Current status of

female breast cancer

in Queensland, 1982 to 2006

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Cancer Council Queensland

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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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Table of Contents

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 fourth in a series, following earlier publications on prostate cancer,[2] lung cancer[3] and colorectal cancer.[4] The most recent data from the Queensland Cancer Registry[5] is used to describe breast cancer incidence, survival, mortality and prevalence among women in Queensland. Comparisons against Australian and international data are presented where applicable. Comment boxes throughout the report provide additional details from scientific literature to supplement the statistical information presented.

An outline of each section of the report, focusing on the main results, is given below:

Section 1 - Introduction

This section contains a brief description of the anatomy of the female breast, how cancer develops, differences between invasive and non-invasive breast cancers, and definitions for the different stages of breast cancer. An overview of the contents and limitations of the report is also included.

Section 2 - Risk Factors

The main risk factors that have been consistently demonstrated to influence the development of breast cancer are age, family history associated with genetic mutations, hormonal factors linked to reproductive and menstrual history, breast density, benign breast disease, obesity, and certain health-related behaviours, such as excessive alcohol consumption and insufficient physical activity.

Section 3 - Screening

More than 202,000 women were screened by BreastScreen Queensland during 2007, with a participation rate of 56% among women aged 50-69 years (the target group) over the two year period 2006-2007. This participation rate was slightly higher than the corresponding Australian average, but fell short of the goal of 70%. Participation rates within BreastScreen Queensland tended to be higher in rural and remote areas (60% among women aged 50-69). The number of women being screened each year is continuing to rise, although participation rates have stabilised in recent years across all age groups.

While the majority of women who were screened (93%) did not have any sign of breast cancer, population screening detected 913 cases of invasive breast cancer among women in Queensland during 2007. The majority (60%) of invasive breast cancers detected by screening were small (15mm or less).

Section 4 - Incidence

Breast cancer was the most commonly diagnosed cancer among females in Queensland, accounting for 27% of all diagnoses between 2002-2006. A total of 2,491 women were diagnosed with breast cancer in Queensland during 2006, equating to an age-standardised rate of 116 cases per 100,000 females. The incidence of breast cancer in Queensland was similar to the national average, while Australia had the twelfth highest rate of breast cancer in the developed world.

Median age at diagnosis was younger for breast cancer patients (58 years) compared to most other types of cancer, with around one-quarter (26%) of female breast cancers diagnosed under the age of 50. Age-specific incidence rates were highest in the 65-69 age group at 360 cases per 100,000 females.

Stage I breast cancers (47%, 1101 cases per year) were only slightly more common than tumours which were more advanced at diagnosis, with 45% (or 1053 cases per year) classified as Stages II/III/IV.

Incidence rates of breast cancer in Queensland peaked in the year 2000, and have remained fairly stable since then (non-significant decrease of 0.9% per year between 2000-2006). There was a particularly strong downwards trend in incidence rates among women aged 50-69 years with Stage I tumours between 2001-2006. In contrast, the overall number of women diagnosed with breast cancer has continued to increase, and has almost tripled from 861 in 1982 to 2491 in 2006. Ongoing increases in the number of new cases is due to a combination of factors, including the introduction of population screening, changes in the prevalence of risk factors, and population growth and ageing.

There were wide variations in incidence rate trends for breast cancer among the countries for which data was available.

Section 5 - Survival

Survival among women with breast cancer in Queensland has shown ongoing improvement over the last few decades. Five-year relative survival increased from 74% for women who were at risk between 1982-1988 to 89% between 2001-2006.

Unlike most other types of cancer, there was generally only a small amount of variation in survival among breast cancer patients by their age at diagnosis. Women aged 40-69 years experienced the highest survival rates (5-year relative survival of 90%).

Stage at diagnosis has a large influence on breast cancer survival. Women with Stage I tumours had 5-year relative survival of 98%, compared to 83% for Stage II/III/IV breast cancers and 50% where stage was unknown.

Survival rates for breast cancer patients in Queensland were similar to the rest of Australia, and were higher than those reported in many other countries throughout the world.

Section 6 - Mortality

There were 432 female deaths caused by breast cancer in Queensland during 2006, resulting in an age-standardised mortality rate of 20 deaths per 100,000 females. Breast cancer accounted for 15% of all cancer deaths among females, and was the second most common cause of cancer-related mortality, following lung cancer.

The majority (85%) of breast cancer deaths in Queensland occurred among women aged 50 years or older, with a median age at death of 66 years. This was much younger than the median age of 73 years for all cancer deaths among females. Breast cancer mortality rates increased sharply with age, and were highest in the 85 years and over age group (163 deaths per 100,000 females).

Breast cancer was the leading cause of premature mortality due to cancer among females, causing 6,278 years of life lost per year (or 18% of all cancer-related premature mortality). The average amount of life expectancy lost due to breast cancer was 14.0 years per death.

Most States and Territories within Australia, including Queensland, reported a similar mortality rate for breast cancer. From an international perspective, the mortality rate for Australia was close to the average for all developed countries.

Breast cancer mortality rates have been decreasing by 2.7% per year in Queensland since 1994, although the number of deaths caused by breast cancer is continuing to rise by 0.7% per year (again due to population growth and ageing). Declines in mortality rates have been observed across all age groups. Downward trends in breast cancer mortality have also been reported throughout Australia, North America and many European countries.

Section 7 - Prevalence

As at the end of 2006, there were 26,361 women (1,219 per 100,000) living in Queensland who had been diagnosed with breast cancer at some time during the previous 25 years and 10,565 women (494 per 100,000) who had been diagnosed within the previous 5 years. Breast cancer was the most prevalent type of cancer among females, accounting for around a third (34%) of all 5-year cancer prevalence in Queensland.

Section 8 – Geographical areas and socio-economic status

Incidence rates of breast cancer were significantly higher among women living in a major city compared to those from outer regional or remote parts of Queensland. There were also large differences in survival for breast cancer by rurality, with 5-year relative survival around 40% lower for women residing in remote areas compared to those living in a major city.

Variation was also observed for breast cancer incidence and survival by socio-economic status. Women living in more advantaged parts of Queensland had higher rates of diagnosis for breast cancer, but they also tended to experience better survival than women in either the middle or disadvantaged socio-economic categories.

Most of the variation in incidence was due to higher rates of Stage I tumours among women in major cities and from more advantaged areas, with less difference in the distribution of more advanced or unknown stage breast cancers. Adjustment of survival by stage accounted for some, but not all, of the area-based variation in survival.

The contrasting differentials for incidence and survival resulted in little variation in breast cancer mortality by either rurality or socio-economic status.

Future updates for most of the Queensland-specific data on breast cancer contained in this report will be available from Queensland Cancer Statistics On-Line (QCSOL), which can be found at www.cancerqld.org.au/research/QCSOL.asp.

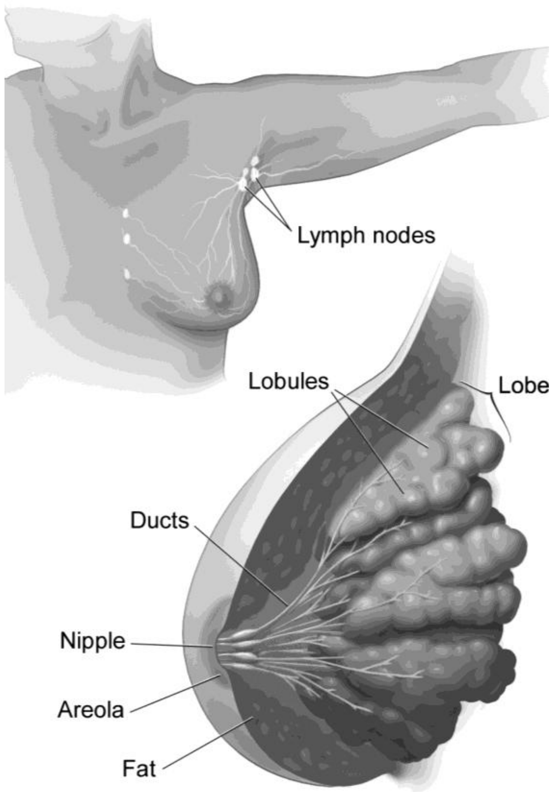
1 Introduction

1.1 What is breast cancer?

Female breasts are a combination of glandular, fibrous and fatty tissue connected to the wall of the chest by ligaments. A number of lobes are located in each breast, which in turn are comprised of many smaller lobules containing tiny grape-like glands that produce milk. The lobules are linked to the nipple by thin tubes called ducts. Fatty tissue surrounds the lobules, giving breasts a soft consistency[6-8] (Figure 1.1).

The breasts also contain a network of lymph vessels which are part of the body's immune structure. Potentially harmful substances circulating in the lymphatic system, such as bacteria or abnormal cells, are filtered by groups of small, round organs named lymph nodes.[6-8]

Figure 1.1: Anatomy of the female breast



Source: National Cancer Institute, visualsonline.cancer.gov/details.cfm?imageid=4347

Breast cancer occurs when abnormal cells form inside the breast and begin to grow out of control, leading to the formation of lumps (or tumours).[6,7,9] Most breast cancers form in the ducts and some form in the lobules, but cancer can occur anywhere in the breast including the fatty or connective tissues.[7,10]

Tumours can either be benign or malignant. Benign breast tumours are not cancer and therefore are usually less serious because they do not spread any further. In contrast, malignant breast tumours are cancerous and can penetrate and damage surrounding healthy tissue in the breast. Cancer cells may also break away from the original (or primary) tumour and invade other parts of the body via the bloodstream or lymphatic system, particularly the bones, liver, lungs and brain.[6,7,9] This process is called metastasis and it greatly increases the likelihood of death.

Within Australia, female breast cancer is one of eight types of cancer included in the National Health Priority Area initiative, in recognition of the impact that it has on the health of Australian women and the potential for significant health gains through early detection.[11]

1.2 Types of breast cancer

Breast cancers can be broadly divided into two types – non-invasive (also called carcinoma in situ) and invasive (or infiltrating). Non-invasive cancers are confined within the ducts or lobules and are generally less serious, while invasive cancers have spread to other breast tissue. If left untreated, non-invasive breast cancer may develop into invasive breast cancer, although this usually takes place over many years.[12] It is also possible that a single breast tumour may have both invasive and non-invasive components.[10]

Note that this report only contains data on invasive breast cancers; non-invasive breast cancers (e.g. ductal carcinoma in situ) have been excluded.

1.3 Cancer stage

Cancer stage provides a measure of how far a tumour has progressed at the time of diagnosis. It is highly correlated with prognosis[13] (see also Section 5.1.3). More advanced cancers are typically (but not always) larger and have usually spread to nearby lymph nodes.

Complete information on stage is not currently collected by the Queensland Cancer Registry. However, details on tumour size, nodal involvement (i.e. whether the cancer had invaded the surrounding lymph nodes) and metastatic status at diagnosis have been collected since 1997, and are combined in this report to provide a proxy measure of stage.

The cancer stages were classified and grouped as follows[14] (see Appendix B for further details):

- Stage I – tumours 20mm or less in diameter with no evidence of lymph node involvement or distant metastasis.
- Stages II/III/IV – includes tumours larger than 20mm in diameter; tumours 20mm or less in diameter (including unknown tumour size) with lymph node involvement; and tumours with distant metastases irrespective of tumour size or lymph node involvement.
- Unknown stage – either unknown lymph node involvement or unknown tumour size without lymph node involvement.

1.4 Purpose, structure and limitations of this report

1.4.1 Purpose

This report was designed to give a statistical overview of breast cancer in Queensland, primarily based on data from the Queensland Cancer Registry (QCR). The QCR maintains a record of all cases of cancer (excluding basal and squamous cell skin cancers) diagnosed in Queensland since 1982. At the time of publication of this report, the latest data available from the QCR was for the 2006 calendar year (see Appendix B for further details).[a]

Unless otherwise stated, estimates for Queensland were averaged over the 5-year period from 2002-2006 (a 5-year period was used to reduce the effects of random fluctuations from year to year). As per usual reporting practices,[5] the data contained in this report relates solely to primary breast cancers. This means that tumours which spread to the breast after originating in other parts of the body, such as the brain or lungs, were not included as breast cancers.

1.4.2 Structure

The main topics covered in this report include:

- how many women are diagnosed with breast cancer? (Incidence – see Chapter 4);
- how long do women live after being diagnosed with breast cancer? (Survival – see Chapter 5);
- how many women die from breast cancer? (Mortality – see Chapter 6); and,
- how many women are still alive after being diagnosed with breast cancer? (Prevalence – see Chapter 7).

For most of these topics, data were examined by age group and spread of breast cancer (based on tumour size and lymph node status – see Section 1.3). Some of the results for breast 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 breast cancer (Chapter 2) along with information on population screening for breast cancer in Queensland (Chapter 3). There is also a section (Chapter 8) which details geographical differences in breast cancer incidence, mortality and survival. Data in Chapter 8 were grouped by geographic regions within Queensland, by rurality (using the ARIA+ index),[15] and by area-based socio-economic status (using the socio-economic index for areas (SEIFA) index of relative socio-economic advantage and disadvantage).[16,17]

A series of comment boxes throughout the report provides background information based on recently published scientific literature regarding the epidemiology of breast cancer and other related topics. Some relevant sources of information (Appendix A) and a detailed description of the data sources, definitions and statistical methods used (Appendix B) are provided at the end of the report.

1.4.3 Limitations

Information on the medical treatment received by cancer patients is not routinely collected by the QCR, in line with the current practices adopted by most of the population-based cancer registries in Australia. Therefore, a detailed discussion of the various options for treating breast cancer is beyond the scope of this report. The absence of information on treatment also limits the ability to examine variations in cancer management as a possible reason for any observed differences in breast cancer survival.

Basal and squamous cell skin cancers were not considered when benchmarking breast cancer against other types of cancer throughout this report. Many of these non-melanoma skin cancers are treated in doctors' surgeries or skin cancer clinics using techniques that preclude histological confirmation and hence they are not registered by the QCR (similar to the practice in most other cancer registries).

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[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).

2 Risk Factors

The main risk factors for female breast cancer can be grouped into the following categories:[18]

- Age
- Family history and genetics
- Reproductive/hormonal factors
- Breast density
- Benign breast disease
- Obesity and health-related behaviours

This chapter will outline the evidence linking these factors to the development of breast cancer.

Comment 2.1 – How well do women understand their risk of developing breast cancer?

An understanding of the risk of developing breast cancer is important because it assists with appropriate decision-making regarding health care. Overestimation of personal risk can lead to unnecessary worry and excessive use of preventive services, while under-estimation of personal risk may result in less motivation to participate in breast cancer screening[19,20] (see Chapter 3).

Studies have found that many women do not have an accurate perception of how likely they are to be diagnosed with breast cancer.[19-21] Increasing age is often under-estimated as a key risk factor for breast cancer,[20-22] whereas the proportion of breast cancers related to family history is commonly overstated in surveys on risk perception.[20,21] Although having a close relative with breast cancer is an important risk factor, this does not mean that a woman will automatically develop breast cancer. Most women are unaware that only about 5% of breast cancer cases are due to genetic factors[23] (see Section 2.2).

A variety of online risk assessment tools are available which can be used to estimate a woman's risk of developing breast cancer (for example, see "www.nbocc.org.au/risk" or "www.cancer.gov/bcrisktool"). Women concerned about their risk should consult a doctor for further advice.

2.1 Age

The single greatest risk factor for breast cancer is increasing age.[24,25] Almost three-quarters (74%) of breast cancers in Queensland are diagnosed among women aged 50 years and over. The risk of being diagnosed with breast cancer rises sharply as age increases, with incidence rates peaking among women aged 65-69 years (see Section 4.2).

2.2 Family history and genetic factors

Most women who are diagnosed with breast cancer do not have a family history of the disease.[23,26] Nonetheless, a family history of breast cancer has been shown to strongly increase the risk of a woman developing breast cancer herself. The level of risk depends on the number of relatives affected, whether they are first-degree relatives (i.e. mother, sister or daughter), whether their cancer occurs in one or both breasts, and their age at diagnosis with breast cancer. For example, a female's risk of breast cancer almost doubles if one first degree relative has had breast cancer, and almost triples if two first degree relatives have been diagnosed. The familial risk of developing breast cancer is greater still if the relative was diagnosed at a younger age.[18,24]

The reasons for clustering of breast cancer within some families remain largely unexplained.[18,27,28] A number of genetic mutations have been linked to a family history of breast cancer, with the most well known involving the BRCA1 and BRCA2 genes. These genes normally help to control cell growth and repair of DNA.[28,29] Mutations in the BRCA1 or BRCA2 genes are rare, occurring in only 0.5% of the population, but they account for around 5% of all breast cancers. Hence, women with BRCA1 or BRCA2 mutations are considered to be at high risk of developing breast cancer,[28] particularly if both of these genes are mutated.[18]

In general, breast cancers that are due to genetic mutations occur before the age of 65.[24]

2.3 Reproductive/hormonal factors

A female's risk of developing breast cancer may be increased by the following factors related to her reproductive and menstrual history:[18,24,26]

- Older age at birth of first child or no children
- Menstrual period beginning at a younger age
- Menopause occurring at an older age
- Not breastfeeding children

Each of these factors is linked to levels of the hormone oestrogen that a woman is exposed to throughout her life, with greater exposure leading to a higher risk.[26] The role of oestrogen in the development of breast cancer is also evidenced by an increased risk associated with long term use of hormone replacement therapy following menopause or recent use of oral contraceptives.[18,26,30]

2.4 Breast density

Breast density is determined by the relative amounts of less dense tissue (such as fat) compared to denser fibrous and glandular tissue.[31,32] The density of tissues in the breast is linked to the likelihood of developing breast cancer among women of a similar age, with a rising trend in breast cancer risk as density increases.[18,32] Women in the highest quartile of breast density have a 3- to 5-fold greater risk of developing breast cancer compared to those in the lowest quartile of breast density (after adjusting for age).[31]

2.5 Benign breast disease

Although not cancerous themselves, benign breast diseases can lead to an increase in the risk of women subsequently developing breast cancer, depending on the type of benign breast disease that they have. Non-proliferative lesions (cells that are changing but not growing or spreading) cause only a small, if any, rise in breast cancer risk. Benign breast diseases with usual hyperplasia (involving an overgrowth of cells in the ducts or lobules) result in a doubling of risk, while atypical hyperplasias (an overgrowth of cells which appear distorted) increase the risk of breast cancer by around four times compared to women without benign breast disease.[18,26,33,34]

The likelihood of developing breast cancer following benign breast disease is greater for women who are diagnosed with benign disease at a younger age and/or those who have a family history of breast cancer.[33] Breast cancer risk is further increased when a woman has multiple benign breast diseases.[35]

2.6 Obesity and health-related behaviours

Higher weight has been consistently associated with an increased risk of breast cancer among post-menopausal women, particularly when the weight gain occurs during early adulthood.[36,37] Many studies have found that overweight or obese post-menopausal women were 30%-50% more likely to be diagnosed with breast cancer compared to those with less body fat.[36] In contrast, being overweight or obese is associated with a lower risk of breast cancer among pre-menopausal women.[36,37] It is not entirely clear why weight has a different effect on the risk of breast cancer depending on age, although it has been found that pre-menopausal women who are overweight produce lower levels of oestrogen, while overweight post-menopausal women generally have higher levels of oestrogen.[38]

There is convincing evidence of a moderate association between alcohol intake and breast cancer,[36,37] probably caused by the effect of alcohol on female hormone levels.[39] Based on studies from around the world, it has been estimated that for every 10g of alcohol consumed per day the relative risk of breast cancer increases by around 7%; this means that drinking even one or two alcoholic beverages per day can increase risk.[36,39] The increased risk is independent of the type of alcohol consumed, and applies to both pre-menopausal and post-menopausal women.[36,39]

Insufficient physical activity has also been identified as having a possible impact on breast cancer, mainly among post-menopausal women.[36,37,40] A recent review of the scientific literature concluded that each hour of physical activity per week decreases the risk of breast cancer by around 6%, provided that the activity is sustained over a long period of time.[40]

Comment 2.2 – Can the risk of developing breast cancer be reduced?

Some of the risk factors for breast cancer, such as family history or reproductive factors, are not amenable to change. However, the risk of developing breast cancer may be reduced by implementing the following lifestyle and health-related behaviours:[18,26,36,37]

- Maintaining a healthy weight
- Limiting alcohol consumption
- Engaging in regular physical activity
- Breastfeeding babies instead of bottle-feeding
- Avoiding oral contraceptives after the age of 40
- Minimising the length of time that hormone replacement therapy is used to treat menopausal symptoms

3 Breast Cancer Screening

3.1 Overview of breast cancer screening services in Queensland

BreastScreen Queensland is part of BreastScreen Australia, a public health program that is jointly funded by the Commonwealth, State and Territory governments.[41] The Program commenced in 1991 and provides the only population-based breast cancer screening services in Queensland.

The aim of BreastScreen Queensland is to reduce the morbidity and mortality caused by breast cancer through the provision of coordinated, high quality, accessible and cost effective screening services. The target group for the Program is asymptomatic women aged 50-69 years, with the aim of screening them every two years.[41] Women aged 40-49 years or 70 years and over are also able to attend if they choose.

BreastScreen Queensland operates a statewide network of 11 Screening and Assessment Services covering the catchment areas of Brisbane Southside, Brisbane Northside, Gold Coast, Ipswich, Toowoomba, Nambour, Bundaberg, Rockhampton, Mackay, Townsville and Cairns. In addition, the Program includes six mobile, two relocatable, and 18 satellite services, which provide screening in over 200 locations across the State. All BreastScreen Queensland Services are fully accredited in accordance with the BreastScreen Australia National Accreditation Standards (see Comment 3.1)

Some mammograms are performed outside the BreastScreen Queensland program through the Wesley Breast Clinic in Brisbane and private radiology practices. However, information is not available from these services, and so ***data in this chapter relates solely to BreastScreen Queensland.***

Comment 3.1 – BreastScreen Australia National Accreditation Standards for breast cancer screening

BreastScreen Queensland is required to meet accreditation standards set in place by BreastScreen Australia "*to ensure that the national mammographic screening program is offering a high quality service to women attending for screening and assessment*".[42] The standards aim to achieve the following outcomes which are critical to a high quality program:[42]

- To maximise the proportion of women aged 50–69 years who are screened every two years, and to ensure equitable access for women in this age group.
- To maximise the number of cancers detected, particularly small cancers, while minimising the number of unnecessary recalls and investigations.
- To ensure that services are acceptable and appropriate to the needs of the eligible population.
- To ensure that services are managed effectively and efficiently.

There are 173 national accreditation standards that are monitored at either six or twelve monthly intervals. Every BreastScreen Queensland Service is assessed for accreditation every two or four years, depending on their accreditation status.

The Cancer Council Australia endorses the major aims of the BreastScreen Australia program.[43,44]

3.2 Attendance at BreastScreen Queensland

A total of 202,437 women were screened by BreastScreen Queensland during 2007. Around two-thirds (64%) of these women were in the target age group of 50-69 years, 25% were aged 40-49 years and 11% were aged over 70 years.

Most of the women who attended BreastScreen Queensland were returning for routine rescreening (171,816 or 85%). Of the 30,621 women who were screened for the first time, 60% were aged 40-49, 38% were in the 50-69 age group and 2% were aged 70 years and over.

The proportion of women who returned for a rescreen within 27 months of their previous screen (as usually recommended) was 75%. However, the rate of attendance for rescreening within the recommended interval varied considerably by age - 71% in the 40-49 age group, 79% in the 50-69 age group and 58% in the 70 and over age group.

Comment 3.2 – What is population-based screening?

Population-based screening is where all individuals within some defined target group are given the opportunity to be systematically tested for a disease prior to the development of symptoms.[45] It is typically an on-going program rather than a “one off” test, with follow-up assessment of those found to have a positive screening test which may eventually lead to diagnosis of the disease. The screening test must be safe, cost-effective and provide clear evidence of better outcomes among those found to have the disease.[45]

Breast cancer screening meets all the criteria required of a population-based screening program, with women in the target age group (50-69 years) invited to have a mammogram every two years. If an abnormality is found, the woman is recalled for further assessment, which may include more extensive mammography, ultrasound or biopsy, to determine whether the identified tissue is cancerous.[46-48] Being recalled does not necessarily mean that cancer has been detected; less than 1 in 15 women who require additional tests following a mammogram are diagnosed with invasive breast cancer (see Section 3.4).

3.3 Participation rate

Participation rates are calculated by dividing the number of women who attended for at least one breastscreen during a two-year period by the total number of women in the corresponding population. The recommended screening interval is generally every two years, therefore participation rates are reported on a biennial basis rather than for single years.

During 2006-2007, the participation rate at BreastScreen Queensland was 56% among women in the target age group of 50-69 years. Participation in Queensland was slightly higher than the corresponding national rate within the target age range,[49] although still below the goal of 70%.[42]

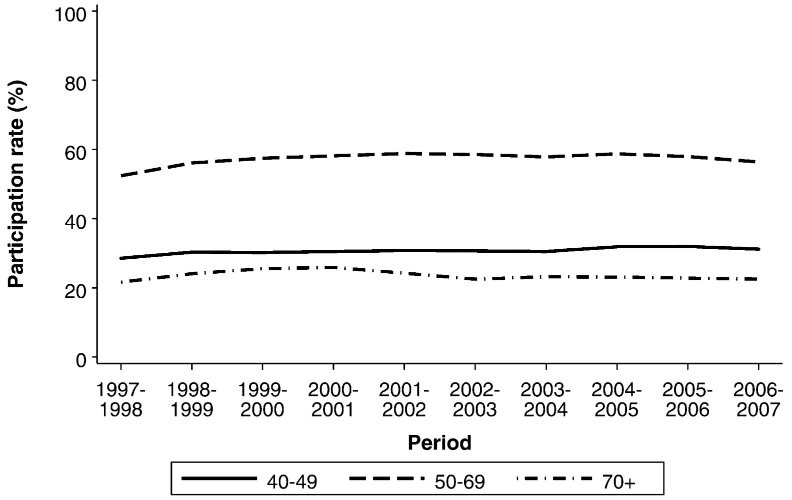
In the other eligible age groups, 31% of women aged 40-49 years and 23% of women aged 70 years and over participated.

Comment 3.3 – What are the benefits of breast cancer screening?

The aim of screening is to detect tumours at an early stage before they begin to spread,[7,47] thereby improving the patient’s prospects for recovery.[48] Routine mammogram screening is the most effective method available for identifying breast cancer at an early stage, often before any change in the breast can be detected by a physical examination, thus increasing the chances of survival.[50-53] An expert panel from the International Agency for Research on Cancer (IARC) concluded in 2002 that participation in population-based mammogram screening reduced the risk of dying from breast cancer by about 35% among women aged 50-69 years[54] (see also Comment 5.4).

After initial growth in participation rates following the introduction of the BreastScreen Queensland program, participation among women in each age group has remained fairly stable over the last few years (Figure 3.1).

Figure 3.1: Participation rates at BreastScreen Queensland by age group, 1997-2007

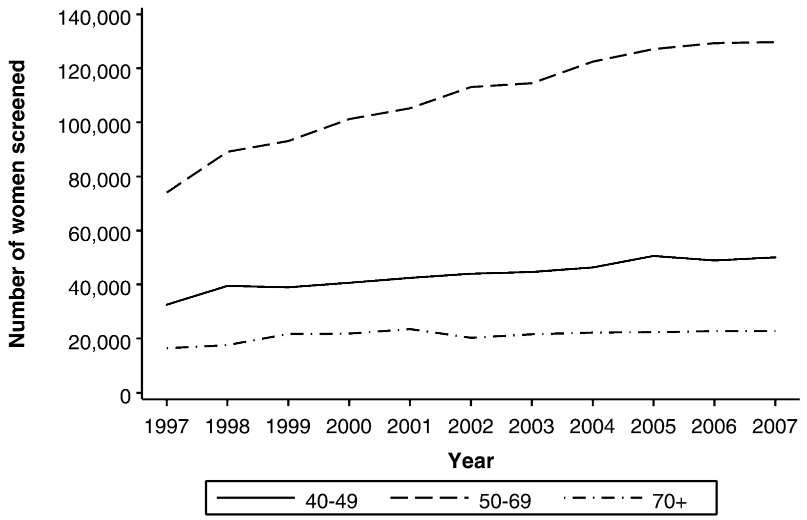


Data source: BreastScreen Queensland, Queensland Health.

Note: Periods shown are overlapping two-year periods.

Although the actual number of women being screened each year has continued to increase, the rate of increase has slowed in recent years to be similar to population growth only (Figure 3.2). Within the target age group, there were 74,008 women screened in 1997, 113,043 screened in 2002 and 129,634 screened in 2007. This equated to an increase of 53% between 1997-2002 compared to an increase of 15% between 2002-2007.

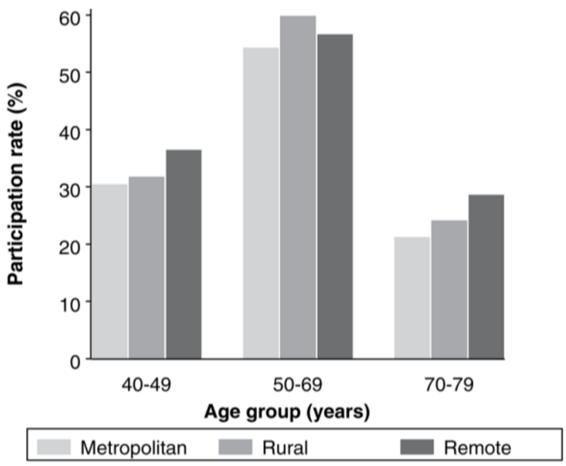
Figure 3.2: Number of women screened at BreastScreen Queensland by age group, 1997-2007



Data source: BreastScreen Queensland, Queensland Health.

Participation rates tended to be higher across all age groups among women in rural and remote parts of Queensland compared to their counterparts in metropolitan areas (Figure 3.3). For example, among women aged 50-69 years, participation rates in 2006-2007 were 54% in metropolitan localities, 60% in rural areas and 57% in remote regions of Queensland. There are several possible reasons for geographic variation in participation rates, such as the provision of mobile services in rural and remote parts of the State. Some of the difference may also be explained by greater access to private radiology services in metropolitan areas,[49] as well as diversity in the characteristics of women living in different parts of Queensland, such as socio-economic status and workforce participation.

Figure 3.3: Participation rates at BreastScreen Queensland by locality and age group, 2006-2007



Data source: BreastScreen Queensland, Queensland Health.

Women living in socio-economically advantaged areas generally had lower participation rates. During 2006-2007, the participation rate was 49% for women aged 50-69 who were from areas in the highest quintile by socio-economic status. Participation among women from a non-English speaking background was relatively high, estimated to be 60% in the 50-69 age group, while the corresponding rate for Indigenous women was 43%.

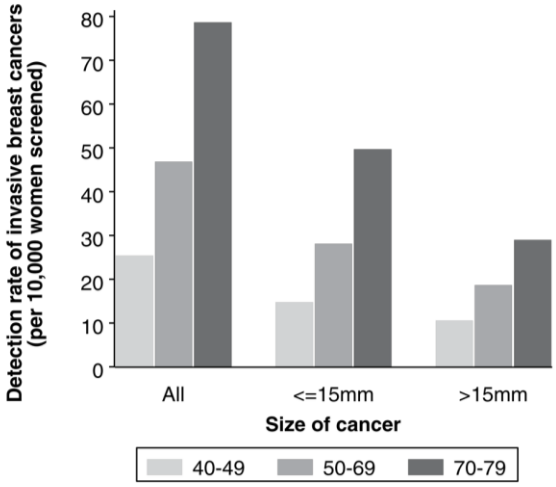
3.4 Outcomes of screening

No signs of breast cancer were found for 93% of the women who were screened during 2007. A total of 913 invasive breast cancers (and 234 cases of ductal carcinoma in situ (DCIS)) were detected among the remaining 7% of women (14,180) who were recalled for further assessment.

Over the last few years, more than one in three cases of invasive breast cancer diagnosed in Queensland, and more than one in two cases among women aged 50-69 years, have been detected by BreastScreen Queensland. The overall detection rate in 2007 was 45 invasive cancers per 10,000 women screened. As would be expected, the detection rate of invasive cancers increased with age - 25 per 10,000 women screened in the 40-49 age group, 47 per 10,000 women screened in the 50-69 age group and 79 per 10,000 women screened in the 70 and over age group (Figure 3.4).

One of the major aims of routine breast cancer screening is the detection of small tumours (i.e. 15mm or less in size), which may lead to improvements in survival as well as better treatment outcomes, such as breast conserving surgery. Of the invasive breast cancers that were detected by BreastScreen Queensland during 2007, the majority (552 cases or 60%) were small tumours. The proportion of small cancers was fairly consistent across each age group - 58% among women aged 40-49, 60% among women aged 50-69 and 63% among women aged 70 years and over.

Figure 3.4: Detection rate of invasive breast cancers by size of cancer and age group, BreastScreen Queensland, 2007



Data source: BreastScreen Queensland, Queensland Health.

As is the case with screening tests for other types of cancer, some cases of invasive breast cancer are diagnosed during the recommended interval between screening visits. These cases are known as "interval cancers",[49] and usually involve tumours which are fast-growing or difficult to detect on a mammogram.[55-57] They also tend to be relatively more common among younger women (aged 40-49 years).[58] The interval cancer rate for women aged 50-69 (the target age-group) screened by BreastScreen Queensland during 2003 was 9 per 10,000 women years at risk.

Interval cancers are often associated with a poorer prognosis,[55-57] highlighting the need for women to be aware of any changes in their breasts in the time between screening visits.

Comment 3.4 – Barriers to breast cancer screening

Research conducted for BreastScreen Queensland has identified a range of issues which may impact on a woman's decision to participate in the screening program, including lack of symptoms or no family history of breast cancer, time pressures, uncertainty about what the procedure involves, safety concerns and feelings of embarrassment.[59]

Another study reported that attitudes about mammograms can also be a predictor of screening participation. Women who were unsure whether screening saved lives or whether mammograms were effective in detecting cancer were less likely to have ever been screened.[60]

There is conflicting evidence as to whether fear of being diagnosed with breast cancer acts as a barrier or a facilitator to screening.[61,62] Being recalled for further testing following the initial mammogram is certainly associated with heightened anxiety, which may impact on future screening behaviour.[62] An inverse association has been reported between screening attendance and the inaccurate belief that an irregular mammogram always means that a woman has breast cancer[60] (see Comment 3.2). The potential discomfort associated with having a mammogram has also been identified as a possible deterrent.[63]

While it is important for women to be aware of changes in their breasts, self-examination cannot replace regular mammogram screening.[60] Self-examination on its own may provide a false sense of security if a woman is unable to detect any abnormalities in her breasts, leading to the mistaken assumption that there is no need to participate in an organised screening program.[64,65]

4 Incidence

The incidence of a disease measures how many people within a population are diagnosed with that disease in a given time period (usually one year). Incidence can either be expressed as a number (i.e. the number of new cases of breast cancer per year) or as a rate (i.e. the number of new cases of breast cancer per 100,000 females per year).

Incidence is an important measure for all types of cancer because it gives an indication as to how many people require 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 breast cancer.

Comment 4.1 – Symptoms of breast cancer

Mammography is a valuable tool in diagnosing breast cancer at an early stage prior to symptoms developing (see Comment 3.3). However, only about one-third of breast cancers in Australia are currently diagnosed by screening,[66] highlighting the importance of women also being aware of any changes in their breasts which may be associated with cancer.

Although the symptoms listed below do not necessarily indicate the presence of breast cancer, women who experience any of the following should see their doctor as promptly as possible:[6,7,67]

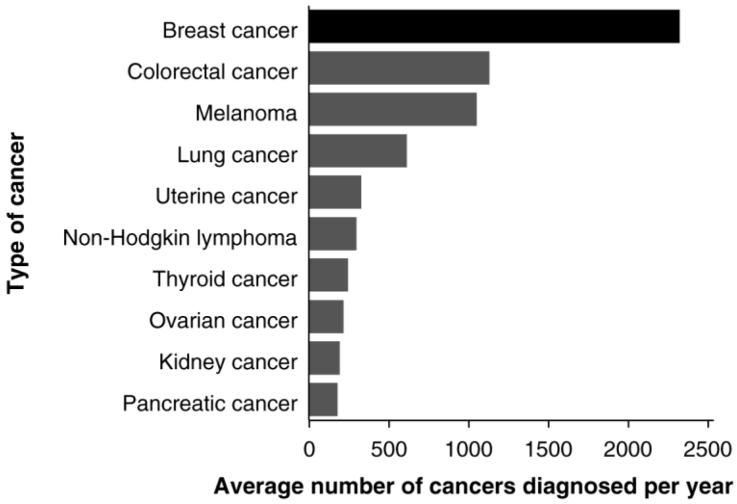
- Changes to the shape, size, feel or colour of the breast;
- A discrete lump or thickening in the breast, nipple or armpit;
- Dimpling or puckering of skin on the breast;
- New or persistent fluid discharge from the nipple;
- A nipple becoming inverted;
- Other changes to the nipple, such as crusting, ulceration or inflammation; or
- Unusual pain or tenderness in the breast or nipple not associated with the menstrual cycle.

4.1 How many women are diagnosed with breast cancer in Queensland each year?

In 2006 there were 2,491 women in Queensland diagnosed with breast cancer. The corresponding age-standardised rate was 116 cases per 100,000 females. Women in Queensland have a 1 in 8 (or 12%) risk of being diagnosed with breast cancer before 85 years of age.

Breast cancer was the most common cancer diagnosed among females in Queensland during the period 2002-2006, with an average of 2321 cases per year, representing 27% of all new cancer diagnoses (Figure 4.1). Colorectal cancer ranked second, with an average of 1128 diagnoses per year (13%), while melanoma was the third most commonly diagnosed cancer among females, with an average of 1050 cases per year (12%).

Figure 4.1: Average number of diagnoses per year for the most common types of cancer among females, Queensland, 2002-2006



Data source: Queensland Cancer Registry.

Comment 4.2 – Are women who have had breast cancer more likely to develop other types of cancer?

A large study based on data from Europe, Canada, Australia and Singapore found that women with breast cancer have a 25% excess risk of subsequently developing other types of cancer, compared to women without breast cancer.[68] The risk of developing a second primary cancer generally increased with the length of time from the initial breast cancer diagnosis, and tended to be higher among women who were younger when they were diagnosed with breast cancer.[68]

The level of increased risk was cancer specific. Women with breast cancer had a higher risk of subsequently being diagnosed with soft tissue sarcoma, thyroid cancer, uterine cancer, leukaemia and ovarian cancer. In contrast, a significantly lower risk was observed among breast cancer patients for an ensuing diagnosis of liver cancer, brain cancer, multiple myeloma or cervical cancer.[68] Similar findings for risk of second primary cancers following breast cancer have been reported in the United States, except that most of the excess risk occurred within the first ten years after the initial diagnosis of breast cancer.[69]

The higher risk of developing a second primary cancer among women with breast cancer is most likely due to the effects of treatment (chemotherapy, radiotherapy and hormonal therapy) combined with shared genetic or lifestyle risk factors (such as increased levels of obesity or alcohol consumption) that are in common with other types of cancer.[68-70] For example, the excess of leukaemia among women with breast cancer is possibly related to chemotherapy, while the increased risk of cancer of the uterus may be linked to hormone therapy.[70] However, the benefits of these therapies to breast cancer patients far outweigh any associated risks.[71]

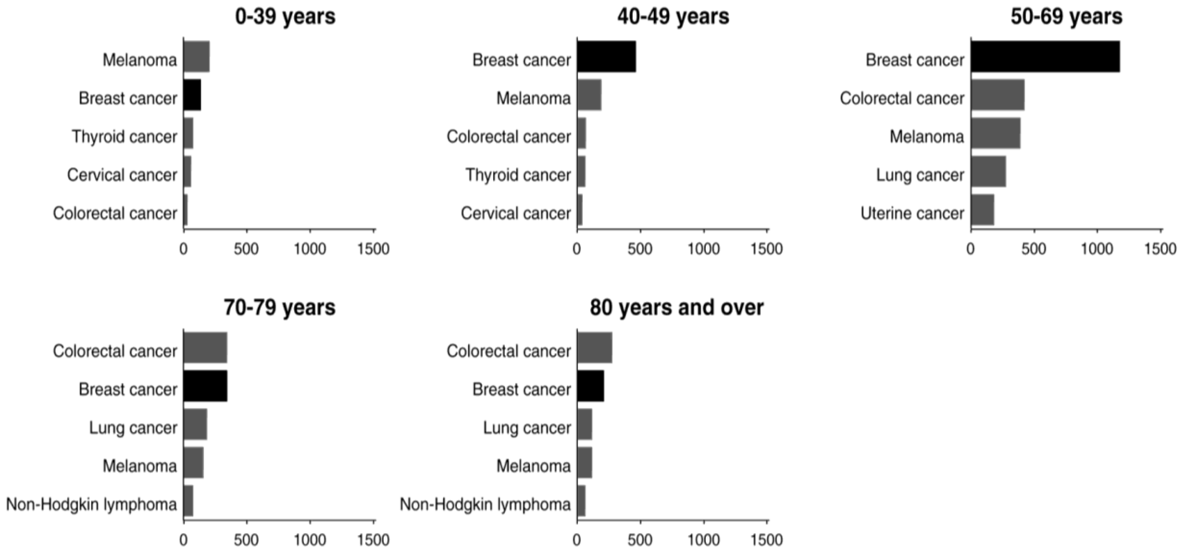
4.2 At what age are women diagnosed with breast cancer?

4.2.1 Most common types of cancer diagnosed by age group

Breast cancer was one of the two leading types of cancer diagnosed for females in each age group (Figure 4.2). It was the most commonly diagnosed cancer for women aged 40-49 years (average of 462 cases per year corresponding to 42% of all cancer diagnoses in that age group), and 50-69 years (1177 cases per year, 34%). Breast cancer ranked second behind melanoma among females aged under 40 years (134 cases per year, 19%), and was the second most common type of cancer after colorectal cancer among women in the 70-79 age bracket (341 cases per year, 19%) and those aged 80 years and over (207 cases per year, 15%).

Figure 4.2: Average number of diagnoses per year for the most common types of cancer among females by age group, Queensland, 2002-2006

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

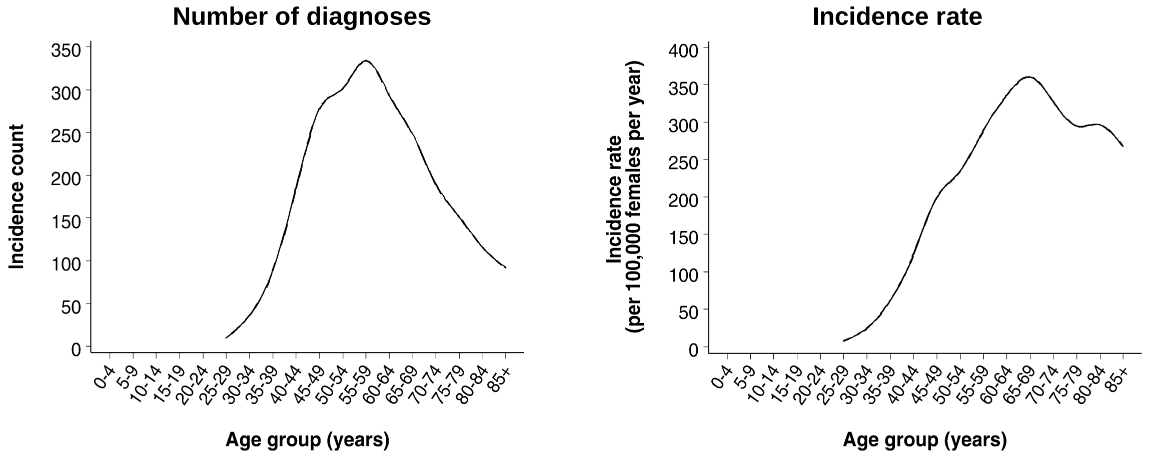


Data source: Queensland Cancer Registry.

4.2.2 Age-specific incidence

The age-specific number of breast cancer diagnoses rose sharply before peaking in the 55-59 age group, with an average of 334 cases per year, and then declined quickly among subsequent age groups, down to an average of 92 cases per year among those aged 85 years and over (Figure 4.3). This was somewhat different to the corresponding pattern for age-specific incidence rates, due to the effect of the underlying population size. Average annual age-specific incidence rates of breast cancer were highest in the 65-69 age group (360 cases per 100,000 females) with a gradual decrease in the incidence rate among older women (267 cases per 100,000 females in the 85 years and over age bracket).

Figure 4.3: Average age-specific incidence of female breast cancer, Queensland, 2002-2006



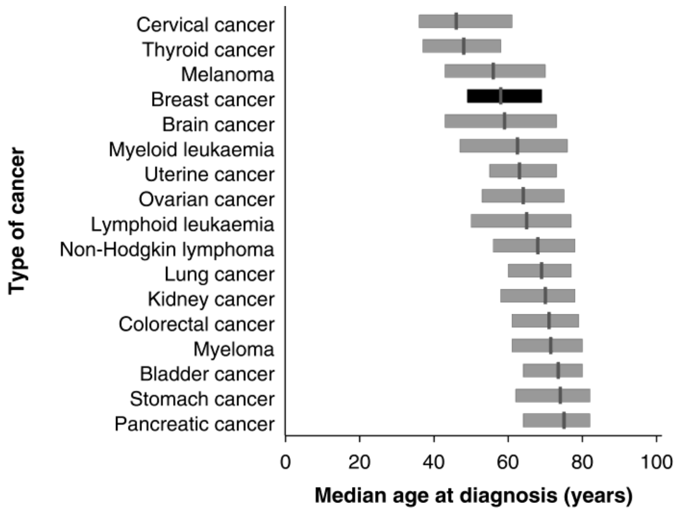
Data source: Queensland Cancer Registry.

4.2.3 Median age at diagnosis

The median (or midpoint) age at diagnosis for breast cancer in Queensland was 58 years, compared to a median age of 64 years for all types of cancer combined (Figure 4.4). Of the main types of cancer, cervical cancer and thyroid cancer had the youngest median age at diagnosis among females (46 and 48 years, respectively), while the median age at diagnosis was highest for pancreatic cancer (75 years), stomach cancer and bladder cancer (both 74 years).

Although still relatively rare among younger women, breast cancer is more commonly diagnosed under the age of 50 years compared to many other types of cancer. Just over one-quarter (26%) of breast cancers were diagnosed among females aged less than 50, compared to colorectal cancer (8%), bladder cancer (7%), lung cancer (7%), or pancreatic cancer (5%). Of the more common types of cancer, cervical cancer (57%) and thyroid cancer (56%) had the greatest proportion of diagnoses among females under 50 years of age.

Figure 4.4: Median age at diagnosis for selected cancers among females, Queensland, 2002-2006



Data source: Queensland Cancer Registry.

Note: Vertical bar shows median age at diagnosis, with the shaded area representing 50% of cases (interquartile range).

Comment 4.3 – Is breast cancer different in younger women?

There is biological evidence to suggest that breast cancer among younger women (under the age of 35 to 40 years at diagnosis) is a distinct disease.[72] Breast cancers in younger women tend to be larger, less well differentiated and more likely to metastasise compared to breast cancers diagnosed in older women.[72-75] As a result, the prognosis tends to be poorer among younger breast cancer patients, and they are more likely to experience a recurrence after treatment.[72-75]

Breast cancer is generally more difficult to diagnose at an earlier age. Routine screening is not recommended for women under the age of 40 (except for those who are identified as being at high risk) because breast cancer is uncommon and mammography is less effective due to the breast tissue being more dense.[73-75] Therefore, the majority of younger women with breast cancer present to a doctor with symptoms, indicative of the cancer being at a more advanced stage.[73,74]

Many of the risk factors for breast cancer apply to women of all ages, such as family history, later age at first birth, early age at menarche, and lack of physical activity.[74] Additional risk factors that are more relevant to younger women include pregnancy (there is an elevated risk of breast cancer immediately prior to delivery and within 5 years of childbirth) and recent oral contraceptive use.[74,75]

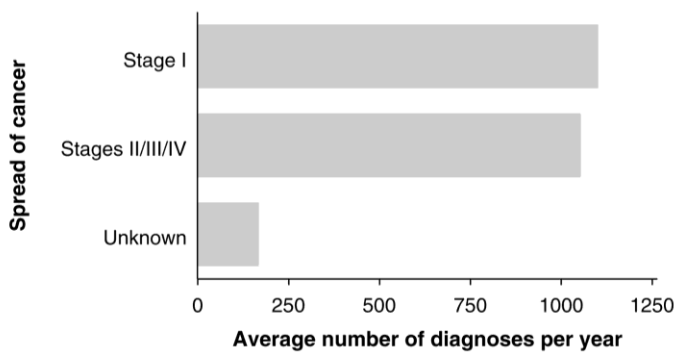
The implications of the various treatment options on younger breast cancer patients, such as the potential for early onset of menopause from either chemotherapy or hormonal therapy, need to be considered prior to the commencement of treatment.[73,75]

4.3 Are breast cancers more likely to be localised or advanced?

4.3.1 Incidence by stage of cancer

There was a fairly even distribution of early versus later stage breast cancers diagnosed among women in Queensland between 2002-2006. Almost half (47%, 1101 cases per year) were Stage I, while 45% (1053 cases per year) were more advanced (Stages II/III/IV). The remaining 7% of breast cancers (167 cases per year) did not have sufficient information to allow classification by stage (Figure 4.5).

Figure 4.5: Average number of female breast cancer diagnoses per year by stage of cancer, Queensland, 2002-2006



Data source: Queensland Cancer Registry.

4.3.2 Incidence by stage of cancer and age

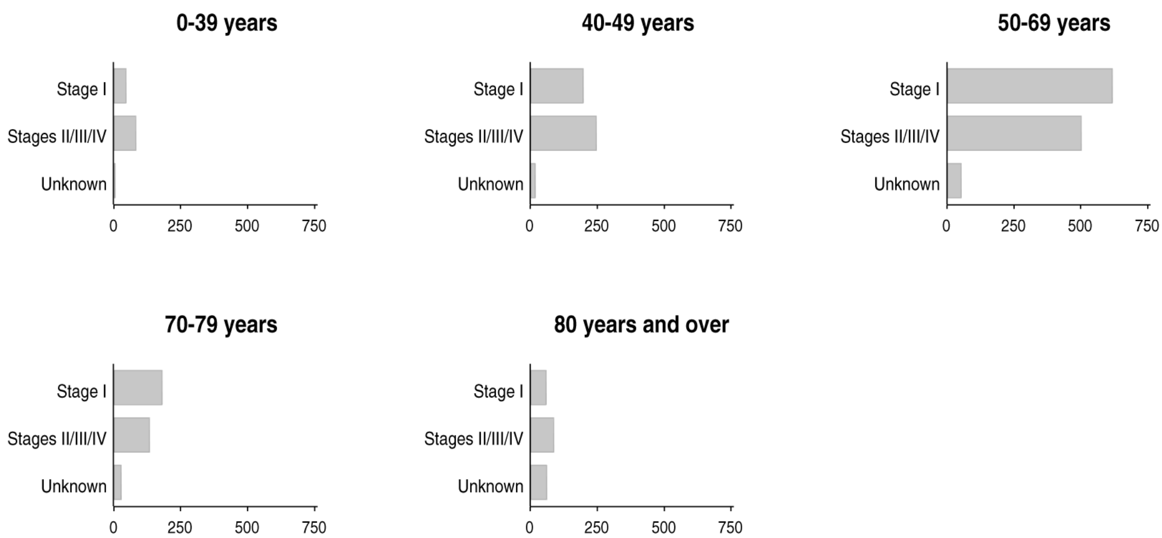
The proportion of Stage I breast cancers was greatest among women aged 50-79 years, which is consistent with mammogram screening occurring within this age range (see Section 3.3). About one-third of all breast cancers diagnosed in the 0-39 age group were Stage I (34% or 46 cases per year), compared to 43% (197 cases per year) in the 40-49 age group, 53% (619 cases per year) in the 50-69 age group, 53% (180 cases per year) in the 70-79 age group and 29% (60 cases per year) among those aged 80 years and over (Figure 4.6).

The highest proportion of Stage II/III/IV breast cancers by age group was among females aged 0-39 years (61%, 82 cases per year), indicative of the more aggressive tumours that are commonly diagnosed among younger women (see Comment 4.3). Tumours where cancer stage was unknown occurred most frequently among women aged 80 years and over (29%, 61 cases per year). Other researchers have also reported that tumours were more likely to have incomplete stage details among elderly breast cancer patients compared to those in the younger age groups.[76]

Differences in the distribution of stage for breast cancer by age group are also reflected in the substantial variation of the median age at diagnosis - 59 years for Stage I breast cancers, 56 years for Stage II/III/IV breast cancers, and 71 years for unknown stage breast cancers.

Figure 4.6: Average number of diagnoses per year by stage of breast cancer and age group among females, Queensland, 2002-2006

Note: For each of the following graphs, y-axis represents “Cancer stage” and x-axis represents “Average number of diagnoses per year”.



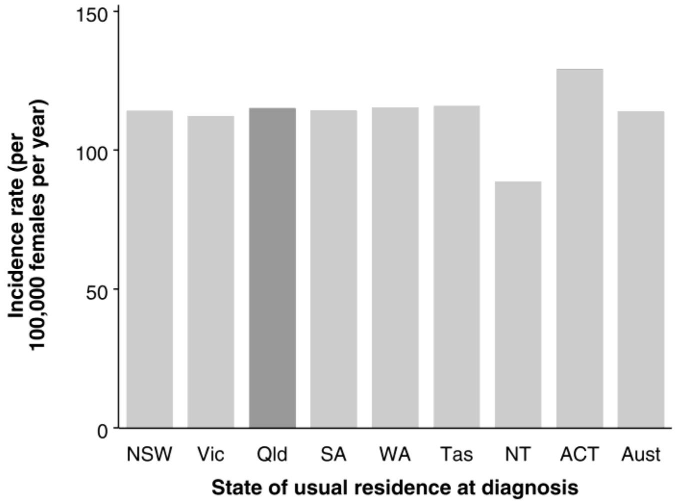
Data source: Queensland Cancer Registry.

4.4 Are incidence rates for breast cancer different elsewhere?

4.4.1 Interstate comparisons for incidence

Between 2001 and 2005, the average annual incidence rate of breast cancer in Queensland (115 cases per 100,000 females) was similar to the national rate of 114 cases per 100,000 females (Figure 4.7). The annual incidence rate of breast cancer was highest in the Australian Capital Territory (129 cases per 100,000 females), and lowest in the Northern Territory (89 cases per 100,000 females).

Figure 4.7: Average age-standardised incidence rates* of female breast cancer by State/Territory, Australia, 2001-2005



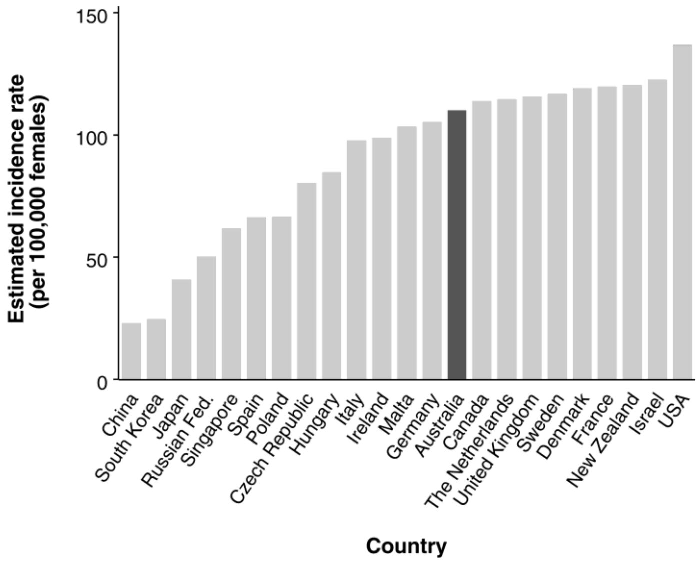
Data source: Australian Institute of Health and Welfare (AIHW).[77]

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

4.4.2 International comparisons for incidence

Breast cancer continues to be the most frequently diagnosed cancer among females worldwide, with an estimated 1.15 million new cases during 2002.[78] This represented 23% of all cancers diagnosed among females that year.[78] Developed countries contain approximately 20% of the world's female population but accounted for more than half (55% or 636,000 cases) of the breast cancer incidence.

Figure 4.8: Estimated age-standardised incidence rates of female breast cancer in selected countries, 2002



Data source: GLOBOCAN 2002, International Agency for Research on Cancer (IARC).[79]

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

There was a large amount of variation in the incidence rate of breast cancer between countries (Figure 4.8), with more developed countries generally having far higher rates compared to less developed countries (see Comment 4.4).[78,80] Of the 43 more developed nations, Australia had the twelfth highest incidence rate of breast cancer in 2002.[79] By region, North America had the highest incidence, followed by Western Europe, while breast cancer incidence rates were lowest in Middle and Eastern Africa and Eastern Asia.[79]

Comment 4.4 – Why are there large differences in the incidence of breast cancer between more developed and less developed countries?

On average, the incidence rate of breast cancer in more developed countries is around three times higher compared to less developed countries.[80,81] A range of factors have the potential to contribute to this variation, particularly those relating to lifestyle.[81-84] Women in more affluent countries have a longer life expectancy,[83] tend to have fewer children, give birth at an older age and are less likely to breastfeed,[81,84] all of which are established risk factors for breast cancer (see Section 2.3). Differences in physical activity, alcohol consumption, use of oral contraceptives and hormone replacement therapy are also likely to contribute.[81-84]

The influence of lifestyle factors on the international disparity in breast cancer incidence is reinforced by studies of migrants to more developed countries, which demonstrate a subsequent rise in breast cancer risk among females who move from areas with lower incidence rates.[81,82,84] An increase in the incidence of breast cancer across successive migrant generations has also been observed.[81,82]

Hereditary factors may account for a small part of the worldwide variation in the incidence of breast cancer, due to differences in the underlying prevalence of certain genetic mutations (mainly in the BRCA1 and BRCA2 genes).[82] Structured screening programs in developed regions of the world could also be responsible for a minor portion of the excess of breast cancer incidence,[85,86] with mammograms likely to detect some cancers that may otherwise have remained undiagnosed (known as “overdiagnosis”).[82] Finally, the low incidence of breast cancer reported in some less developed countries may be related to data inaccuracy stemming from the lack of adequately-resourced cancer registration systems.[87]

4.5 Have breast cancer incidence rates changed over time?

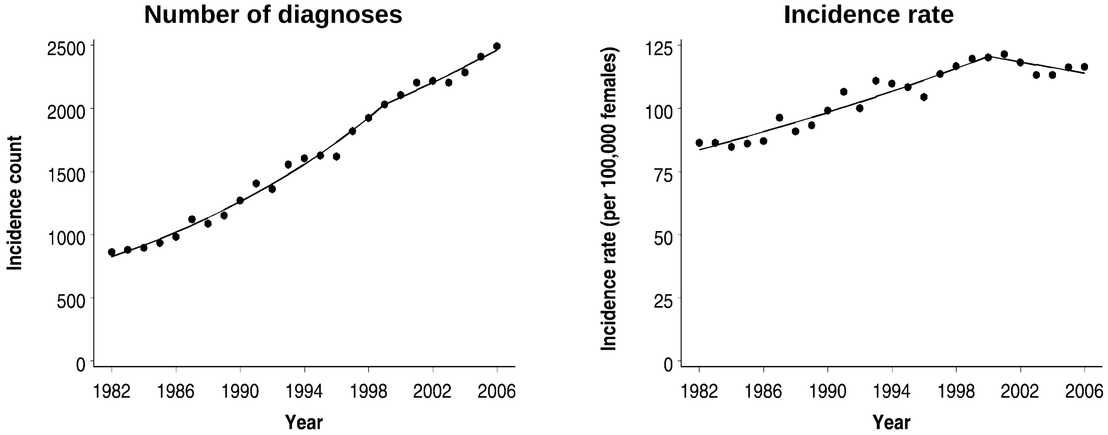
4.5.1 Incidence trends for Queensland

The number of women diagnosed with breast cancer in Queensland each year has almost tripled from 861 cases in 1982 to 2491 cases in 2006 (Figure 4.9). The increase in the number of breast cancer cases averaged 5.4% per year between 1982-1999, followed by a rise of 2.8% per year between 1999-2006.

Trends in the number of women diagnosed with breast cancer are affected by population growth and the ageing of the population. The number of breast cancer cases may continue to rise simply because of increases in the number of older women in the population. Changes in the underlying population can be accounted for by examining trends in the corresponding incidence rates.

Compared to the large, ongoing increase in the number of women diagnosed with breast cancer, the trend in the incidence rate of breast cancer in Queensland appears to have already peaked (Figure 4.9). The incidence rate rose by 2.1% per year from 1982 to 2000, but has since been declining by 0.9% per year (although this decrease was not statistically significant).

Figure 4.9: Trends in female breast cancer incidence, Queensland, 1982-2006



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

Number of diagnoses	**Incidence rate**
1982-1999 = +5.4% (+5.0%,+5.8%)	1982-2000 = +2.1% (+1.7%,+2.4%)
1999-2006 = +2.8% (+1.7%,+3.9%)	2000-2006 = -0.9% (-2.2%,+0.4%)

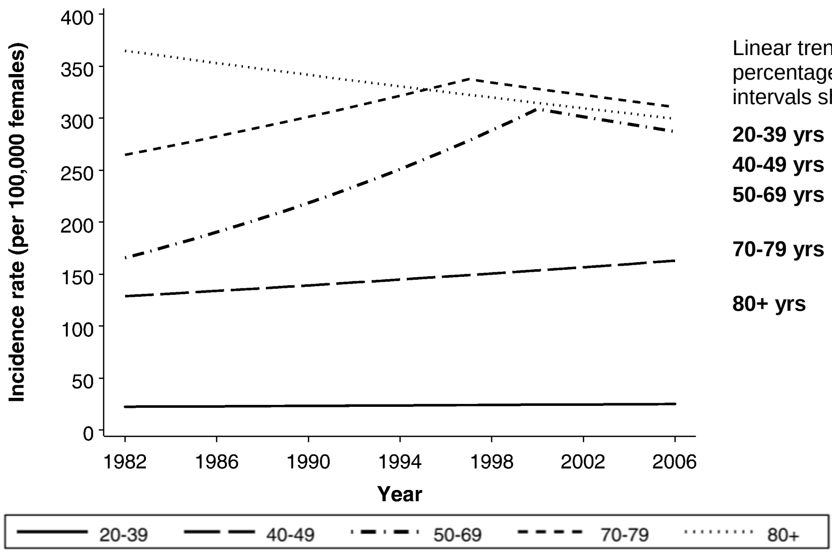
Data source: Queensland Cancer Registry.

Notes: Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, NCI.[88]

4.5.2 Incidence trends for Queensland by age group

There was considerable variation in breast cancer incidence rate trends by age group (Figure 4.10). Incidence rates among women aged 20-39 remained fairly stable (non-significant increase of 0.5% per year), while rates of breast cancer in the 40-49 age group grew steadily by 1.0% per year between 1982-2006. In contrast, breast cancer incidence rates appear to have peaked in recent years among women in the 50-69 and 70-79 age groups, with non-significant decreases of 1.2% per year since 2000 and 0.9% per year since 1997 respectively. An ongoing decline of 0.8% per year was observed for women aged 80 years and over.

Figure 4.10: Trends in female breast cancer incidence rates by age group (20 years and over)*, Queensland, 1982-2006



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

20-39 yrs	1982-2006 = +0.5% (-0.3%,+1.3%)
40-49 yrs	1982-2006 = +1.0% (+0.6%,+1.4%)
50-69 yrs	1982-2000 = +3.5% (+3.1%,+4.0%)
	2000-2006 = -1.2% (-2.8%,+0.4%)
70-79 yrs	1982-1997 = +1.6% (+0.8%,+2.5%)
	1997-2006 = -0.9% (-2.4%,+0.6%)
80+ yrs	1982-2006 = -0.8% (-1.4%,-0.3%)

Data source: Queensland Cancer Registry.

Notes: *There were an insufficient number of cases to calculate breast cancer incidence trends for females aged 0-19 years.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, NCI.[88]

Comment 4.5 – Why have breast cancer trends changed over time?

Trends are often influenced by competing factors, some of which may cause the incidence of cancer to increase while others drive incidence downwards. The direction of the trend will depend on which factors have the greatest effect over a given time period.

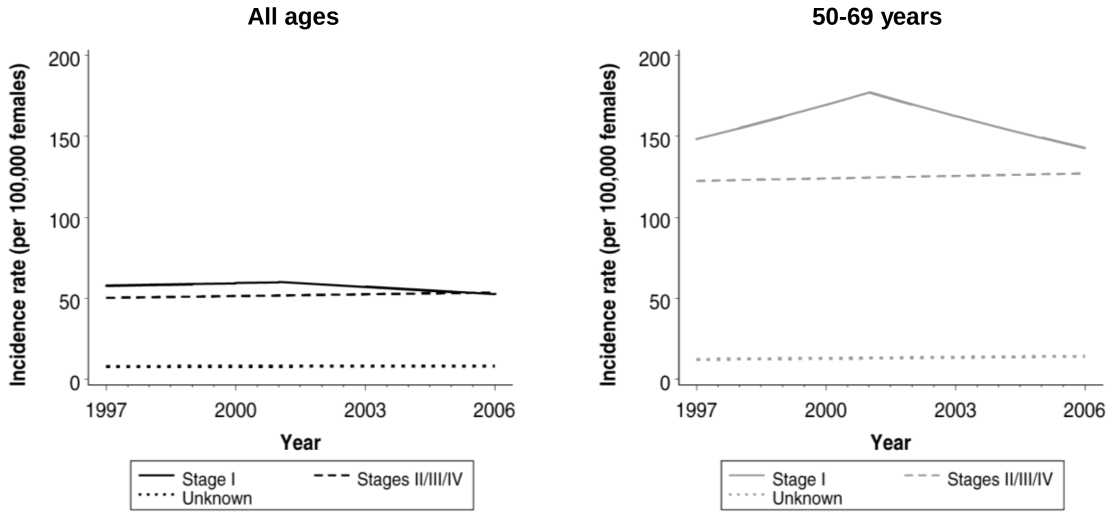
Increases in breast cancer incidence rates in Australia during the 1990s appear to be linked to the introduction of population-based mammogram screening, especially in relation to trends among women aged 50 to 69 years.[66,89] Other factors which have led to a rise in breast cancer incidence rates among developed countries over the past few decades include the growing prevalence of obesity, earlier age at puberty, excessive alcohol consumption, reduced physical activity and having children (if any) at an older age.[82,83,89]

In contrast, sudden decreases that have been observed in the incidence rate of breast cancer among women aged 50 to 69 in several countries (including Australia) since 2002 appear consistent with a reduction in the use of hormone replacement therapy,[30,90-92] combined with a plateau in participation rates for mammograms over recent years.[93]

4.5.3 Incidence trends for Queensland by stage of cancer

Overall incidence rates of Stage I breast cancers fell by 2.6% per year from 2001. This trend was even more pronounced among women aged 50-69 (decrease of 4.2% per year from 2001). In contrast, incidence rates for more advanced breast cancers (Stages II/III/IV) remained relatively stable during 1997 to 2006, while trends for breast cancers with unknown stage were non-significant due to considerable fluctuation from year to year (Figure 4.11).

Figure 4.11: Trends in female breast cancer incidence rates by stage of cancer, Queensland, 1997-2006*



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

	All ages		50-69 years
Stage I	1997-2001 = +1.0% (-1.7%,+3.8%) 2001-2006 = -2.6% (-4.3%,-0.8%)	**Stage I**	1997-2001 = +4.5% (+0.6%,+8.6%) 2001-2006 = -4.2% (-6.5%,-1.9%)
Stages II/III/IV	1997-2006 = +0.7% (-0.1%,+1.5%)	**Stages II/III/IV**	1997-2006 = +0.4% (-0.4%,+1.3%)
Unknown	1997-2006 = +0.4% (-1.3%,+2.1%)	**Unknown**	1997-2006 = +1.7% (-2.6%,+6.2%)

Data source: Queensland Cancer Registry.

Notes: *Data for stage of cancer based on tumour size and nodal status are only available from 1997 onwards.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, NCI.[88]

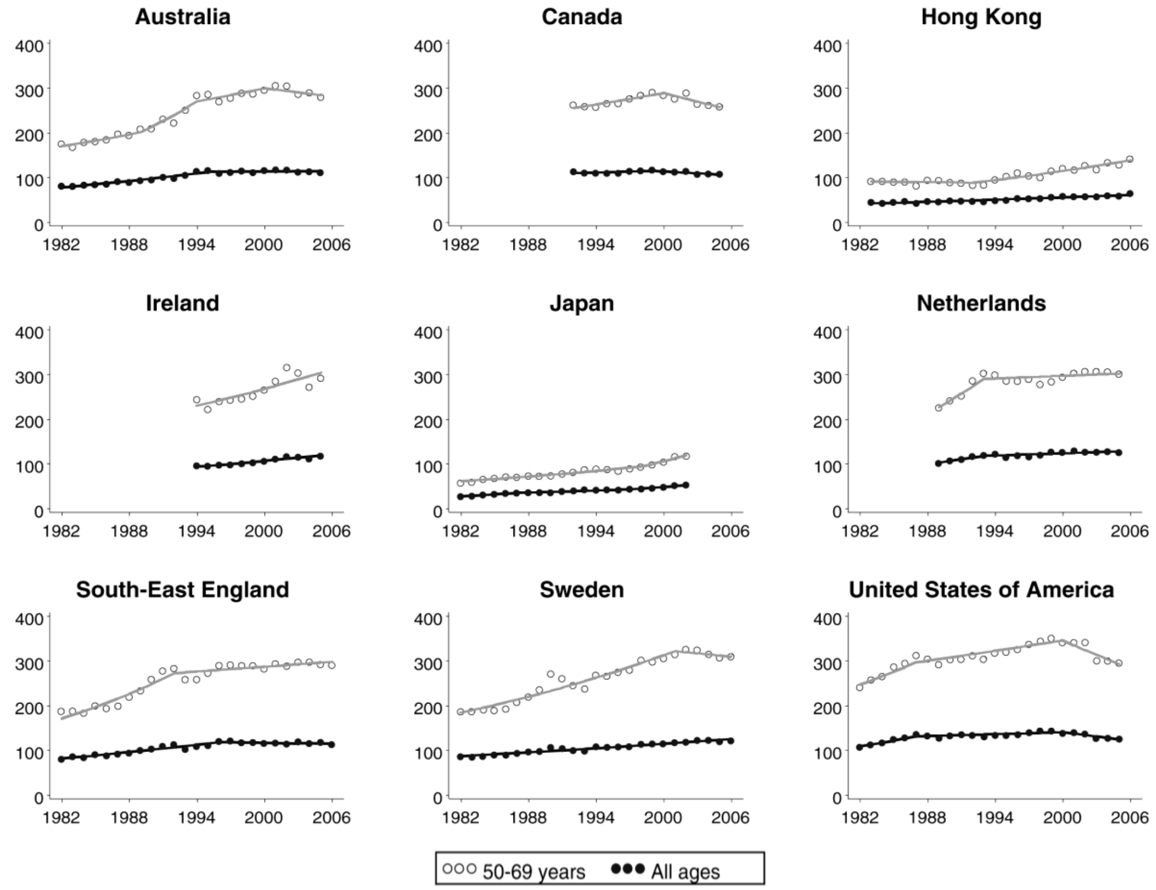
Following the introduction of population screening during the 1980s and 1990s, the incidence of localised breast cancers in Australia and other countries increased, while rates of advanced breast cancers either remained stable or underwent moderate declines.[94] However, the latest trends from the United States have shown a decline in smaller/localised breast tumours,[93] similar to the results observed in Queensland. This is consistent with a stabilisation in the usage of mammogram screening over the past few years[93] (see also Comment 4.5).

4.5.4 International incidence trends

The incidence of breast cancer has been rising in many parts of the world over the past few decades.[81,95] The estimated number of breast cancer cases among women worldwide increased by approximately 350,000 (or 45%) between 1990 and 2002.[78,96]

Figure 4.12: Recent national and international trends in female breast cancer incidence for selected countries/registry areas, 1982-2006*

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



Data sources: Australian Institute of Health and Welfare,[97] Canadian Council of Cancer Registries,[98] Hong Kong Cancer Registry,[99] National Cancer Registry of Ireland,[100] National Cancer Center Japan,[101] Netherlands Cancer Registry,[102] Thames Cancer Registry (South-East England),[103] National Board of Health and Welfare (Sweden),[104] National Cancer Institute (USA) SEER-9.[105]

Notes: * Data available from 1982-2005 for Australia, 1992-2005 for Canada, 1983-2006 for Hong Kong, 1994-2005 for Ireland, 1982-2002 for Japan, 1989-2005 for the Netherlands, 1982-2006 for South-East England and Sweden, and 1982-2005 for the USA.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, NCI.[88]

Large differences were obvious in trends for breast cancer incidence rates between the countries for which longitudinal data are presented (Figure 4.12). In Australia, incidence rates of breast cancer among all age groups combined increased by 2.9% per year between 1982-1995, but rates have remained fairly stable from 1995 onwards. There was an even greater increase of 6.1% per year between 1989-1994 among women aged 50-69 years, while more recently there is evidence that rates within this age group have started to decline (non-significant decrease of 1.0% per year between 2000-2005).

Female breast cancer incidence rates went up slowly in North America during the 1990s, but have exhibited a significant decrease since the turn of the century (-2.4% per year between 2000-2005 in the United States and -1.2% per year between 1999-2005 in Canada). The corresponding trends among women aged 50-69 were -3.2% per year between 2000-2005 in the United States and -2.2% per year in Canada between 2000-2005.

Overall rates of breast cancer have continued to increase in many European countries,[81,94,106-109] including Ireland (2.2% per year between 1994-2005), Sweden (1.5% per year between 1982-2006) and the Netherlands (0.7% per year between 1993-2005). Ongoing increases in incidence rates for breast cancer have also been reported in Eastern and Central Europe,[94] although there is evidence of a recent change in the direction of incidence trends in a few European countries. For example, following rapid increases up until the mid 1990s, trends in breast cancer incidence rates in South-East England have remained stable for females in all age groups combined between 1996-2006 (Figure 4.12), while recent declines have been observed in parts of Italy.[110]

Among women aged 50-69 years there was a rise of 2.6% per year between 1994-2005 in Ireland and a smaller increase of 0.6% per year in South-East England since 1992. The corresponding age-specific breast cancer incidence rates appear to have already peaked in Sweden (non-significant decrease of 0.8% per year between 2001-2006) while rates for women aged 50-69 years have been fairly stable in the Netherlands since 1993.

Incidence has been increasing in many parts of Asia. There have been large, consistent increases in the incidence rate of breast cancer among women in Japan, most recently 4.1% per year for all age groups combined between 1997-2002 and 6.2% per year within the 50-69 age group between 1998-2002. Incidence rates increased steadily by 1.6% per year in Hong Kong between 1983-2006 for all females (and by 3.3% per year since 1992 for the 50-69 age group). Breast cancer incidence rates are also thought to be rising rapidly in China (by around 4%-5% per year between 2000-2005),[111] and annual increases of between 1%-2% have been reported in several cancer registries in India.[112]

Full details of the trends for each country included in Figure 4.12 are shown in Appendix C.

Comment 4.6 – The future international burden of breast cancer

It has been estimated that the annual international incidence of breast cancer will reach 1.5 million cases by the year 2010,[113] with a prediction of 3.2 million cases by 2050.[83]

Over the coming years, breast cancer incidence is expected to increase more rapidly in less developed countries due to a combination of faster population growth,[83] coupled with the adoption of a more “westernised” lifestyle, involving lower levels of physical activity and delays in childbearing.[84,114] As a result, the worldwide breast cancer burden is likely to be heavily influenced by changes to incidence in the Asia region, particularly China.[115]

5 Survival

Survival is the length of time a person remains alive after being diagnosed with breast cancer. The crude survival rate is the proportion of people diagnosed with breast cancer who remain alive after a given length of time, for example 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 less than 100% suggests that breast cancer patients have poorer survival compared to the general population (see Appendix B for more details).

Comment 5.1 – What are the main factors that affect breast cancer survival?

Survival from breast cancer may be influenced by prognostic factors (characteristics of the patient or their tumour which determine the likelihood of relapse or metastasis) and predictive factors (which are associated with how responsive the cancer will be to different treatments).[116-118]

The most important ***prognostic*** factor for breast cancer is whether the cancer has spread to the lymph nodes or beyond,[116,118] and furthermore, how many lymph nodes are cancerous.[117,119] Patients without lymph node involvement have a significantly improved chance of surviving (see Section 5.1.3). Other patient and clinical-related factors that are associated with better survival include:[116-120]

- smaller tumour size (less than 1-2cm)
- lower grade of tumour (well-differentiated)
- aged between 40-69 years at diagnosis
- absence of other diseases (e.g. cardiovascular disease, diabetes)
- human epidermal growth factor receptor type 2 (HER-2) protein not overexpressed
- favourable genetic profile

A healthy lifestyle is also likely to enhance survival for women diagnosed with breast cancer.[119] For example, in addition to being a recognised risk factor for developing breast cancer, there is mounting evidence that obesity generally results in a worse prognosis.[121,122]

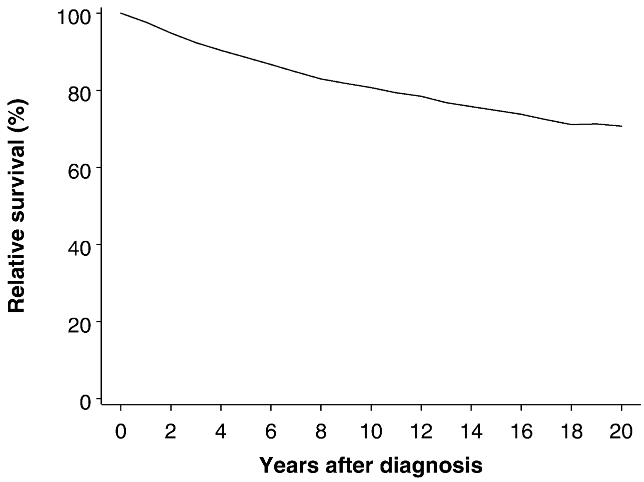
To date, the only widely accepted ***predictive*** factor is whether a tumour is positive for oestrogen or progesterone receptors, which helps to determine whether treatment with hormonal therapy (such as tamoxifen) will be successful.[116-118] The ability to tailor therapy for an individual patient based on other factors remains limited at this time.[117]

5.1 How long do women in Queensland live after being diagnosed with breast cancer?

5.1.1 Survival

Relative survival for breast cancer steadily declines as time from diagnosis increases. One-year relative survival for women with breast cancer in Queensland between 2001 to 2006 was 98% (i.e. only slightly lower than the expected survival for the general population), whereas relative survival rates after 5, 10 and 20 years were 89%, 81% and 71% respectively (Figure 5.1).

Figure 5.1: Relative survival from female breast cancer, Queensland, 2001-2006



Data source: Queensland Cancer Registry.

Notes: Relative survival calculated using the period method for females aged 0-89 years at diagnosis.
Data are for "at risk" cases in the period 2001-2006.
"N" is the initial number of "at risk" cases.

Comment 5.2 – What are some of the main issues among breast cancer survivors?

Research has found that breast cancer survivors usually experience an overall quality of life that is similar to women in the general population, particularly among those who were aged 50 years or over when they were diagnosed with breast cancer and among longer-term survivors.[123,124]

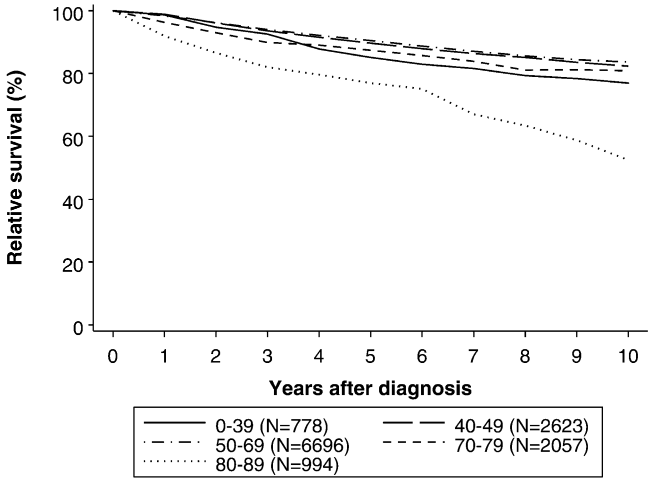
Survivors may, however, face some on-going issues stemming from breast cancer and its treatment, with common problems including fatigue, depression, sleep disturbance, lymphoedema (swelling), breast discomfort and sexual dysfunction.[124-128] The potential for early menopause as a result of treatment with hormonal therapy or chemotherapy is also a concern for younger women diagnosed with breast cancer.[125,129]

Physical activity has consistently been found to alleviate fatigue and improve other aspects related to quality of life among breast cancer survivors.[126,130,131] Furthermore, exercise can prevent weight gain that often accompanies treatment for breast cancer, which may in turn lower the risk of recurrence and improve survival.[130]

5.1.2 Survival by age group

Five-year relative survival for breast cancer was highest (90%) for women aged 40-69 years at diagnosis, compared to 87% for the 70-79 age group, 85% among those aged 0-39 years and 77% for the 80-89 age group (Figure 5.2). These age-specific survival patterns for breast cancer are different to most other types of cancer, which generally have a consistent decrease in survival as age at diagnosis increases,[132] and most likely reflect the more aggressive nature of breast cancers that tend to develop in younger women (see Comment 4.3).

Figure 5.2: Relative survival from female breast cancer by age group, Queensland, 2001-2006



Data source: Queensland Cancer Registry.

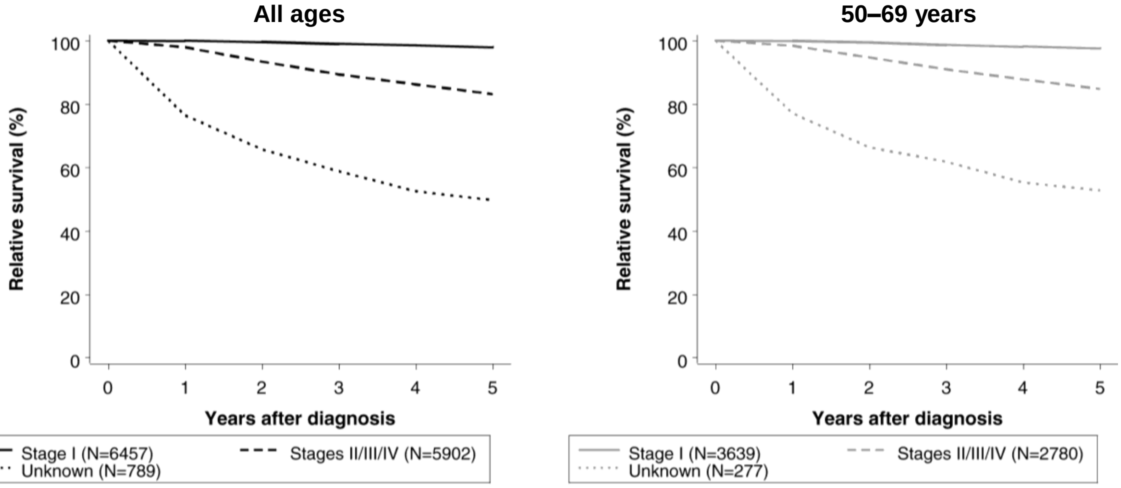
Notes: Relative survival calculated using the period method for females aged 0-89 years at diagnosis.
Data are for "at risk" cases in the period 2001-2006.
"N" is the initial number of "at risk" cases within each age group.

5.1.3 Survival by stage of breast cancer

Survival for women with Stage I breast cancer was almost the same as for women in the general population, with 5-year relative survival of 98%. In contrast, 5-year survival for breast cancer patients diagnosed at a more advanced stage was 83%, while only 50% of women with breast cancers of unknown stage survived for 5 years, relative to the general population. There was a similar pattern in survival by stage of breast cancer for women aged 50-69 years (Figure 5.3).

It has been suggested that a possible reason for patients with unknown stage having much poorer survival is that they have advanced co-morbidity or frailty (due to age or other factors), resulting in their cancers not being as thoroughly investigated or treated.[133]

Figure 5.3: Relative survival from female breast cancer by stage of cancer, Queensland, 2001-2006



Data source: Queensland Cancer Registry.

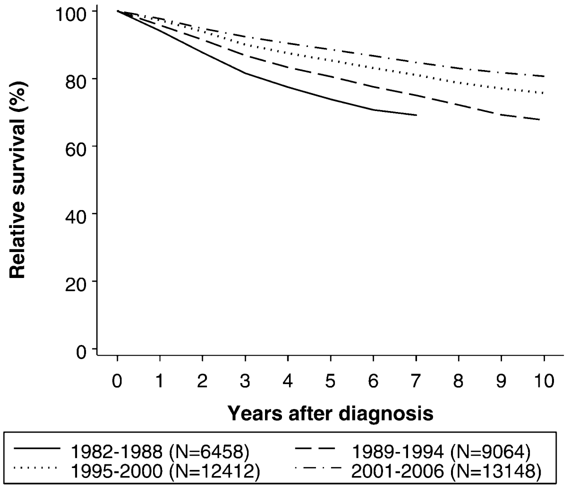
Notes: Relative survival calculated using the period method for females aged 0-89 years at diagnosis.
Data are for "at risk" cases in the period 2001-2006.
"N" is the initial number of "at risk" cases within each group.

5.1.4 Survival by 'at risk' time period

There have been significant, ongoing advances in breast cancer survival within Queensland since the early 1980s, as demonstrated by the improved survival curves for more recent time periods (Figure 5.4). Five-year relative survival has increased from 74% during 1982-1988 to 89% between 2001-2006.

Consistent improvements in survival for women diagnosed with breast cancer have also been observed throughout Australia,[66] North America,[134,135] and Europe[109,136] over the last 20 to 30 years (see Comment 5.3).

Figure 5.4: Relative survival from female breast cancer by 'at risk' time period, Queensland, 1982-2006



Data source: Queensland Cancer Registry.

Notes: Relative survival calculated using the period method for females 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.

Comment 5.3 – Why has survival from breast cancer improved over time?

A study conducted in Queensland found that earlier diagnosis (due to screening of asymptomatic women) and advances to the treatments available have both made important contributions to the observed improvements in survival for breast cancer patients.[137] Similar findings have been reported elsewhere around the world,[138,139] although recent increases in survival for breast cancer in the United States have come about despite a less favourable stage distribution, and thus are most likely due to more effective treatment.[140]

One of the most important achievements in the treatment of breast cancer has been the success of hormonal therapies, such as tamoxifen, raloxifene and aromatase inhibitors, which lower the risk of recurrence among patients with oestrogen-receptor positive tumours.[141-143] Chemotherapy has also progressed, with the implementation of improved drug regimes that minimise toxicity.[142-144]

The gains achieved in the treatment of breast cancer over the previous 20 to 30 years appear set to continue,[145] particularly the prospect of individually tailored therapies in the future.[142-144] Emerging treatments, such as trastuzumab (or herceptin), which acts on tumours that have an overexpression of human epidermal growth factor (HER) and inhibits proliferation of cancer cells,[142,143] are likely to further improve survival from breast cancer in the coming years.

Comment 5.4 – Interpreting the effect of screening on survival

Measuring the benefits of population screening in terms of survival is complex given that screening may introduce some biases into the calculation of survival.[146,147] These include lead-time bias (where a cancer is diagnosed earlier as a result of screening, but there is no real improvement in survival), length bias (where slower growing, and hence less aggressive, tumours are more likely to be diagnosed via screening than fast-growing tumours), overdiagnosis (the detection of latent tumours by screening that would otherwise have remained unnoticed) and selection bias (where women who undergo screening have different health-related characteristics compared to those who are not screened).[146,147] A more detailed description of the effects of screening on survival is included in Appendix B.

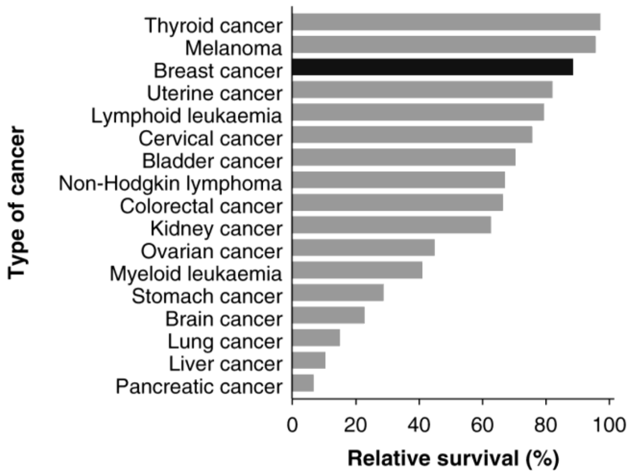
Even after taking these potential biases into account, population screening for breast cancer has still been shown to result in a significant improvement in survival[146,147] (see also Comment 3.3).

5.2 How does survival from breast cancer compare with other cancers?

Survival for breast cancer was better than most other types of cancer among females during 2001-2006 (Figure 5.5), with 5-year relative survival averaging 69% for all cancers combined compared to 89% for breast cancer.

Thyroid cancer and melanoma had the highest 5-year relative survival rates of 97% and 96% respectively. In contrast, 5-year relative survival was 6% for pancreatic cancer, 10% for liver cancer and 15% for lung cancer. Other female-specific cancers, such as uterine, cervical and ovarian cancer, all had lower 5-year relative survival than breast cancer (82%, 76% and 45% respectively).

Figure 5.5: 5-year relative survival for selected cancers among females, Queensland, 2001-2006



Data source: Queensland Cancer Registry.

Notes: Relative survival calculated using the period method for females aged 0-89 years at diagnosis.
Data are for "at risk" cases in the period 2001-2006.

5.3 Is survival for breast cancer different elsewhere?

Variations in survival for breast cancer, either within Australia or internationally, need to be interpreted with caution. Survival estimates may be influenced by a number of factors, such as differences in scope, timing, population coverage, data quality and statistical methodology[148,149] (see Appendix B for further details).

5.3.1 Interstate comparisons for survival

Only minor differences were observed in survival for breast cancer among women within Australia (Table 5.1). The national 5-year relative survival rate (88%) was similar to Queensland (89%).

Table 5.1: 5-year relative survival[a] for female breast cancer by State/Territory

State/Territory	Years	Method	Ages	5-year survival (%) (95% confidence interval)
Queensland	2001-2006	Period	0-89	88.5 (87.9-89.2)
New South Wales	1999-2003	Multi-year cohort	15-89	88.0 (87.0-89.0)
Victoria	2000-2004	Period	All ages	87 (86-89)
South Australia	1997-2003	Cohort	All ages	85.0 (84.3-85.7)
Western Australia	1998-2002	N.S.	15+	91.1 (90.0-92.3)
Northern Territory[b]	1991-2001	Cohort	N.S.	87 (82-90)
Australia – Total	**1998-2004**	**Cohort**	**All ages**	**87.8 (87.5-88.1)**

Data sources: Queensland Cancer Registry; Cancer Institute NSW;[150] The Cancer Council Victoria;[151] South Australian Cancer Registry;[152] Western Australian Cancer Registry;[153] Northern Territory;[154] and the Australian Institute of Health and Welfare.[155]

Notes: a. Comparisons of survival rates between States and Territories can be influenced by inconsistencies in the age ranges included, variations in the time periods being considered, and differing methodologies. 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 breast cancer survival were not available for Tasmania or the Australian Capital Territory.

5.3.2 International comparisons for survival

In the United States, 5-year relative survival for breast cancer between 1996-2004 was 89%,[156] slightly higher than the results reported for Canada between 2001-2003 (87%)[157] and Japan between 1993-1996 (85%).[158] Breast cancer survival was generally lower in Europe, with average 5-year relative survival estimated to be 79% between 2000-2002,[136] although there was a large amount of variation in survival evident throughout Europe. Survival tended to be higher in Northern Europe (5-year relative survival of 93% in Iceland and 86% in both Sweden and Finland) while rates were typically lower in Eastern Europe (Czech Republic 69%, Poland 74%, Slovenia 75%), probably reflecting differences in a variety of clinical (e.g. tumour stage and biology) and treatment-related factors (e.g. organisation of health services, training of health-care professionals).[136]

Recent and reliable data on breast cancer survival are lacking for many other parts of the world, particularly among less developed countries.[83] Five-year relative survival between 1990-1994 was estimated at 84% in Cuba, 58% for the region covered by two cancer registries in Brazil, and 39% for one area in Algeria.[149]

Incidence and mortality data suggest that survival for breast cancer is substantially better in more developed countries compared to less developed countries.[78] This is partly attributed to the lack of population screening programs in less developed countries resulting in later stage at diagnosis, combined with inadequate access to appropriate medical services.[78,81,83,87] Variation in survival may also be influenced by the mix of breast cancer biology. Early-onset, aggressive breast tumours that are oestrogen-receptor negative, and therefore less responsive to hormonal therapy, are more dominant in Asia and Africa compared to North America, Europe or Australia.[80]

6 Mortality

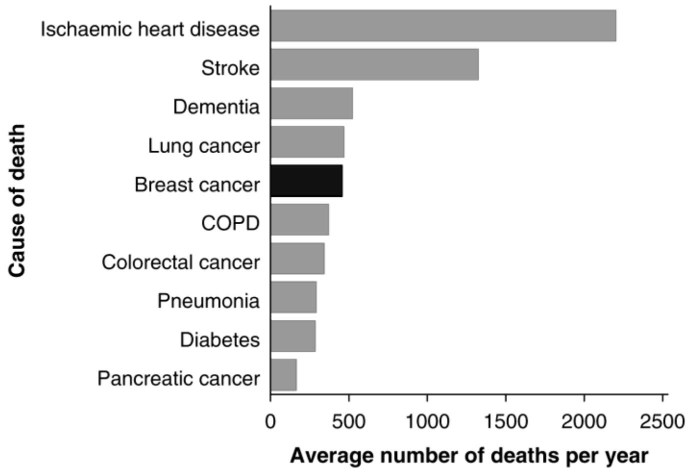
Mortality measures how many people in a population die from a specific disease over a given time period. Similar to incidence, mortality can either be expressed as a number (i.e. the number of deaths due to breast cancer per year) or as a rate (i.e. the number of deaths due to breast cancer per 100,000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

6.1 How many women die from breast cancer in Queensland each year?

During 2006, 432 women died from breast cancer in Queensland. This corresponded to an age-standardised mortality rate of 20 deaths per 100,000 females. Women in Queensland have a risk of 1 in 41 (over 2%) of dying from breast cancer before the age of 85.

Between 2002-2006, breast cancer was the fifth most common cause of death among females in Queensland, representing 4% of all deaths (Figure 6.1). Ischaemic heart disease was the most common cause of death among females (20% of all deaths), followed by stroke (12%), dementia (5%) and lung cancer (4%). In regard to mortality by age group, breast cancer was found to be the most common cause of death among women aged 40-69 years.

Figure 6.1: Average number of deaths per year for the most common causes of death among females, Queensland, 2002-2006

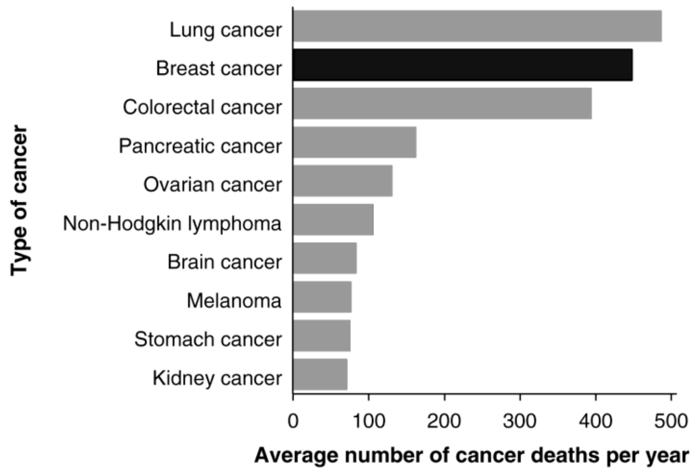


Data source: Australian Bureau of Statistics.[159]

Note: COPD = chronic obstructive pulmonary disease.
ICD-10 codes used to define each condition were based on those used by ABS[160] and AIHW.[161]

Breast cancer was the second most common cause of cancer-related mortality among females (accounting for 15% of all cancer deaths), having recently been surpassed by lung cancer (17%) (Figure 6.2).

Figure 6.2: Average number of deaths per year for the most common types of cancer among females, Queensland, 2002-2006



Data source: Queensland Cancer Registry.

Comment 6.1 – Mortality to incidence ratio for breast cancer

The ratio of the mortality rate to incidence rate (MR:IR), also known as the case fatality rate, provides a measure of the severity of a disease. It is generally in the range of 0 to 1, although there are situations where the ratio can be greater than 1. The closer the MR:IR ratio is to 0 the more likely a person is to survive, and conversely, the nearer the ratio 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 breast cancer between 2002-2006 was 0.19, due to the generally good survival rates associated with breast cancer (see Chapter 5). In comparison, the MR:IR ratio for females with melanoma (which has even better survival than breast cancer) was 0.07, while for lung cancer patients (who have poor survival) the MR:IR ratio was 0.79.

Large variations in the MR:IR ratio for breast cancer have been reported around the world, ranging from 0.19 for females in North America to 0.69 for females in Africa.[80] This disparity primarily arises from international differences in survival for breast cancer (see Section 5.3.2).

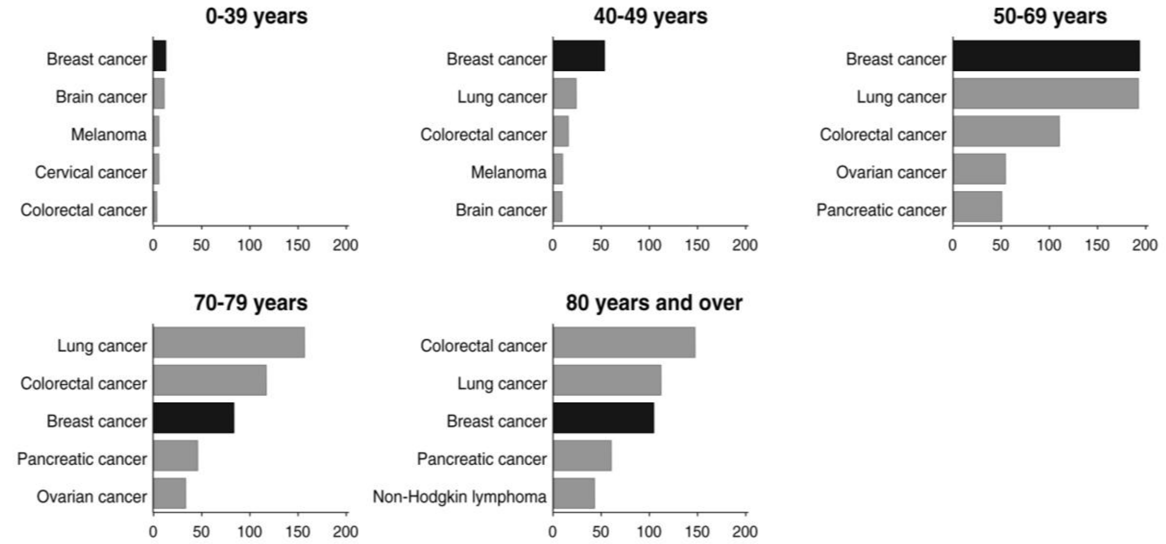
6.2 At what age do women die from breast cancer?

6.2.1 Most common types of cancer deaths by age group

Breast cancer was one of the leading causes of cancer-related deaths within every age bracket among females in Queensland (Figure 6.3). It was the most common reason for cancer-related deaths among females aged 0-39, 40-49 and 50-69 years, accounting for 18%, 31% and 20% of cancer deaths respectively in those age groups. Breast cancer was the third most common cause of cancer deaths for women aged either 70-79 or 80 years and over (11% of cancer-related deaths in both age groups) behind lung cancer and colorectal cancer.

Figure 6.3: Average number of deaths per year for the most common types of cancer among females by age group, Queensland, 2002-2006

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

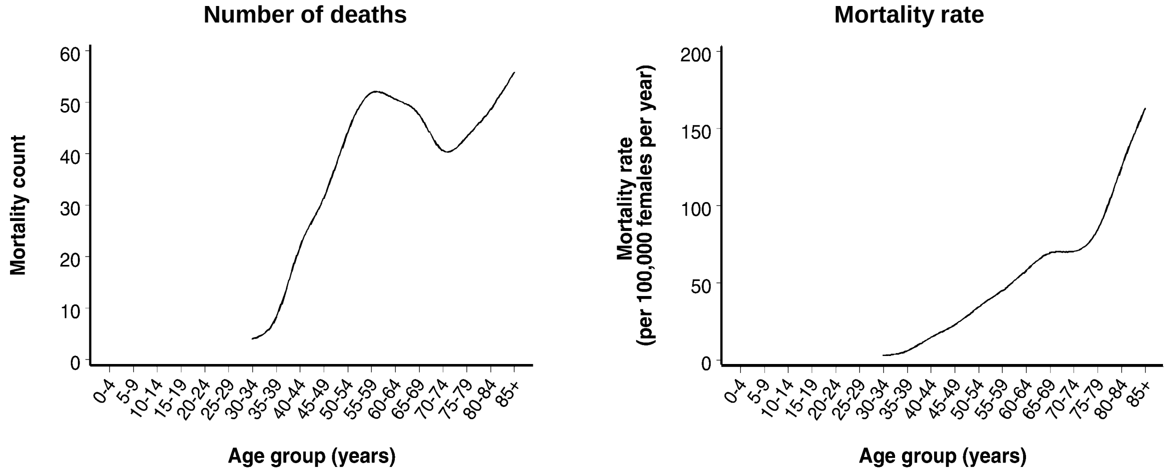


Data source: Queensland Cancer Registry.

6.2.2 Age-specific mortality

Most breast cancer deaths (85%) in Queensland occurred among women aged 50 years or older (Figure 6.4). Age-specific mortality was highest among women aged 85 years and over, both in terms of the number of deaths (56 per year) and the mortality rate (163 deaths per 100,000).

Figure 6.4: Average age-specific mortality for female breast cancer, Queensland, 2002-2006

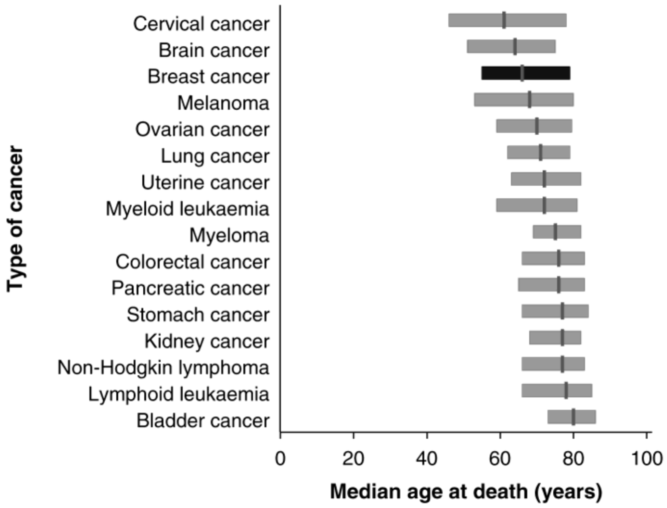


Data source: Queensland Cancer Registry.

6.2.3 Median age at death

The median age at death for women in Queensland who died from breast cancer between 2002 and 2006 was 66 years (Figure 6.5). This was considerably lower than the median age of 73 years for all cancer deaths among females. Women who died from cervical cancer had a younger median age at death (61 years), in contrast to those who died from bladder cancer (median age of 80 years).

Figure 6.5: Median age at death for selected cancers among females, Queensland, 2002-2006



Data source: Queensland Cancer Registry.

Note: Vertical bar shows median age at death, with the shaded area representing 50% of deaths (interquartile range).

Comment 6.2 – Are women with breast cancer at increased risk of dying from other causes?

A study conducted by the Cancer Council Queensland found that approximately 1 in 6 (16%) deaths among breast cancer patients were due to causes other than cancer.[162] Women diagnosed with breast cancer were no more likely to die from non-cancer causes than other women; in fact, the risk of mortality from cardiovascular disease was 16% lower for breast cancer patients compared to the general population.[162]

The probability of dying from breast cancer versus other causes of death depends on a number of factors such as stage, hormone receptor status and age at diagnosis.[163] Women with breast cancer were more likely to die from breast cancer than other causes if they were under 60 years of age at diagnosis or if they were diagnosed with metastatic disease at any age.[163]

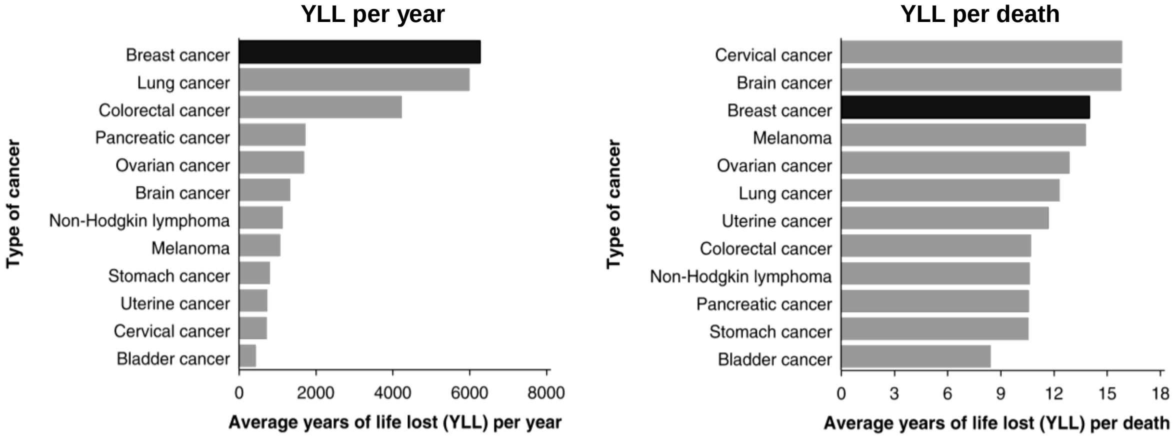
6.3 How much premature mortality is caused by breast cancer?

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.

Breast cancer was the leading cause of premature mortality due to cancer in females, causing an estimated total of 6,278 YLL per year in Queensland between 2002-2006 (Figure 6.6). This equated to 18% of cancer-related premature mortality and 6% of all premature mortality among females.

The average premature mortality per death from breast cancer (14.0 YLL per death) was greater than the average premature mortality per death for all cancers combined among females (11.9 YLL per death). Of the major types of cancer among females, cervical and brain cancers (both 15.8 YLL per death) caused the highest average premature mortality per death (Figure 6.6).

Figure 6.6: Premature mortality for selected types of cancer among females, Queensland, 2002-2006



Data source: Queensland Cancer Registry.

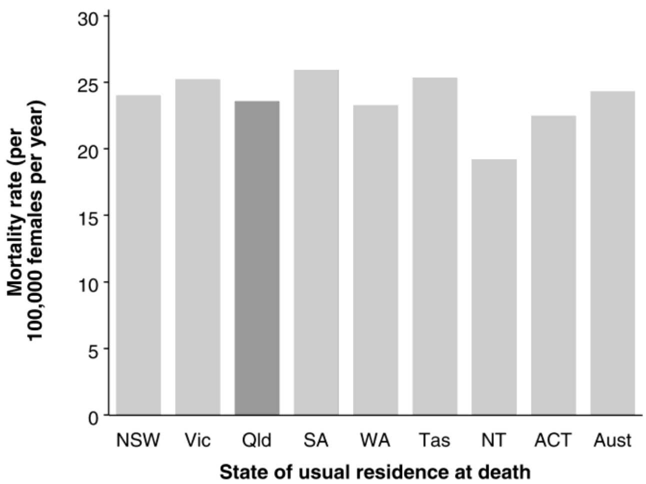
Notes: YLL was calculated using life expectancy data from the 2003 Australian Burden of Disease study,[164] based on 3% discounting with no age weighting.

6.4 Are mortality rates for breast cancer different elsewhere?

6.4.1 Interstate comparisons for mortality

The average annual breast cancer mortality rate in Australia between 2001-2005 was 24 deaths per 100,000 females (Figure 6.7). There were no statistically significant differences in the mortality rate for any of the States or Territories (including Queensland), although the rate in the Northern Territory was somewhat lower at 19 deaths per 100,000 females.

Figure 6.7: Average age-standardised mortality rates* of female breast cancer by State/Territory, Australia, 2001-2005



Data source: Australian Institute of Health and Welfare (AIHW).[165]

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

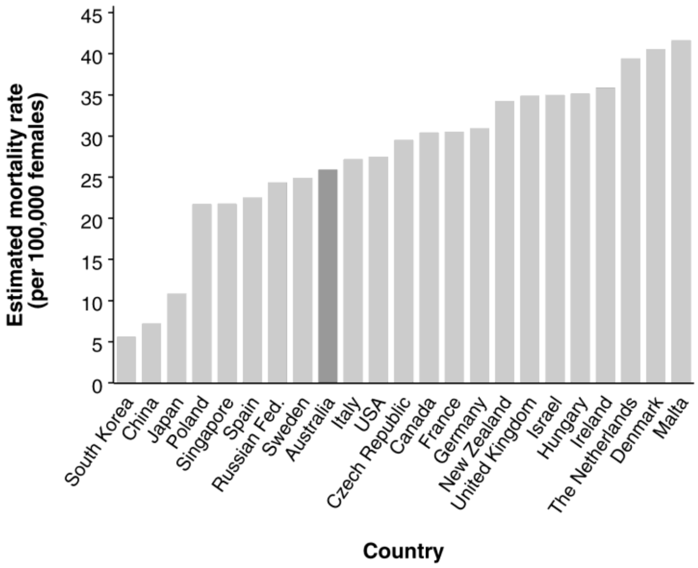
6.4.2 International comparisons for mortality

Breast cancer was the leading cause of cancer-related mortality for females worldwide during 2002, with an estimated 411,000 deaths (or 14% of all cancer deaths among females), followed by lung cancer (331,000 deaths, 11%) and cervical cancer (274,000 deaths, 9%).[78]

The breast cancer mortality rate for women in Australia was similar to the estimated average among more developed nations (Figure 6.8). Mortality rates due to breast cancer were highest in Northern and Western Europe and lowest in Eastern Asia.[79]

Although less than half (45%) of all new cases of breast cancer are diagnosed within less developed countries, it was estimated that 54% of deaths caused by breast cancer occur in those countries.[78] This disparity is mainly due to differences in survival between more developed and less developed countries (see Section 5.3.2).

Figure 6.8: Estimated age-standardised mortality rates of female breast cancer in selected countries, 2002



Data source: GLOBOCAN 2002, International Agency for Research on Cancer (IARC).[79]

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

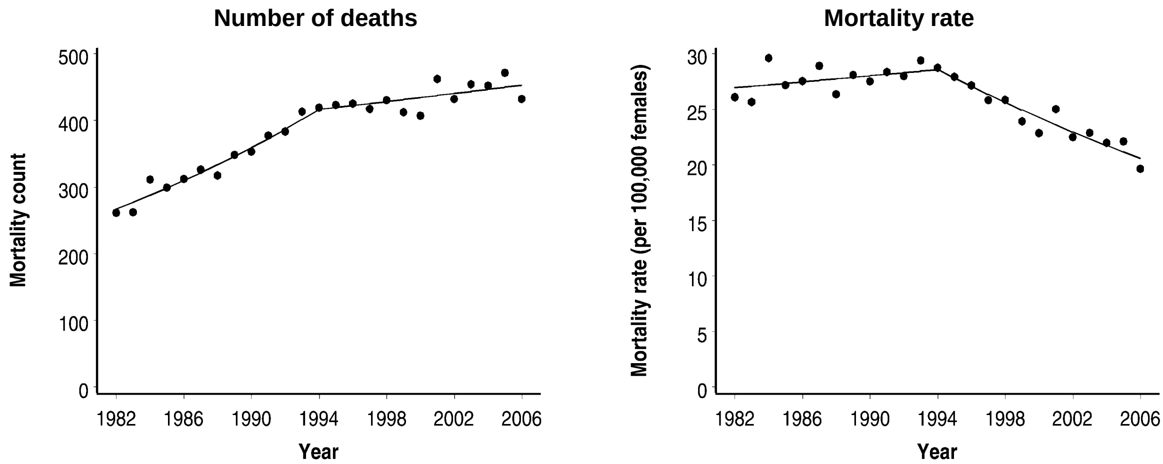
6.5 Have breast cancer mortality rates changed over time?

6.5.1 Mortality trends for Queensland

There were 261 deaths among women due to breast cancer in Queensland during 1982, compared to 432 deaths during 2006. The number of deaths increased rapidly (by an average of 3.8% per year) between 1982-1994, but annual growth has since slowed to 0.7% between 1994-2006 (Figure 6.9).

In contrast, the mortality rate due to breast cancer in Queensland grew slowly between 1982-1994 (a non-significant rise of 0.5% per year), but has decreased by 2.7% per year since then (Figure 6.9). Similar to incidence trends (see Section 4.5.1), apparent differences over time between mortality rates and the actual number of deaths are mainly due to population growth and ageing.

Figure 6.9: Trends in female breast cancer mortality, Queensland, 1982-2006



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

Number of deaths
1982-1994 = +3.8% (+3.1%, +4.5%)
1994-2006 = +0.7% (+0.1%, +1.3%)

Mortality rate
1982-1994 = +0.5% (-0.2%, +1.2%)
1994-2006 = -2.7% (-3.3%, -2.1%)

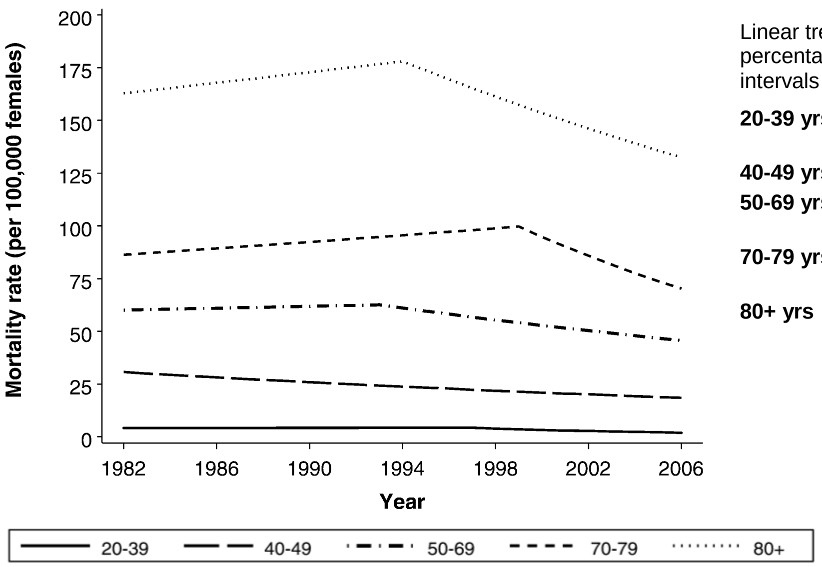
Data source: Queensland Cancer Registry.

Notes: Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, NCI.[88]

6.5.2 Mortality trends for Queensland by age group

Breast cancer mortality rates have been decreasing across all age groups since at least the mid to late 1990s (Figure 6.10). The greatest decline has occurred among women aged 20-39 years (-8.3% per year since 1997). Mortality rates have also been dropping by 2.1% per year since 1982 for women aged 40-49, 2.4% per year since 1993 for women aged 50-69, 4.9% per year since 1999 for women aged 70-79, and 2.4% per year since 1994 in the 80 years and over age group.

Figure 6.10: Trends in female breast cancer mortality by age group (20 years and over)*, Queensland, 1982-2006



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

20-39 yrs 1982-1997 = +0.2% (-2.3%,+2.6%)
1997-2006 = -8.3% (-13.6%,-2.7%)
40-49 yrs 1982-2006 = -2.1% (-2.9%, -1.3%)
50-69 yrs 1982-1993 = +0.4% (-0.7%,+1.4%)
1993-2006 = -2.4% (-3.1%, -1.7%)
70-79 yrs 1982-1999 = +0.8% (-0.3%,+2.0%)
1999-2006 = -4.9% (-8.4%, -1.3%)
80+ yrs 1982-1994 = +0.7% (-0.9%,+2.4%)
1994-2006 = -2.4% (-3.7%, -1.2%)

Data source: Queensland Cancer Registry.

Notes: * There were an insufficient number of deaths to calculate breast cancer mortality trends for females aged 0-19 years.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, NCI.[88]

6.5.3 International mortality trends

Trends in female breast cancer mortality rates between 1982-2006 for 27 selected countries, including Australia, are shown in Figure 6.11. The most recent mortality trends in these countries can be summarised as follows:

- significantly increasing for all age groups combined and the 50-69 age group – Japan, Mexico, South Korea, Venezuela;
- significantly increasing for all age groups combined and stable in the 50-69 age group – Argentina;
- stable for all age groups combined and significantly increasing in the 50-69 age group – Romania, Russia, Singapore, Ukraine;
- stable for all age groups combined and the 50-69 age group – Kazakhstan;
- significantly decreasing for all age groups combined and stable in the 50-69 age group – Bulgaria, Hong Kong, Poland; and
- significantly decreasing for all age groups combined and the 50-69 age group – Australia, Canada, France, Germany, Hungary, Ireland, Israel, Italy, Netherlands, New Zealand, Spain, Sweden, United Kingdom, United States.

Figure 6.11: Recent national and international trends in female breast cancer mortality for selected countries, 1982 to 2006*

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

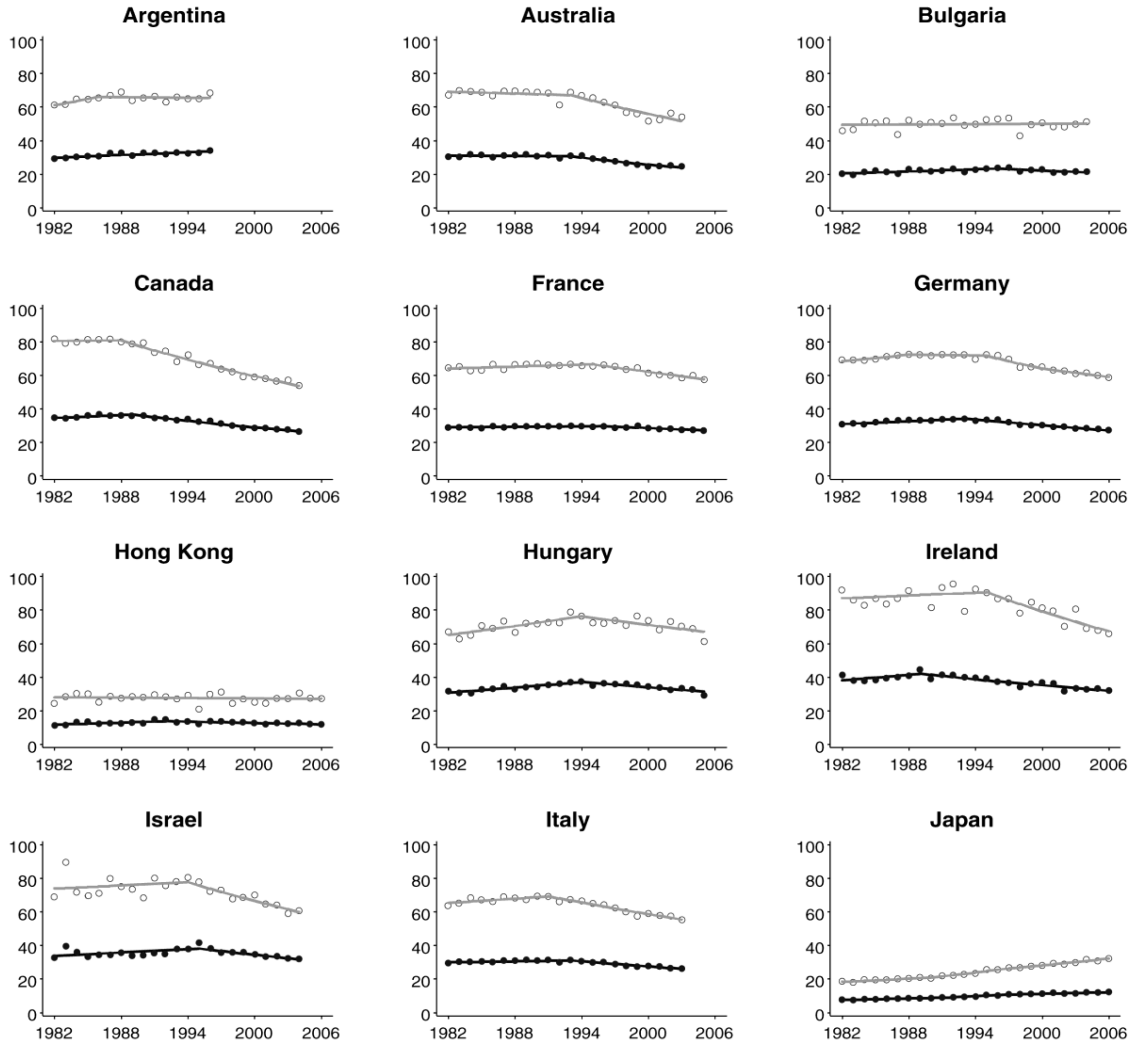
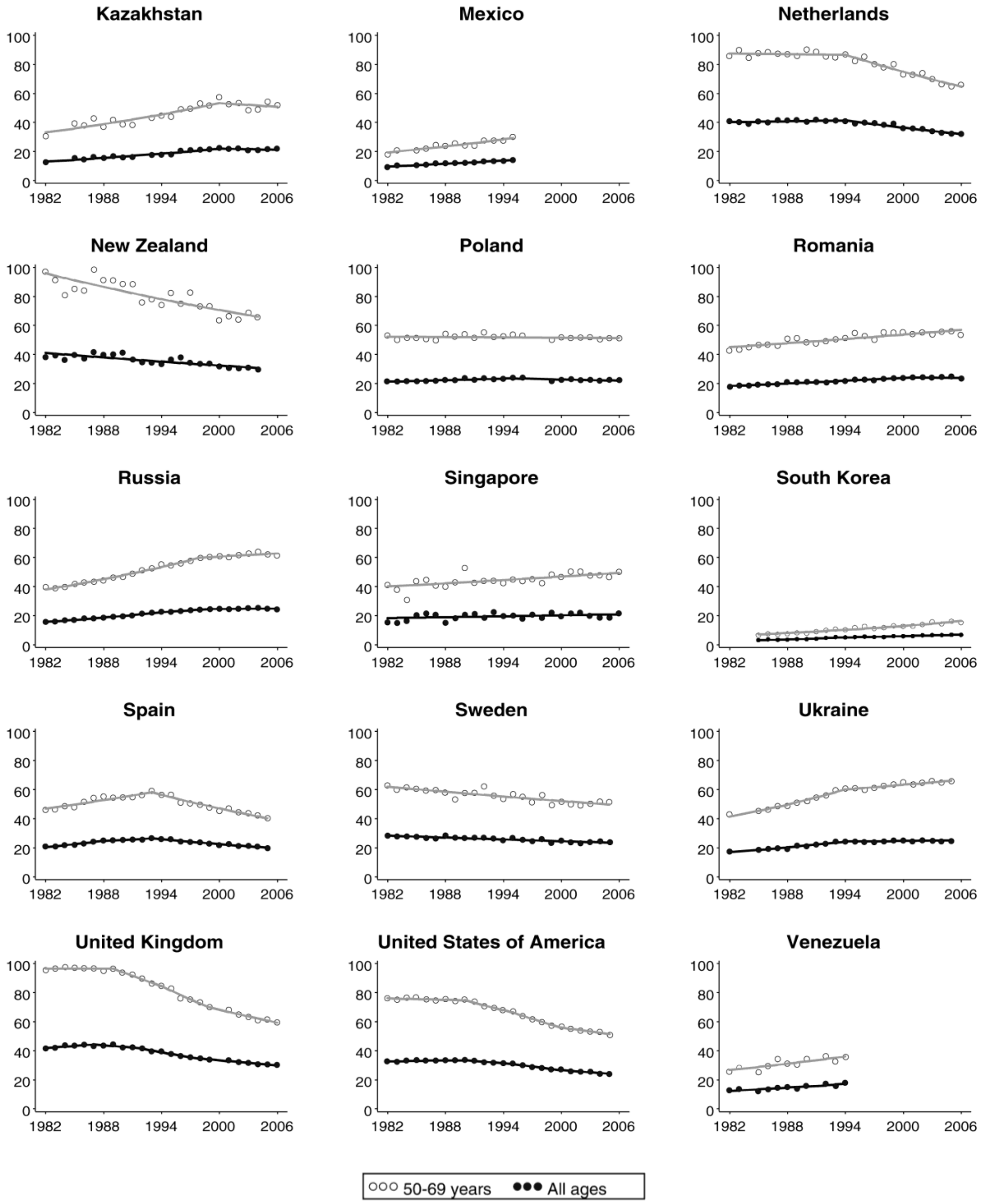


Figure 6.11 (*cont.*) Recent national and international trends in female breast cancer mortality for selected countries, 1982 to 2006*

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) [166]

Notes: * Breast cancer mortality rates available from 1982 to 2006 for Germany, Hong Kong, Ireland, Japan, Kazakhstan, Netherlands, Poland, Romania, Russia, Singapore, and the United Kingdom; 1982 to 2005 for France, Hungary, Spain, Sweden, Ukraine and the United States; 1982 to 2004 for Canada, Israel, and New Zealand; 1982 to 2003 for Australia and Italy; 1982 to 1996 for Argentina; 1982 to 1995 for Mexico; and 1982 to 1994 for Venezuela.
Rates age-standardised to the Australian standard population (2001).
Trends modelled using Joinpoint software (version 3.0), Statistical Research and Applications Branch, NCI.[88]

For all age groups combined, the largest recent increases in the mortality rate of breast cancer were recorded in Mexico, South Korea, and Venezuela, which each had annual rises of 2.8% from 1982-1995, 1993-2006 and 1982-1994 respectively. In contrast, breast cancer mortality rates decreased by 2.5% per year in Australia (1993-2003), 2.3% per year in Spain (1993-2005) and 2.1% per year in The Netherlands (1994-2006) and Canada (1989-2004).

Among women aged 50-69 years, mortality rates were increasing by 4.0% per year in South Korea (1985-2006), 3.3% per year in Mexico (1982-1995) and 2.6% per year in Venezuela (1982-1994). The largest annual decreases in breast cancer mortality within this age group were observed in Spain (-3.0% between 1993-2005) and Ireland (-2.7% between 1995-2006).

Full details of the trends for each country included in Figure 6.11 are shown in Appendix C.

Comment 6.3 – Why are breast cancer mortality rates decreasing?

Mortality rates for breast cancer have been decreasing in most developed countries around the world since the early to mid 1990s.[81,167] Declines in mortality rates have tended to be greater among females aged under 50 years.[167,168] The favourable mortality trends over recent years are generally attributed to a combination of earlier detection (as a result of population screening) and improved treatment,[81,95] although the exact contributions of these and other factors remains unclear.[167,169] It appears likely that the decline in mortality rates among many developed countries will persist into the foreseeable future,[167] particularly as incidence rates start to decline and survival continues to improve.

7 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 2002 and 31st December 2006 who were still alive at the end of that period. Prevalence can either 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, 20-year and 25-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 breast cancer.

Comment 7.1 – What factors influence cancer prevalence?

Prevalence is related to both incidence and survival. Due to the high incidence of female breast cancer internationally (see Section 4.4.2) combined with relatively good survival rates (see Section 5.3.2), it is the most prevalent type of cancer in the world, followed by colorectal cancer and prostate cancer.[78]

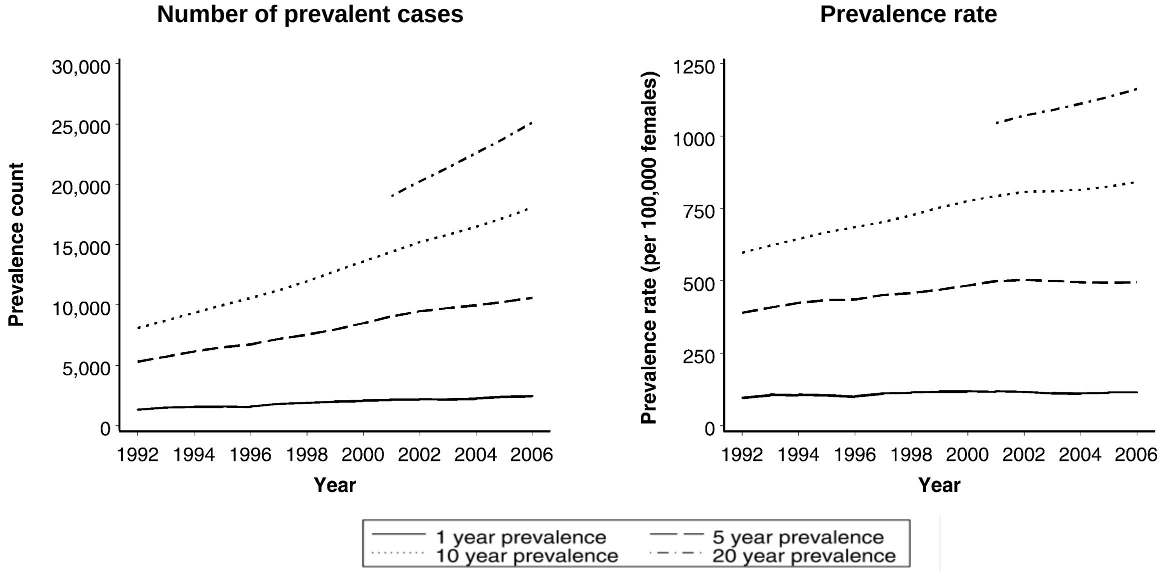
There were an estimated 4.4 million females still alive at the end of 2002 who had been diagnosed with breast cancer during the previous 5 years.[78] In contrast, despite the higher incidence of lung cancer among males and females combined, it has relatively low prevalence due to the poor survival of lung cancer patients (estimated 5-year prevalence of 1.4 million persons worldwide in 2002).[78]

7.1 How many women living in Queensland have been diagnosed with breast cancer?

A total of 26,361 women living in Queensland at the end of 2006 had been diagnosed with breast cancer at some time during the previous 25 years, equating to a rate of 1,219 per 100,000 females. Over two-thirds (68%) of these 25-year prevalent breast cancer cases had been diagnosed within the previous 10 years (18,056 cases or 841 per 100,000 females), while 40% had been diagnosed within 5 years (10,565 cases or 494 per 100,000 females).

Although mid- and longer-term prevalence counts for breast cancer have continued to increase, prevalence rates have generally been levelling off or growing more slowly in recent years (Figure 7.1). This disparity between the trends in prevalence counts and prevalence rates is primarily because rates adjust for population growth and ageing (see also Section 4.5.1). For example, the 5-year prevalence count for breast cancer increased by 100% between the end of 1992 and the end of 2006, compared to a corresponding rise of 27% in the 5-year prevalence rate.

Figure 7.1: Trends in the limited duration prevalence of female breast cancer (counts and rates), Queensland, 1992-2006



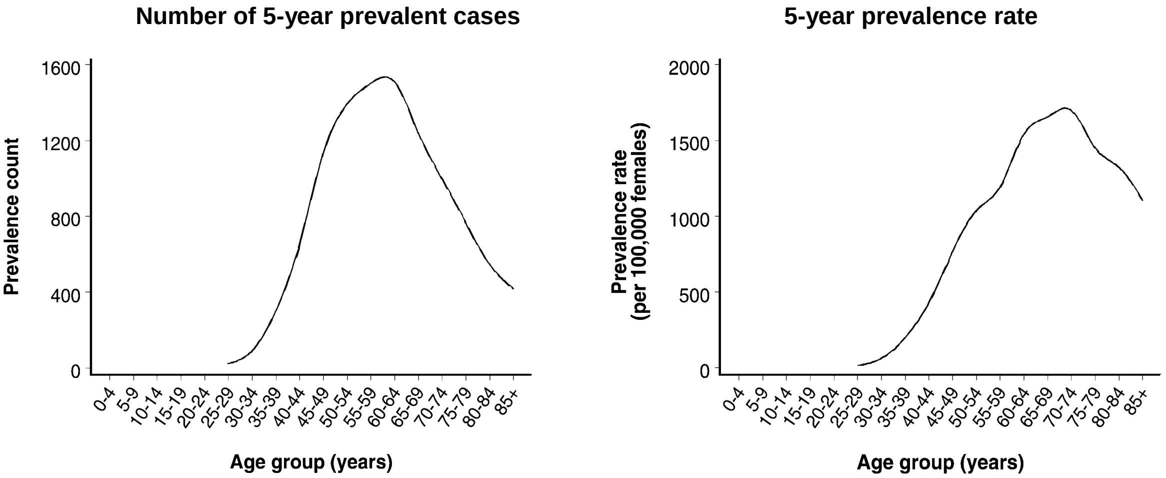
Data source: Queensland Cancer Registry.

Notes: Prevalence data are as at 31st December of the year shown.
Data for 25-year prevalence are only available for 2006 and so are not shown on the graphs.
Rates age-standardised to the Australian standard population (2001).

7.2 How much does the prevalence of breast cancer vary by age group?

The number of 5-year prevalent breast cancer cases rose sharply up to the age of 65. As at the end of 2006, there were 1,509 prevalent cases of breast cancer among women aged 60-64 years, whereas the highest 5-year prevalence rate occurred in the 70-74 age group, with 1,698 cases per 100,000 females (Figure 7.2).

Figure 7.2: Age-specific 5-year prevalence of female breast cancer, Queensland, 2006



Data source: Queensland Cancer Registry.

Notes: Prevalence data are as at 31st December 2006.

Comment 7.2 – The economic cost of breast cancer in Australia

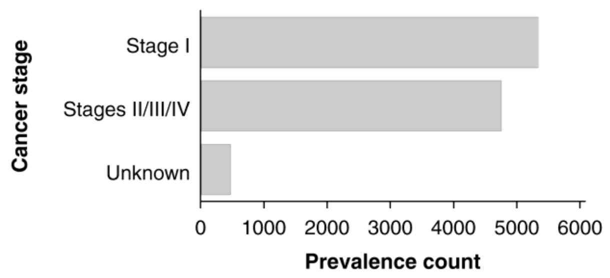
According to the Australian Institute of Health and Welfare, an estimated $241 million was spent on breast cancer in Australia during the 2000/2001 financial year, including $135 million (56%) for treatment, $96 million (40%) for population screening and $11 million (5%) for other preventative measures.[170] Breast cancer was by far the most costly cancer among females, accounting for 15% of total expenditure on cancer.[170]

However, at an individual level, breast cancer treatment was relatively inexpensive compared to the financial cost of other types of cancer. The lifetime treatment cost for a woman diagnosed with breast cancer was estimated at around $11,900 per patient, which was only around half of the average cost of $21,900 per patient for all cancers combined.[170]

7.3 What is the distribution of breast cancer prevalence by stage?

At the end of 2006, more than half of the 5-year prevalent cases of breast cancer in Queensland were initially diagnosed as Stage I tumours (51%, or 5,337 cases). Women whose breast cancers were diagnosed at Stages II/III/IV accounted for a further 45% (or 4,755 cases) of 5-year prevalence, while only 4% (473 cases) of 5-year prevalent cases were not staged at diagnosis (Figure 7.3).

Figure 7.3: 5-year prevalence counts by stage of female breast cancer, Queensland, 2006



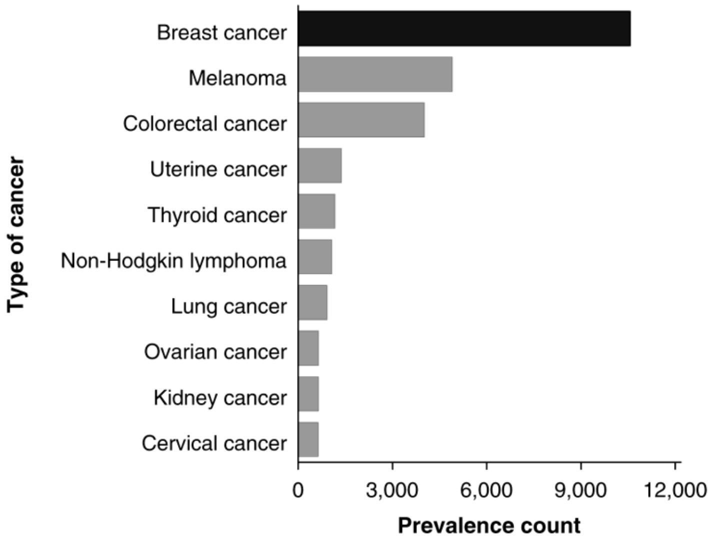
Data source: Queensland Cancer Registry.

Notes: Prevalence data are as at 31st December 2006.

7.4 How does the 5-year prevalence of breast cancer compare with other cancers?

At the end of 2006 there were 31,102 females living in Queensland who had been diagnosed with cancer during the previous 5 years. Breast cancer was by far the most prevalent type of cancer, responsible for around a third (34% or 10,565 cases) of all 5-year cancer prevalence (Figure 7.4). Melanoma ranked second (16% or 4,901 prevalent cases), while colorectal cancer accounted for a further 13% (4,021 prevalent cases).

Figure 7.4: 5-year prevalence counts for the most prevalent types of cancer among females, Queensland, 2006



Data source: Queensland Cancer Registry.

Notes: Prevalence data are as at 31st December 2006.

8 Geographical variation

This chapter provides information on geographical variability in incidence, survival and mortality for breast cancer in Queensland between 1997-2006. Data was analysed according to geographic region, rurality and area-based socio-economic status (see Appendix B for further details on the definitions used for these categories). An understanding of differences in cancer data by locality or socio-economic characteristics is important when planning the allocation of health resources and services. The information may also be useful as a starting point for researchers to conduct more detailed studies into the possible causes of any geographical differences in cancer incidence or survival.

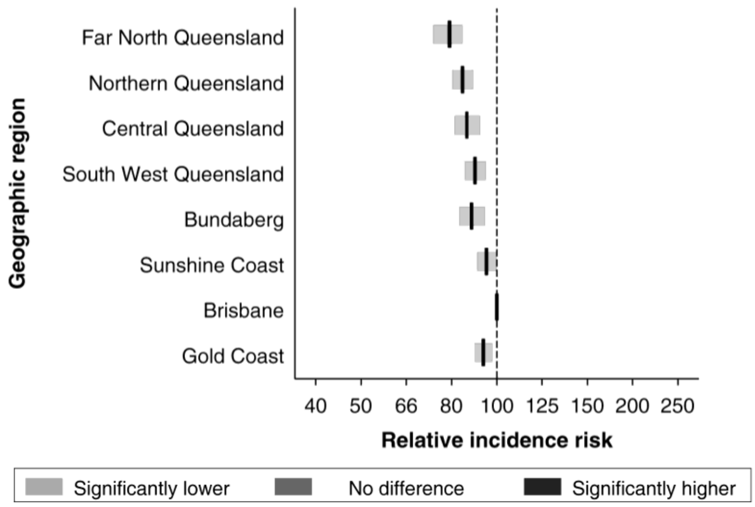
8.1 Is there variation in breast cancer incidence within Queensland?

8.1.1 Breast cancer incidence by geographic region

The risk of being diagnosed with breast cancer was lower for women in all areas of Queensland outside of the capital city Brisbane during the period 1997-2006 (Figure 8.1). Relative to Brisbane, the incidence risk ranged from 21% lower in Far North Queensland to 5% lower on the Sunshine Coast.

Most of the variation throughout Queensland in breast cancer incidence was due to differences in the incidence rate of Stage I tumours, with only small regional differences for advanced or unknown stage breast cancers.

Figure 8.1: Relative risk of female breast cancer incidence by geographic region, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

Notes:
1. Geographic regions were defined according to the areas administered by the various offices of the Cancer Council Queensland (see Appendix B) and were based on place of usual residence at time of diagnosis.
2. Relative incidence risk was expressed in comparison to the reference category of Brisbane (i.e. relative incidence risk = 100 for Brisbane).
3. The vertical bar for each region shows the estimated relative risk, with the corresponding 95% confidence interval indicated by the shaded area.

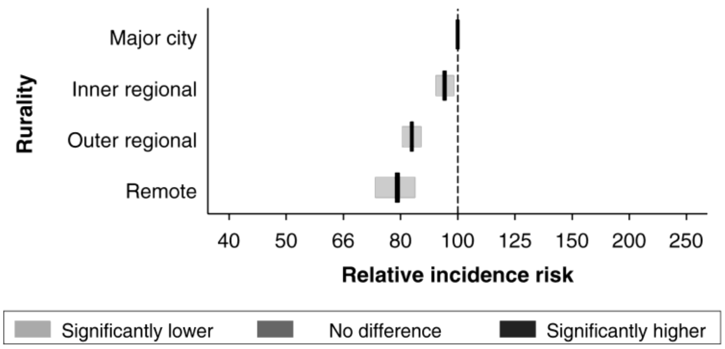
Statistical test results for overall geographic variation: Chi-sq=96.97, df=7, p<0.001.

8.1.2 Breast cancer incidence by rurality

There was a distinct gradient in breast cancer incidence rates by rurality in Queensland (Figure 8.2). Compared to their counterparts living in major city localities, women in inner regional areas had a 5% lower risk of developing breast cancer, those in outer regional areas had a 16% lower risk, while the risk was 21% lower in remote regions. In particular, the incidence of Stage I breast cancer was lower among women in outer regional or remote regions in relation to those who lived in a major city (by 26% and 30%, respectively).

National breast cancer incidence data displayed a similar pattern by rurality. Between 1998-2002, incidence rates were 117 per 100,000 females in major cities, 114 per 100,000 females in inner regional areas, 105 per 100,000 females in outer regional areas, 101 per 100,000 females in remote areas and 94 per 100,000 females in very remote areas.[66] An excess of breast cancer incidence in urban areas compared to rural areas has also been reported in several countries around the world.[171]

Figure 8.2: Relative risk of female breast cancer incidence by rurality, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

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

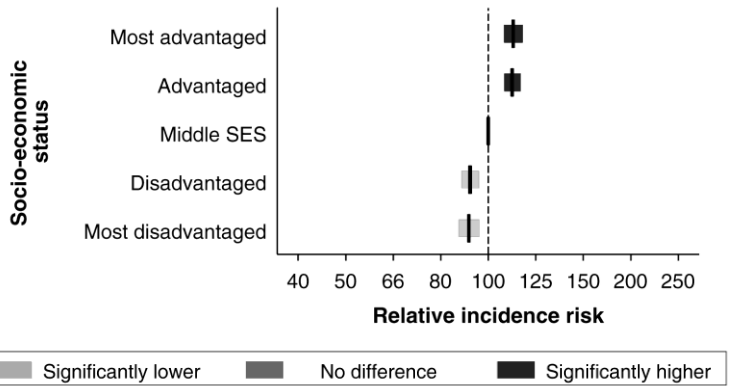
Statistical test results for overall geographic variation: Chi-sq=109.29, df=3, p<0.001.

8.1.3 Breast cancer incidence by socio-economic status

There was also a clear relationship between incidence rates of breast cancer and socio-economic status in Queensland (Figure 8.3). Women living in areas of higher economic status were 13% more likely to be diagnosed with breast cancer, while women in disadvantaged areas had an 8% lower risk of developing breast cancer, compared to those in the middle socio-economic status group. Differences by socio-economic status were even more pronounced for the incidence of Stage I breast cancers, with women in the most advantaged areas being 27% more likely to be diagnosed with Stage I tumours than those in the middle group.

These findings are typical, with higher levels of breast cancer incidence generally associated with higher socio-economic status. In Australia, breast cancer incidence rates were significantly higher for women living in areas of higher socio-economic status, and significantly lower for those living in regions with the lowest socio-economic status.[66] Similar patterns have also been reported in the United States[172,173] and Europe.[174,175]

Figure 8.3: Relative risk of female breast cancer incidence by socio-economic status, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

Notes:
1. Socio-economic status was defined using the SEIFA index of relative socio-economic advantage and disadvantage (see Appendix B) and was based on place of usual residence at time of diagnosis.
2. Relative incidence risk was expressed in comparison to the reference category of 'Middle SES' (i.e. relative incidence risk = 100 for 'Middle SES').
3. 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: Chi-sq=164.47, df=4, p<0.001.

Comment 8.1 – Possible causes of variation in the incidence of breast cancer by socio-economic status

Variations in breast cancer incidence by socio-economic status have been linked to lifestyle factors and screening behaviour. Women living in more affluent areas are more likely to have their first child at a later age, have fewer children and use hormone replacement therapy,[173-175] all of which are risk factors for developing breast cancer (see Chapter 2). Moderate differences in screening by socio-economic status have also been reported, with women from more affluent areas tending to have higher participation rates in mammogram programs, which may increase incidence rates.[173,174]

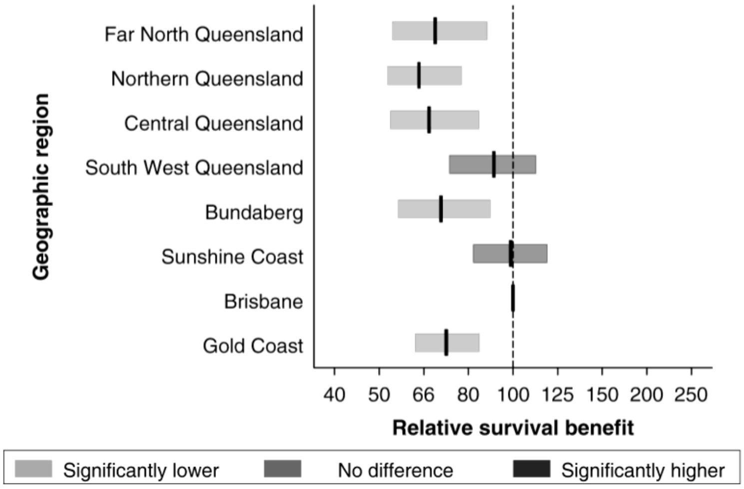
An excess in breast cancer incidence persists among women from areas with higher socioeconomic status even after adjusting for individual characteristics. This suggests that there may be community-level effects as well, such as environmental exposures or shared attitudes about behaviours known to be risk factors for breast cancer.[173]

8.2 Is there variation in breast cancer survival within Queensland?

8.2.1 Breast cancer survival by geographic region

With the exception of the Sunshine Coast and South-West Queensland, breast cancer survival was considerably poorer (between 27% to 36% lower) in most other parts of the state compared to Brisbane (Figure 8.4). While the size of the survival differences generally diminished after adjusting for stage at diagnosis, survival still remained significantly lower in Northern Queensland, Bundaberg and the Gold Coast.

Figure 8.4: Relative benefit of 5-year survival for female breast cancer by geographic region, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

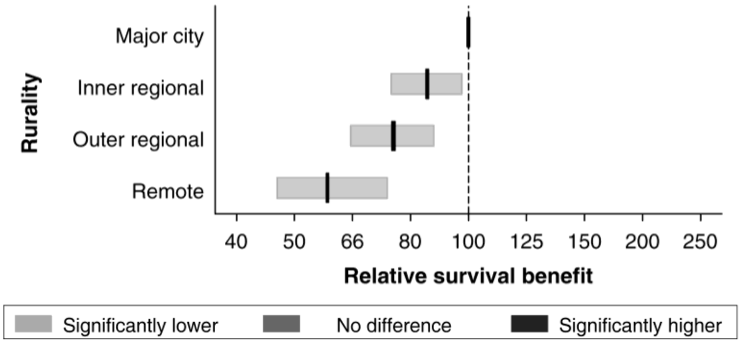
Notes:
1. Relative survival calculated using the period approach, for persons aged 0-89 years at diagnosis.
2. Data are for 'at risk' cases in the period 1997-2006.
3. Geographic regions were defined according to the areas administered by the various offices of the Cancer Council Queensland (see Appendix B) and were based on place of usual residence at time of diagnosis.
4. 5-year relative survival benefit was expressed in comparison to the reference category of Brisbane (i.e. relative survival benefit = 100 for Brisbane).
5. 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: Chi-sq=42.83, df=7, p<0.001.

8.2.2 Breast cancer survival by rurality

Survival from breast cancer was poorer for those residing outside a major city. The 5-year relative survival for breast cancer was 14% lower among women from inner regional areas, 24% lower in outer regional areas and 41% lower in remote areas than their counterparts from the major city area (Figure 8.5). Again, adjustment for stage at diagnosis accounted for some, but not all, of these variations in survival.

Figure 8.5: Relative benefit of 5-year survival for female breast cancer by rurality, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

Notes:
1. Relative survival calculated using the period approach, for females aged 0-89 years at diagnosis.
2. Data are for 'at risk' cases in the period 1997-2006.
3. Rurality was defined using the ARIA+ (Accessibility/Remoteness Index for Australia) classification (see Appendix B) and was based on place of usual residence at time of diagnosis.
4. 5-year relative survival benefit was expressed in comparison to the the to the reference category of 'Major city' (i.e. relative survival benefit = 100 for 'Major city').
5. 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: Chi-sq=27.57, df=3, p<0.001.

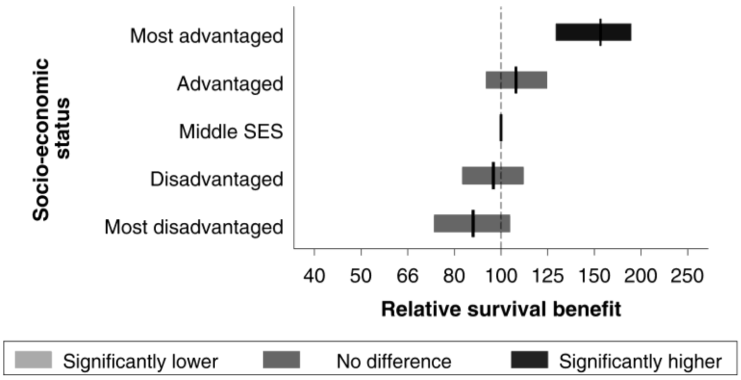
Although there was some evidence of a declining gradient in survival from breast cancer at the national level as distance from major cities increases, the differences were not significant (5-year relative survival of 88% in major cities compared to 85% in remote/very remote regions).[155]

8.2.3 Breast cancer survival by socio-economic status

While the incidence of breast cancer increased with higher socio-economic status, women from advantaged areas also tended to have better survival from breast cancer. Women living in the most advantaged parts of Queensland were 57% more likely to survive for 5 years following a diagnosis of breast cancer than women in middle class areas (Figure 8.6). The corresponding difference was 38% after adjusting for stage of breast cancer at diagnosis.

Although still significant, differences in survival from breast cancer by socio-economic status were smaller throughout Australia, with 5-year relative survival of 90% among women in the highest socio-economic status quintile compared to 86% for those in the lowest quintile.[155]

Figure 8.6: Relative benefit of 5-year survival for female breast cancer by socio-economic status, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

Notes:
1. Relative survival calculated using the period approach, for females aged 0-89 years at diagnosis.
2. Data are for 'at risk' cases in the period 1997-2006.
3. Socio-economic status was defined using the SEIFA index of relative socio-economic advantage and disadvantage (see Appendix B) and was based on place of usual residence at time of diagnosis.
4. 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').
5. 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: Chi-sq=36.83, df=4, p<0.001.

Comment 8.2 – Socio-economic and geographic issues affecting the survival of breast cancer patients

Differences in survival for breast cancer patients by socio-economic status appear to be primarily related to stage at diagnosis.[176-178] Women from disadvantaged areas tend to present to their doctors with more advanced tumours, which may reflect lower rates of screening.[176,177] However, even after taking stage into account, disparities in survival by socio-economic status persist, possibly indicating that variation in treatment may also be a factor.[177,178]

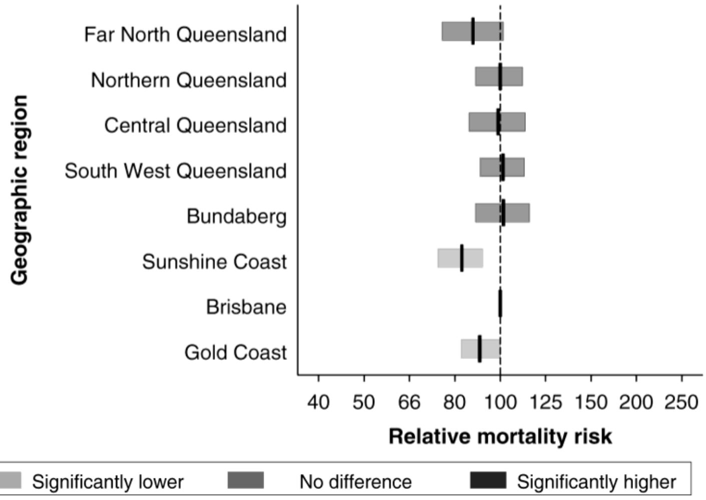
In regard to locality, one study in Western Australia found that although district of residence had little effect on breast cancer survival, patients treated in rural hospitals had higher mortality rates.[179] Other research has found that differences in survival between women in rural and urban areas were negated when adjusted for the treatment received.[180] These findings may be due, at least in part, to the lack of specialist or high caseload surgeons in rural areas.[179,180]

8.3 Is there variation in breast cancer mortality within Queensland?

8.3.1 Breast cancer mortality by geographic region

The risk of dying from breast cancer was similar throughout most parts of Queensland except for the Sunshine Coast and Gold Coast (Figure 8.7). Women from those areas had breast cancer mortality risks that were 17% and 9% lower, respectively, in relation to women from Brisbane. The difference for the Sunshine Coast remained significant after adjusting for stage at diagnosis.

Figure 8.7: Relative risk of female breast cancer mortality by geographic region, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

Notes:
1. Geographic regions were defined according to the areas administered by the various offices of the Cancer Council Queensland (see Appendix B) and were based on place of usual residence at time of diagnosis.
2. Relative mortality risk was expressed in comparison to the reference category of Brisbane (i.e. relative mortality risk = 100 for Brisbane).
3. 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: Chi-sq=18.74, df=7, p=0.009.

Comment 8.3 – Breast cancer among Indigenous Australians

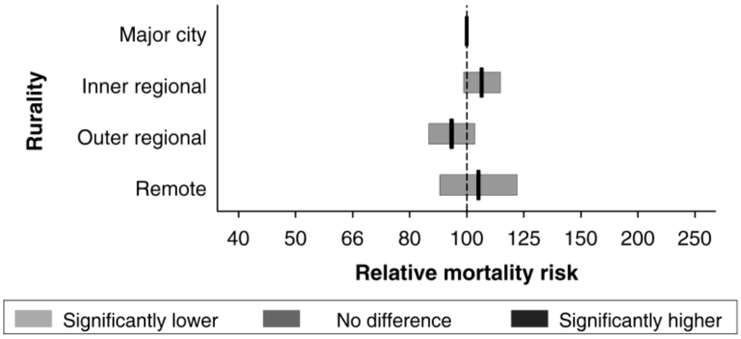
Available data indicates that breast cancer is the most commonly diagnosed type of cancer among Indigenous females, accounting for 25% of all cancers diagnosed among Aboriginal and Torres Strait Islander women across Australia during 2000-2004.[66,181] However, the age-standardised incidence of breast cancer in Indigenous women appears to be lower than for non-Indigenous women.[182,183] This may be due to some combination of higher fertility, greater lactation or lower participation rates in breast screening programs for Indigenous women compared to other women.[182,184,185]

In contrast, mortality from breast cancer among Indigenous women is similar to or higher than for non-Indigenous women, due to poorer survival from breast cancer among Indigenous women.[66,154] Some of the disparity in survival is likely to result from Indigenous women presenting with more advanced breast cancers,[186,187] possibly stemming from less awareness of symptoms, delays in seeking medical advice and reluctance to have a mammogram or perform self-examination.[187,188] Other factors that may help to explain lower survival rates among Indigenous women include being less likely to receive appropriate treatment (due to a combination of cultural, language and socio-economic barriers) as well as the higher prevalence of comorbid diseases compared to the general population.[185,187-189]

8.3.2 Breast cancer mortality by rurality

Breast cancer mortality was similar among women in Queensland irrespective of the rurality of where they lived (Figure 8.8).

Figure 8.8: Relative risk of female breast cancer mortality by rurality, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

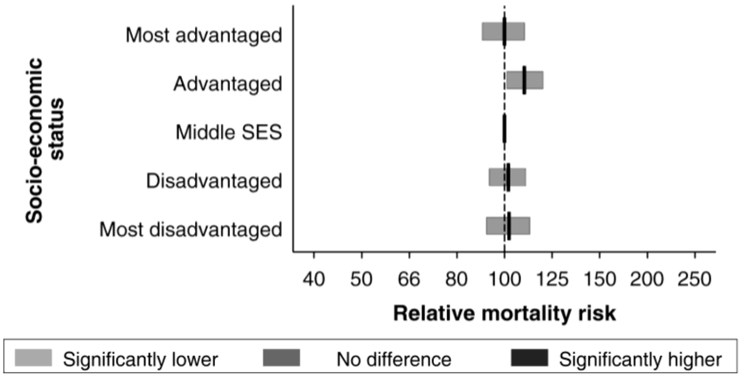
Notes: 1. Rurality was defined using the ARIA+ (Accessibility/Remoteness Index for Australia) classification (see Appendix B) and was based on place of usual residence at time of diagnosis.
2. Relative incidence risk was expressed in comparison to the reference category of 'Major city' (i.e. relative incidence risk = 100 for 'Major city').
3. 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: Chi-sq=5.82, df=3, p=0.121.

8.3.3 Breast cancer mortality by socio-economic status

There were no significant differences in breast cancer mortality among women in Queensland in regard to the socio-economic status of their area of residence (Figure 8.9).

Figure 8.9: Relative risk of female breast cancer mortality by socio-economic status, Queensland, 1997-2006



Data source: Queensland Cancer Registry.

Notes: 1. Socio-economic status was defined using the SEIFA index of relative socio-economic advantage and disadvantage (see Appendix B) and was based on place of usual residence at time of diagnosis.
2. Relative incidence risk was expressed in comparison to the reference category of 'Middle SES' (i.e. relative incidence risk = 100 for 'Middle SES').
3. 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: Chi-sq=6.27, df=4, p=0.180.

Appendix A – Other sources of information

A.1 Related publications on cancer in Queensland

Queensland Cancer Registry. *Cancer in Queensland: Incidence and Mortality, 1982 to 2006*. Brisbane: QCR, Cancer Council Queensland and Queensland Health, March 2009. (www.cancerqld.org.au/pdf/1982to2006finaltablesBookmarked.pdf)

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

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

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

Queensland Health, *BreastScreen Queensland: A decade of achievement 1991-2001*. Brisbane: QH, October 2005. (www.health.qld.gov.au/breastscreen/documents/29324.pdf)

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

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

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

A.2 Related publications on breast cancer in Australia

Australian Institute of Health and Welfare. *BreastScreen Australia monitoring report 2004-2005*. Cancer series no. 42. AIHW, May 2008. (http://www.aihw.gov.au/publications/can/bsamr04-05/bsamr04-05.pdf)

Australian Institute of Health and Welfare, National Breast Cancer Centre. *Breast cancer survival by size and nodal status in Australia*. Cancer Series no. 39. AIHW, September 2007. (www.aihw.gov.au/publications/can/bcsbsansia/bcsbsansia.pdf)

Australian Institute of Health and Welfare, National Breast Cancer Centre, 2006. *Breast cancer in Australia: an overview, 2006*. Cancer Series no. 34. AIHW, October 2006. (www.aihw.gov.au/publications/can/bca06/bca06.pdf)

A.3 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.

- *National Breast and Ovarian Cancer Centre* (www.breasthealth.com.au)
  Information for women who have been diagnosed with breast cancer, or have concerns.

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

- *National Health and Medical Research Council* (www.nhmrc.gov.au/publications)
  Clinical practice guidelines for the prevention, early detection and management of early and advanced breast cancers as well as breast cancer in younger women.

Appendix B – Methods

B.1 Breast 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.[5] These definitions are based on the World Health Organization's International Classification of Diseases for Oncology, 3rd edition (ICD-O3).[190] Breast cancer was defined as the ICD-O3 code C50.

The groupings for stage of cancer were based on the International Union Against Cancer (UICC) classification of breast cancer stages, as outlined in the Australian Clinical Practice Guidelines for early breast cancer.[14] Tumour size, nodal involvement and presence of metastases (the TNM system) are used to classify breast cancer stages. While the QCR does not collect this detailed information, information has been recorded on tumour size and lymph node involvement since 1997. These data items have been used to approximate breast cancer stage, as defined in Table B1.

The only component of the Stage I breast cancer definition which could not be confirmed from the QCR data was the absence of metastasis (M0). Although it would be unlikely that these cases had metastasised, this could not be definitively ruled out. Also, as it was not possible to distinguish between Stages II, III or IV with the available information, these were combined into the one grouping. Breast cancers which were diagnosed as a result of metastatic disease were included in this category.

The "unknown" category contained tumours of unknown size or unknown lymph node involvement when the tumour size was 20mm or less. It is more likely that lymph node involvement or tumour size were not assessed for cases where the cancer was very advanced at diagnosis.[133]

Table B1: Definitions of stage of breast cancer

Cancer stage	*Definition*	*Equivalent TNM clinical classification*
Stage I	Tumours of not more than 20 mm diameter, with no evidence of lymph node involvement or distant metastases	T1, N0, M0
Stage II/III/IV	Cancers larger than 20 mm diameter, and/or with evidence of spread to lymph nodes; or distant metastases	Any of the following: • T0-4, N1-2,M0 • T2-4, N0, M0 • Any T, Any N, M1
Unknown	Contains the following tumours: a. Unknown tumour size b. Unknown lymph node status if tumour size is less than or equal to 20 mm	Any of the following: • Unknown T • Unknown N if T1

Source: iSource National Breast Cancer Centre.[14]

B.2 Data sources

Australian Bureau of Statistics (ABS)

Estimated resident population data were obtained from the Australian Bureau of Statistics.[191] 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.[159] 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 breast cancer incidence data for the period 2001-2005 were published by the Australian Institute of Health and Welfare.[77] Breast cancer mortality data for 2001-2005 were obtained from the State and Territories General Record of Incidence of Mortality (GRIM) books.[165] 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 and mortality trend data for Australia were also sourced from the AIWH, via the online Australian Cancer Incidence and Mortality (ACIM) books.[97] These are interactive spreadsheets containing incidence data from 1982 to 2005 and mortality data from 1968 to 2006 by age and sex for the major types of cancer.

BreastScreen Queensland

All data relating to breast cancer screening included in this report were obtained from BreastScreen Queensland, a population-based public health program which has been providing free breast cancer screening for eligible women in Queensland since 1991.[41] For further details about Breast-Screen Queensland, refer to Section 3.1.

Canadian Council of Cancer Registries (CCCR)

Incidence trends for Canada were sourced from the Canadian Council of Cancer Registries and downloaded from the online surveillance data provided by the Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada.[98] 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 1992-2005.

Hong Kong Cancer Registry

The Hong Kong Cancer Registry is a population-based cancer registry which has collected cancer incidence data since 1963.[99] 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 1983-2006.

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 2006 were obtained from their online statistical databases.[104]

National Cancer Center (Japan)

Data on cancer incidence in Japan were estimated by the Center for Cancer Control and Information Services, National Cancer Center, using information collected by a network of population-based cancer registries. National estimates were available from 1975 to 2002.[101] 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.[192] 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 the principal source of cancer incidence and survival data in the United States.[105] 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.[193] Another eight registries were 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,[100] 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 online for the years 1989 to 2005.[102]

Queensland Cancer Registry (QCR)

The majority of data on breast cancer in Queensland reported in this publication were provided by the Queensland Cancer Registry (QCR) based on an agreement between Queensland Health and Cancer Council Queensland allowing access to non-identifiable data. The use of this data is restricted to epidemiological analysis and must adhere to an approved publication protocol.

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 2006.[5] 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.[5]

Thames Cancer Registry (South-East England)

The Thames Cancer Registry (TCR) covers the residential population of London, Surrey, Sussex and Kent (about 24% of the total United Kingdom population). It is one of 12 population-based cancer registries in the UK and has collected cancer incidence data since 1960.[103] Aggregated data for breast cancer patients, including information on year of diagnosis (1980 to 2006), age group and sex were obtained through a specific request to the TCR.

World Health Organization (WHO)

Mortality and population data used for calculating international trends in breast cancer deaths were extracted from the WHO mortality database.[166] Data were available by cause of death, year of death, age group and sex. Records were selected when the death was coded to breast cancer, using the eighth, ninth and tenth revisions of the International Classification of Disease (ICD8 and ICD9: 174, ICD10: C50).

Breast cancer mortality trends were calculated from the WHO data between 1982 and 2006 for 27 selected countries (including Australia) which had data of sufficient quality and quantity (although the years of data available varied between countries). The selected countries averaged at least 200 deaths due to female breast cancer per year, and at least 80% of all deaths were registered.

Recent international breast 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).[79] 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 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).[194] The yearly percentage changes for incidence and mortality trends were calculated using Joinpoint software v3.0.[88]

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 8). This approach was used because the age-specific rates may be less stable when the population of interest is smaller. 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.[195]

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 88.5% with a 95% confidence interval of 87.9%-89.2%. This means that there is a 95% probability that the true survival rate will be somewhere between 87.9% and 89.2%.

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. breast 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. breast 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 breast cancer at 40 years of age would lose a greater number of years of (expected) life than a person who dies from breast 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).[164] 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 breast cancer sites.

Prevalence

Although incidence is an important measure when describing the short-term impact of breast 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 breast cancer. Prevalence is one measure that can provide this information. The prevalence of breast cancer represents the number of people who had a diagnosis of breast 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 2006) as prevalent when they were diagnosed within a specific time period. Limited duration prevalence estimates for breast cancer were presented for 1-, 5-, 10-, 20- and 25-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, 25-year limited duration prevalence for breast cancer could not be calculated for Queensland prior to the end of 2006.

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 1997-2006 were regressed against age group and geographical area (both as categorical variables). 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.

Relative risks that were significantly greater than 100 indicate an increased risk of breast 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.

Models were further adjusted by breast cancer stage (results not shown).

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.[196]

Patients who were still alive at 31st December 2006 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 breast 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.[197] 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,[132] the period approach is gaining popularity and is recognised as providing more up-to-date survival estimates.[198]

A suite of computer programs developed by Paul Dickman from the Karolinska Institutet in Sweden[199] 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[159]) was calculated based on the Ederer II method.[200] 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 breast 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.[132,150]

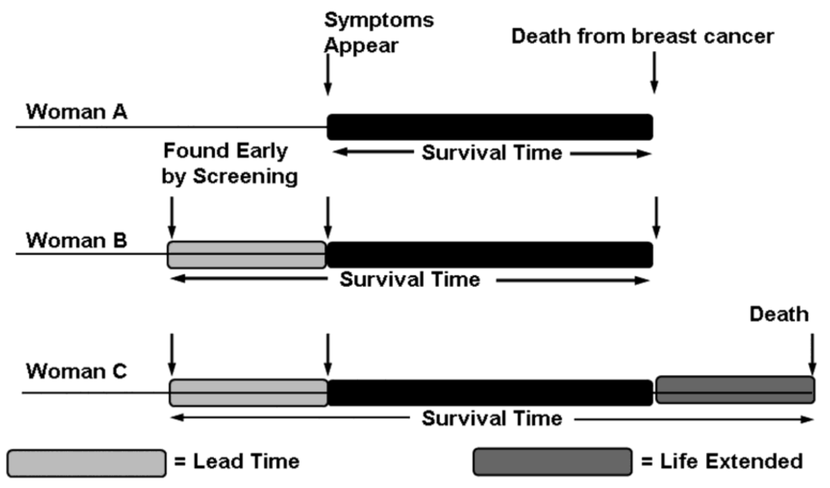
Survival and the effects of screening

Cancer screening can bias survival calculations in several different ways.[201] These biases must be accounted for when estimating any improvements in survival that result from early detection.

***Lead-time bias*:** Cancers detected through screening are typically detected at an earlier stage in their development than those detected symptomatically. However, this does not necessarily prolong the patient's life; while the time of diagnosis is brought forward, the time of death may remain the same.[201]

The resultant difference in survival is known as lead-time bias, and is illustrated in Figure B.1. Woman A is diagnosed with breast cancer after symptoms appear, then after a period of survival, dies from the disease. In contrast, Woman B is diagnosed with breast cancer before symptoms appear (for example, as a result of mammogram screening). After a seemingly longer period of survival, she also dies from breast cancer. Thus, even though the measured survival time is longer for Woman B, she does not live any longer than Woman A. Woman B has not benefited by the earlier detection of her breast cancer; in fact, she has lived longer knowing that she had the cancer, without living longer overall. Finally, consider Woman C. Her breast cancer is detected at the same time as Woman B, but her actual life is longer than either Woman A or Woman B, possibly due to some form of effective treatment. Therefore, compared to Woman B, Woman C had a true increase in survival as a result of her early diagnosis.

Figure B.1: Lead-time bias



***Length bias*:** Regular screening is most effective for detecting slower growing, less aggressive tumours. Faster growing tumours may arise between screening tests, and then be diagnosed as a result of the associated symptoms. This leads to an inherent bias when comparing the outcomes for screen-detected versus symptom-detected cancers, due to the different characteristics of the two groups of tumours.[201]

***Overdiagnosis*:** Some tumours that are detected by screening lack true malignant potential, and are so slow-growing that they will never threaten the health of the person being screened. Over-diagnosis not only distorts survival calculations, but it can also be detrimental by inflicting the stress associated with a diagnosis of cancer along with unnecessary treatment.[201]

***Selection bias*:** This may occur when those are screened for cancer have distinct characteristics that may impact on survival.[201] For example, women who choose to have a regular mammogram may be more health conscious than those who do not participate in screening, thereby artificially inflating the relative survival estimates among the screened group.

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).[196] Models were adjusted for age. Further models also adjusted for stage (results not shown). 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 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.[88] 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,[88] was selected.

B.4 Geographical and socio-demographic areas

Three area-based measures were analysed in this report: geographic region (eight areas), rurality (four categories) and socio-economic status (five categories). Each of these measures were defined to cover Queensland completely and without overlap, and were based on the female's place of usual residence when she was diagnosed with breast cancer.

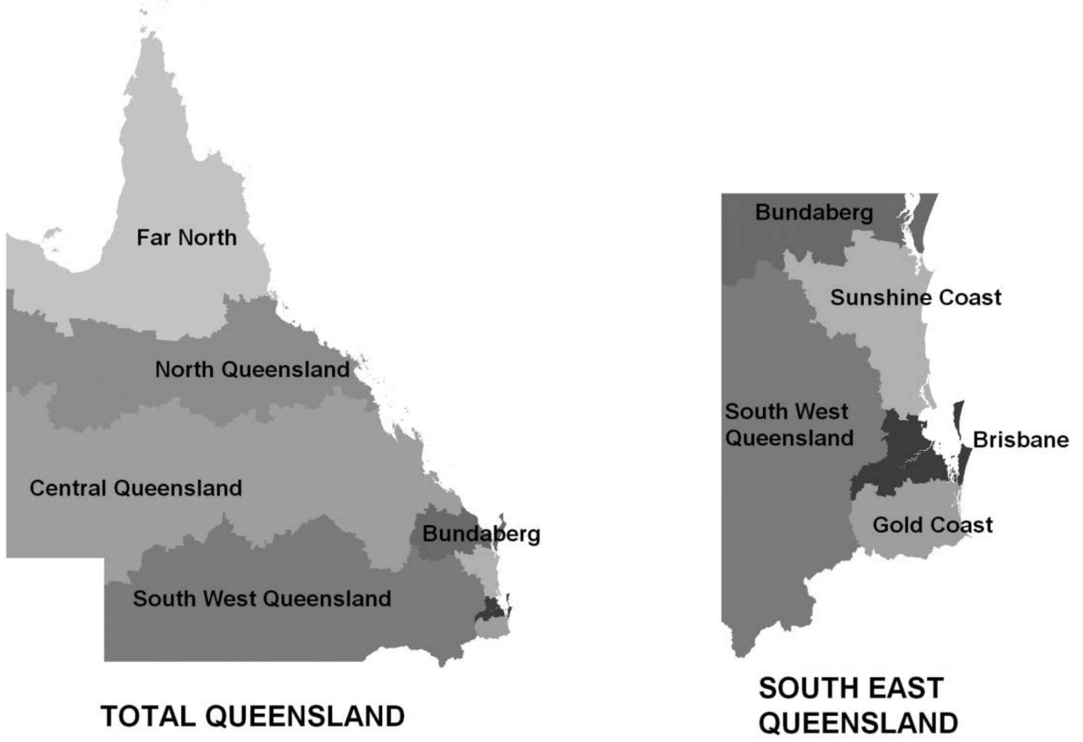
Statistical local areas (SLAs) were the building blocks used to create the area-based groupings. SLAs are part of the Australian Standard Geographic Classification used by the Australian Bureau of Statistics.[202] They correspond either to Local Government Areas (LGAs) or suburbs in larger LGAs (e.g. Brisbane City). In 2006 there were 478 SLAs in Queensland.[202]

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. Breast cancer records that had missing or undefined SLAs (about 0.4% of all records between 1997 and 2006) were excluded from the analysis.

Geographic region

The geographic regions include 8 distinct areas that cover Queensland (see Figure B.2). These regions coincide with the areas administered by the various statewide offices of the Cancer Council Queensland. Brisbane was used as the reference group for the analyses by geographic regions.

Figure B.2: Geographic regions, Queensland

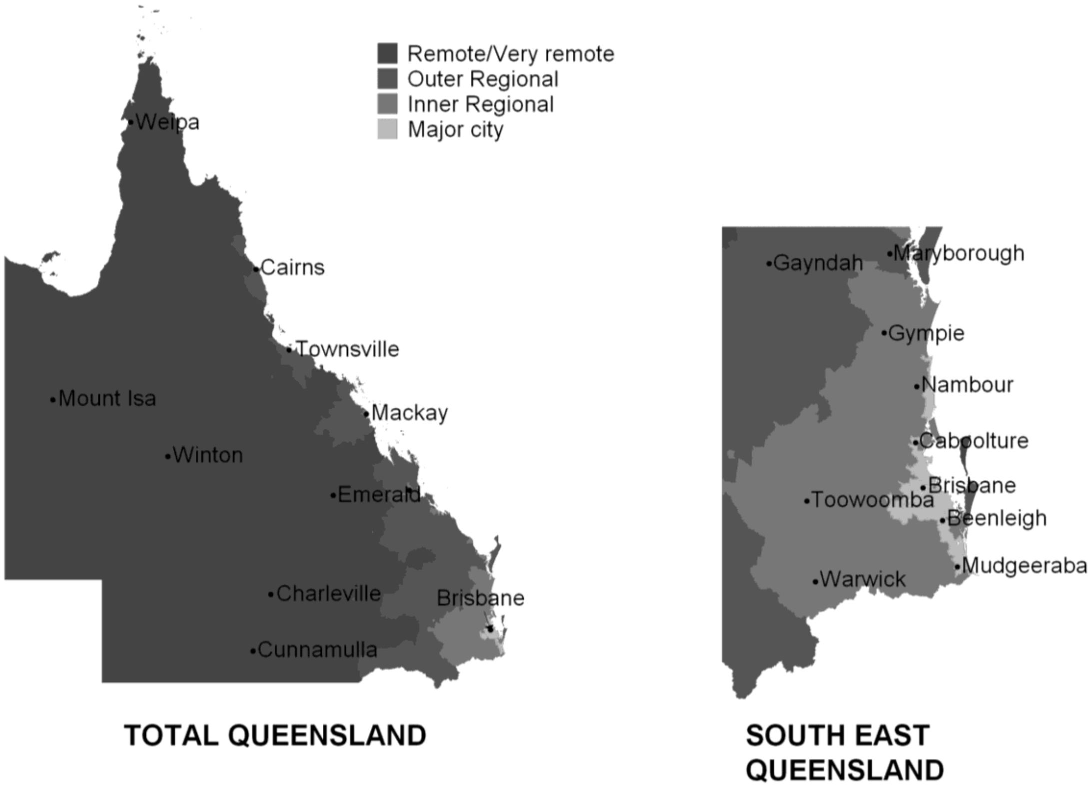


Rurality

Categories of rurality in Queensland used throughout this report were defined using the ARIA+ (Accessibility/Remoteness Index for Australia) classification (Figure B.3).[15] The grouping of major city had the largest population and so was chosen as the reference category for the analyses by rurality.

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.[203]

Figure B.3: Rurality classification, Queensland



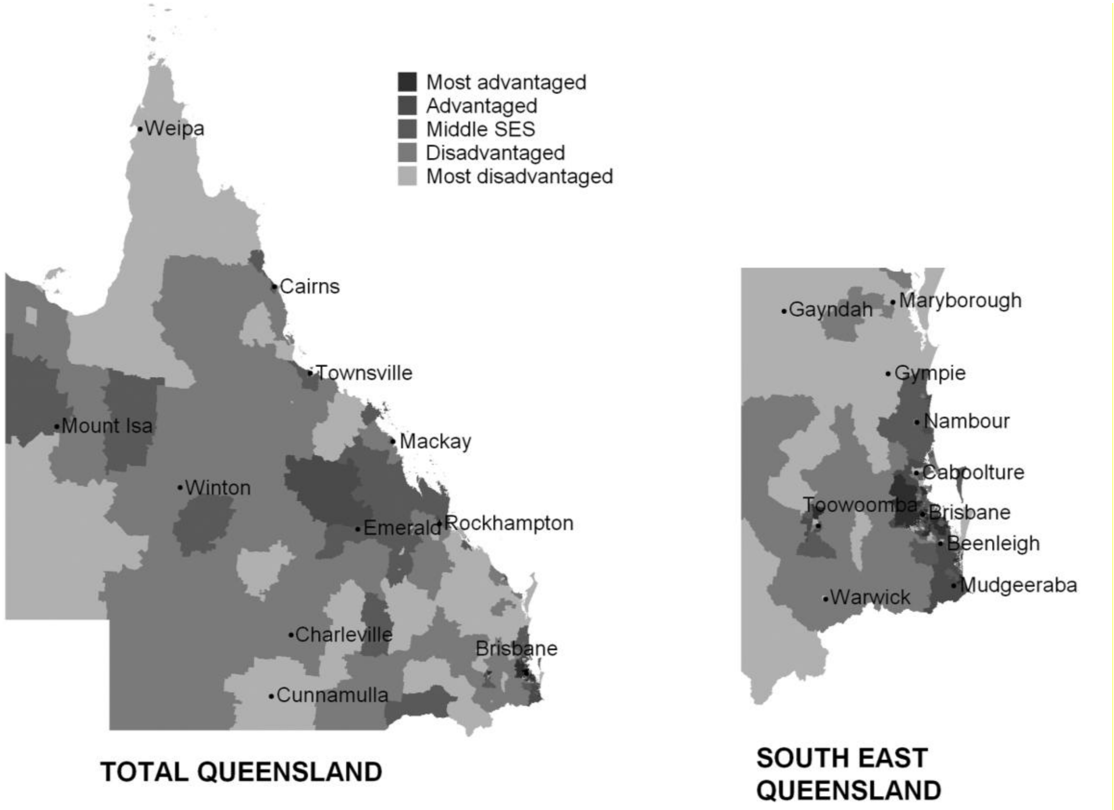
Socio-economic status (SES)

Socio-economic status was defined according to the SLA where the person was living at the time of their diagnosis with breast cancer. This area-based approach was used because information on occupation of cancer patients collected by the Queensland Cancer Registry was not reported well enough to provide an index of individual socio-economic status. Other standard approximations of socio-economic status (e.g. income, education) were not collected by the QCR.

Using the Socio-Economic Indexes for Areas (SEIFA) index of relative socio-economic advantage and disadvantage compiled by the Australian Bureau of Statistics,[16] SLAs in Queensland were ranked from the most to the least disadvantaged and then divided into quintiles (see Figure B.4). The quintiles were labelled as follows: most advantaged, advantaged, middle SES, disadvantaged and most disadvantaged. The middle category was used as the reference group for the analyses by socio-economic status.

The index of relative socio-economic advantage and disadvantage was based on a variety of data items available at the SLA level, such as the percentages of: people with high income; people who were unemployed; households paying cheap rental; households with no car; and households with broadband internet connection. Note that three other SEIFA indexes are also available. Further details of the SEIFA indexes are reported elsewhere,[17] with only minor changes to these published groups made to incorporate recent SLA boundary changes.

Figure B.4: Socio-economic status classification, Queensland



Appendix C – International trend tables

Table C.1: International trend information for female breast cancer incidence, 1982-2006 (See Figure 4.12)

Country	Trend 1		Trend 2		Trend 3	
	Period	Yearly percentage change (95% CI)	Period	Yearly percentage change (95% CI)	Period	Yearly percentage change (95% CI)
All ages						
Australia	1982-1995	+2.9 (+2.4, +3.4)	1995-2005	+0.1 (-0.4, +0.7)		
Canada	1992-1999	+0.7 (-0.2, +1.5)	1999-2005	-1.2 (-2.2, -0.2)		
Hong Kong	1983-2006	+1.6 (+1.4, +1.9)				
Ireland	1994-2005	+2.2 (+1.7, +2.7)				
Japan	1982-1987	+5.3 (+2.9, +7.6)	1987-1997	+2.0 (+1.2, +2.8)	1997-2002	+4.1 (+2.5, +5.8)
Netherlands	1989-1993	+3.5 (+0.9, +6.1)	1993-2005	+0.7 (+0.3, +1.1)		
South-East England	1982-1996	+2.6 (+2.2, +3.1)	1996-2006	-0.3 (-0.9, +0.4)		
Sweden	1982-2006	+1.5 (+1.4, +1.7)				
USA	1982-1987	+3.8 (+2.3, +5.4)	1987-2000	+0.5 (+0.2, +0.9)	2000-2005	-2.4 (-3.5, -1.2)
Ages 50-69 years						
Australia*	1989-1994	+6.1 (+3.0, +9.2)	1994-2000	+1.7 (-0.0, +3.5)	2000-2005	-1.0 (-2.6, +0.6)
Canada	1992-2000	+1.6 (+0.6, +2.5)	2000-2005	-2.2 (-3.9, -0.6)		
Hong Kong	1983-1992	-0.3 (-1.8, +1.2)	1992-2006	+3.3 (+2.6, +3.9)		
Ireland	1994-2005	+2.6 (+1.3, +3.8)				
Japan	1982-1998	+2.7 (+2.2, +3.2)	1998-2002	+6.2 (+3.3, +9.1)		
Netherlands	1989-1993	+6.3 (+3.2, +9.5)	1993-2005	+0.3 (-0.1, +0.8)		
South-East England	1982-1992	+4.8 (+3.6, +6.0)	1992-2006	+0.6 (+0.1, +1.2)		
Sweden	1982-2001	+3.0 (+2.5, +3.4)	2001-2006	-0.8 (-3.4, +2.0)		
USA	1982-1987	+3.8 (+1.9, +5.6)	1987-2000	+1.2 (+0.7, +1.6)	2000-2005	-3.2 (-4.6, -1.8)

* The trend for breast cancer incidence in Australian females aged 50-69 years between 1982 and 1989 was +2.4 (+1.0, +3.9).

Table C.2: International trend information for female breast cancer mortality, 1982-2006 (See Figure 6.11)

Country	Trend 1		Trend 2		Trend 3		Trend 4	
	Period	Yearly percentage change (95% CI)	Period	Yearly percentage change (95% CI)	Period	Yearly percentage change (95% CI)	Period	Yearly percentage change (95% CI)
All ages								
Argentina	1982-1996	+0.9 (+0.6, +1.1)						
Australia	1982-1993	-0.1 (-0.6, +0.5)	1993-2003	-2.5 (-3.1, -1.9)				
Bulgaria	1982-1996	+1.0 (+0.4, +1.5)	1996-2004	-1.3 (-2.4, -0.1)				
Canada	1982-1989	+0.8 (-0.0, +1.6)	1989-2004	-2.1 (-2.3, -1.9)				
France	1982-1996	+0.2 (-0.0, +0.4)	1996-2005	-1.0 (-1.4, -0.7)				
Germany	1982-1993	+0.9 (+0.6, +1.2)	1993-2006	-1.8 (-2.0, -1.5)				
Hong Kong	1982-1992	+1.7 (+0.4, +2.9)	1992-2006	-1.1 (-1.6, -0.5)				
Hungary	1982-1994	+1.6 (+1.0, +2.1)	1994-2005	-1.5 (-2.1, -0.9)				
Ireland	1982-1989	+1.4 (-0.1, +3.0)	1989-2006	-1.6 (-2.0, -1.3)				
Israel	1982-1995	+0.9 (+0.2, +1.7)	1995-2004	-2.0 (-3.0, -1.0)				
Italy	1982-1993	+0.3 (-0.0, +0.6)	1993-2003	-1.8 (-2.1, -1.4)				
Japan	1982-1992	+1.9 (+1.4, +2.4)	1992-1997	+3.5 (+1.9, +5.2)	1997-2006	+1.4 (+1.0, +1.8)		
Kazakhstan	1982-2000	+2.9 (+2.4, +3.4)	2000-2006	-0.5 (-2.5, +1.6)				
Mexico	1982-1995	+2.8 (+2.4, +3.3)						
Netherlands	1982-1994	+0.2 (-0.1, +0.6)	1994-2006	-2.1 (-2.5, -1.8)				
New Zealand	1982-2004	-1.3 (-1.7, -0.9)						
Poland	1982-1995	+0.8 (+0.5, +1.1)	1995-2006	-0.6 (-1.0, -0.2)				
Romania	1982-2001	+1.5 (+1.3, +1.6)	2001-2006	-0.2 (-1.3, +0.9)				
Russia	1982-1994	+3.0 (+2.8, +3.3)	1994-1999	+1.9 (+0.6, +3.1)	1999-2006	+0.2 (-0.3, +0.7)		
Singapore	1982-2006	+0.6 (-0.0, +1.1)						
South Korea	1985-1993	+6.2 (+4.3, +8.1)	1993-2006	+2.8 (+2.2, +3.4)				
Spain	1982-1988	+3.3 (+2.3, +4.3)	1988-1993	+1.3 (-0.3, +3.0)	1993-2005	-2.3 (-2.6, -2.0)		
Sweden	1982-2005	-0.8 (-1.0, -0.7)						
Ukraine	1982-1994	+3.0 (+2.7, +3.4)	1994-2005	+0.3 (-0.0, +0.6)				
UK	1982-1987	+1.2 (+0.5, +1.8)	1987-1992	-1.3 (-2.2, -0.4)	1992-1997	-3.2 (-4.1, -2.2)	1997-2006	-1.8 (-2.1, -1.5)
USA	1982-1990	+0.3 (+0.1, +0.5)	1990-1995	-1.7 (-2.3, -1.1)	1995-2000	-2.9 (-3.5, -2.3)	2000-2005	-1.9 (-2.3, -1.4)
Venezuela	1982-1994	+2.8 (+1.8, +3.8)						

Table C.2 *(cont)*: International trend information for female breast cancer mortality, 1982-2006 (See Figure 6.11)

Country	Trend 1		Trend 2		Trend 3		Trend 4	
	Period	Yearly percentage change (95% CI)	Period	Yearly percentage change (95% CI)	Period	Yearly percentage change (95% CI)	Period	Yearly percentage change (95% CI)
Ages 50-69 years								
Argentina	1982-1986	+2.0 (-1.0, +5.0)	1986-1996	-0.0 (-0.7, +0.6)				
Australia	1982-1993	-0.3 (-1.1, +0.6)	1993-2003	-2.6 (-3.5, -1.7)				
Bulgaria	1982-2004	+0.1 (-0.3, +0.5)						
Canada	1982-1988	+0.1 (-1.0, +1.2)	1988-2004	-2.5 (-2.8, -2.3)				
France	1982-1995	+0.3 (+0.0, +0.6)	1995-2005	-1.4 (-1.8, -1.0)				
Germany	1982-1988	+0.9 (+0.3, +1.6)	1988-1995	-0.1 (-0.7, +0.5)	1995-2000	-2.2 (-3.4, -1.1)	2000-2006	-1.3 (-2.0, -0.7)
Hong Kong	1982-2006	-0.1 (-0.6, +0.4)						
Hungary	1982-1994	+1.3 (+0.5, +2.1)	1994-2005	-1.1 (-2.0, -0.3)				
Ireland	1982-1995	+0.3 (-0.7, +1.3)	1995-2006	-2.7 (-3.9, -1.4)				
Israel	1982-1994	+0.4 (-0.7, +1.6)	1994-2004	-2.5 (-3.8, -1.2)				
Italy	1982-1991	+0.7 (+0.1, +1.2)	1991-2003	-1.8 (-2.2, -1.5)				
Japan	1982-1990	+1.5 (+0.8, +2.3)	1990-1997	+3.5 (+2.5, +4.5)	1997-2006	+2.2 (+1.7, +2.6)		
Kazakhstan	1982-2000	+2.7 (+1.9, +3.4)	2000-2006	-0.8 (-3.6, +2.1)				
Mexico	1982-1995	+3.3 (+2.5, +4.0)						
Netherlands	1982-1994	-0.1 (-0.5, +0.4)	1994-2006	-2.4 (-2.8, -2.0)				
New Zealand	1982-2004	-1.7 (-2.1, -1.3)						
Poland	1982-2006	-0.1 (-0.2, +0.1)						
Romania	1982-2006	+1.0 (+0.8, +1.2)						
Russia	1982-1998	+2.9 (+2.7, +3.1)	1998-2006	+0.6 (+0.0, +1.2)				
Singapore	1982-2006	+0.9 (+0.5, +1.3)						
South Korea	1985-2006	+4.0 (+3.5, +4.5)						
Spain	1982-1993	+2.0 (+1.4, +2.6)	1993-2005	-3.0 (-3.5, -2.5)				
Sweden	1982-2005	-1.0 (-1.2, -0.7)						
Ukraine	1982-1994	+3.2 (+2.8, +3.6)	1994-2005	+0.9 (+0.6, +1.2)				
UK	1982-1989	+0.0 (-0.5, +0.5)	1989-1994	-2.6 (-3.8, -1.4)	1994-1999	-3.8 (-5.1, -2.4)	1999-2006	-2.3 (-3.1, -1.5)
USA	1982-1990	-0.2 (-0.5, +0.1)	1990-1995	-2.3 (-3.1, -1.5)	1995-2000	-3.4 (-4.2, -2.5)	2000-2005	-1.7 (-2.3, -1.1)
Venezuela	1982-1994	+2.6 (+1.2, +3.9)						

References

1. The Cancer Council Queensland, 2008. *2007 Annual Review: new name, same values*. TCCQ: Brisbane. Retrieved 15 May 2008, from www.cancerqld.org.au/pdf/AnnualReport2007.pdf.
2. 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: Brisbane. Retrieved 18 April 2007, from www.qldcancer.com.au/downloads/prostate_report.pdf.
3. 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: Brisbane. Retrieved 24 June 2008, from www.cancerqld.org.au/pdf/lung_report.pdf.
4. Youlden DR, Cramb SM, Baade PD, 2008. *Current status of colorectal cancer in Queensland, 1982 to 2005*. Viertel Centre for Research in Cancer Control, The Cancer Council Queensland: Brisbane. Retrieved 30 Sept 2008, from www.cancerqld.org.au/pdf/colorectal_report.pdf.
5. Queensland Cancer Registry, 2009. *Cancer in Queensland: Incidence and Mortality, 1982 to 2006*. QCR, Cancer Council Queensland and Queensland Health: Brisbane. Retrieved 23 March 2009, from www.cancerqld.org.au/pdf/1982to2006finaltablesBookmarked.pdf.
6. National Cancer Institute, 2005. *What you need to know about breast cancer*. NCI, National Institutes of Health: NIH Publication No. 05-1556. Retrieved 15 July 2008, from www.cancer.gov/pdf/WYNTK/WYNTK_breast.pdf.
7. Queensland Cancer Fund, 2004. *Understanding breast cancer*. QCF: Brisbane. Retrieved 31 July 2008, from www.cancerqld.org.au/pdf/resources/qcf5101_breastcancer_web.pdf.
8. Tortora GJ, Grabowski SR, 1996. *Principles of anatomy and physiology*. Eighth edition. HarperCollins: New York.
9. Ely S, Vioral AN, 2007. Breast cancer overview. *Plast Surg Nurs*, 27(3):128-133.
10. American Cancer Society, National Comprehensive Cancer Network, 2007. *Breast cancer: treatment guidelines for patients (Version IX)*. Retrieved 31 July 2008, from www.nccn.org/patients/patient_gls/_english/pdf/NCCN%20Breast%20Guidelines.pdf.
11. Australian Institute of Health and Welfare, 1998. *National Health Priority Areas report on cancer control, 1997*. (AIHW Cat. No. PHE 4). AIHW. Retrieved 29 May 2007, from www.aihw.gov.au/publications/phe/nhpacc97/nhpacc97.pdf.
12. Stuart K, Boyages J, Brennan M, et al., 2005. Ductal carcinoma in situ--management update. *Aust Fam Physician*, 34(11):949-954.
13. Singletary SE, Connolly JL, 2006. Breast cancer staging: working with the sixth edition of the AJCC Cancer Staging Manual. *CA Cancer J Clin*, 56(1):37-47.
14. iSource National Breast Cancer Centre Early Breast Cancer Working Group, 2001. *Clinical practice guidelines for the management of early breast cancer: 2nd edition*. National Health and Medical Research Council: Canberra. Retrieved 1 Oct 2008, from www.nhmrc.gov.au/publications/synopses/cp74syn.htm.
15. Glover J, Tennant S, 2003. *Remote areas statistical geography in Australia: Notes on the Accessibility/Remoteness Index for Australia (ARIA+ version)*. Public Health Information Development Unit, The University of Adelaide: Adelaide. Retrieved 19 Jan 2007, from www.publichealth.gov.au/pdf/WP9_Remoteness_ARIA+.pdf.
16. Australian Bureau of Statistics, 2008. *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2006*. ABS Cat. No. 2033.0.55.001. ABS: Canberra. Retrieved 15 Dec 2008, from www.abs.gov.au/ausstats/abs@.nsf/PrimaryMainFeatures/2033.0.55.001?OpenDocument.
17. Australian Bureau of Statistics, 2008. *Information Paper: An Introduction to Socio-Economic Indexes for Areas (SEIFA), 2006*. ABS Cat. No. 2039.0. ABS: Canberra. Retrieved 19 Jan 2009, from www.abs.gov.au/ausstats/abs@.nsf/mf/2039.0/.
18. Cuzick J, 2003. Epidemiology of breast cancer--selected highlights. *Breast*, 12(6):405-411.
19. Hopwood P, 2000. Breast cancer risk perception: what do we know and understand? *Breast Cancer Res*, 2(6):387-391.
20. Paul C, Barratt A, Redman S, et al., 1999. Knowledge and perceptions about breast cancer incidence, fatality and risk among Australian women. *Aust N Z J Public Health*, 23(4):396-400.

21. Grunfeld EA, Ramirez AJ, Hunter MS, et al., 2002. Women's knowledge and beliefs regarding breast cancer. *Br J Cancer*, 86(9):1373-1378.
22. Moser K, Patnick J, Beral V, 2007. Do women know that the risk of breast cancer increases with age? *Br J Gen Pract*, 57(538):404-406.
23. New South Wales Breast Cancer Institute, 2006. Family history of breast cancer. *Aust Fam Physician*, 35(1-2):49-50.
24. McPherson K, Steel CM, Dixon JM, 2000. ABC of breast diseases: Breast cancer---epidemiology, risk factors, and genetics. *BMJ*, 321(7261):624-628.
25. Vogel VG, 2008. Epidemiology, genetics, and risk evaluation of postmenopausal women at risk of breast cancer. *Menopause*, 15(4 Suppl):782-789.
26. Key TJ, Verkasalo PK, Banks E, 2001. Epidemiology of breast cancer. *Lancet Oncol*, 2(3):133-140.
27. Hopper JL, 2001. Genetic epidemiology of female breast cancer. *Semin Cancer Biol*, 11(5):367-374.
28. Turnbull C, Rahman N, 2008. Genetic predisposition to breast cancer: past, present, and future. *Annu Rev Genomics Hum Genet*, 9:321-345.
29. Zheng L, Li S, Boyer TG, et al., 2000. Lessons learned from BRCA1 and BRCA2. *Oncogene*, 19(53):6159-6175.
30. Chlebowski RT, Kuller LH, Prentice RL, et al., 2009. Breast Cancer after Use of Estrogen plus Progestin in Postmenopausal Women. *N Engl J Med*, 360(6):573-587.
31. Vachon CM, van Gils CH, Sellers TA, et al., 2007. Mammographic density, breast cancer risk and risk prediction. *Breast Cancer Res*, 9(6):217.
32. Boyd NF, Martin LJ, Yaffe MJ, et al., 2006. Mammographic density: a hormonally responsive risk factor for breast cancer. *J Br Menopause Soc*, 12(4):186-193.
33. Hartmann LC, Sellers TA, Frost MH, et al., 2005. Benign Breast Disease and the Risk of Breast Cancer. *N Engl J Med*, 353(3):229-237.
34. American Cancer Society, 2006. *Non-cancerous breast conditions*. Retrieved 6 Aug 2008, from www.cancer.org/docroot/CRI/content/CRI_2_6X_Non_Cancerous_Breast_Conditions_59.asp.
35. Worsham MJ, Raju U, Lu M, et al., 2007. Multiplicity of Benign Breast Lesions Is a Risk Factor for Progression to Breast Cancer. *Clin Cancer Res*, 13(18):5474-5479.
36. McTiernan A, 2003. Behavioral risk factors in breast cancer: can risk be modified? *Oncologist*, 8(4):326-334.
37. World Cancer Research Fund and American Institute for Cancer Research, 2007. *Food, nutrition, physical activity, and the prevention of cancer: a global perspective*. AICR: Washington DC.
38. Warren B, Devine C, 2001. *A woman's body type and the risk of breast cancer*. Fact Sheet #42, Cornell University Program on Breast Cancer and Environmental Risk Factors in New York State (BCERF): New York. Retrieved 1 Dec 2008, from envirocancer.cornell.edu/factsheet/general/fs42.bodytype.pdf.
39. Singletary KW, Gapstur SM, 2001. Alcohol and Breast Cancer: Review of Epidemiologic and Experimental Evidence and Potential Mechanisms. *JAMA*, 286(17):2143-2151.
40. Monninkhof EM, Elias SG, Vlems FA, et al., 2007. Physical Activity and Breast Cancer: A Systematic Review. *Epidemiology*, 18(1):137-157.
41. Queensland Health, 2005. *BreastScreen Queensland: A decade of achievement 1991-2001*. QH: Brisbane. Retrieved 12 Nov 2008, from www.health.qld.gov.au/breastscreen/documents/29324.pdf.
42. BreastScreen Australia, 2004. *National Accreditation Standards*. BreastScreen Australia Quality Improvement Program: Canberra. Retrieved 1 Sept 2008, from www.breastscreen.info.au/internet/screening/publishing.nsf/Content/br-accreditation/$File/standards.pdf.
43. The Cancer Council Australia, 2007. *National Cancer Prevention Policy 2007-09*. TCCA: Sydney. Retrieved 28 Jan 2009, from www.cancer.org.au/Policy/NationalCancerPreventionPolicy.htm.
44. The Cancer Council Australia, 2004. *Position statement: early detection of breast cancer*. TCCA: Sydney. Retrieved 29 Aug 2008, from www.cancer.org.au//File/PolicyPublications/PSearlydetectionbreastcancerMAY04.pdf.
45. Australian Population Health Development Principal Committee (Screening Subcommittee), 2008. *Population based screening framework*. Australian Health Ministers' Advisory Committee: Canberra.

46. Cancer Research UK, 2007. *The mammogram*. Cancer Research UK: London. Retrieved 11 Aug 2008, from www.cancerhelp.org.uk/help/default.asp?page=3302.
47. Queensland Health. *The simple facts about having a breastscreen*. QH: Brisbane. Retrieved 12 Aug 2008, from www.health.qld.gov.au/breastscreen/documents/33274.pdf.
48. Nemec CF, Listinsky J, Rim A, 2007. How should we screen for breast cancer? Mammography, ultrasonography, MRI. *Cleve Clin J Med*, 74(12):897-904.
49. Australian Institute of Health and Welfare, 2008. *BreastScreen Australia monitoring report 2004-2005*. Cancer series no. 42. Cat. No. CAN 37. AIHW: Canberra. Retrieved 12 Nov 2008, from www.aihw.gov.au/publications/can/bsamr04-05/bsamr04-05.pdf.
50. Zorbas HM, 2003. Breast cancer screening. *Med J Aust*, 178(12):651-652.
51. Freedman DA, Petitti DB, Robins JM, 2004. On the efficacy of screening for breast cancer. *Int. J. Epidemiol.*, 33(1):43-55.
52. Elmore JG, Armstrong K, Lehman CD, et al., 2005. Screening for Breast Cancer. *JAMA*, 293(10):1245-1256.
53. Duffy SW, Smith RA, Gabe R, et al., 2005. Screening for breast cancer. *Surg Oncol Clin N Am*, 14(4):671-697.
54. International Agency for Research on Cancer, 2002. *Breast Cancer Screening.* IARC Handbooks of Cancer Prevention. Vol. 7. IARC Press: Lyon, France.
55. Gilliland FD, Joste N, Stauber PM, et al., 2000. Biologic Characteristics of Interval and Screen-Detected Breast Cancers. *J. Natl. Cancer Inst.*, 92(9):743-749.
56. Raja MAK, Hubbard A, Salman AR, 2001. Interval breast cancer: is it a different type of breast cancer? *The Breast*, 10(2):100-108.
57. Hofvind S, Geller B, Skaane P, 2008. Mammographic Features and Histopathological Findings of Interval Breast Cancers. *Acta Radiologica*, 49(9):975 - 981.
58. Taylor R, Page A, Bampton D, et al., 2004. Age-specific interval breast cancers in New South Wales and meta-analysis of studies of women aged 40-49 years. *J Med Screen*, 11(4):199-206.
59. Queensland Health, 2005. *BreastScreen Queensland 2005 Research Findings* (unpublished report prepared by Market & Communications Research).
60. Achat H, Close G, Taylor R, 2005. Who has regular mammograms? Effects of knowledge, beliefs, socioeconomic status, and health-related factors. *Preventive Medicine*, 41(1):312-320.
61. Consedine NS, Magai C, Krivoshekova YS, et al., 2004. Fear, Anxiety, Worry, and Breast Cancer Screening Behavior: A Critical Review. *Cancer Epidemiol Biomarkers Prev*, 13(4):501-510.
62. Brett J, Bankhead C, Henderson B, et al., 2005. The psychological impact of mammographic screening. A systematic review. *Psychooncology*, 14(11):917-938.
63. Miller D, Livingstone V, Herbison P, 2008. Interventions for relieving the pain and discomfort of screening mammography. *Cochrane Database Syst Rev*, (1):CD002942.
64. McCready T, Littlewood D, Jenkinson J, 2005. Breast self-examination and breast awareness: a literature review. *J Clin Nurs*, 14(5):570-578.
65. Austoker J, 2003. Breast self examination. *BMJ*, 326(7379):1-2.
66. Australian Institute of Health and Welfare, National Breast Cancer Centre, 2006. *Breast cancer in Australia: an overview, 2006*. Cancer series no. 34, Cat. No. CAN 29. AIHW: Canberra. Retrieved 4 Sept 2007, from www.aihw.gov.au/publications/can/bca06/bca06.pdf.
67. Austoker J, 1994. Screening and self examination for breast cancer. *BMJ*, 309(6948):168-174.
68. Mellemkjaer L, Friis S, Olsen JH, et al., 2006. Risk of second cancer among women with breast cancer. *Int J Cancer*, 118(9):2285-2292.
69. Raymond JS, Hogue CJ, 2006. Multiple primary tumours in women following breast cancer, 1973-2000. *Br J Cancer*, 94(11):1745-1750.
70. Kirova YM, De Rycke Y, Gambotti L, et al., 2008. Second malignancies after breast cancer: the impact of different treatment modalities. *Br J Cancer*, 98(5):870-874.
71. Matesich SM, Shapiro CL, 2003. Second cancers after breast cancer treatment. *Semin Oncol*, 30(6):740-748.
72. Anders CK, Hsu DS, Broadwater G, et al., 2008. Young age at diagnosis correlates with worse prognosis and defines a subset of breast cancers with shared patterns of gene expression. *J Clin Oncol*, 26(20):3324-3330.

73. Brennan M, French J, Houssami N, et al., 2005. Breast cancer in young women. *Aust Fam Physician*, 34(10):851-855.
74. Yankaskas BC, 2005. Epidemiology of breast cancer in young women. *Breast Dis*, 23:3-8.
75. Axelrod D, Smith J, Kornreich D, et al., 2008. Breast Cancer in Young Women. *Journal of the American College of Surgeons*, 206(6):1193-1203.
76. Louwman WJ, Vulto JCM, Verhoeven RHA, et al., 2007. Clinical epidemiology of breast cancer in the elderly. *European Journal of Cancer*, 43(15):2242-2252.
77. Australian Institute of Health and Welfare, Australasian Association of Cancer Registries, 2008. *Cancer in Australia: an overview, 2008*. Cancer Series no. 46. Cat. No. CAN 42. AIHW: Canberra. Retrieved 19 Dec 2008, from www.aihw.gov.au/publications/can/ca08/ca08.pdf.
78. Parkin DM, Bray F, Ferlay J, et al., 2005. Global cancer statistics, 2002. *CA Cancer J Clin*, 55(2):74-108.
79. Ferlay J, Bray F, Pisani P, et al., 2004. *GLOBOCAN 2002: Cancer incidence, mortality and prevalence worldwide*. Retrieved 23 July 2007, from www-dep.iarc.fr/.
80. Kamangar F, Dores GM, Anderson WF, 2006. Patterns of Cancer Incidence, Mortality, and Prevalence Across Five Continents: Defining Priorities to Reduce Cancer Disparities in Different Geographic Regions of the World. *J Clin Oncol*, 24(14):2137-2150.
81. Bray F, McCarron P, Parkin DM, 2004. The changing global patterns of female breast cancer incidence and mortality. *Breast Cancer Res*, 6(6):229-239.
82. Parkin DM, Fernandez LM, 2006. Use of statistics to assess the global burden of breast cancer. *Breast J*, 12 Suppl 1:S70-S80.
83. Hortobagyi GN, de la Garza Salazar J, Pritchard K, et al., 2005. The global breast cancer burden: variations in epidemiology and survival. *Clin Breast Cancer*, 6(5):391-401.
84. Porter P, 2008. "Westernizing" women's risks? Breast cancer in lower-income countries. *N Engl J Med*, 358(3):213-216.
85. Paci E, Warwick J, Falini P, et al., 2004. Overdiagnosis in screening: is the increase in breast cancer incidence rates a cause for concern? *J Med Screen*, 11(1):23-27.
86. Svendsen AL, Olsen AH, von Euler-Chelpin M, et al., 2006. Breast cancer incidence after the introduction of mammography screening: what should be expected? *Cancer*, 106(9):1883-1890.
87. Igene H, 2008. Global health inequalities and breast cancer: an impending public health problem for developing countries. *Breast J*, 14(5):428-434.
88. National Cancer Institute, 2005. *Joinpoint Regression Program, Version 3.0*. Retrieved 16 July 2007, from srab.cancer.gov/ joinpoint/.
89. Chiu C, Morrell S, Page A, et al., 2006. Population-based mammography screening and breast cancer incidence in New South Wales, Australia. *Cancer Causes Control*, 17(2):153-160.
90. Canfell K, Banks E, Moa AM, et al., 2008. Decrease in breast cancer incidence following a rapid fall in use of hormone replacement therapy in Australia. *Med J Aust*, 188(11):641-644.
91. Ravdin PM, Cronin KA, Howlader N, et al., 2007. The Decrease in Breast Cancer Incidence in 2003 in the United States. *N Engl J Med*, 356(16):1670-1674.
92. Kumle M, 2008. Declining breast cancer incidence and decreased HRT use. *Lancet*, 372(9639):608-610.
93. Jemal A, Ward E, Thun MJ, 2007. Recent trends in breast cancer incidence rates by age and tumor characteristics among U.S. women. *Breast Cancer Res*, 9(3):R28.
94. Hery C, Ferlay J, Boniol M, et al., 2008. Changes in breast cancer incidence and mortality in middle-aged and elderly women in 28 countries with Caucasian majority populations. *Ann Oncol*, 19(5):1009-1018.
95. Althuis MD, Dozier JM, Anderson WF, et al., 2005. Global trends in breast cancer incidence and mortality 1973-1997. *Int J Epidemiol*, 34(2):405-412.
96. Parkin DM, 1998. The global burden of cancer. *Seminars in Cancer Biology*, 8(4):219-235.
97. Australian Institute of Health and Welfare, 2008. *Australian Cancer Incidence and Mortality (ACIM) Books*. Version 1.1. AIHW: Canberra. Retrieved 13 Jan 2009, from www.aihw.gov.au/cancer/data/acim_books/index.cfm.
98. Canadian Council of Cancer Registries. *Cancer surveillance on-line (cancer incidence charts)*. Centre for Chronic Disease Prevention and Control, Public Health Agency of Canada: Toronto. Retrieved 27 July 2008, from dsol-smed.phac-aspc.gc.ca/dsol-smed/cancer/index_e.html.

99. Hong Kong Cancer Registry. *Cancer Statistics Query System by ICD-10*. Hospital Authority: Hong Kong. Retrieved 29 July 2008, from www3.ha.org.hk/cancereg/eng/stat.asp.
100. National Cancer Registry Ireland. *The National Cancer Registry Ireland: incidence, mortality, treatment and survival*. Retrieved 27 July 2008, from www.ncri.ie/ncri.
101. National Cancer Center Japan. *Cancer incidence 1975-2002*. Center for Cancer Control and Information Services, National Cancer Center: Tokyo. Retrieved 27 July 2008, from ganjoho.ncc.go.jp/professional/statistics/statistics.html.
102. Association of Comprehensive Cancer Centres. *Netherlands Cancer Registry*. Retrieved 1 Aug 2008, from www.ikcnet.nl/page.php?id=225&nav_id=97.
103. Thames Cancer Registry. *About Thames Cancer Registry*. Retrieved 13 January 2008, from www.thames-cancer-reg.org.uk/.
104. National Board of Health and Welfare (Socialstyrelsen). *Cancer statistical database*. NBHW: Stockholm. Retrieved 1 Aug 2008, from 192.137.163.40/epcfs/FisFrameSet.asp?FHStart=ja&W=1024&H=768&modul=can.
105. National Cancer Institute. *Surveillance, Epidemiology, and End Results (SEER) Program* (www.seer.cancer.gov) Limited-Use Data (1973-2005). NCI, DCCPS, Surveillance Research Program, Cancer Statistics Branch. Released April 2008, based on the November 2007 submission.
106. Sant M, Francisci S, Capocaccia R, et al., 2006. Time trends of breast cancer survival in Europe in relation to incidence and mortality. *International Journal of Cancer*, 119(10): 2417-2422.
107. Belot A, Grosclaude P, Bossard N, et al., 2008. Cancer incidence and mortality in France over the period 1980-2005. *Rev Epidemiol Sante Publique*, 56(3):159-175.
108. Becker N, Altenburg HP, Stegmaier C, et al., 2007. Report on trends of incidence (1970-2002) of and mortality (1952-2002) from cancer in Germany. *J Cancer Res Clin Oncol*, 133(1):23-35.
109. Karim-Kos HE, de Vries E, Soerjomataram I, et al., 2008. Recent trends of cancer in Europe: A combined approach of incidence, survival and mortality for 17 cancer sites since the 1990s. *European Journal of Cancer*, 44(10):1345-1389.
110. Zanetti R, Ponti A, Rosso S, et al., 2008. The beginning of a decline in breast cancer incidence in Italy? *Tumori*, 94(3):293-296.
111. Yang L, Parkin DM, Ferlay J, et al., 2005. Estimates of Cancer Incidence in China for 2000 and Projections for 2005. *Cancer Epidemiol Biomarkers Prev*, 14(1):243-250.
112. Murthy N, Agarwal U, Chaudry K, et al., 2007. A study on time trends in incidence of breast cancer - Indian scenario. *European Journal of Cancer Care*, 16(2):185-186.
113. Bray F, Moller B, 2006. Predicting the future burden of cancer. *Nat Rev Cancer*, 6(1):63-74.
114. Garcia M, Jemal A, Ward E, et al., 2007. *Global Cancer Facts & Figures, 2007*. American Cancer Society: Atlanta. Retrieved 9 Dec 2008, from www.cancer.org/downloads/STT/Global_Facts_and_Figures_2007_rev2.pdf.
115. Linos E, Spanos D, Rosner BA, et al., 2008. Effects of Reproductive and Demographic Changes on Breast Cancer Incidence in China: A Modeling Analysis. *J Natl Cancer Inst*, 100(19):1352-1360.
116. Lonning PE, 2007. Breast cancer prognostication and prediction: are we making progress? *Ann Oncol*, 18(Suppl. 8):viii3-viii7.
117. Cianfrocca M, Goldstein LJ, 2004. Prognostic and Predictive Factors in Early-Stage Breast Cancer. *Oncologist*, 9(6):606-616.
118. Hayes D, Isaacs C, Stearns V, 2001. Prognostic factors in breast cancer: current and new predictors of metastasis. *Journal of Mammary Gland Biology and Neoplasia*, 6(4):375-392.
119. Soerjomataram I, Louwman M, Ribot J, et al., 2008. An overview of prognostic factors for long-term survivors of breast cancer. *Breast Cancer Res Treat*, 107:309-330.
120. American Cancer Society, 2007. *Breast cancer facts and figures 2007-2008*. ACS, Inc: Atlanta. Retrieved 12 Dec 2008, from www.cancer.org/downloads/STT/BCFF-Final.pdf.
121. Carmichael AR, 2006. Obesity and prognosis of breast cancer. *Obesity Reviews*, 7(4):333-340.
122. Barnett GC, Shah M, Redman K, et al., 2008. Risk Factors for the Incidence of Breast Cancer: Do They Affect Survival From the Disease? *J Clin Oncol*, 26(20):3310-3316.

123. DiSipio T, Hayes S, Newman B, et al., 2008. Health-related quality of life 18 months after breast cancer: comparison with the general population of Queensland, Australia. *Support Care Cancer*, 16(10):1141-1150.
124. Mols F, Vingerhoets AJ, Coebergh JW, et al., 2005. Quality of life among long-term breast cancer survivors: a systematic review. *Eur J Cancer*, 41(17):2613-2619.
125. Janz NK, Mujahid M, Chung LK, et al., 2007. Symptom experience and quality of life of women following breast cancer treatment. *J Womens Health (Larchmt)*, 16(9):1348-1361.
126. Bower JE, 2008. Behavioral symptoms in patients with breast cancer and survivors. *J Clin Oncol*, 26(5):768-777.
127. Reich M, Lesur A, Perdrizet-Chevallier C, 2008. Depression, quality of life and breast cancer: a review of the literature. *Breast Cancer Res Treat*, 110(1):9-17.
128. Hayes SC, Janda M, Cornish B, et al., 2008. Lymphedema after breast cancer: incidence, risk factors, and effect on upper body function. *J Clin Oncol*, 26(21):3536-3542.
129. Baucom DH, Porter LS, Kirby JS, et al., 2005. Psychosocial issues confronting young women with breast cancer. *Breast Dis*, 23:103-113.
130. Alfano CM, Smith AW, Irwin ML, et al., 2007. Physical activity, long-term symptoms, and physical health-related quality of life among breast cancer survivors: a prospective analysis. *J Cancer Surviv*, 1(2):116-128.
131. McNeely ML, Campbell KL, Rowe BH, et al., 2006. Effects of exercise on breast cancer patients and survivors: a systematic review and meta-analysis. *Canadian Medical Association Journal*, 175(1):34-41.
132. Youlden D, Baade P, Coory M, 2005. *Cancer Survival in Queensland, 2002*. Queensland Health and Queensland Cancer Fund: Brisbane. Retrieved 27 Feb 2007, from www.qldcancer.com.au/pdf/research/survival.asp.pdf.
133. Australian Institute of Health and Welfare, National Breast Cancer Centre, 2007. *Breast cancer survival by size and nodal status in Australia*. Cancer series no. 39. Cat. No. CAN 34. AIHW: Canberra. Retrieved 19 Aug 2008, from www.aihw.gov.au/publications/can/bcsbsansia/bcsbsansia.pdf.
134. Jemal A, Clegg LX, Ward E, et al., 2004. Annual report to the Nation on the status of cancer, 1975-2001, with a special feature regarding survival. *Cancer*, 101(1):3-27.
135. Ugnat A, Xie L, Semenciw R, et al., 2005. Survival patterns for the top four cancers in Canada: the effects of age, region and period. *Eur J Cancer Prev*, 14(2):91-100.
136. Verdecchia A, Francisci S, Brenner H, et al., 2007. Recent cancer survival in Europe: a 2000-02 period analysis of EUROCARE-4 data. *Lancet Oncol*, 8(9):784-796.
137. Webb PM, Cummings MC, Bain CJ, et al., 2004. Changes in survival after breast cancer: improvements in diagnosis or treatment? *Breast*, 13(1):7-14.
138. Berry DA, Inoue L, Shen Y, et al., 2006. Chapter 6: Modeling the Impact of Treatment and Screening on U.S. Breast Cancer Mortality: A Bayesian Approach. *J Natl Cancer Inst Monogr*, 2006(36):30-36.
139. Thomson CS, Brewster DH, Dewar JA, et al., 2004. Improvements in survival for women with breast cancer in Scotland between 1987 and 1993: impact of earlier diagnosis and changes in treatment. *European Journal of Cancer*, 40(5):743-753.
140. Brenner H, Gondos A, Arndt V, 2007. Recent Major Progress in Long-Term Cancer Patient Survival Disclosed by Modeled Period Analysis. *J Clin Oncol*, 25(22):3274-3280.
141. Early Breast Cancer Trialists' Collaborative Group, 2001. Tamoxifen for early breast cancer. *Cochrane Database Syst Rev*, Issue 1:Art. No. CD000486.
142. Moulder S, Hortobagyi GN, 2008. Advances in the treatment of breast cancer. *Clin Pharmacol Ther*, 83(1):26-36.
143. Colozza M, de Azambuja E, Cardoso F, et al., 2006. Breast Cancer: Achievements in Adjuvant Systemic Therapies in the Pre-Genomic Era. *Oncologist*, 11(2):111-125.
144. McArthur HL, Hudis CA, 2007. Breast cancer chemotherapy. *Cancer J*, 13(3):141-147.
145. Baum M, 2002. The changing face of breast cancer--past, present and future perspectives. *Breast Cancer Res Treat*, 75 (Suppl 1):S1-S5.
146. Mahnken JD, Chan W, Freeman DH, et al., 2008. Reducing the effects of lead-time bias, length bias and over-detection in evaluating screening mammography: a censored bivariate data approach. *Stat Methods Med Res*, 17(6):643-663.
147. Lawrence G, Wallis M, Allgood P, et al., 2008. Population estimates of survival in women with screen-detected and symptomatic breast cancer taking account of lead time and length bias. *Breast Cancer Res Treat*:[published online ahead of print, July 12, 2008].

148. Gatta G, Buiatti E, Conti E, et al., 1997. Variations in the survival of adult cancer patients in Italy. *Tumori*, 83:497-504.
149. Coleman MP, Quaresma M, Berrino F, et al., 2008. Cancer survival in five continents: a worldwide population-based study (CONCORD). *Lancet Oncol*, 9(8):730-756.
150. Tracey E, Barraclough H, Chen W, et al., 2007. *Survival from Cancer in NSW: 1980 to 2003*. Cancer Institute NSW: Sydney. Retrieved 7 April 2008, from www.cancerinstitute.org.au/cancer_inst/publications/pdfs/em-2007-01_survival_from_cancer_in_NSW.pdf.
151. English D, Farrugia H, Thursfield V, et al., 2007. *Cancer Survival Victoria 2007: Estimates of survival in 2004 (and comparisons with earlier periods)*. The Cancer Council Victoria: Melbourne. Retrieved 7 April 2008, from www.cancervic.org.au/downloads/about_our_research/canstats/cancer_survival_vic/Survival_2007_Full_Report.pdf.
152. South Australian Cancer Registry, 2007. *Cancer in South Australia 2004 (with incidence projections to 2007)*. Cancer Series 27. South Australian Department of Health: Adelaide. Retrieved 20 Mar 2007, from www.dh.sa.gov.au/pehs/cancer-report2004.htm.
153. Threlfall TJ, Thompson JR, 2004. *Cancer incidence and mortality in Western Australia, 2002*. Statistical series number 71. Department of Health, Western Australia: Perth. Retrieved 23 May 2008, from www.health.wa.gov.au/wacr/downloads/Rep02.pdf.
154. Condon JR, Lee H, Garling LS, 2006. *Cancer survival, Northern Territory 1991-2001*. Northern Territory Cancer Registry, Department of Health and Community Services: Darwin. Retrieved 28 May 2008, from www.nt.gov.au/health/docs/cancer_report.pdf.
155. Australian Institute of Health and Welfare, Cancer Australia & Australasian Association of Cancer Registries, 2008. *Cancer survival and prevalence in Australia: cancers diagnosed from 1982 to 2004*. Cancer Series No. 42. Cat. No. CAN 38. AIHW: Canberra. Retrieved 6 Oct 2008, from www.aihw.gov.au/publications/index.cfm/title/10484.
156. Ries LAG, Melbert D, Krapcho M, et al., 2008. *SEER Cancer Statistics Review, 1975-2005*. National Cancer Institute: Bethesda, MD. Retrieved 9 October 2008, from www.seer.cancer.gov/csr/1975_2005.
157. Canadian Cancer Society & National Cancer Institute of Canada, 2008. *Canadian Cancer Statistics 2008*. CCS: Toronto. Retrieved 9 October 2008, from www.cancer.ca/Canada-wide/About%20cancer/Cancer%20statistics/~/media/CCS/Canada%20wide/Files%20List/English%20files%20heading/pdf%20not%20in%20publications%20section/Canadian%20Cancer%20Society%20Statistics%20PDF%202008_614137951.ashx.
158. Tsukuma H, Ajiki W, Ioka A, et al., 2006. Survival of Cancer Patients Diagnosed between 1993 and 1996: a Collaborative Study of Population-Based Cancer Registries in Japan. *Jpn J Clin Oncol*, 36(9):602-607.
159. Australian Bureau of Statistics, 2007. *Unit record mortality data for Queensland by State of usual residence, 1982-2005*. (unpublished data). ABS: Canberra.
160. Australian Bureau of Statistics, 2006. *Causes of death, 2004*. ABS Cat. No. 3303.0. ABS: Canberra. Retrieved 23 Aug 2007, from www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/68D51845F3970A92CA25713000705D3A/$File/33030_2004.pdf.
161. Australian Institute of Health and Welfare, 2006. *Australia’s health 2006*. AIHW Cat. No. AUS 73. AIHW: Canberra. Retrieved 23 Aug 2007, from www.aihw.gov.au/ publications/aus/ah06/ah06.pdf.
162. Baade PD, Fritschi L, Eakin EG, 2006. Non-cancer mortality among people diagnosed with cancer (Australia). *Cancer Causes Control*, 17(3):287-297.
163. Schairer C, Mink PJ, Carroll L, et al., 2004. Probabilities of death from breast cancer and other causes among female breast cancer patients. *J Natl Cancer Inst*, 96(17):1311-1321.
164. Begg S, Vos T, Barker B, et al., 2007. *The burden of disease and injury in Australia 2003*. (AIHW Cat. No. PHE 82). Australian Institute of Health and Welfare: Canberra. Retrieved 25 May 2007, from www.aihw.gov.au/publications/index.cfm/title/10317.
165. Australian Institute of Health and Welfare, 2005. *State and Territories GRIM (General Record of Incidence of Mortality) Books*. AIHW: Canberra. Retrieved 27 June 2008, from www.aihw.gov.au/mortality/data/grim_books_st.cfm.
166. World Health Organization, 2008. *WHO mortality database: tables* (online database). WHO: Geneva. Retrieved 4 Sept 2008, from www.who.int/healthinfo/morttables.
167. Levi F, Bosetti C, Lucchini F, et al., 2005. Monitoring the decrease in breast cancer mortality in Europe. *Eur J Cancer Prev*, 14(6):497-502.
168. Tyczynski JE, Plesko I, Aareleid T, et al., 2004. Breast cancer mortality patterns and time trends in 10 new EU member states: mortality declining in young women, but still increasing in the elderly. *Int J Cancer*, 112(6):1056-1064.

169. Jatoi I, Miller AB, 2003. Why is breast-cancer mortality declining? *Lancet Oncol*, 4(4):251-254.
170. Australian Institute of Health and Welfare, 2005. *Health system expenditures on cancer and other neoplasms in Australia, 2000-01*. Health and Welfare Expenditure Series No. 22. (AIHW Cat. No. HWE 29). AIHW: Canberra. Retrieved 3 Nov 2008, from www.aihw.gov.au/publications/hwe/hsecna00-01/hsecna00-01.pdf.
171. Hall SA, Kaufman JS, Millikan RC, et al., 2005. Urbanization and Breast Cancer Incidence in North Carolina, 1995-1999. *Annals of Epidemiology*, 15(10):796-803.
172. Reynolds P, Hurley SE, Quach AT, et al., 2005. Regional variations in breast cancer incidence among California women, 1988-1997. *Cancer Causes Control*, 16(2):139-150.
173. Robert SA, Strombom I, Trentham-Dietz A, et al., 2004. Socioeconomic risk factors for breast cancer: distinguishing individual- and community-level effects. *Epidemiology*, 15(4):442-450.
174. Shack L, Jordan C, Thomson CS, et al., 2008. Variation in incidence of breast, lung and cervical cancer and malignant melanoma of skin by socioeconomic group in England. *BMC Cancer*, 8:271.
175. Carlsen K, Høybye MT, Dalton SO, et al., 2008. Social inequality and incidence of and survival from breast cancer in a population-based study in Denmark, 1994-2003. *European Journal of Cancer*, 44(14):1996-2002.
176. Adams J, White M, Forman D, 2004. Are there socioeconomic gradients in stage and grade of breast cancer at diagnosis? Cross sectional analysis of UK cancer registry data. *BMJ*, 329(7458):142.
177. Downing A, Prakash K, Gilthorpe MS, et al., 2007. Socioeconomic background in relation to stage at diagnosis, treatment and survival in women with breast cancer. *Br J Cancer*, 96(5):836-840.
178. Byers T, Wolf H, Bauer K, et al., 2008. The impact of socioeconomic status on survival after cancer in the United States. *Cancer*, 113(3):582-591.
179. Hall S, Holman CD, Sheiner H, et al., 2004. The influence of socio-economic and locational disadvantage on survival after a diagnosis of lung or breast cancer in Western Australia. *J Health Serv Res Policy*, 9(Suppl 2):10-16.
180. Mitchell KJ, Fritschi L, Reid A, et al., 2006. Rural-urban differences in the presentation, management and survival of breast cancer in Western Australia. *Breast*, 15(6):769-776.
181. Pink B, Allbon P, 2008. *The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples 2008*. Australian Bureau of Statistics and Australian Institute of Health and Welfare: Canberra. Retrieved 24 Oct 2008, from www.aihw.gov.au/publications/index.cfm/title/10583.
182. Condon J, 2004. *Cancer, Health Services and Indigenous Australians. Aboriginal and Torres Strait Islander Primary Health Care Review: Consultant Report No 5*. Department of Health and Ageing: Canberra. Retrieved 22 Oct 2008, from www.health.gov.au/internet/main/publishing.nsf/Content/health-oatsih-pubs-reviewphc.htm/$FILE/5cancer.pdf.
183. Homewood J, Coory M, Dinh B, 2005. *Cancer among people living in rural and remote Indigenous communities in Queensland; an update 1997-2002*. Information circular 70. Health Information Branch, Queensland Health: Brisbane. Retrieved 21 Oct 2008, from www.health.qld.gov.au/publications/infocirc/info70.pdf.
184. School of Public Health and Tropical Medicine, James Cook University, 2002. *Early detection and management of breast and cervical cancer in Aboriginal and Torres Strait Islander women: Supporting the role of the General Practitioner*. JCU: Townsville. Retrieved 24 Oct 2008, from www.jcu.edu.au/school/sphtm/antonbreinl/links/RACGP.pdf.
185. Cunningham J, Rumbold AR, Zhang X, et al., 2008. Incidence, aetiology, and outcomes of cancer in Indigenous peoples in Australia. *Lancet Oncol*, 9(6):585-595.
186. Shaw IM, Elston TJ, 2003. Retrospective, 5-year surgical audit comparing breast cancer in indigenous and non-indigenous women in Far North Queensland. *ANZ J Surg*, 73(9):758-760.
187. Condon JR, Barnes T, Armstrong BK, et al., 2005. Stage at diagnosis and cancer survival for Indigenous Australians in the Northern Territory. *Med J Aust*, 182(6):277-280.
188. McMichael C, Kirk M, Manderson L, et al., 2000. Indigenous women's perceptions of breast cancer diagnosis and treatment in Queensland. *Aust N Z J Public Health*, 24(5):515-519.
189. Valery PC, Coory M, Stirling J, et al., 2006. Cancer diagnosis, treatment, and survival in Indigenous and non-Indigenous Australians: a matched cohort study. *Lancet*, 367(9525):1842-1848.

190. World Health Organization, 2000. *International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3)*. Retrieved 20 June 2008, from www.who.int/classifications/icd/adaptations/oncology/en/.
191. Australian Bureau of Statistics, 2008. *Population by Age and Sex, Australian States and Territories, June 2008*. ABS Cat. No. 3201.0. ABS: Canberra. Retrieved 16 Dec 2008, from www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3201.0Jun%202008?OpenDocument.
192. Marugame T, Kamo K, Katanoda K, et al., 2006. Cancer incidence and incidence rates in Japan in 2000: estimates based on data from 11 population-based cancer registries. *Jpn J Clin Oncol*, 36(10):668-675.
193. Pickle LW, Hao Y, Jemal A, et al., 2007. A new method of estimating United States and state-level cancer incidence counts for the current calendar year. *CA Cancer J Clin*, 57(1):30-42.
194. SAS Institute Inc, 2004. *Base SAS® 9.1 Procedures Guide*. Retrieved 20 Aug 2007, from support.sas.com/documentation/onlinedoc/91pdf/index.html.
195. Australian Bureau of Statistics, 2003. *Population by age and sex - 2001 census edition*. ABS Cat. No. 3201.0. ABS: Canberra. Retrieved 23 July 2007, from www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/8779B5EB7EC544EDCA256CF60000E966/$File/32010_jun%201997%20to%20jun%202002.pdf.
196. Dickman PW, Sloggett A, Hills M, et al., 2004. Regression models for relative survival. *Stat Med*, 23(1):51-64.
197. Brenner H, 2002. Long-term survival rates of cancer patients achieved by the end of the 20th century: a period analysis. *Lancet*, 360(9340):1131-1135.
198. Brenner H, Gefeller O, Hakulinen T, 2004. Period analysis for 'up-to-date' cancer survival data: theory, empirical evaluation, computation realisation and applications. *Eur J Cancer*, 40:326-335.
199. Dickman PW, 2004. *Estimating and modelling relative survival using SAS*. Retrieved 24 July 2007, from www.pauldickman.com/rsmodel/sas_colon/.
200. Ederer F, Axtell LM, Cutler SJ, 1961. The relative survival rate: a statistical methodology. *NCI Monogr*, 6:101-121.
201. Kramer BS, Croswell JM, 2008. Cancer Screening: The Clash of Science and Intuition. *Annual Rev Med*: [published online ahead of print, Sept 19, 2008].
202. Australian Bureau of Statistics, 2006. *Australian Standard Geographic Classification (ASGC), 2006*. ABS Cat. No. 1216.0. ABS: Canberra. Retrieved 24 Oct 2008, from www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1216.0Jul%202006?OpenDocument.
203. Information and Research Branch, Department of Health and Aged Care, 2001. *Measuring remoteness: Accessibility/Remoteness Index of Australia (ARIA)*. Revised edition. Occasional Papers: New series No. 14. DHAC: Canberra. Retrieved 25 July 2007, from www.health.gov.au/internet/wcms/Publishing.nsf/Content/9E3A2AAA51E74D2ACA256F1800575941/$File/ocpanew14.pdf.