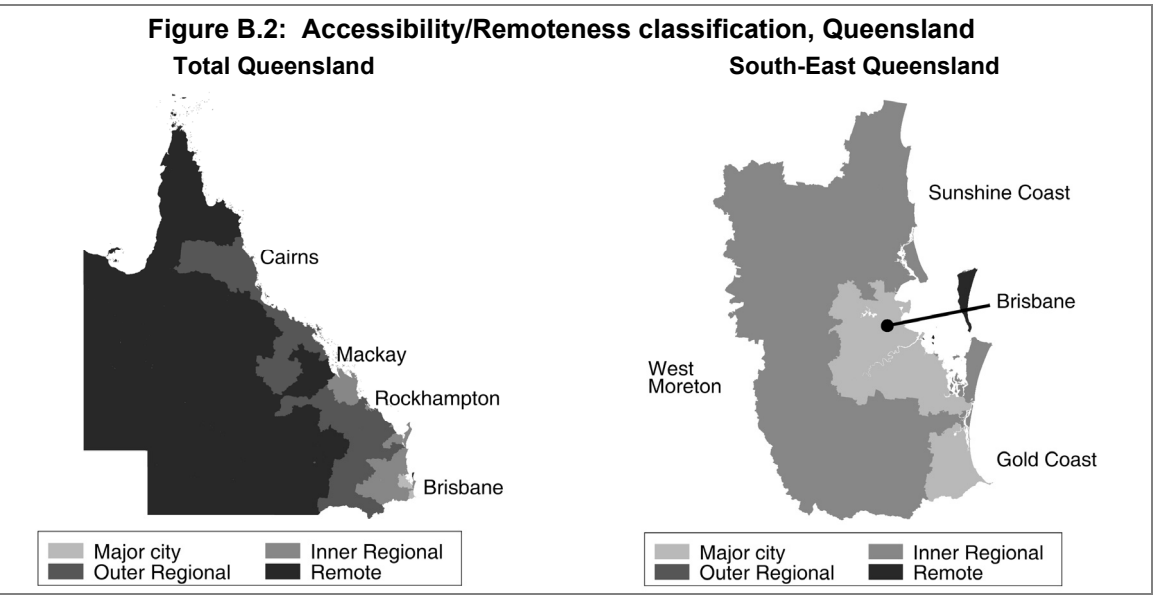
Total Queensland was used as the reference group for the analyses by geographic regions.

Figure B.1: Geographic regions, Queensland

Accessibility/Remoteness

Categories of accessibility/remoteness in Queensland used throughout this report were defined by the ARIA+ (Accessibility/Remoteness Index for Australia) classification (Figure B.2).[21]

Figure B.2: Accessibility/Remoteness classification, Queensland



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. 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 geographical remoteness classifications have been described elsewhere.[255]

The grouping of major city had the largest population and so was chosen as the reference category for the analyses by remoteness/accessibility.

Socio-economic status (SES)

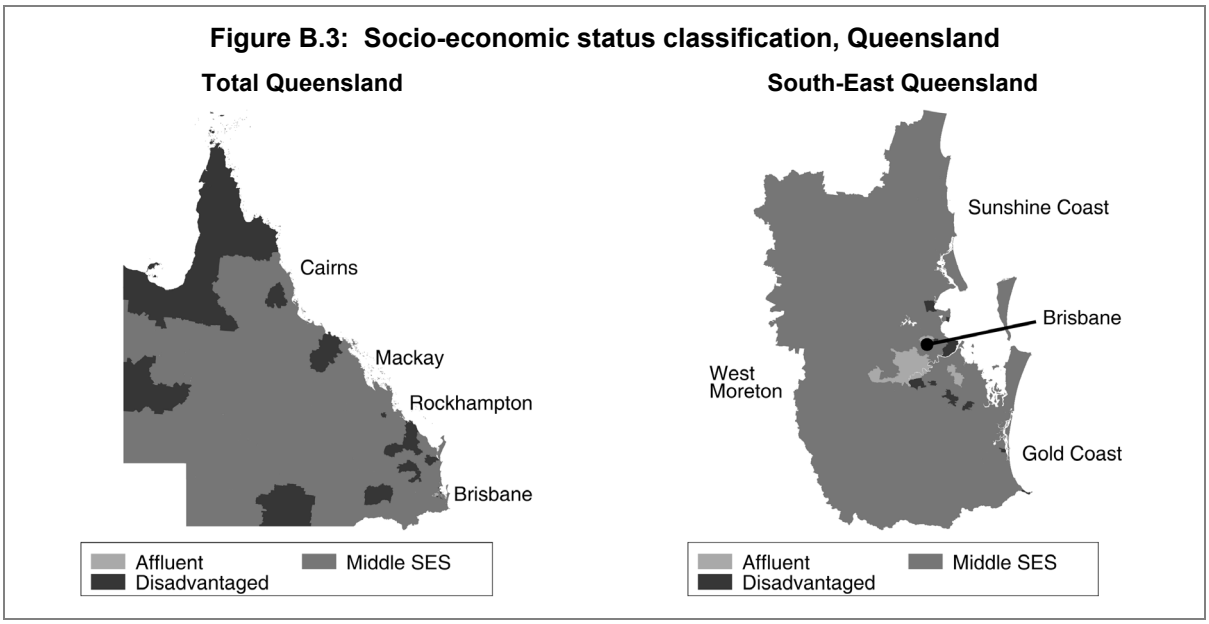
An area-based approach was used to define socio-economic status, according to the SLA where the person was living at the time of their diagnosis with colorectal cancer.

Using the Socio-Economic Indexes for Areas (SEIFA) index of relative socio-economic disadvantage compiled by the Australian Bureau of Statistics,[22] SLAs in Queensland were ranked from the most to the least disadvantaged. Four SEIFA indexes are available. The index of relative socio-economic disadvantage was based on the percentage of people in the SLA with low income, low educational attainment and who were unemployed or employed in relatively unskilled occupations. The top 10% of SLAs were assigned to the disadvantaged group, the bottom 10% to the affluent group, with the remaining 80% placed in the middle SES category (see Figure B.3). Note that the middle 80% of SLAs were not subdivided further due to many SLAs in Queensland including neighbourhoods with markedly different socio-economic characteristics.

The middle SES category was the largest group, so it was used as the reference category for the analyses by socio-economic status.

Further details of the SEIFA indexes are reported elsewhere,[22] with only minor changes to these published groups made to incorporate recent SLA boundary changes.

Figure B.3: Socio-economic status classification, Queensland



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