Cancer Institute NSW Monograph

Lives at Risk from Cancer in New South Wales 2007–2036

A health economics study of cancer in New South Wales

December 2008

Parisa Glass, Elizabeth Tracey, Paul Smetanin, Paul Kobak, Alexei Pavlichev, James Bishop

In Collaboration with RiskAnalytica, Toronto, Canada

The NSW Government agency dedicated to the control and cure of cancer through prevention, detection, innovation, research and information.

NSW Government

cancer institute NSW

Cancer Institute NSW catalogue number: IM-2008-2

National Library of Australia Cataloguing-in-Publication data:

Lives at Risk from Cancer in New South Wales 2007–2036

State Health Publication number SHPN (CI) 080118

ISBN 978-1-74187-302-3

Key words: cancer, cost, New South Wales.

Suggested citation:

Glass P, Tracey E, Smetanin P, Kobak P, Pavlichev A, Bishop J. *Lives at Risk from Cancer in NSW 2007–2036*. Sydney: Cancer Institute NSW, December 2008.

Published by the Cancer Institute NSW, December 2008.

Cancer Institute NSW
Level 1, Biomedical Building
Australian Technology Park
EVELEIGH NSW 2015
PO Box 41
Alexandria NSW 1435

Telephone	(02) 8374 5600
Facsimile	(02) 8374 5700
E-mail	information@cancerinstitute.org.au
Homepage	www.cancerinstitute.org.au
Publications	www.cancerinstitute.org.au/publications

Online cancer statistics
www.statistics.cancerinstitute.org.au

Cover image: prostate cancer cell division. Coloured scanning electron micrograph (SEM) of two prostate cancer cells in the final stage of cell division (cytokinesis).

Contents

List of tables and figures

Caution when using forecasts

Caution should be used when using forecast or estimated results of the type contained within this report. Such forecasts are estimations only reflecting the past population, health and economic trends. Any future action not considered in the current simulation (e.g. new management actions such as screening, treatment, technology and service delivery) will inevitably result in a change of the system parameters and will require re-simulation.

Furthermore, given certain historical data limitations (e.g. disability estimates, cancer risk factor knowledge, screening levels and impacts, employee wage and salary decompositions), the projections contained in this report are subject to various data completeness and consistency issues, which could not have been avoided within the context of the current report.

The information provided in this report was complied in 2006 and as such all financial figures have been presented in 2006 dollar value. The financial projections explore the cost of cancer from 2007 to 2036.

Foreword from the Minister

The NSW Government has recognised the large burden cancer places on our community. The Government has acted to implement the *NSW Cancer Plan 2007–2010* a strategic approach and a blueprint for cancer control in the State.

This report, *Lives at Risk from Cancer in NSW 2007–2036,* estimates the likely number of cancers and their costs in the next 10 to 30 years. The picture reveals a large future burden on our community, but with an increase in disability rather than death as an increasingly frequent outcome. The costs to NSW overall are large if these estimates hold true.

Such a future prediction underlines the importance of our strategy to prevent more cancers or to find them earlier when they are less advanced and can be treated more effectively. We hope that through such measures fewer people will need to endure cancer in the future.

Hon. Jodi McKay MP

Minister for Tourism
Minister for the Hunter
Minister for Small Business
Minister for Science and Medical Research
Minister Assisting the Minister for Health (Cancer)

Chief Cancer Officer's report

Cancer currently represents the major burden of disease facing our community. It is the major cause of death, the major cause of premature deaths and the major cause of deaths in the productive age groups 45 to 65 years.[1,2] The incidence rates have increased by 10 per cent in men and seven per cent in women over the last few years.[3] The exceptions are increasing incidence rates of prostate cancer and decreasing incidence rates of breast cancer.

However, the numbers of cancer cases continue to increase. This report, *Lives at Risk from Cancer in NSW 2007–2036*, simulates the major factors at work increasing the number of cancer cases. The simulations have suggested that around two-thirds of cancer cases can be attributed to the population ageing and growing. Other risk factors such as smoking and lifestyle are modelled.

The report estimates that over the next 10 years more than 400,000 people will be diagnosed with cancer in NSW and around 140,000 are at risk of dying of the disease.

The economic costs in the future include the direct health costs of treating cancer, but a 'double dip' economic burden with a reduced ability to pay for such costs from a loss of productivity of those who are diagnosed with cancer. Over the next 10 years cancer is predicted to cost NSW around $106 billion. The major indirect cost is loss of wages associated with cancer disability or death.

Predictions over the next 30 years are less accurate and should be interpreted with caution. However, it is estimated in NSW, based on historic trends that around 1.5 million people will be diagnosed with cancer in the next 30 years and around 500,000 are at risk of dying of this disease.

Past trends also suggest that cancer death rates will continue to fall. These simulations suggest that years of life lost to cancer will have relatively less impact and disability will become a more important consequence of many cancers and their treatment in the future. It is estimated that in 2036 there will be 700,000 cancer survivors in NSW.

These simulations provide a glimpse of the future, assuming that we are unable to intervene and substantially reduce known risk factors to prevent cancer. The predictions of such large numbers of cancer cases and their costs could be changed if we were able to prevent more cancers or diagnose more of them much earlier and therefore treat them more effectively.

This report provides an urgent incentive to change the future as predicted in this report by more effective cancer prevention, screening and treatment programs.

Professor Jim Bishop AO MD MMed MBBS FRACP FRCPA

Chief Cancer Officer
CEO, Cancer Institute NSW

- Over the next 10 years, an estimated 412,000 people in New South Wales will be diagnosed with cancer and 145,000 may die of the disease.
- The cumulative incidence counts of cancer in the 10 years from 2007–2016 is expected to be more than 30 per cent higher than those seen in the previous 10 years (1997–2006).
- It is estimated that cancer will cost the New South Wales economy around $106 billion and $320 billion over the next 10 and 30 years respectively.

1. Executive Summary

Cancer has a significant impact on the lives and the economics of our community. This report provides a forward simulation of the life and economic consequences of cancer for the NSW population for the period of 2007 to 2036.

The report estimates the impact of several individual cancers including breast, prostate, large bowel, lung and melanoma of the skin, as well as simulating outcomes for the complete group of all cancers.

Over the next 10 years an estimated 412,000 people will be diagnosed with cancer and 145,000 may die of the disease. While we can be less certain for longer term predictions, it is estimated, based on the current trends, that over the next 30 years around 1.5 million people in NSW may be diagnosed with cancer and an estimated 500,000 people may die from their cancer. By the end of the 2036, an estimated 700,000 cancer survivors are expected to be living with cancer or cured of the disease in NSW (**Figure 1**).

These increases are due to several factors, such as an increasing and ageing population and changes in risk factor exposure as well as other environmental risks.

An increase in number is predicted to be particularly important for prostate cancer and melanoma. The expected numbers of prostate cancer are associated with the ageing population. Additional factors, such as the increased use of Prostate Specific Antigen (PSA) tests, are also expected to increase the number of future prostate cancers detected. Melanoma is highly influenced by exposure to ultraviolet (UV) radiation, mainly through excessive and unprotected exposure to the sun.

For lung cancer, the expected future reduction in smoking prevalence is expected to significantly impact on the future incidence of the disease with a drop in age standardised rates of this disease expected.

However, other cancer-risk behaviours are expected to increase the burden of disease in NSW (**Table 1**).[i] In the next 10 years an estimated 2.3 million years of life will be lost due to cancer. An overwhelming contribution of total years of life lost due to death will be due to lung cancer due to the low survival of this cancer. Conversely, the years of life lost due to disability is projected to be high for prostate and breast cancer which is associated with longer survival for these cancers. The projected years of life lost due to death and disability become less clear when looking 30 years into the future. However, it is predicted that approximately 7.5 million years of life will be lost in NSW as a result of cancer in the next 30 years.

The projected burden of cancer above is expected to contribute to substantial economic costs to our community over the next 10 and 30 years (**Table 2**). The direct costs of health care are expected to have significant impact on the economy. The indirect costs are expected to have a substantially larger impact on the economy than the direct health costs with lost wages from those diagnosed with cancer being the single largest contributor to indirect costs of this disease.

Over the 10-year period between 2007 and 2016, the cumulative total direct and indirect costs of cancer will be approximately $106 billion which consists of an estimated $18.2 billion in direct health care costs, $37.6 billion in the lost wages, $26.2 billion in loss of corporate profits and $24.2 billion in the loss of government taxes.

Long-term projections indicate that it will cost at least $64 billion over the next 30 years to fund the direct health care costs of cancer in NSW. This consists of $38.4 billion for the cost of hospitalisation, $4.5 billion for out of hospital expenses, $21.4 billion for pharmaceuticals and other expenses.[ii] Indirect costs for the next 30 years were estimated at approximately $260 billion which comprises $110.5 billion in lost wages, $78 billion in lost corporate profits and $71.6 billion in lost government taxes (**Figure 2**). These cost estimations do not include the added burden of pain and suffering or the emotional and financial cost to care givers.

The number of cancer cases in the NSW health system is expected to increase significantly over the next 30 years. The cumulative incidence counts of cancer in the 10 years from 2007–2016 is expected to be more than 30% higher than those seen in the previous 10 years (1997–2006). While, the predictions for the next 30 years are less certain, there may be an increase of about 110 per cent in cumulative incidence counts over the next 30 years (2007–2036)

i. Burden of disease is measured by Diability Adjusted Life Years (DALY), a combination of years of life lost due to death (YLL) and disability (YLD).

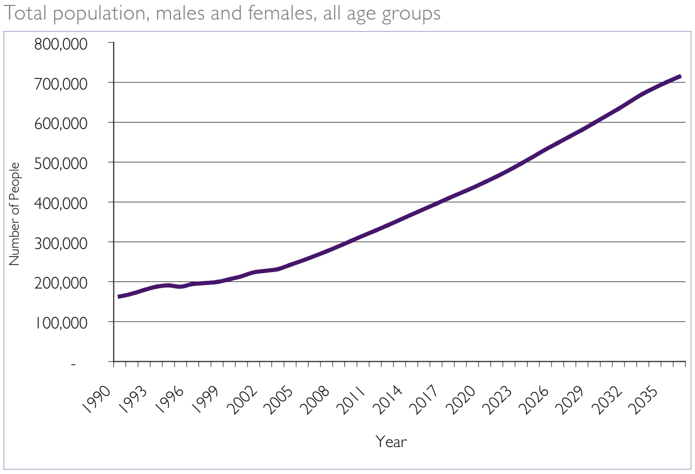
ii. Pharmaceuticals and other expenses also includes prevention and screening costs.

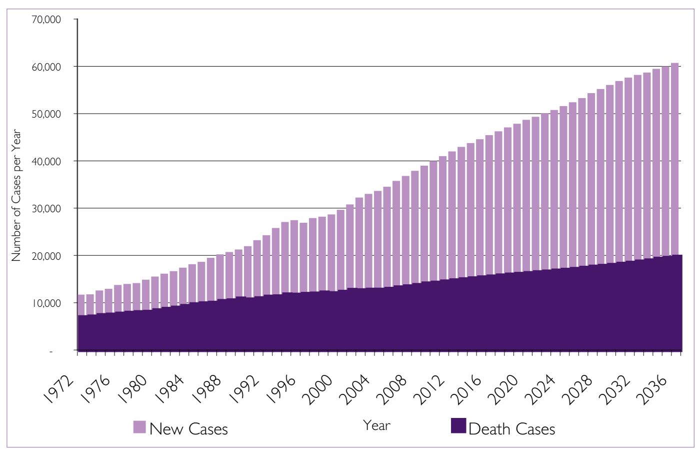
compared to the previous 30 years (1977–2006). In 2006 dollars, cancer may cost the economy over $106 billion in the next 10 years and over $320 billion in the next 30 years.

It is further expected that NSW will experience a growing cancer 'double dipping' impact which is representative of the ability of cancer to not only increase the direct costs of health care, but to also erode the State's economic ability to pay for such health care (**Figure 3**). This 'double dipping' impact is expected to place significant pressure on the NSW public expenditure in the future.

Figure 1 New Cancer Cases and Cancer Related Deaths per year up to 2036

Total population, males and females, all age groups





Total cancer cases in health system per year (1990 to 2036)

Total cancer cases and deaths per year (1972 to 2036)

Total in health system is the sum of New Cases Alive at Year-end, Non New Case Prevalence Alive at Year-end and Death for Year.

Historical incidence data up to 2003: NSW Central Cancer Registry.

Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Simulations and analysis: Sematanin, P. and Kobak, P. RiskAnalytica Life at Cancer Risk Analysis for Cancer Institute NSW, November 2006.

Table 1 NSW Cancer DALYs – Five-year intervals (2007–2036)

New South Wales
Disability Adjusted Life Years
10 Year Totals (2007 to 2016)

Total	2007 to 2016 Total	2007 to 2016 Years of Life Disability	2007 to 2016 Years of Life Lost
All Cancers	4,442,394	2,115,554	2,326,841
Breast	561,370	306,179	255,191
Colorectal	521,459	241,966	279,493
Lung	473,485	36,354	437,131
Melanoma	495,776	348,189	147,587
Prostate	450,119	325,770	124,349

New South Wales
Disability Adjusted Life Years
30 Year Totals (2007 to 2036)

Total	2007 to 2036 Total	2007 to 2036 Years of Life Disability	2007 to 2036 Years of Life Lost
All Cancers	16,778,034	9,255,107	7,522,927
Breast	2,205,516	1,394,496	811,020
Colorectal	1,986,953	1,018,777	968,176
Lung	1,491,544	164,287	1,327,258
Melanoma	1,935,053	1,429,438	505,615
Prostate	2,166,194	1,712,575	453,619

Figure 2 Future Cost of Cancer in NSW

New South Wales
Economic Cost Dissections
2006 Present Values

ALL CANCERS
Simulated expectation

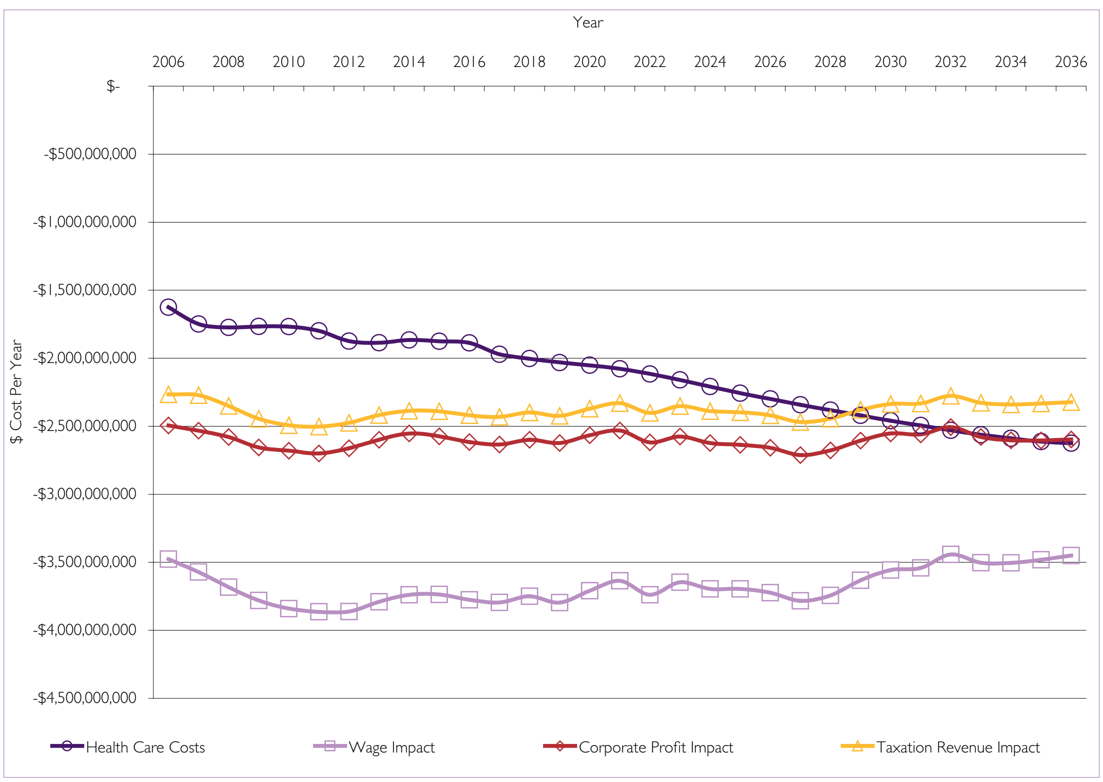


Table 2 NSW Cancer, Economic Cost – Five-year intervals (2007–2036)

New South Wales
Key economic cost dissections, cumulative from 2006 ($ millions)
Major cancer types, 2006 present values, 2007–2036 (5-year intervals)

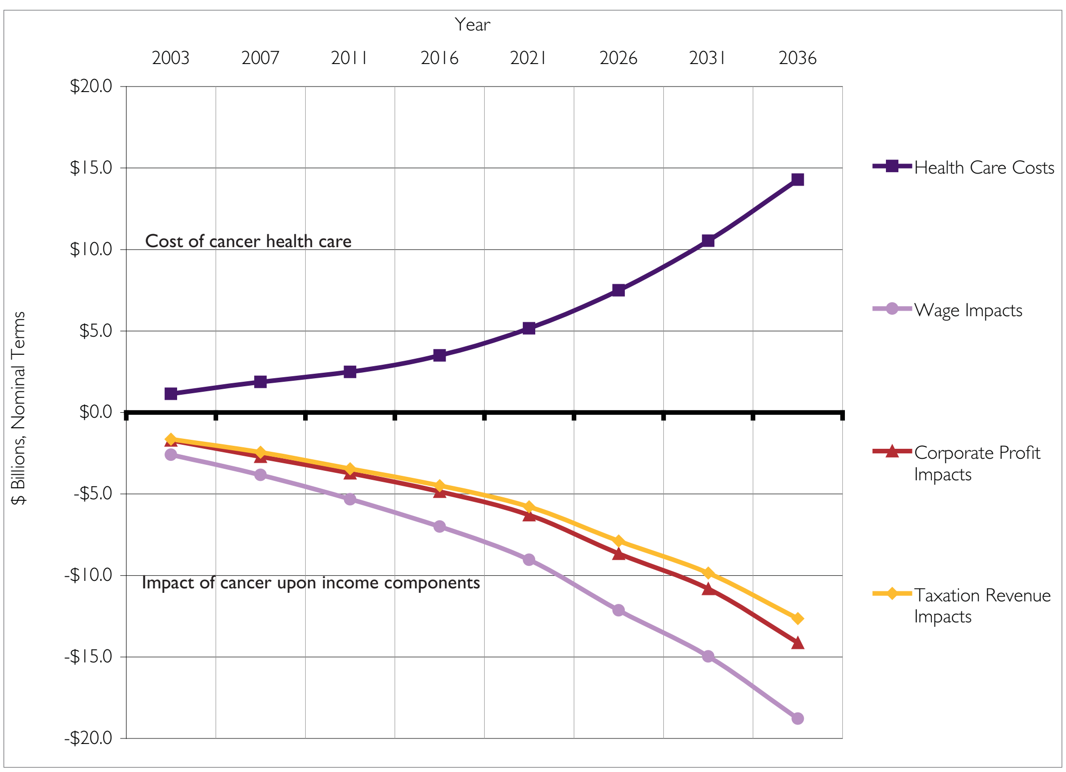
Health Care Costs	2007	2011	2016	2021	2026	2031	2036
All Cancers	-$1,748	-$8,856	-$18,245	-$28,380	-$39,419	-$51,515	-$64,434
Breast	-$119	-$596	-$1,185	-$1,764	-$2,342	-$2,933	-$3,538
Colorectal	-$109	-$549	-$1,089	-$1,604	-$2,105	-$2,606	-$3,108
Lung	-$57	-$279	-$537	-$767	-$972	-$1,157	-$1,322
Melanoma	-$14	-$67	-$130	-$191	-$249	-$309	-$369
Prostate	-$131	-$705	-$1,543	-$2,504	-$3,619	-$4,912	-$6,374
Wage Impacts	**2007**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**
All Cancers	-$3,571	-$18,738	-$37,642	-$56,328	-$74,828	-$93,086	-$110,467
Breast	-$417	-$2,255	-$4,705	-$7,361	-$10,227	-$13,321	-$16,578
Colorectal	-$469	-$2,446	-$4,877	-$7,231	-$9,517	-$11,746	-$13,842
Lung	-$302	-$1,506	-$2,863	-$4,062	-$5,098	-$5,985	-$6,759
Melanoma	-$720	-$3,628	-$6,898	-$9,872	-$12,690	-$15,438	-$18,063
Prostate	-$1,151	-$5,945	-$11,754	-$17,345	-$22,552	-$27,482	-$31,941
Corporate Profit Impacts	**2007**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**
All Cancers	-$2,533	-$13,146	-$26,150	-$39,104	-$52,217	-$65,324	-$78,213
Breast	-$244	-$1,299	-$2,667	-$4,170	-$5,841	-$7,685	-$9,708
Colorectal	-$355	-$1,838	-$3,638	-$5,407	-$7,168	-$8,898	-$10,588
Lung	-$287	-$1,416	-$2,669	-$3,780	-$4,764	-$5,627	-$6,399
Melanoma	-$380	-$1,920	-$3,661	-$5,285	-$6,865	-$8,415	-$9,930
Prostate	-$650	-$3,345	-$6,624	-$9,842	-$12,983	-$16,023	-$18,918
Taxation Revenue Impacts	**2007**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**
All Cancers	-$2,272	-$12,064	-$24,152	-$36,106	-$48,067	-$60,026	-$71,626
Breast	-$250	-$1,370	-$2,846	-$4,446	-$6,194	-$8,109	-$10,164
Colorectal	-$305	-$1,612	-$3,204	-$4,749	-$6,269	-$7,769	-$9,209
Lung	-$213	-$1,074	-$2,036	-$2,884	-$3,628	-$4,277	-$4,854
Melanoma	-$421	-$2,153	-$4,096	-$5,870	-$7,569	-$9,243	-$10,863
Prostate	-$686	-$3,591	-$7,095	-$10,477	-$13,686	-$16,765	-$19,615
Sum of All Average Costs	**2007**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**
All Cancers	-$10,124	-$52,805	-$106,189	-$159,918	-$214,531	-$269,951	-$324,740
Breast	-$1,030	-$5,521	-$11,402	-$17,741	-$24,604	-$32,048	-$39,988
Colorectal	-$1,238	-$6,446	-$12,808	-$18,991	-$25,060	-$31,020	-$36,747
Lung	-$859	-$4,276	-$8,104	-$11,493	-$14,463	-$17,046	-$19,334
Melanoma	-$1,535	-$7,767	-$14,786	-$21,218	-$27,373	-$33,405	-$39,225
Prostate	-$2,619	-$13,587	-$27,016	-$40,168	-$52,841	-$65,183	-$76,849

Table 2 continued.

2006 present value is the estimated value in the year specified as viewed by a person living in 2006 after adjusting for the interest rate value of money as derived from a NSW Govt. zero coupon bond curve.
Cumulative costs in 2006 present value terms represent the sum of the specified costs over a period of time in 2006 dollar terms. The result is equivalent to the amount of money that would have to be invested in 2006 in order to fund the specified impacts or costs over a period of time.
Total health care expenditure is the sum of Hospital Admitted Patients, Out-of-hospital Medical Services, Pharmaceuticals Requiring Prescription and Other Professional Services. Not included are Research Costs, Over-the-Counter Drugs.
Wages are defined as compensation of employees based upon Australian Bureau of Statistics Series 5220.0 Table 24. Total Factor Income by Industry and Principal Components, New South Wales - Current prices
Corporate profits are defined as gross operating surplus based upon Australian Bureau of Statistics Series 5220.0 Table 24. Total Factor Income by Industry and Principal Components, New South Wales - Current prices
Taxation Revenue is defined as a net compulsory levy imposed by a government based upon Australian Bureau of Statistics Series 5506.0 Taxation Revenue, 2004-2005, Commonwealth and State Governments.
The sum of each economic cost sums health care, wage, corporate profit and taxation revenue. This measure provides an approximate indication of the total indirect cost of a cancer to the economy. Caution should be used in the precise interpretation of the sum as there will be double counting involved (eg. taxation revenue and wages/corporate profit).

Figure 3 NSW Cancer, Economic Cost Dissections, Nominal Values (2003–2036)[iii]

All cancers, 5-year intervals



A Nominal Value is the estimated value in the year specified. Total health care expenditure is the sum of Hospital Admitted Patients, Out-of-hospital Medical Services, Pharmaceutical Requiring Prescription and Other Professional Services. Not included are research costs and over-the-counter drugs. Wages are defined as compensation of employees based on Australian Bureau of Statistics Series 5220.0 Table 24. Total Factor Income by industry and principal components, NSW – current prices. Corporate profits are defined as gross operating surplus based on ABS Series 5506.0 Taxation Revenue, 2004–2005, Commonwealth and State Governments.

iii. This is a graph of expected nominal costs. However, it is important to note that the trends seen here do not take into account the future market forces. Future market forces may influence the economy's ability to adjust for factors such as wages, interest rates and any other which may act to balance out the economy.

2. Introduction

Ageing of the New South Wales population and exposure through lifestyle risk factors will directly influence the future number of cancers detected.

Recent Australian data indicates a drop of 14% in cancer mortality between 1986 and 2004.[1,2] Latest NSW data indicates that survival five years post diagnosis is now 63%. This survival is more than 88 per cent for cancers of the prostate and breast and 90 per cent for melanoma of the skin. Even though survival for some cancers has improved, for others it remains low. For example, the five-year survival for lung cancer is still low at 14 per cent.[3]

In NSW, there were 34,227 cancers in 2005. Of these 19,316 were males and 14,911 were females. This number excluded non-melanoma skin cancer, which was estimated to be approximately 147,653 cases.[3]

The top five cancers in NSW, accounting for 61% of all new cancers in 2005, were cancers of the prostate 5,913 (17%), bowel (colorectal) 4,483 (13%), breast 4,070 (12%), melanoma 3,505 (10%) and lung 2,950 (9%).[3]

In 2005, the most common causes of cancer deaths in NSW were lung 2,371 (19%), bowel 1,585 (13%), unknown primary site 940 (8%), prostate 980 (8%) and breast 877 (7%). These five accounted for 54% of all cancer deaths in that year.[3]

Despite advances in cancer control, cases diagnosed are increasing with one in two men and one in three women now at risk of developing cancer in their lifetime in Australia. It is expected that the growth and ageing of the population of Australia will result in more cancers in the future.

As well as ageing, exposure to certain lifestyle factors has a direct influence on the onset of cancer. Lifestyle factors such as smoking have long been established as risk factors for lung and other cancers.[4] In more recent years, other risk factors have been studied including the influence of overweight and obesity on the onset of bowel and breast cancer.[5] There are a number of modifiable risk factors world-wide contributing to the onset of cancer.[6] Therefore, lifestyle modification initiatives that will reduce these risk factors are expected to reduce the risk of cancer in the future.

The predicted rise in cancer will not only affect the health and well being of individuals, but also affect the patient's and society's ability to pay for its management.

The costs associated with cancer may be divided into direct health costs and indirect costs. Direct costs include cost of health care and associated products and services. This may also include the cost of research and development, which may take many years to influence practice. Indirect costs may include the costs to the economy and the individuals, some of which are not carefully monitored. However, the burden of pain and suffering is immeasurable and always present when considering cancer.

An accurate estimation of the costs of cancer is important for the future planning and for more efficient health care reforms. For example, estimation of the future costs and benefits of chemoprevention of breast cancer may assist in more informed economic decision-making for women in our population who are currently at high risk of developing breast cancer. Also, the universal implementation of cancer control programs, such as the new bowel cancer screening program, should reduce the impact of bowel cancer in the future by detecting cancers early at a stage when treatment is more effective.

This report is a forward prediction of the potential life and economic impact of cancer on the NSW population over the period of the next 30 years, from 2007 to 2036.[iv] This report uses the Life at Cancer Risk (www.riskanalytica.com) simulation platform with the NSW population and NSW cancer rates and economic data as inputs. Such estimations have been previously performed internationally. The Canadian Strategy for Cancer Control has used similar forward simulations for the population of Canada.[7]

iv. Population data inputs generally span 1972 to 2005, cancer data inputs generally span 1972 to 2003, and economic data inputs generally span 1978 to 2005.

The report contains the following information:

1. Cancer modeling for prostate, breast, melanoma, lung and colorectal cancers, and a general category of all cancers for NSW.
2. Cancer risk factor breakdown across smoking, obesity, physical inactivity and sun exposure.
3. For the general category of cancers, a comprehensive account of:
    a. population measures: projection of new cancer cases, prevalence, death and potential years of life lost from disability and premature death – using the Department of Planning and Natural Resources population projections
    b. labour force measures: new cancer cases in the working population
    c. economic influence of cancer measured in 2006 dollars for net present valued wages, corporate profits, personal income tax, corporate income tax, consumption taxes, and health care costs.

3. Methodology

Economic predictions included the direct and indirect cost of cancer to New South Wales over the next 30 years.

Life at Cancer Risk is a risk management platform in which historical data are used to simulate a number of possible future population, disease and economic states.

Within the last several decades, a number of public health models have been developed in an effort to simulate the future state of population and disease progression. Although different in general design and intent, Life at Cancer Risk shares some successful aspects of such models, primarily the PREVENT and POHEM.[8,9]

PREVENT is a mathematical model, which uses epidemiological and demographic data to simulate the effect of an intervention on the risk factor prevalence and the state of the disease. It transforms epidemiological data, such as exposure prevalence and relative risk, to absolute population health measures, such as mortality and morbidity. The model assumes that disease-specific incidence and mortality are a function of the prevalence of such risk factor exposure. PREVENT methodology was among the first to combine epidemiological and demographical principles into a dynamic population model. Using this model it is possible to examine long-term effectiveness of intervention programs.[10]

The outcome of the PREVENT model depends on the validity of input data. In this context the relationship between risk factor and health outcome is an important measure. PREVENT is capable of modelling multiple diseases and multiple risk factors. In addition, it accounts for the latency period between disease incidence and death and the lag period (time by which the risk factor of ex-exposed becomes as small as it can – residual risk). At each point in time PREVENT can estimate the incidence of disease based on the effect of present and past interventions on relative risk. That is, the model takes the view that incidence evolves over time due to relative risk trends.

The POHEM model is an example of a micro-simulation model which, unlike other models which simulate changes at a population level or cohort level, simulates these changes at an individual level and estimates the effects of changes in the various risk factor exposures on the incidence and prevalence of specific diseases such as cancer.[9,11] In this model, the population can be followed through time and adjustments made according to probability of events such as morbidity and mortality. In this case population surveys are used to estimate these probabilities using Monte Carlo techniques to assign probability that an event will occur. The health outcomes at population level are obtained by aggregating individual results. The major strength of this model is that it can simulate various diseases, risk factors and report various outcomes such as mortality, morbidity and costs. This model, however, requires a very comprehensive data input.

3.1 Framework

Life at Cancer Risk simulates both the future health states of the population and the related economic implications with respect to the dynamic constraints contained within the historical data. As in the PREVENT method, the current method transforms epidemiological data, such as exposure, prevalence and relative risk, to absolute population health measures, such as mortality and morbidity. The framework's methodology allows simulating multiple diseases and multiple risk factors, while taking into account the variability of risk exposure in time through the lag and latency corrections.

The Life at Cancer Risk model also simulates solutions with respect to the resolution level of available data. In general, the simulations will be carried out in population cells (such as PREVENT) in which all individuals are deemed indistinguishable, but these can also be carried out at the level of an individual (distinguishable individuals as in POHEM) if data on individual level are available. The future incidence and mortality estimates are both simulated using historically based transition tables, while the future prevalence of the disease is simulated based on its behaviour in the past and the future (projected) population dynamics.

For the purposes of this report, a Markov Chain Monte Carlo process was employed to probe the possible effects of dynamical variables (constrained by past data) on the changing population (in terms of demographics as well as exposure to the various risk factors). The choices (future possible states) were allowed to be constructed in a manner that did not alter the dynamics (as well as their rates of change) as recorded in the past. Changes which are outside of that set must be implicitly assumed based upon new information (such as new treatment techniques or new drugs) and as such new simulations are necessary after such assumptions.

3.2 The model

Life at Cancer Risk simulation can be described as consisting of four modules, which together simulate the possible cancer incidence, mortality and prevalence in NSW and the associated economic impacts (**Figure 4**).

Population Module (M1)

In this report, the population module was the first part of the simulation, which estimated the dynamics and the expected future population. The methodology took into account variables such as current rate of birth, mortality, immigration, emigration, and labour force dimensions (participation, unemployment and dependants) as gathered by the Australian Bureau of Statistics (ABS) through past census data.

In the current study no population was simulated, rather the ABS future population projections were adopted without bias, which means that all data assumptions employed by ABS were adopted.

Risk Factor Module (M2)

An integral aspect of Life at Cancer Risk was the division of the population into equivalent groups based upon age, gender and risk factor exposure in order to simulate the health outcomes for the disease. That is, a person (within this module) was differentiated by a specific risk factor exposure (such as the level of smoking): currently exposed, formerly exposed and never exposed to the risk factor. The formerly exposed group was divided into *n* groups based on the length of time since the change in behaviour had taken place. The module also allowed a set of concurrent risk factor exposures (such as smoking, high BMI, etc) to be considered. The procedure of such general risk factor exposure model is limited only by the availability and quality of historical co-occurrence data.

A group of people of a specific age/gender who posses the same risk exposure characteristics (e.g. quit smoking five years ago) were considered to be indistinguishable. The module then predicted the risk factor for these individuals from a randomly selected series of risk factor tables using Monte Carlo process. That is, this group was allowed to resume, quit or take up a risk factor exposure behaviour (such as smoking) based on the probability of this choice obtained from past behaviour.

In general, the risk (attributed to disease development) within the population was a function of two independent factors: risk due to identified causes (such as smoking exposure) and risk due to unidentified causes. Each population was linked with a specific range of disease risk in excess of that associated with a population with only unidentified risk exposure (base risk). The identified as well as unidentified risks were further divided by age and gender under the constraining condition that unidentified risk can be assumed as equal for all individuals. Despite the ability of the model to consider the added effect of multiple risk factors or any combination of risk factor co-morbidities, no such attempts were made in the current study due to the lack of general supporting data. As a result, the simulations within the current report were limited to at most two co-morbid risk factors.

The model used Monte Carlo process by means of which an exposed individual was chosen to change the behaviour (smoking cessation) or by means of which a non-exposed individual became exposed. This was a process by which it was decided whether an individual (age *a* at time *t*) of one state was transformed into another state or remained within the same state (same exposure). The Monte Carlo process was adopted here under the assumption that the dynamics (which govern such a process) must be obtained entirely from the historical data.[12,13] That is, a future simulation could not assume new dynamics which were not present in the past (no new smoking cessation mechanisms other than those already present in the past) and each simulated state was based on its immediate previous state. In other words dynamic rate of change from the past dictated the rate of change for the future resulting in trajectory of rate of risk factor prevalence.[14]

Disease Module (M3)

Using the exposed populations (prevalence of risk factors), the incidence, mortality as well as the associated prevalence of different cancer types was simulated. Within each risk exposure population a person was chosen (transitioned) to stay healthy, become sick or die. Such transitions are chosen by the Monte Carlo algorithm from a series of historically determined distributions of disease transition and life tables. The exposure of every population to the unidentified risk was assumed equivalent.

The risk associated with the exposure to identified risk factors was represented by the relative risk (RR) which was measured with respect to those who have never been exposed (risk of the disease for those exposed relative to those who were never exposed). When a person's exposure to the risk factor changed (e.g. smoking cessation), the relative risk associated with the disease would decrease in the future. The change however would not be immediate and in general was a function of the number of years (after the change in exposure has taken place). For instance, relative to a never smoker, the current smokers as well as the ex-smokers would then have a higher probability of disease incidence and mortality and therefore they would also have a lower probability of staying healthy.

The model used a continuous process of risk reduction due to a change in a specific risk factor exposure (such as smoking cessation) or a general risk exposure (such as the time dependant probability of disease incidence and mortality). The process used a modified method based upon risk specific lag and latency periods developed for the Dutch statistics model PREVENT in which the risk reduction was not immediate but rather gradual and characterized by a remnant risk at the and of such change period. Despite the ability of the model to consider the added effect of multiple risk factors or any combination of risk factor co-morbidities, no such attempts were made in the current study due to the lack of supporting data.

The incidence at any specific time was given by the sum of the incidence for non-exposed, exposed and formerly exposed. Similarly, mortality was a function of incidence and their survival. In this case mortality was computed as a combination of survival (of those diagnosed in the past) as well as the environmental contributions (factors which are independent of the survival statistics). Prevalence was simulated with incidence and mortality simulations.

Economic Module

The future state of prevalence was further used to estimate the cost of cancer for the next 30 years. Cost of illness in this study took into account both, direct and indirect costs under the Human Capital approach.

In the current study the considered health costs associated with the burden of the disease included; hospital admissions, out of hospital costs, prescription medicine and professional services. In addition various impacts on the NSW and Australian economy were taken into account including costs associated with the disease dependant loss of productivity, loss of wages, loss of corporate profits as well as the inevitable loss of government taxation revenue. The historical costs were obtained from Federal and State Government agencies as well as from other national / international published data.

3.3 Life indicators

The results of simulations are presented with respect to the following life measures:

- Cancer incidence (crude and age-standardised counts of annual new cases). Cancer incidence is decomposed into age, gender, stage/severity, cancer type, risk factor exposure and economic labour force groups.[v]

v. A key assumption in the determination of labour force cancer incidence modeling is that cancer does not discriminate between those people who are working, willing to work, are currently unemployed, or who are unwilling to work.

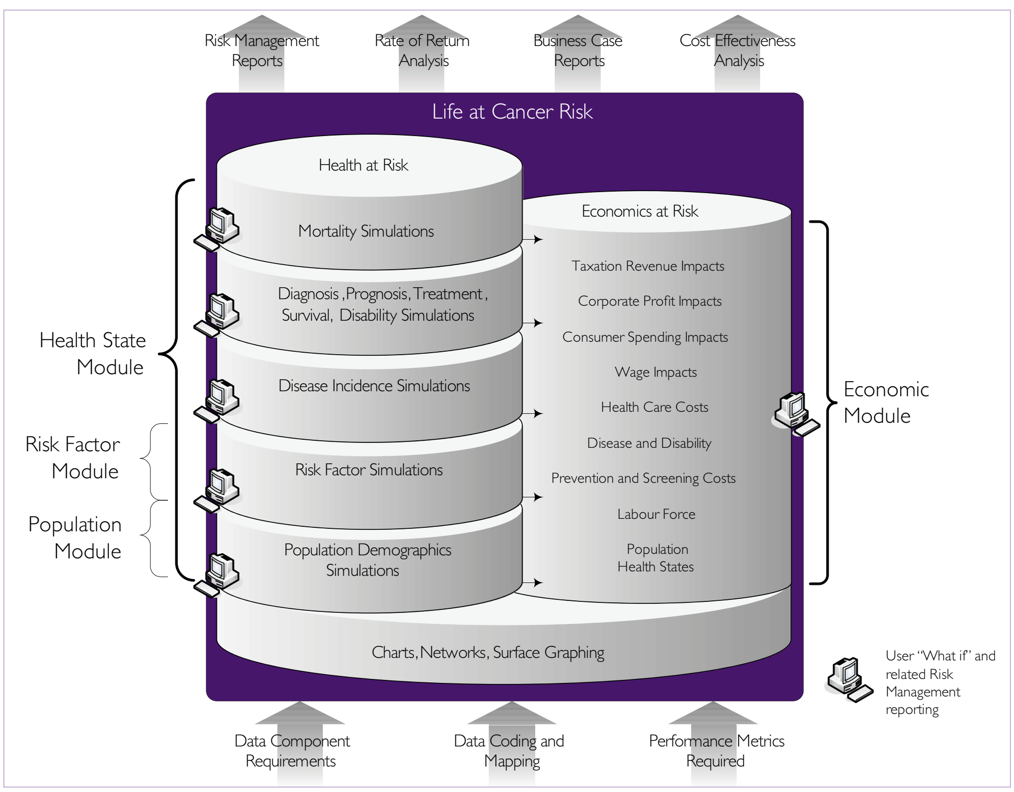
- Cancer mortality (crude and age-standardised counts of annual death cases which are attributed to the disease). Cancer mortality is decomposed into age, gender, stage/severity, years of survival, cancer type and risk factor exposure groups.
- Cancer prevalence (crude and age-standardised counts of the number of people living with the disease). Cancer prevalence is decomposed into age, gender, stage/severity, years of survival, cancer type and risk factor exposure groups.
- DALY (Disability adjusted life years lost due to the disease). Cancer related disability is decomposed into age, gender, stage/severity, years of survival, cancer type and risk factor exposure groups.

3.4 Economic indicators

The results of simulations are presented with respect to the following economic measures:

- Total employee compensation (which has been termed wages in this report).
- Corporate gross operating surplus[vi] (which has been termed corporate profits in this report).
- Taxation revenue (Commonwealth and State Government).[vii]
- Total health care costs including costs related to hospital admissions, out-of-hospital medical services, pharmaceuticals requiring prescription and other professional services. Not included are research costs and over-the-counter drugs.

Figure 4 RiskAnalytica Life at Cancer Risk



vi. based upon Australian Bureau of Statistics Series 5220.0 Table 24.

vii. Taxation Revenue is defined as a net compulsory levy imposed by a government (decomposed into personal income tax, corporate income tax, GST and payroll tax) based upon Australian Bureau of Statistics Series 5506.0 Taxation Revenue, 2004-2005, Commonwealth and State Governments.

- The number of new cases of cancer in NSW is primarily attributed to an increase in population aged 50 years and older.
- It is assumed that lifestyle factors of smoking, obesity, physical inactivity and sun exposure will continue based on historic trends.
- The total cost of cancer in New South Wales is expected to be about $106 billion in the next 10 years.

Cancer in New South Wales

4. Cancer risk factor prevalence

Lifestyle risk factors and their association with cancer have been studied previously.[15] This report investigates the effect of modifiable risk factors on the population of NSW and how they will affect cancer. This is discussed in detail in Appendix C.

The following lifestyle habits were used as risk factors for simulation of cancer:

1. smoking
2. obesity
3. physical inactivity
4. sun exposure.

The prevalence of these risk factors was simulated for NSW population. Risk factor prevalence was further used for simulation of cancer incidence, mortality and prevalence and subsequent economic costs associated with cancer in NSW. Age was regarded as a risk factor not related to lifestyle.

The forward simulations of rates of prevalence was generated based on the assumption that the historical rate dynamics at which risk factor prevalence has been changing in NSW will remain unchanged for the entire simulation period and no new interventions will be introduced during this time to change this trend.

4.1 Smoking

Historical smoking prevalence rates between 1977 and 2003 were obtained for NSW and smoking prevalence rates from 2004 through to 2036 were further projected (**Figure 5**).

Smoking prevalence rates for both genders are expected to decrease throughout the simulation period. The smoking prevalence rates for males are expected to be higher than for females throughout the simulation period with the margin between males and females decreasing over time.

4.2 High BMI[viii]

Historical prevalence rates of the NSW residents with high BMI between 1990 and 2003 were obtained and high BMI prevalence rates from 2004 through to 2036 were further projected (**Figure 6**).

Prevalence rates for high BMI for both genders are expected to increase throughout the simulation period with males expected to have higher rates than females.

4.3 Physical inactivity

Historical physical inactivity prevalence rates in the NSW population between 1977 and 2003 were obtained and the rates from 2004 through to 2036 were further projected (**Figure 7**).

Physical inactivity for both genders is expected to fluctuate throughout the simulation period, with an overall downward trend. Males are expected to display a higher rate of physical inactivity compared to females throughout the simulation period.

4.4 Sun exposure

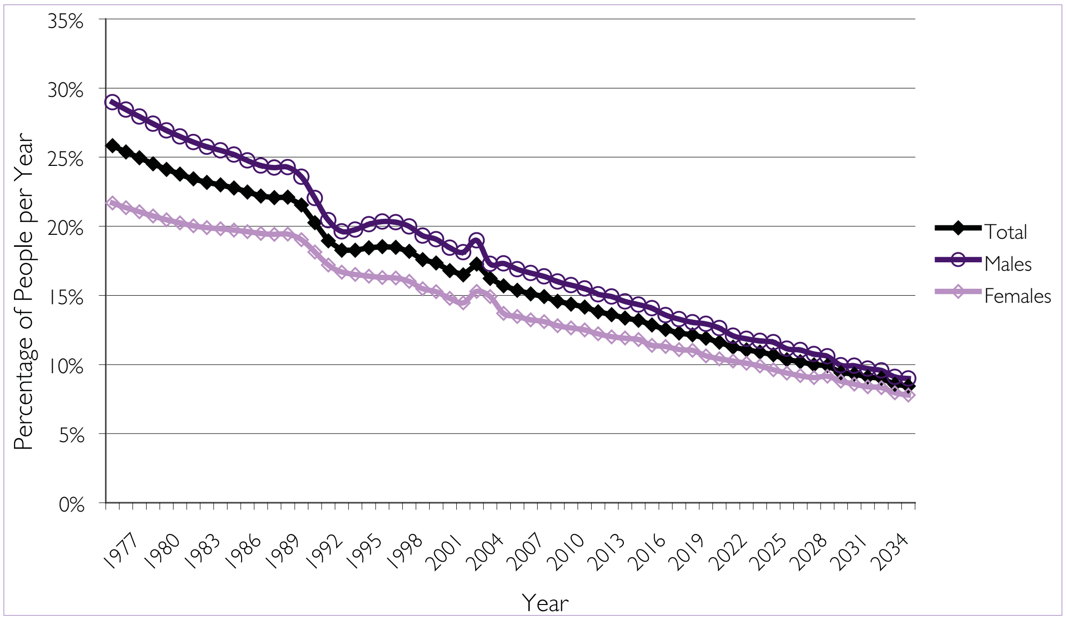
Historical prevalence rates of extensive sun exposure of the NSW residents between 1990 and 2003 were obtained and the exposure prevalence rates from 2004 through to 2036 were further projected (**Figure 8**).

Extensive sun exposure for both genders, are expected to fluctuate throughout the simulation period, with an overall upward trend. Females are expected to display a higher rate of extensive sun exposure than males throughout the simulation period.

viii. High BMI is defined as BMI above 25 kg/m2.

Figure 5 NSW Smoking Prevalence Rates (1977–2036)

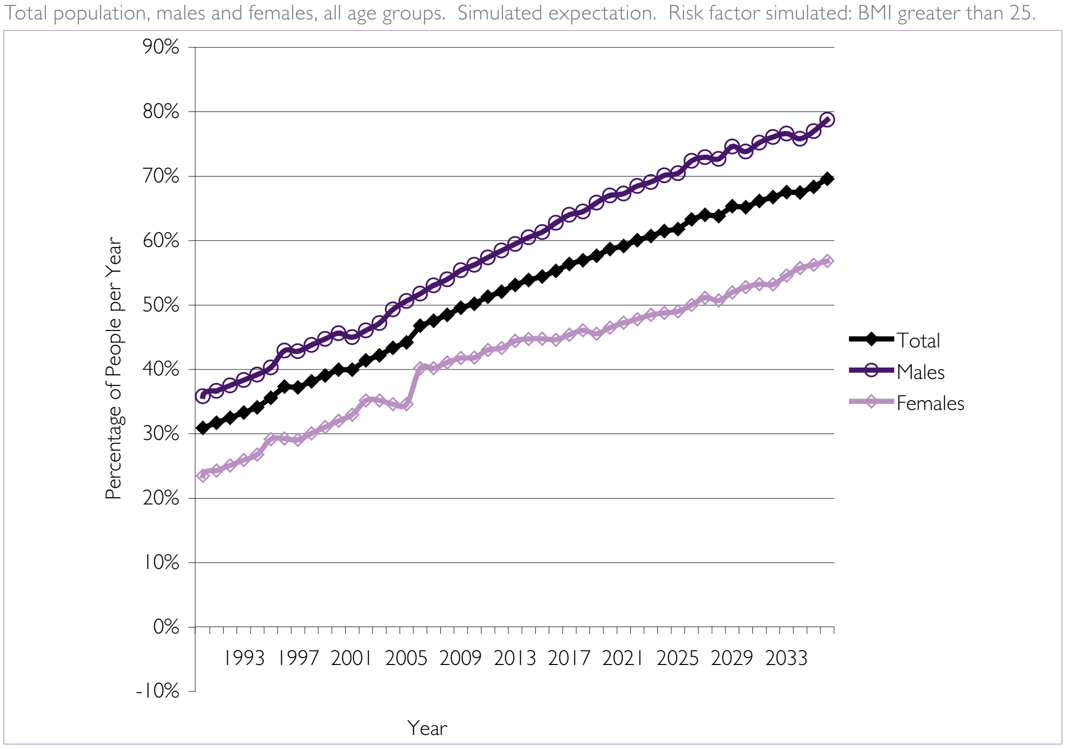
Total population, males and females, all age groups. Simulated expectation. Risk factor simulated: smokers.



Historical risk factor data: NSW Population Health Survey 2005. Centre for Epidemiology and Research, NSW Department of Health.

Figure 6 NSW High BMI Prevalence Rates (1990–2036)

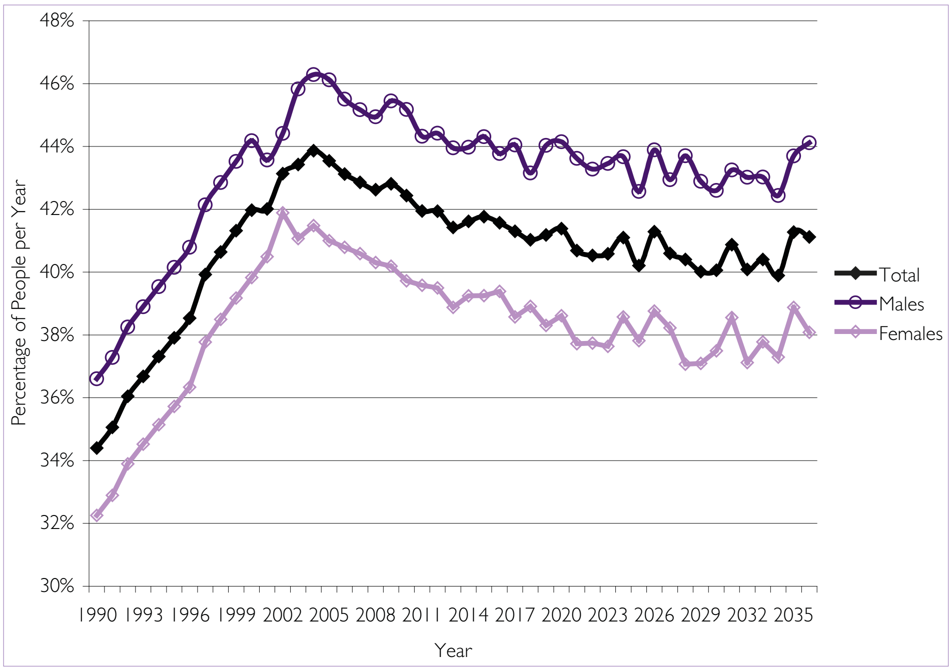
Total population, males and females, all age groups. Simulated expectation. Risk factor simulated: BMI greater than 25.



Historical risk factor data: NSW Population Health Survey 2005. Centre for Epidemiology and Research, NSW Department of Health.

Figure 7 NSW Physical Inactivity Prevalence Rates (1990–2036)

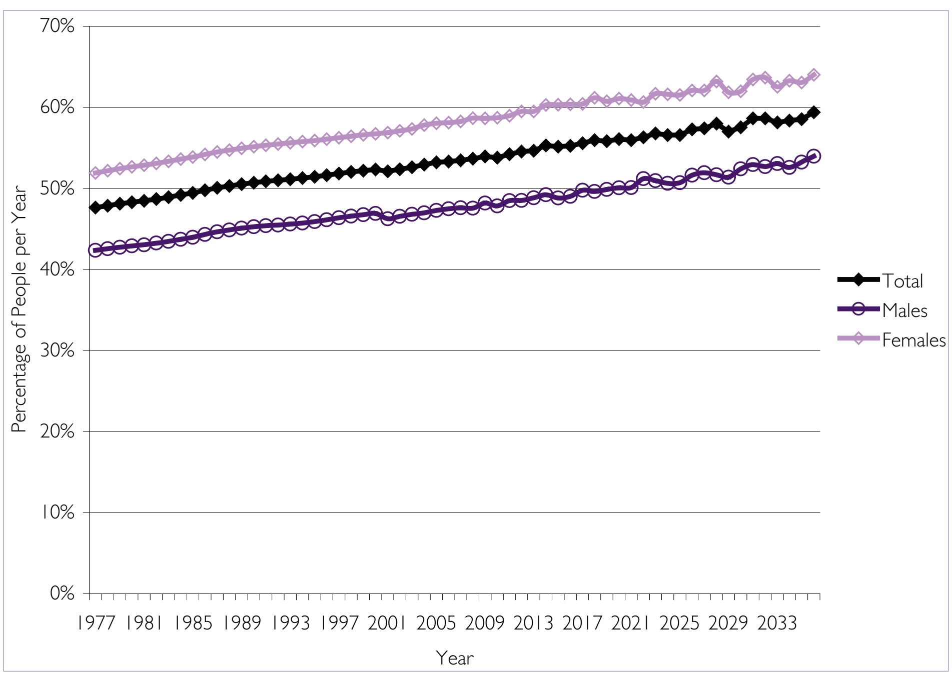
Total population, males and females, all age groups. Simulated expectation. Risk factor simulated: Physical inactivity.



Historical risk factor data: NSW Population Health Survey 2005. Centre for Epidemiology and Research, NSW Department of Health.

Figure 8 NSW Sun Exposure Prevalence Rates (1990–2036)

Total population, males and females, all age groups. Simulated expectation. Risk factor simulated: Sun exposure.



Historical risk factor data: NSW Population Health Survey 2005. Centre for Epidemiology and Research, NSW Department of Health.

5. **Population** projection analysis (2007–2036)

The rates of population change and the age profile were simulated for NSW. The age and gender breakdown of the NSW Australian Bureau of Statistics actual and projected resident population for NSW were projected (**Figure 9**).

According to these projections, by 2036, the number of people in the older age group will increase substantially for both sexes. Males between 40 and 44 years old will comprise the largest age group through out the simulation period. Early in the simulation period, the largest age group for females include those aged between 30 and 34 years old, while in 2036, the 40 to 44 age group is expected to dominate the female age distribution.

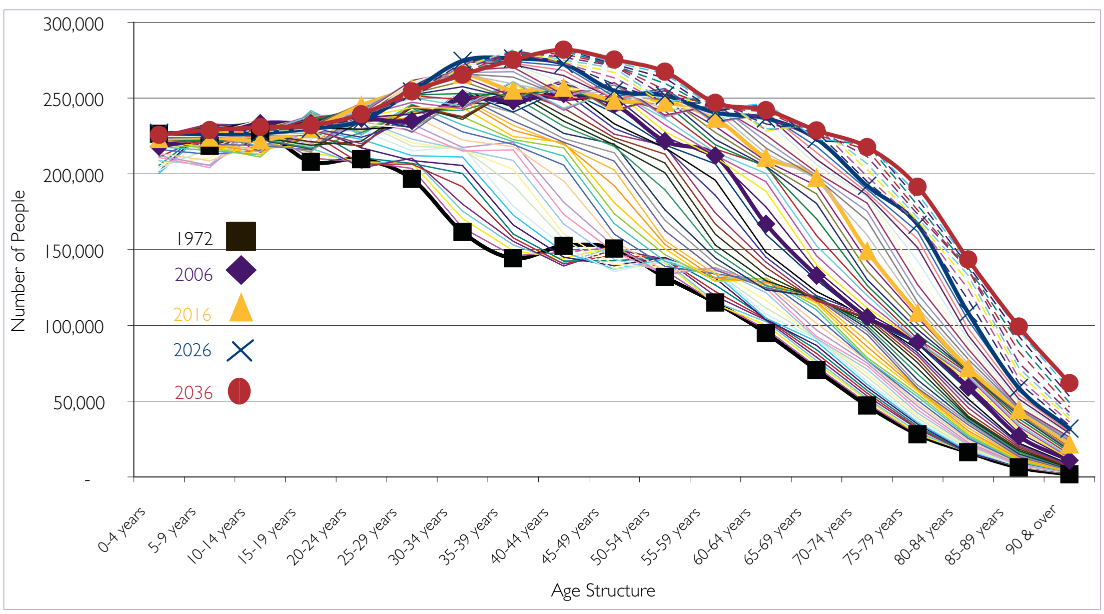
The ageing nature of the NSW population is a persistent and cumulative process. The rate of change for each future year is based on a growing 60 years and over population age group with contribution from this age group increasing from 34 per cent in the previous 30 years (1971–2006) to 78.3 per cent in the next 30 years (2007 to 2036) (**Figure 10**).

The following sections discuss the forward simulations for incidence, mortality and prevalence of cancer in NSW and the subsequent economic cost of cancer. The top five cancer types in NSW are explored in separate chapters.

All forward simulations are based on the assumption that the historical trends of cancer data as recorded by the NSW Central Cancer Registry, risk factor prevalence recorded for NSW population and direct and indirect costs associated with cancer will continue into the future and no change will be introduced to change this trend.

Figure 9a NSW Population Age Distributions, males, (1972–2036)

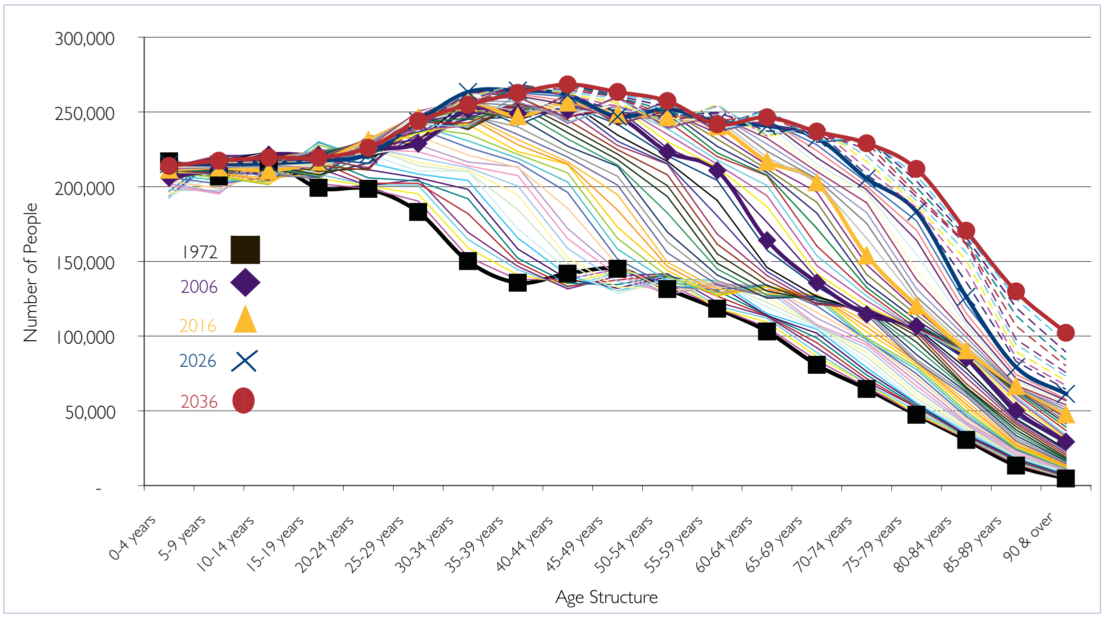
Simulated expected age structure of New South Wales male population.



Population data: Australian Bureau of Statistics, 3222.0 Table B1. Population projections, by age and sex, NSW – Series B

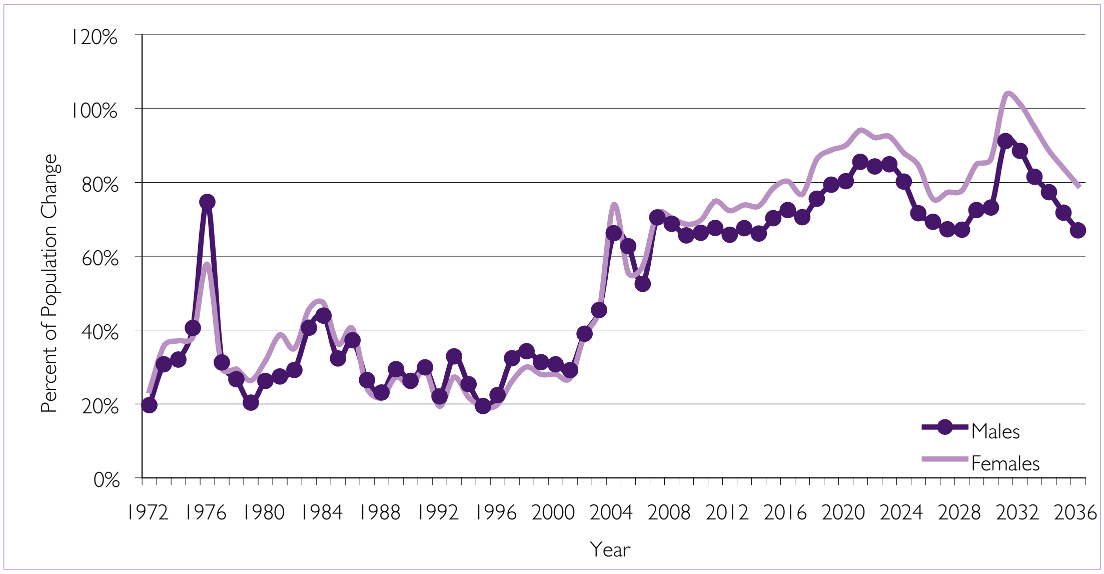
Figure 9b NSW Population Age Distributions, females, (1972–2036)

Simulated expected age structure of New South Wales female population.



Population data: Australian Bureau of Statistics, 3222.0 Table B1. Population projections, by age and sex, NSW – Series B.

Figure 10 NSW Population: Proportion of Population Change Explained by 60 years and Over (1972–2036)



Population data: Australian Bureau of Statistics, 3222.0 Table B1. Population projections, by age and sex, NSW – Series B.

6. Cancer: new cases

Historical cancer incidence between 1972 and 2003 were obtained from NSW Central Cancer Registry (NSW CCR) and incidence cases from 2004 through to 2036 were simulated (**Figure 11**). The age and gender breakdown of historical and simulated incidence case were further projected (**Figure 12**).

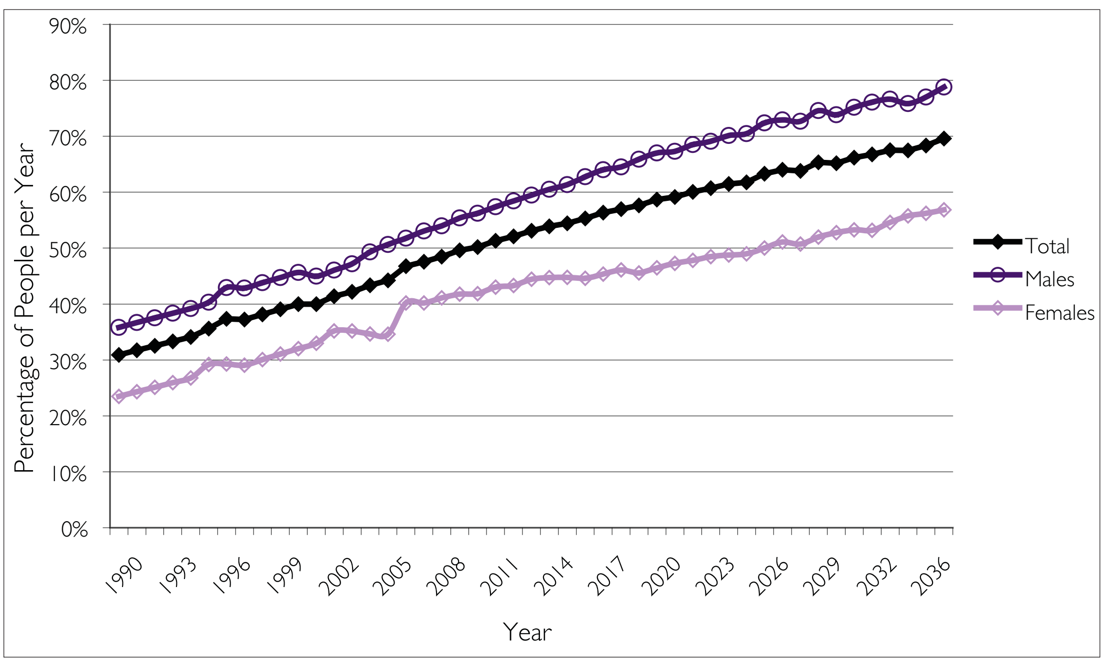
The number of new cancer cases in NSW is expected to increase throughout the simulation period. The proportion of cancer cases among older people will continue to remain higher in the future for both males and females. This is expected to be primarily attributed to an increase in population aged 50 years and over.

The incidence of top five most common cancers in NSW was simulated (**Figure 13**). These results are discussed in detail in separate chapters of this report. The cumulative cases of cancer from 2007–2036 were further explored (**Table 3**).

The simulation results indicated that the incidence cases for prostate cancer will be increasing substantially more than other cancers studied. The number of diagnosed lung cancers is projected to increase slightly over the next 30 years.

Figure 11 NSW New Cancer Cases (1972–2036)

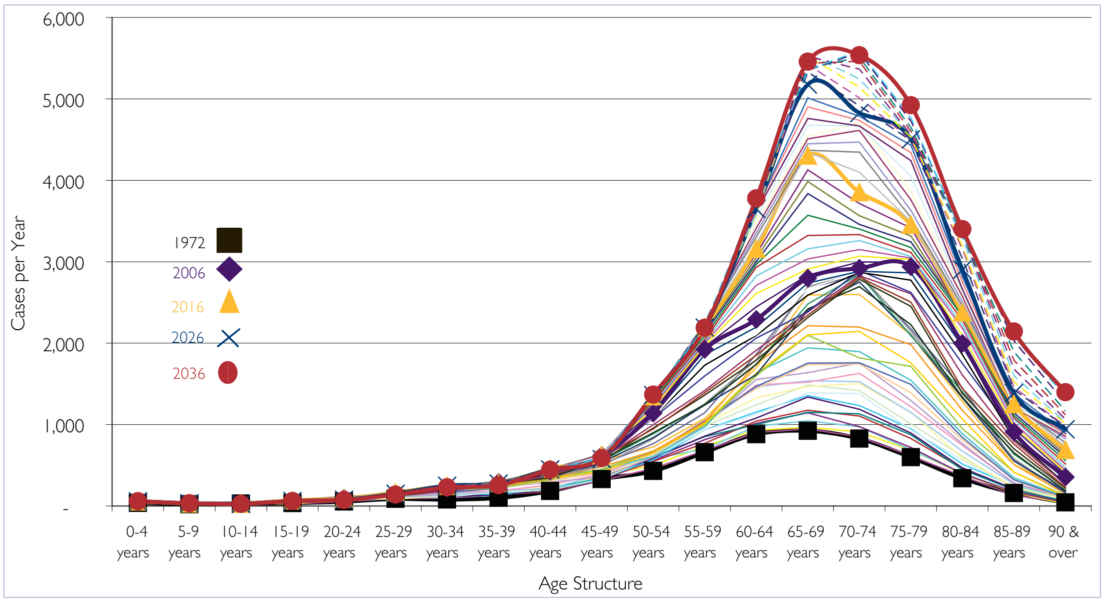
Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 12a NSW New Cancers, Population Age Distribution, males (1972–2036)

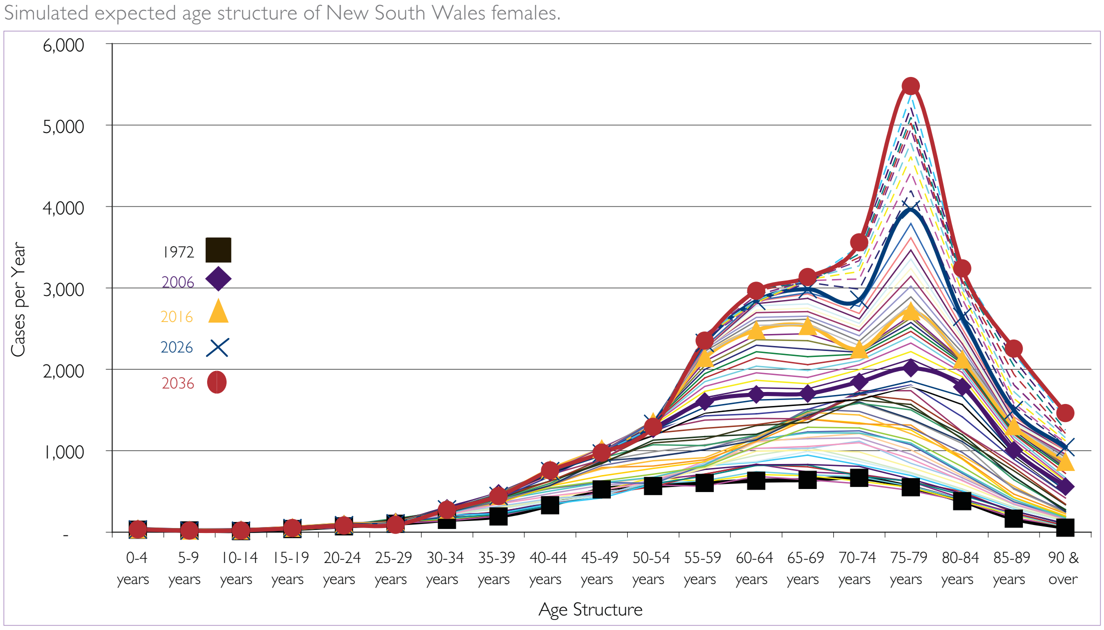
Simulated expected age structure of New South Wales males.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 12b NSW New Cancers, Population Age Distribution, females (1972–2036)

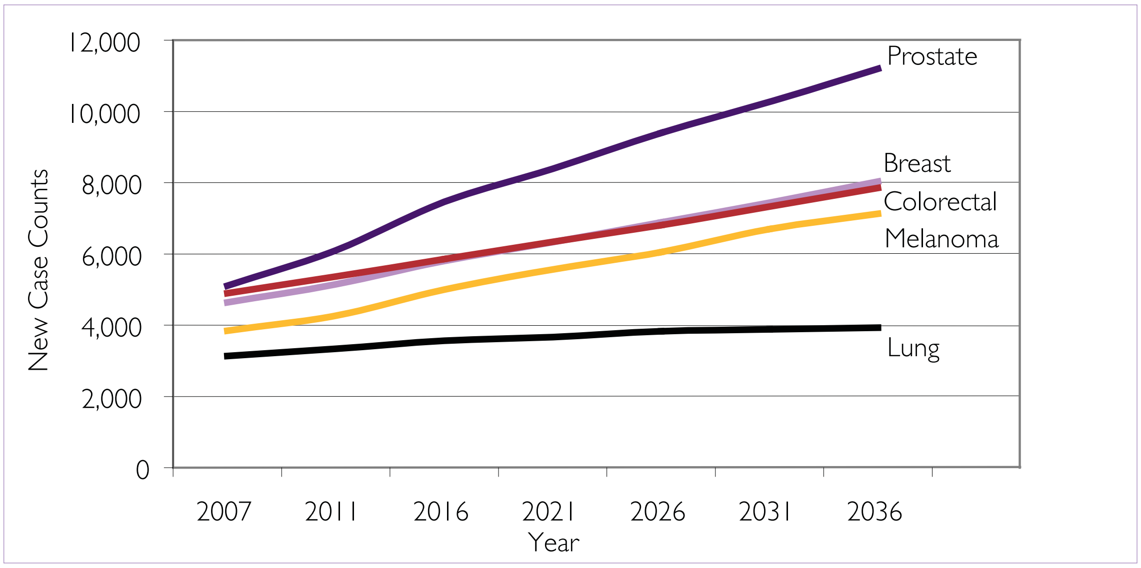
Simulated expected age structure of New South Wales females.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 13 NSW New Cases for Major Cancer Types (2007–2036)

Yearly new case counts.



New Cases are those cancer patients that were diagnosed with cancer during the specified year.

Table 3 NSW New Cases – Five-year Intervals (2007–2036)

Yearly New Case and Cumulative New Case Counts from 2006
Major Cancer Types, 2007–2036

New Cancer Cases for Year Specified	2007	2011	2016	2021	2026	2031	2036
All Cancers	36,671	40,863	45,295	49,182	53,131	57,467	60,569
Breast	4,641	5,143	5,797	6,331	6,884	7,438	8,029
Colorectal	4,899	5,368	5,854	6,341	6,809	7,328	7,853
Lung	3,134	3,338	3,561	3,667	3,826	3,881	3,934
Melanoma	3,847	4,265	4,998	5,566	6,051	6,695	7,127
Prostate	5,108	6,095	7,464	8,393	9,398	10,269	11,196
Cumulative New Cancer Cases from 2006	**2007**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**
All Cancers	36,671	193,979	412,006	650,454	907,803	1,187,183	1,483,520
Breast	4,641	24,522	52,214	82,823	116,048	152,121	191,061
Colorectal	4,899	25,736	54,004	84,743	117,848	153,375	191,906
Lung	3,134	16,234	33,673	51,727	70,594	89,908	109,413
Melanoma	3,847	20,385	43,921	70,590	99,836	132,086	167,072
Prostate	5,108	28,061	62,707	102,800	147,569	197,240	251,437

New Cases are those cancer patients that were diagnosed with cancer during the specified year.
Cumulative new case counts is the sum of all cancer patients diagnosed with cancer as of the beginning of 2006.

7. Cancer: deaths

Historical cancer-related mortality between 1972 and 2003 were obtained using ABS deaths as recorded in GRIM Books 3002 and cancer mortality from 2004 through to 2036 in NSW was simulated (**Figure 14**). The age and gender breakdown of historical and simulated mortality were further projected (**Figure 15**).

The number of cancer-related deaths in NSW is expected to increase throughout the simulation period. Cancer-related deaths will continue to remain higher in older people in both males and females. The primary driver of cancer-related deaths is attributed to an increase in population aged 50 years and over.

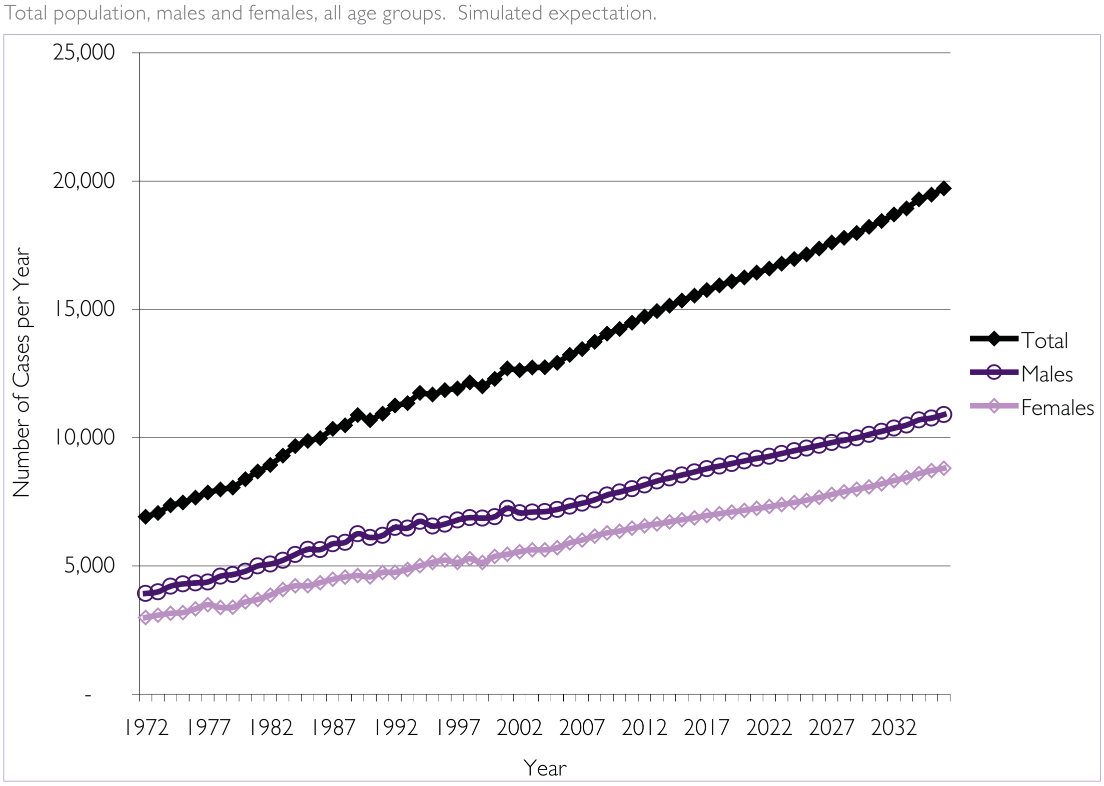
Mortality for top five most common cancers in NSW was simulated (**Figure 16**). These results are discussed in detail in separate chapters of this report. The cumulative number of deaths cases from 2007–2036 were further explored (**Table 4**).

Number of deaths attributed to the top five main cancers is expected to increase through-out the simulation period. Lung cancer will remain as the major cause of cancer mortality until early 2020s after which it is expected that prostate cancer will become the major contributor with colorectal cancer accelerating later in the simulation.

Historical incidence and mortality between 1972 and 2003 and simulated incidence and mortality from 2004 through to 2036 for all cancers in NSW were compared (**Figure 17**). Cancer incidence and mortality are expected to increase throughout the simulation period. The incidence is expected to increase at a higher rate than the mortality, suggesting an increase in cancer prevalence in the future.

Figure 14 NSW Cancer Deaths (1972–2036)

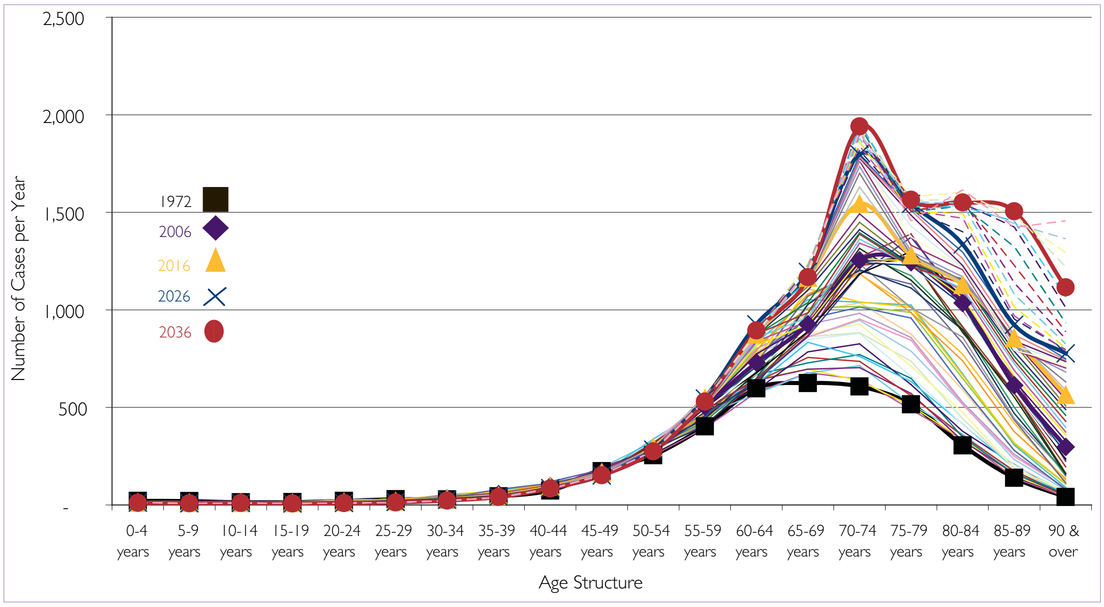
Total population, males and females, all age groups. Simulated expectation.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 15a NSW Cancer Deaths, Population Age Distribution, males (1972–2036)

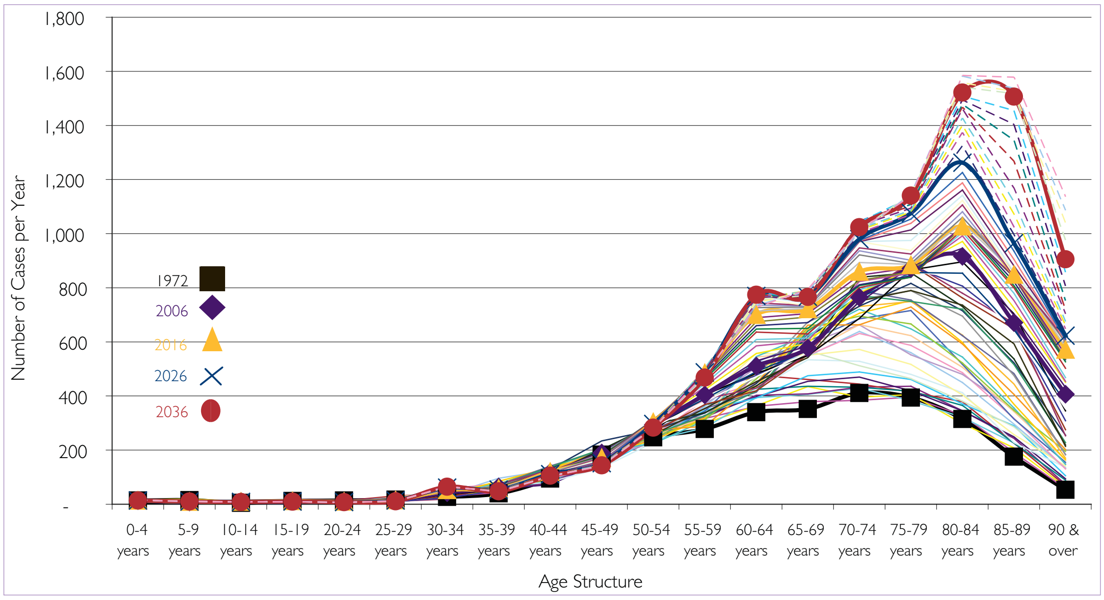
Simulated expected age structure of New South Wales males.



Historical mortality data up to 2003: AIHW General Records of Incidence of Mortality (GRIM Books) 2003.

Figure 15b NSW Cancer Deaths, Population Age Distribution, females (1972–2036)

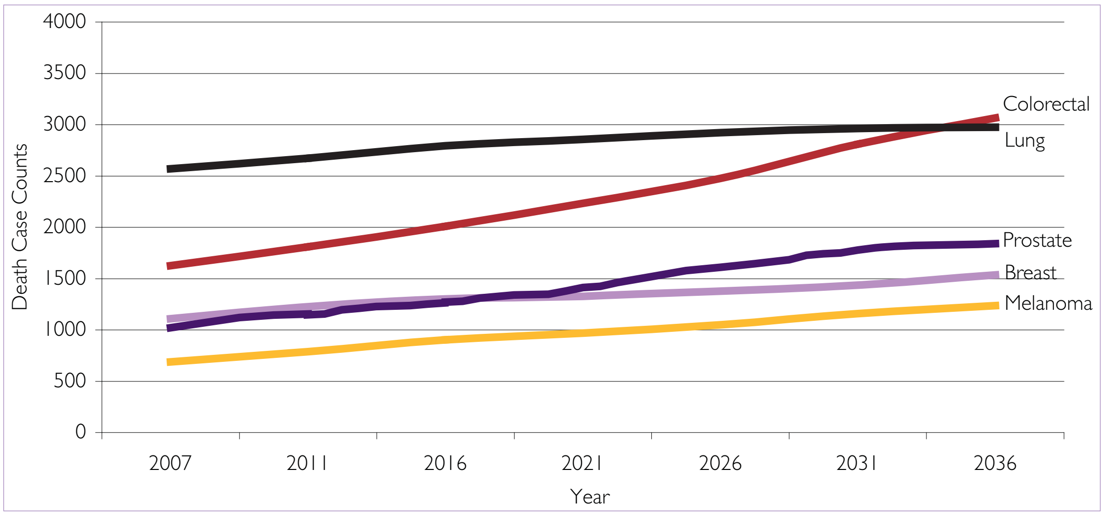
Simulated expected age structure of New South Wales males.



Historical mortality data up to 2003: AIHW General Records of Incidence of Mortality (GRIM Books) 2003.

Figure 16 NSW Cancer Deaths, Major Cancer Types (2007–2036)

Yearly death counts, five-year intervals.



Death for Year are those cancer patients who had died of their cancer during the specified year.

Table 4 NSW Cancer Deaths – Five-year Intervals (2007–2036)

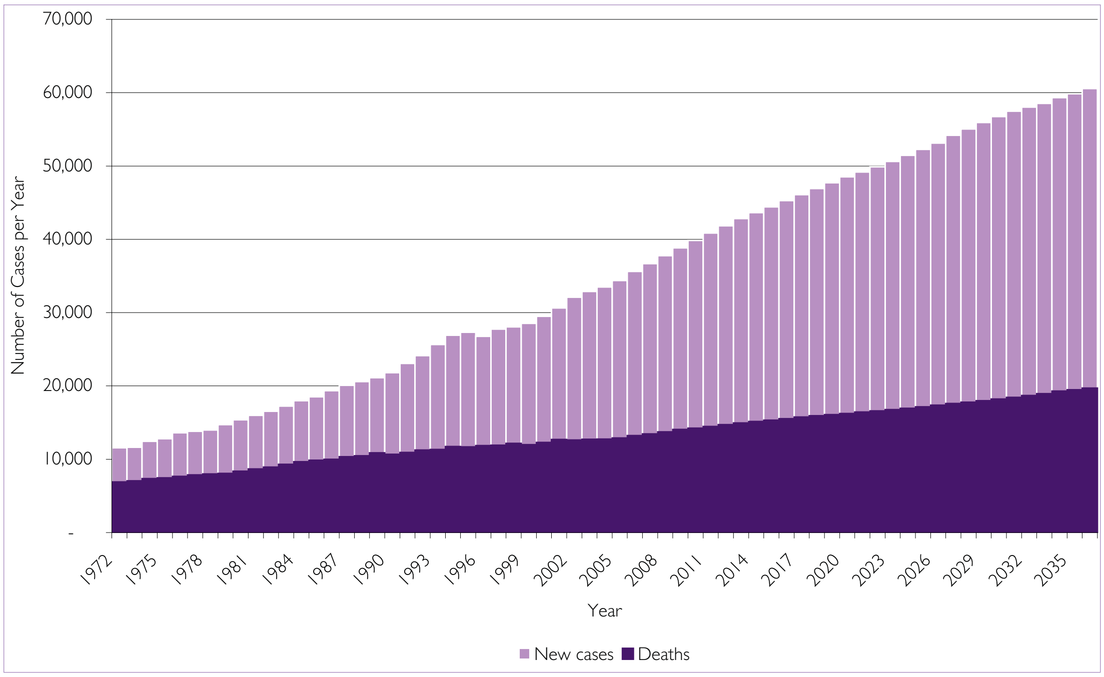
Yearly Deaths and Cumulative Death Case Counts from 2006
Major Cancer Types

Cancer Death Cases for Year Specified	2007	2011	2016	2021	2026	2031	2036
All Cancers	13,456	14,483	15,540	16,433	17,370	18,444	19,714
Breast	1,109	1,227	1,302	1,328	1,381	1,438	1,535
Colorectal	1,626	1,812	2,011	2,234	2,475	2,810	3,067
Lung	2,569	2,673	2,795	2,856	2,922	2,962	2,974
Melanoma	689	787	902	970	1,050	1,158	1,237
Prostate	1,004	1,110	1,272	1,396	1,559	1,721	1,752
Cumulative Cancer Death Cases from 2006	**2007**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**
All Cancers	13,456	69,971	145,659	226,113	310,959	401,000	497,122
Breast	1,109	5,848	12,226	18,821	25,637	32,696	40,285
Colorectal	1,626	8,606	18,287	29,011	40,931	54,310	69,310
Lung	2,569	13,139	26,918	41,118	55,570	70,347	85,220
Melanoma	689	3,713	7,976	12,695	17,775	23,349	29,367
Prostate	1,004	6,190	12,217	19,685	27,142	35,788	44,529

Death for Year are those cancer patients who had died of their cancer during the specified year.
Cumulative death case counts is the sum of all cancer patients who had died from their cancer as of the beginning of 2006

Figure 17 NSW New Cancer Cases and Deaths (1972–2036)

Total population, New South Wales, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Records of Incidence of Mortality (GRIM) 2003.

8. Cancer: prevalence

In this study, yearly cancer prevalence was calculated as a function of the annual incidence as well as the number of deaths at the end of a given year. Under the assumption of continuing historical survival trends the yearly prevalence (age-specific) estimates were in major part affected by the increasing and ageing population in NSW.

Historical cancer-related prevalence in NSW between 1994 and 2003 were obtained from NSW CCR and the cancer prevalence from 2004 through to 2036 was simulated (**Figure 18**). Age and sex breakdown of historical and simulated cancer prevalence for all cancers were further projected (**Figure 19**).

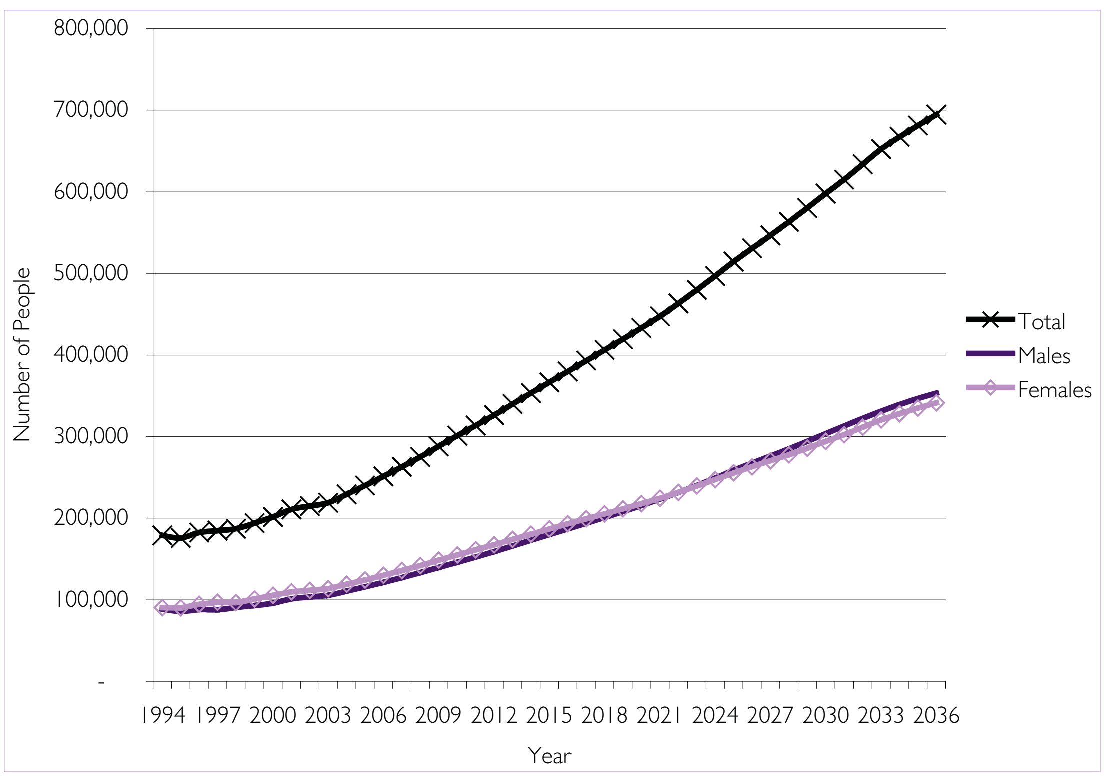
The number of people living with cancer in NSW is expected to increase throughout the simulation period.

The proportion of cancer prevalence among older people will continue to remain higher in the future for both genders with the primary driver of cancer-related deaths in NSW attributed to an increase in population aged 50 years and over.

The prevalence of top five most common cancers in NSW was further projected (**Figure 20** & **Table 5**). The prevalence of prostate and breast cancer is expected to increase substantially over the next 30 years. The prevalence for colorectal cancer and melanoma will be increasing over time with numbers much less than for breast and prostate. The prevalence for lung cancer is expected to increase at a much lower rate.

Figure 18 NSW Cancer Prevalence (1994–2036)

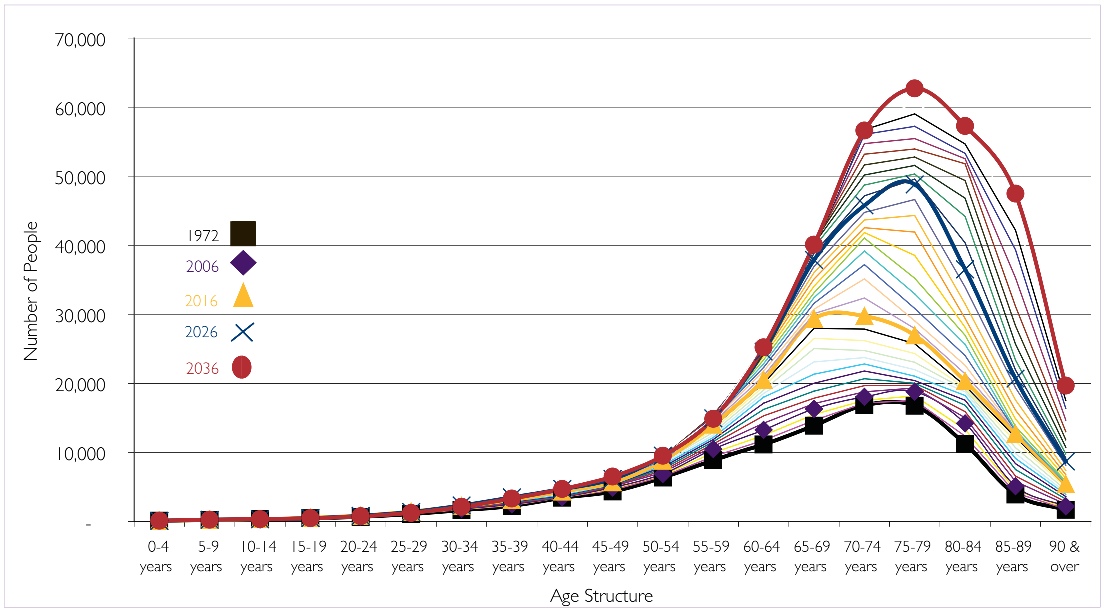
Total population, New South Wales, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 19a NSW Cancer Prevalence, Population Age Distribution, males (2003–2036)

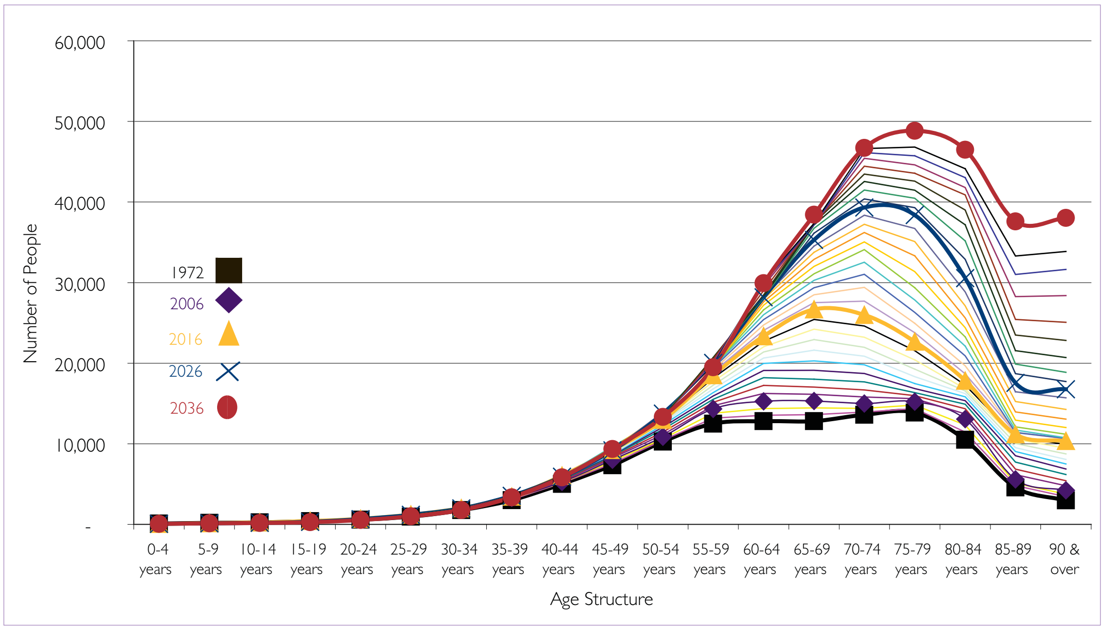
Simulated expected age structure of New South Wales males.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Mortality (GRIM Books), 2003.

Figure 19b NSW Cancer Prevalence, Population Age Distribution, females (2003–2036)

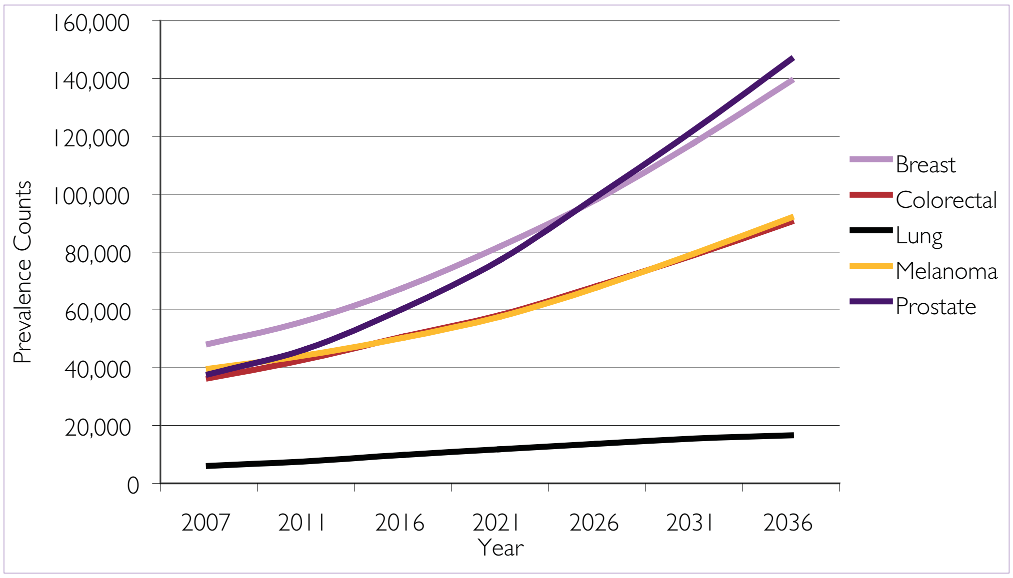
Simulated expected age structure of New South Wales females.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Mortality (GRIM Books), 2003.

Figure 20 NSW Cancer Prevalence, Top-five Cancers (2007–2036)

Yearly cancer prevalence. Major cancer types, five-year intervals.



Cancer Prevalence measures the number of people living with cancer at the end of the year specified.

Table 5 NSW Cancer Prevalence, Major Cancer Types and All Cancers, Five-year Intervals (2007–2036)

Yearly Cancer Prevalence

Cancer Prevalence for Year Specified	2007	2011	2016	2021	2026	2031	2036
All Cancers	262,877	313,604	379,816	447,447	530,621	615,127	694,638
Breast	48,249	56,109	67,542	81,927	98,281	117,772	139,197
Colorectal	36,402	42,826	50,706	58,200	68,292	78,901	90,407
Lung	5,992	7,594	9,799	11,766	13,708	15,450	16,575
Melanoma	39,617	44,274	50,260	57,562	67,789	79,436	91,949
Prostate	37,782	46,403	60,343	77,224	99,271	122,191	146,687

Cancer prevalence measures the number of people living with cancer at the end of the year specified.

New Cases Alive at Year End are those cancer patients that were diagnosed with cancer during the specified year and who are alive at the end of the specified year.

Non New Case Prevalence Alive at Year End are those cancer patients that were diagnosed with cancer during the previous 15 years of the specified year and who are alive at the end of the specified year.

The method of prevalence used here is survival dependent. See Appendix D.

9. **Disability** Adjusted Life Years (DALYs)

Cancer burden in NSW measured in Disability Adjusted Life Years (DALYs) for all age groups for both genders between 2003 and 2036 were simulated (**Figure 21**).

The burden associated with cancer is expected to increase through-out the simulation period. The burden of cancer for males is expected to be higher than for females. It is predicted that early in the simulation period, the burden due to mortality (number of years of life lost (YLL) will be higher than the burden due to disability, (number of years lived with disability (YLD). However, later in the simulation, burden associated with disability will become more important than burden associated with death.

The simulated results indicated that in NSW (**Table 6**):

YLL:

- Between 2007 and 2016 (10-year simulation), the average growth rate is estimated to be 1.38% per annum (1.45% per annum for males and 1.30% per annum for females).
- Between 2016 and 2036 (30-year simulation), the average growth rate is estimated to be 0.50% per annum (0.46% per annum for males and 0.55% per annum for females).

YLD:

- Between 2007 and 2016 (10-year simulation), the average growth rate is estimated to be 4.22% per annum (4.41% per annum for males and 4.04% per annum for females).
- Between 2016 and 2036 (30-year simulation), the average growth rate is estimated to be 3.07% per annum (3.24% per annum for males and 2.89% per annum for females).

DALY:

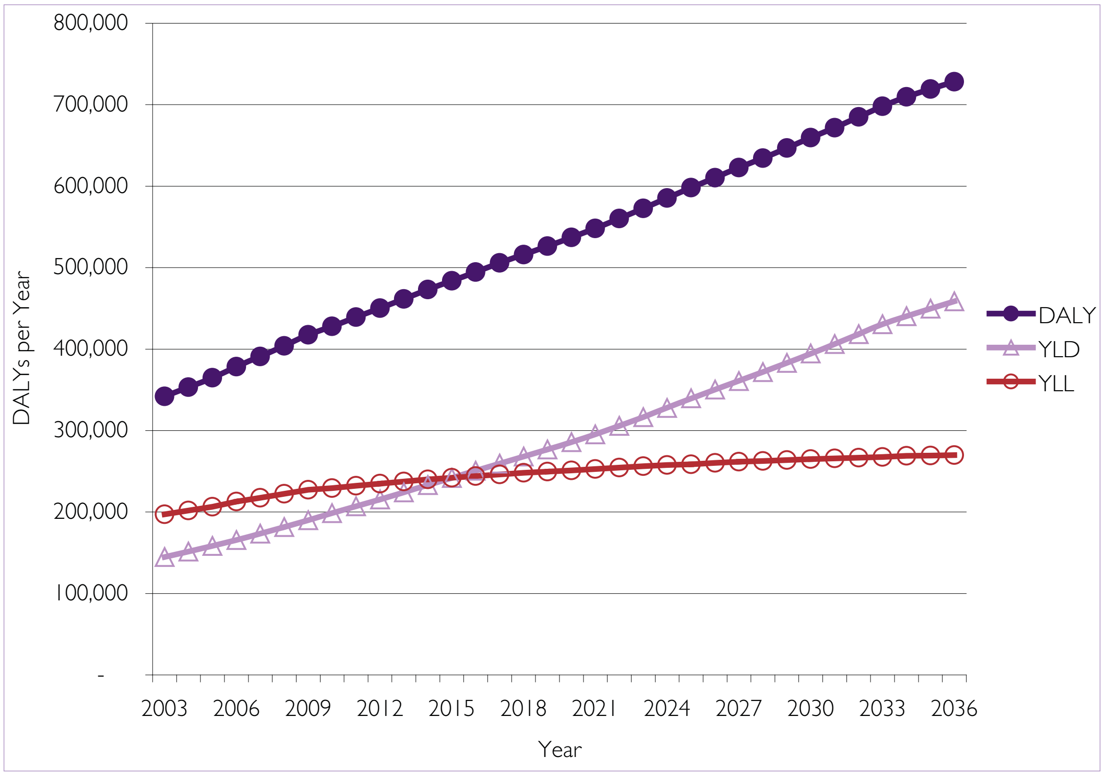
- Between 2007 and 2016 (10-year simulation), the average growth rate is estimated to be 2.71% per annum (2.81% per annum for males and 2.61% per annum for females).
- Between 2017 and 2036 (30-year simulation), the average growth rate is estimated to be 1.95% per annum (2.02% per annum for males and 1.88% per annum for females).

Table 6 Burden of Disease Associated with Cancer in NSW (2007–2036)

	Year	All	Males	Females
YLL				
	2007	217,344	112,926	104,418
	2016	243,950	127,092	116,859
	2036	269,762	139,276	130,486
YLD				
	2007	173,422	86,084	87,339
	2016	250,623	126,520	124,102
	2036	458,514	239,181	219,332
DALY				
	2007	390,766	199,010	191,757
	2016	494,573	253,612	240,961
	2036	728,276	378,457	349,819

Figure 21 NSW Cancer DALYs (2003–2036)

Total population, New South Wales, males and females, all age groups. Simulated expectation.



Disability data: Colin Mathers, Chris Stevenson, Simon Eckermann (1999) AIHW, Disability Coefficients for different cancer types; and Males JM, Essink-Bot ML, Kramers PG et al: A national burden of disease calculation: Dutch disability-adjusted life-years. American Journal of Public health 90(8): 1241-1247, 2000.

10. **Economic** impacts of cancer in NSW

This section discusses the financial impacts of cancer in NSW. The results of simulations are presented with respect to the following economic measures:

Direct costs

- Total health care costs. Health care costs include costs related to hospital admitted patients, out-of-hospital medical services, pharmaceuticals requiring prescription and other professional Services.[ix] Estimation of the health cost was limited due to lack of data on private and public health care cost distinctions, and itemised health care cost contributions (such as cost of pharmaceuticals, treatment/doses per patient.

Indirect costs[x]

- Total employee compensation (which has been termed wages in this report): decomposed into age, gender, stage/severity, survival, cancer type, risk factor exposure groups.[xi]
- Corporate profits: decomposed into the source age, gender, stage/severity, years survival, cancer type and risk factor exposure groups.
- Taxation revenue (Commonwealth and State Government)[xii] decomposed into age, gender, stage/severity, years survival, cancer type, risk factor exposure groups and different tax types (personal income tax, corporate income tax, GST, payroll tax).

The simulation result for each economic indicator is decomposed into direct and indirect influences of death and disability contributing to the each cost.

10.1 Labour force

The magnitude of the economic results will largely depend on future labour force, employment as well as average wages dictated by economic constraints.

For the purposes of this study, the labour force corresponds to that portion of the population able to work at any time.

The employment percentage corresponds to the portion of the labour force employed at a specific time.

The age and gender breakdown of historical and simulated labour workforce in the NSW population were further projected indicating a growing labour force in NSW in the next 30 years (**Figure 22** and **Figure 23**).

Labour force participation and cancer incidence estimated previously were further used to estimate the number of people in the labour market who will be directly affected by cancer (**Figure 24**).

10.2 Economic consequences of cancer

The financial cost of cancer in NSW was simulated (**Figure 25** and **Table 7**). All aspects of cost attributed to cancer are expected to increase with loss of wages being the largest cost projected. The cost of health care is also expected to increase over time and proportionally shows the largest growth.

The Double Economic Impact of Cancer

As discussed earlier, it is predicted that the number of cancer cases in the NSW will increase significantly over the next 30 years. The cumulative number of new cases of cancer from 2007–2016 is expected to be over 30% higher than those seen in the previous 10 years (1997–2006). While, the predictions for the next 30 years are less certain, we may experience an increase of about 110% in cumulative number of new cases of cancer over the next 30 years (2007–2036) compared to the previous 30 years (1977–2006).

Meanwhile the NSW health system will incur higher costs to treat and support patients. An increase of 87% by 2016 in nominal terms and an increase of 662% by 2036 in nominal terms. In real, terms cancer may cost the economy over $106 billion in the 10 years and over $320 billion in the next 30 years.

It is expected that over the next 30 years, NSW will experience a growing cancer 'double dipping' impact (**Figure 26**). Cancer not only will have the ability to increase the

ix. Research Costs and Over-the-Counter Drugs are not included.

x. Influenced by future labour force.

xi. Given the non-availability of NSW or Australian wage distinctions between age groups and gender, a key assumption supporting wage simulations was the use of Canadian average age group and gender wage ratios.

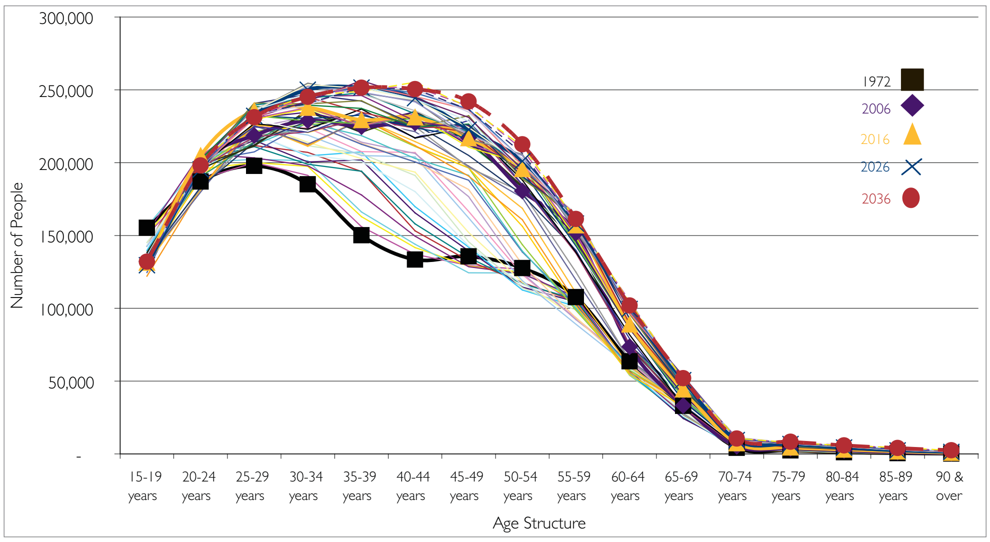
xii. Taxation Revenue is defined as a net compulsory levy imposed by a government.

costs of health care, but it also will erode the economy's ability to pay for such health care.

Trends such as the ones shown in **Figure 26** do not take into account future market forces such as changes in wages and interest rates. These forces as well as others are expected to influence the economy and the economy's ability to cope with such dramatic changes seen here. However, it is important to note that costs are expected to increase and the economy will need to find a way to pay for them.

Figure 22a NSW Labour Force, Age Distribution, males, (1978–2036)

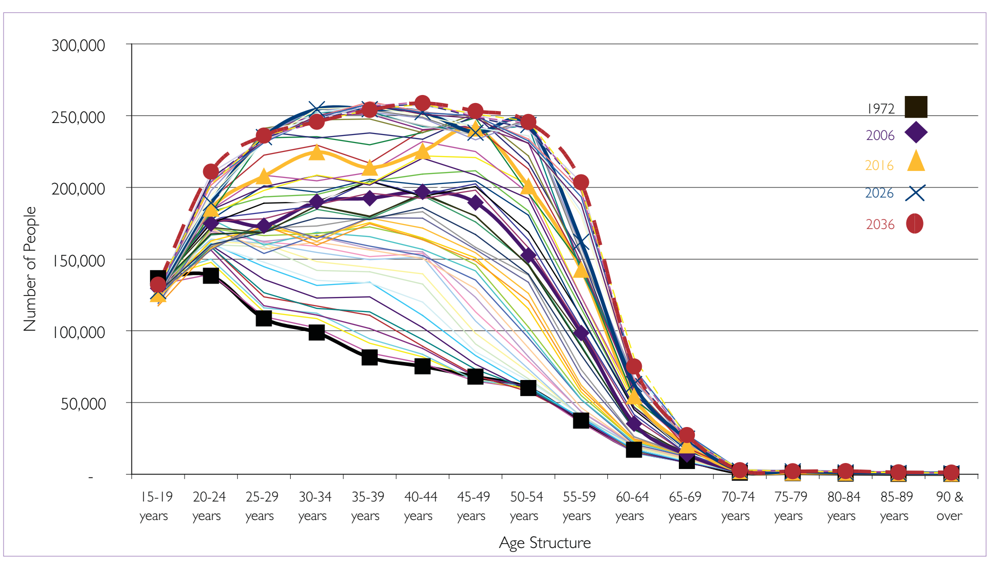
Simulated expected age structure of New South Wales males.



Labour force historical data: Australian Bureau of Statistics Labourfource Data Cube 6291.0.55.001 LM2 – Labour force status by sex, age, NSW.

Figure 22b NSW Labour Force, Age Distribution, females, (1978–2036)

Simulated expected age structure of New South Wales females.



Labour force historical data: Australian Bureau of Statistics Labourfource Data Cube 6291.0.55.001 LM2 – Labour force status by sex, age, NSW.

Figure 23 NSW Labour Force, Age Profile (2006 and 2036)

Simulated expectation. Age Pyramid of Labour Force.

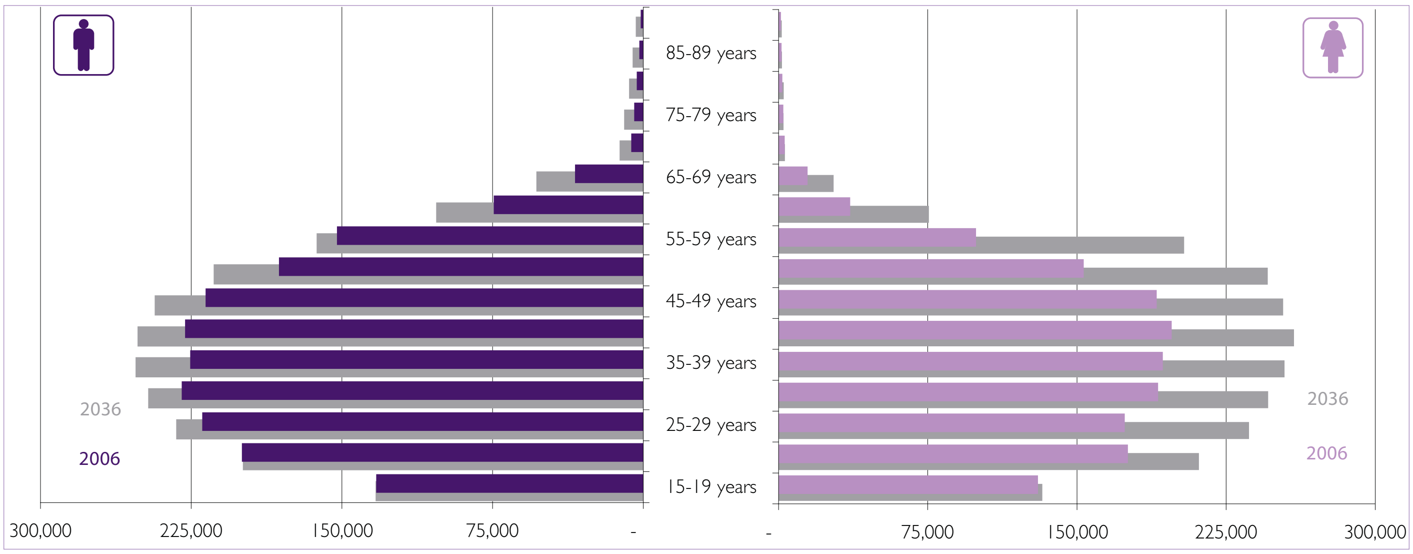
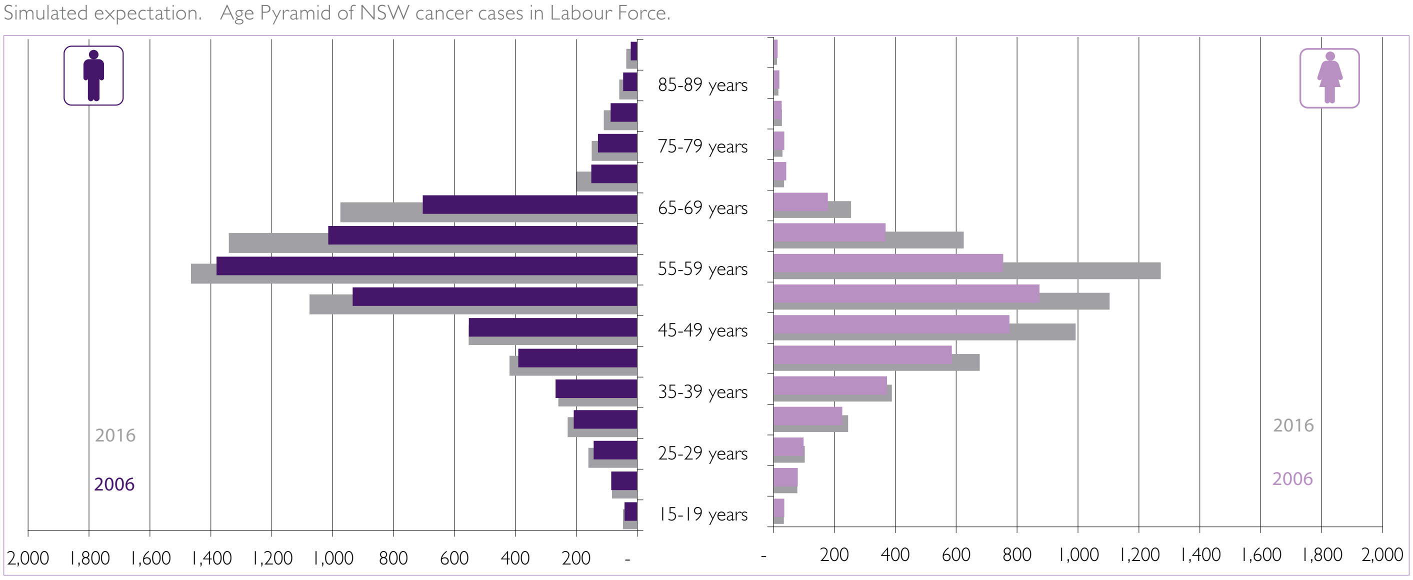


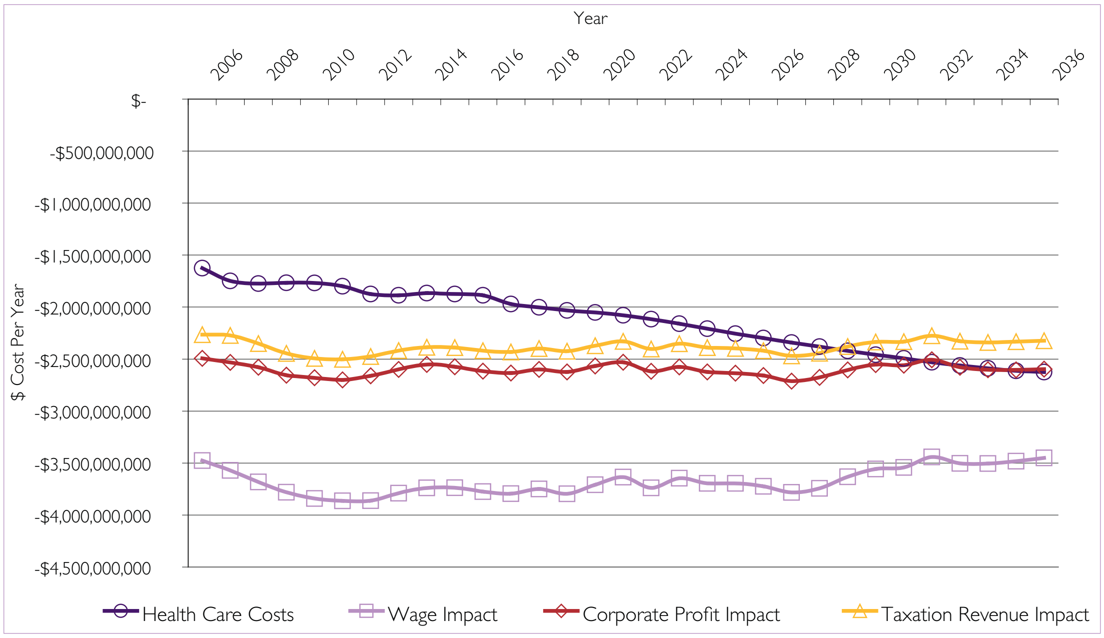
Figure 24 NSW New Cancer Cases, Labour Force, Age Profile (2006 and 2016)

Simulated expectation. Age Pyramid of NSW cancer cases in Labour Force.



Labour force historical data: Australian Bureau of Statistics Labourforce Data Cube 6291.0.55.001 LM2 – Labour force status by sex, age, NSW.

Figure 25 NSW Economic Costs of Cancer (2006–2036)



Economic cost dissections. 2006 present vales. All cancers. Simulated expectation 2006 present is the estimated value in the year specified as viewed by a person living in 2006 after adjusting for the interest rate value of money as derived from a NSW Government zero coupon bond curve. Total health care expenditure is the sum of Hospital Admitted Patients, Out-of-pocket Medical Services, Pharmaceuticals Requiring Prescription and Other Professional Services. Not included are research Costs, Over-the-counter Drugs. Wages are defined as compensation of employees based upon ABS Series 5220.0 Table 24 Factor Income by Industry and Principal Components, NSW current prices. Corporate Profits are defined as gross operating surplus based upon ABS Series 5220.0 Table 24 Factor Income by Industry and Principal Components, NSW current prices. Taxation Revenue is defined as a net compulsory levy imposed by a government based upon ABS Series 5506.0 Taxation Revenue, 2004–2005, Commonwealth and State Governments.

Table 7 NSW Economic Cost of Cancer (2007–2036)

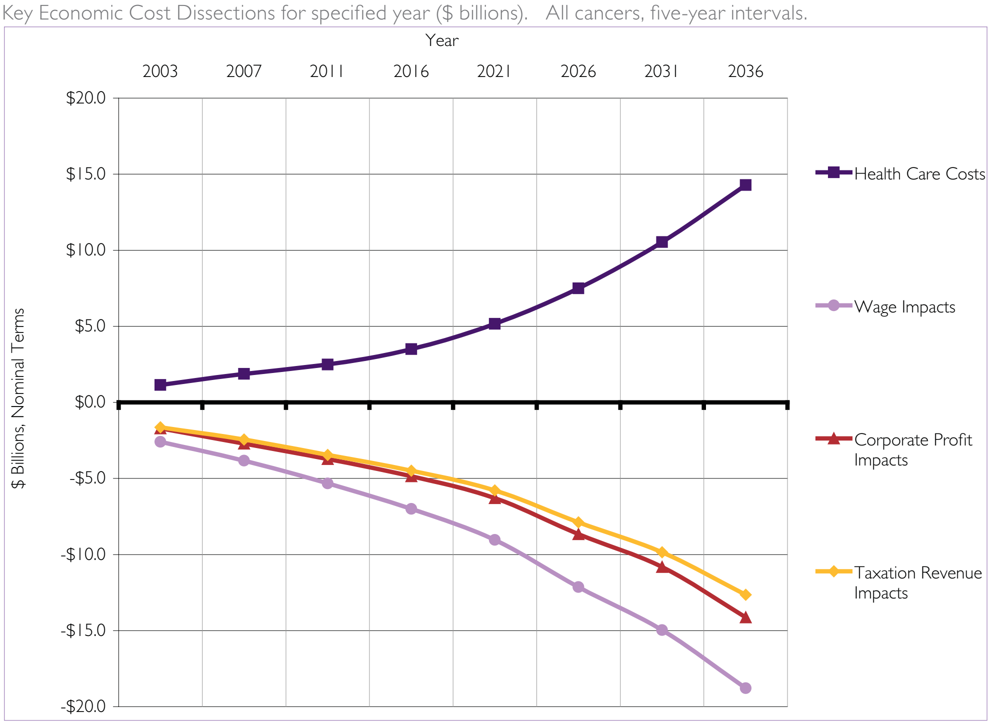
Key Economic Cost Dissections, Cumulative from 2007 ($ millions)
Major Cancer Types, 2006 Present Values, 2007-2036 (5-year intervals).

Health Care Costs	2007	2011	2016	2021	2026	2031	2036
All Cancers	-$1,748	-$8,856	-$18,245	-$28,380	-$39,419	-$51,515	-$64,434
Breast	-$119	-$596	-$1,185	-$1,764	-$2,342	-$2,933	-$3,538
Colorectal	-$109	-$549	-$1,089	-$1,604	-$2,105	-$2,606	-$3,108
Lung	-$57	-$279	-$537	-$767	-$972	-$1,157	-$1,322
Melanoma	-$14	-$67	-$130	-$191	-$249	-$309	-$369
Prostate	-$131	-$705	-$1,543	-$2,504	-$3,619	-$4,912	-$6,374
Wage Impacts	2007	2011	2016	2021	2026	2031	2036
All Cancers	-$3,571	-$18,738	-$37,642	-$56,328	-$74,828	-$93,086	-$110,467
Breast	-$417	-$2,255	-$4,705	-$7,361	-$10,227	-$13,321	-$16,578
Colorectal	-$469	-$2,446	-$4,877	-$7,231	-$9,517	-$11,746	-$13,842
Lung	-$302	-$1,506	-$2,863	-$4,062	-$5,098	-$5,985	-$6,759
Melanoma	-$720	-$3,628	-$6,898	-$9,872	-$12,690	-$15,438	-$18,063
Prostate	-$1,151	-$5,945	-$11,754	-$17,345	-$22,552	-$27,482	-$31,941
Corporate Profit Impacts	2007	2011	2016	2021	2026	2031	2036
All Cancers	-$2,533	-$13,146	-$26,150	-$39,104	-$52,217	-$65,324	-$78,213
Breast	-$244	-$1,299	-$2,667	-$4,170	-$5,841	-$7,685	-$9,708
Colorectal	-$355	-$1,838	-$3,638	-$5,407	-$7,168	-$8,898	-$10,588
Lung	-$287	-$1,416	-$2,669	-$3,780	-$4,764	-$5,627	-$6,399
Melanoma	-$380	-$1,920	-$3,661	-$5,285	-$6,865	-$8,415	-$9,930
Prostate	-$650	-$3,345	-$6,624	-$9,842	-$12,983	-$16,023	-$18,918
Taxation Revenue Impacts	2007	2011	2016	2021	2026	2031	2036
All Cancers	-$2,272	-$12,064	-$24,152	-$36,106	-$48,067	-$60,026	-$71,626
Breast	-$250	-$1,370	-$2,846	-$4,446	-$6,194	-$8,109	-$10,164
Colorectal	-$305	-$1,612	-$3,204	-$4,749	-$6,269	-$7,769	-$9,209
Lung	-$213	-$1,074	-$2,036	-$2,884	-$3,628	-$4,277	-$4,854
Melanoma	-$421	-$2,153	-$4,096	-$5,870	-$7,569	-$9,243	-$10,863
Prostate	-$686	-$3,591	-$7,095	-$10,477	-$13,686	-$16,765	-$19,615
Sum of All Average Costs	2007	2011	2016	2021	2026	2031	2036
All Cancers	-$10,124	-$52,805	-$106,189	-$159,918	-$214,531	-$269,951	-$324,740
Breast	-$1,030	-$5,521	-$11,402	-$17,741	-$24,604	-$32,048	-$39,988
Colorectal	-$1,238	-$6,446	-$12,808	-$18,991	-$25,060	-$31,020	-$36,747
Lung	-$859	-$4,276	-$8,104	-$11,493	-$14,463	-$17,046	-$19,334
Melanoma	-$1,535	-$7,767	-$14,786	-$21,218	-$27,373	-$33,405	-$39,225
Prostate	-$2,619	-$13,587	-$27,016	-$40,168	-$52,841	-$65,183	-$76,849

2006 present value is the estimated value in the year specified as viewed by a person living in 2006 after adjusting for the interest rate value of money as derived from a NSW Govt. zero coupon bond curve. Cumulative costs in 2006 present value terms represent the sum of the specified costs over a period of time in 2006 dollar terms. The result is equivalent to the amount of money that would have to be invested in 2006 in order to fund the specified impacts or costs over a period of time. Total health care expenditure is the sum of Hospital Admitted Patients, Out-of-hospital Medical Services, Pharmaceuticals Requiring Prescription and Other Professional Services. Not included are Research Costs, Over-the-Counter Drugs. Wages are defined as compensation of employees based upon Australian Bureau of Statistics Series 5220.0 Table 24. Total Factor Income by Industry and Principal Components, New South Wales - Current prices Corporate profits are defined as gross operating surplus based upon Australian Bureau of Statistics Series 5220.0 Table 24. Total Factor Income by Industry and Principal Components, New South Wales - Current prices Taxation Revenue is defined as a net compulsory levy imposed by a government based upon Australian Bureau of Statistics Series 5506.0 Taxation Revenue, 2004-2005, Commonwealth and State Governments. The sum of each economic cost sums health care, wage, corporate profit and taxation revenue. This measure provides an approximate indication of the total indirect cost of a cancer to the economy. Caution should be used in the precise interpretation of the sum as there will be double counting involved (eg. taxation revenue and wages/corporate profit).

Figure 26 NSW Economic Cost of Cancer, Nominal Values (2003–2036)[xiii]

Key Economic Cost Dissections for specified year ($ billions). All cancers, five-year intervals.



A Nominal Value is the estimated value in the year specified. Total health care expenditure is the sum of Hospital Admitted Patients, Out-of-pocket Medical Services, Pharmaceuticals Requiring Prescription and Other Professional Services. Not included are research Costs, Over-the-counter Drugs. Wages are defined as compensation of employees based upon ABS Series 5220.0 Table 24 Factor Income by Industry and Principal Components, NSW current prices. Corporate Profits are defined as gross operating surplus based upon ABS Series 5220.0 Table 24 Factor Income by Industry and Principal Components, NSW current prices. Taxation Revenue is defined as a net compulsory levy imposed by a government based upon ABS Series 5506.0 Taxation Revenue, 2004–2005, Commonwealth and State Governments.

10.3 Health care costs

For the purpose of this report, the total health care costs of cancer in NSW included the following components:

- costs associated with admitted cancer patients
- out-of-hospital medical costs associated with cancer treatment
- costs of cancer pharmaceuticals requiring prescription
- other cancer-related health costs.

The constraints on modelling health care cost expectations were largely imposed by the quality and quantity of historical data. Therefore, the focus of this report is on the total input health costs to the extent provided by the data.

The total health care costs of cancer in NSW between 2006 and 2036 were simulated using past national data on health costs (**Figure 27**). All components of the health care cost are expected to increase with admitted patients contributing to majority of the cost. The cost for admitted patients is projected to increase over the simulation period.

xiii. This graph shows data in nominal values. The data conversion to present values will reduce the dramatic change seen in here. However, the overall trend remains.

Cancer Health Care Costs in NSW

2007–2016 (10 Year Simulation Period)

All components of health care costs associated with cancer are expected to rise by about 8% over the next 10 years from $1.75 billion in 2007 to $1.89 billion in 2016.

The changes are expected to be as follows:

- The costs for admitted patients are expected to account for a slightly lesser share of the health care costs in 2016 (60.1%) than in 2007 (61.2%). These costs are expected to increase by 6.0% from $1.07 billion in 2007 to $1.14 billion in 2016.
- The costs for out-of-hospital medical care are expected to account for a slightly larger share of the health care costs in 2016 (7.0%) than in 2007 (6.8%). These costs are expected to increase by 11.0% from $119 million in 2007 to $132 million in 2016.
- The costs for pharmaceuticals requiring a prescription are expected to account for a slightly larger share of the health care costs in 2016 (10.5%) than in 2007 (10.2%). These costs are expected to increase by 11.0% from $178 million in 2007 to $198 million in 2016.
- Other health care costs are expected to account for a slightly larger share of the health care costs in 2016 (22.4%) than in 2007 (21.8%). These costs are expected to increase by 11.0% from $381 million in 2007 to $423 million in 2016.

2007-2036 (30 Year Simulation Period)

The total health care costs associated with cancer are expected to rise over the next 30 years by about 50% from $1.75 billion in 2007 to $2.63 billion in 2036.

The changes are expected to be as follows:

- The costs for admitted patients are expected to account for a slightly lesser share of the health care costs in 2036 (58.7%) than in 2007 (61.2%). These costs are expected to increase by 44% from $1.07 billion in 2007 to $1.54 billion in 2036.
- The costs for out-of-hospital medical care are expected to account for a larger share of the health care costs in 2036 (7.3%) than in 2007 (6.8%). These costs are expected to increase by 59.8% from $119 million in 2007 to $190 million in 2036.
- The costs for pharmaceuticals requiring prescription are expected to account for a larger share of the health care costs in 2036 (10.8%) than in 2007 (10.2%). These costs are expected to increase by 59.8% from $178 million dollars in 2007 to $285 million in 2036.
- Other health care costs are expected to account for a larger share of the health care costs in 2036 (23.2%) than in 2007 (21.8%). These costs are expected to increase by 59.8% from $381 million in 2007 to $608 million in 2036.

10.4 NSW cancer wage impact

For the purpose of this report, the net impact of cancer on NSW wages included the following components:

- Direct cancer impact on wages associated with cancer-related disability.
- Indirect cancer impact on wages associated with cancer-related disability.
- Direct cancer impact on wages associated with cancer-related deaths.
- Indirect cancer impact on wages associated with cancer-related deaths.

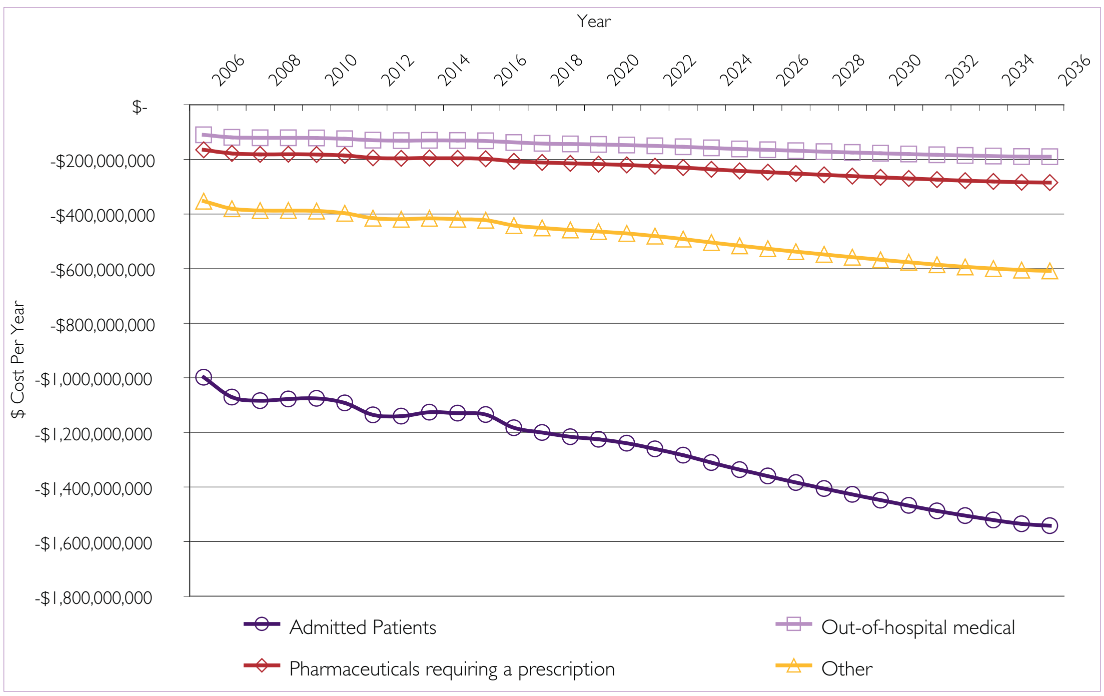
The net direct and indirect effect on wages due to cancer death and disability were simulated for the population of NSW (**Figure 28**). The effects on wages are expected to remain relatively stable over the simulation period with the largest component attributed to direct and indirect effects of disability caused by cancer. In other words, cancers with high survivals are expected to have a large influence on wages for the next 30 years.

Simulation of wage impact indicated that in NSW:

- Total wage impact of cancer was expected to have been $3.57 billion in 2007 increasing to $3.78 billion in 2016 and $3.45 billion in 2036.
- Direct impact on wages associated with cancer-related disability was expected to have been $1.04 billion in 2007 increasing to $1.13 billion in 2016 and $883 million in 2036.
- Indirect impact on wages associated with cancer-related disability was expected to be $1.59 billion in 2007, $1.70 billion in 2016 and $1.64 billion in 2036.
- Direct impact on wages associated with cancer-related deaths was expected to be $373 million in 2007, $376 million in 2016 and $327 million in 2036.
- Indirect impact on wages associated with cancer-related deaths was expected to be $573 million in 2007, $565 million in 2016 and $603 million in 2036.

Figure 27 NSW Cancer Health Costs (2006–2036)

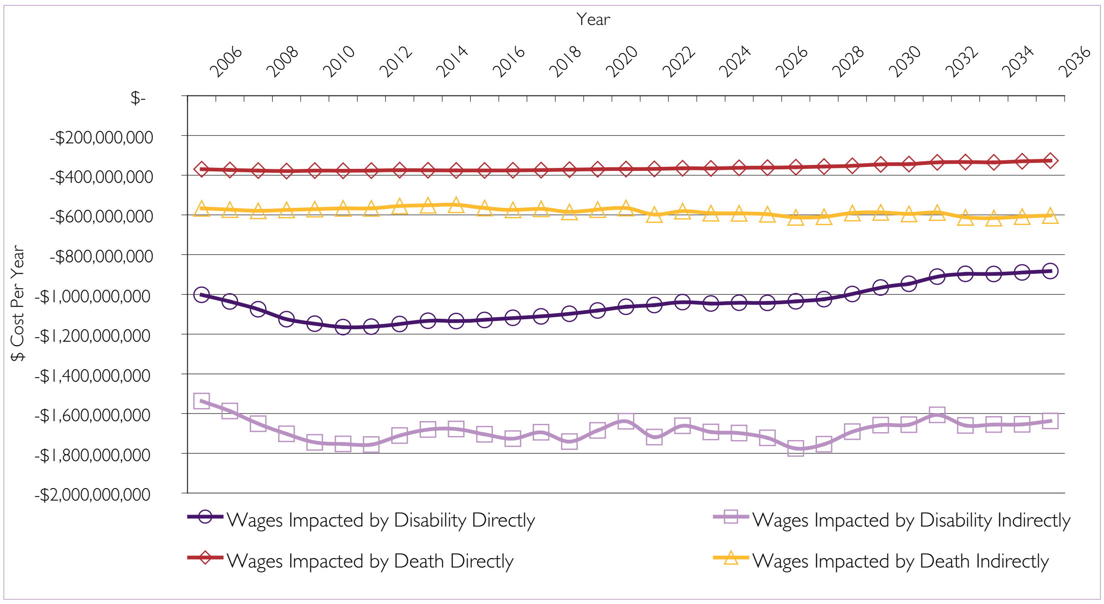
Health cost attribution, 2006 present values. All cancers. Simulated expectation.



2006 present is the estimated value in the year specified as viewed by a person living in 2006 after adjusting for the interest rate value of money as derived from a NSW Government zero coupon bond curve. The proportions of total expenditure in public acute-hospitals that relate to admitted patients. Estimated from Australian Hospital Statistics 2001–02 (AIHW 2003a). Includes private hospital expenditure data derived from ABS. Private medical services provided by both general practiioners, specialists, includes general practitioner, imageing, pathology, non referred and other medical services. Pharmaceuticals issued under the PBS and the Department of Veterans' Affairs Repatriation PBS. Pharmaceuticals that are dispensed in hospitals are included in the estimates of hospital costs. Other professional services obtained from Health Expenditure Australia 2001–02 (AIHW 2003b) and allocated to disease by adjusting 1993–94 disease figures for demographic change. Historical health cost data: AIHW Cat. No. HWE 4 (Health and Welfare Expenditure Series No. 4, 1998), AIHW Cat. No. HWE 29 (Health and Welfare Expenditure Series no. 22, 2005).

Figure 28 NSW Effects of Cancer on Wages (2006–2036)

Wage impact components, direct and indirect disability and death impacts. All cancers. Simulated expectation



2006 present is the estimated value in the year specified as viewed by a person living in 2006 after adjusting for the interest rate value of money as derived from a NSW Government zero coupon bond curve. The proportions of total expenditure in public acute-hospitals that relate to admitted patients. Estimated from Australian Hospital Statistics 2001–02 (AIHW 2003a). Includes private hospital expenditure data derived from ABS. Private medical services provided by both general practiioners, specialists, includes general practitioner, imaging, pathology, non referred and other medical services. Pharmaceuticals issued under the PBS and the Department of Veterans' Affairs Repatriation PBS. Pharmaceuticals that are dispensed in hospitals are included in the estimates of hospital costs. Other professional services obtained from Health Expenditure Australia 2001–02 (AIHW 2003b) and allocated to disease by adjusting 1993–94 disease figures for demographic change. Historical health cost data: AIHW Cat. No. HWE 4 (Health and Welfare Expenditure Series No. 4, 1998), AIHW Cat. No. HWE 29 (Health and Welfare Expenditure Series no. 22, 2005).

10.5 NSW cancer corporate profit impact

For the purpose of this study, the net corporate profit impacts of cancer in NSW included the following components:

- Direct impact on corporate profits associated with cancer-related disability.
- Indirect impact on corporate profits associated with cancer-related disability.
- Direct impact on corporate profits associated with cancer-related deaths.
- Indirect impact on corporate profits associated with cancer-related deaths.

The net direct and indirect effect of cancer on corporate profits due to cancer death and disability were simulated (**Figure 29**). Disability is expected to have the highest influence on corporate profit earnings through out the simulation period.

The simulation analysis on corporate profits indicated that in NSW:

- Net corporate profit impact of cancer was expected to be $2.53 billion in 2007, $2.62 billion in 2016 and $2.60 billion in 2036.
- Direct impact on corporate profits associated with cancer-related disability was expected to be $596 million in 2007, $668 million in 2016 and $624 million in 2036.

- Indirect impact on corporate profits associated with cancer-related disability was expected to be $908 million in 2007, $1.01 billion in 2016 and $1.16 billion in 2036.
- Direct impact on corporate profits associated with cancer-related deaths was expected to $407 million in 2007, $374 million in 2016 and $286 million in 2036.
- Indirect impact on corporate profits associated with cancer-related deaths was expected to be $622 million in 2007, $565 million in 2016 and $530 million in 2036.

10.6 NSW cancer taxation revenue impact[xiv]

For the purpose of this study, the net impact of cancer on taxation revenue income in NSW included the following components:

- Direct impact on taxation revenues associated with cancer-related disability.
- Indirect impact on taxation revenues associated with cancer-related disability.
- Direct impact on taxation revenues associated with cancer-related deaths.
- Indirect impact on taxation revenues associated with cancer-related deaths.

The net direct and indirect effect of cancer on taxation revenue due to cancer death and disability was simulated (**Figure 30**). The effect of cancer on taxation revenue is expected to continue over the next 30 years. The largest component of the effect is expected to be due to cancer-caused disability.

Simulation of taxation revenue impact indicated that in NSW:

- Net taxation revenue impact of cancer was expected to be $2.27 billion in 2007, $2.42 billion in 2016 and $2.32 billion in 2036.
- Direct impact on taxation revenues associated with cancer-related disability was expected to be $620 million in 2007, $690 million in 2016 and $583 million in 2036.
- Indirect impact on taxation revenues associated with cancer-related disability was expected to be $946 million in 2007, $1.04 billion in 2016 and $1.08 billion in 2036.
- Direct impact on taxation revenues associated with cancer-related deaths was expected to be $279 million in 2007, $274 million in 2016 and $232 million in 2036.
- Indirect impact on taxation revenues associated with cancer-related deaths was expected to be $426 million in 2007, $413 million in 2016 and $429 million in 2036.

The simulation results in this report considered the influence of lifestyle factors such as smoking, obesity, physical inactivity and excessive sun exposure on the onset of cancer. It is expected that these risk-factors will have a major influence on risk of many but not all cancers. However, the influence of population dynamics is expected to have the main influence with an ageing population in NSW responsible for the highest risk of developing cancer.

The future number of new cancer cases and its consequences is expected to have a large impact on the economy of NSW. It is predicted that the economy will face a ‘double dipping' impact which will place further pressure on the publicly funded health care system as taxation revenues from cancer patients reduce. The pressure is also expected to influence the privately funded health care system and the economy as wages and corporate profits are projected to reduce.

The simulations shown here only explore the future dynamics based on past trends and any changes which affect the way we prevent or manage cancer will influence the future trends.

xiv. Taxation revenue includes revenue from income and corporate income tax.

Figure 29 NSW Cancer Corporate Profit Impact (2006–2036)

Corporate profit impact components, 2006 present values. All cancers. Simulated expectation.

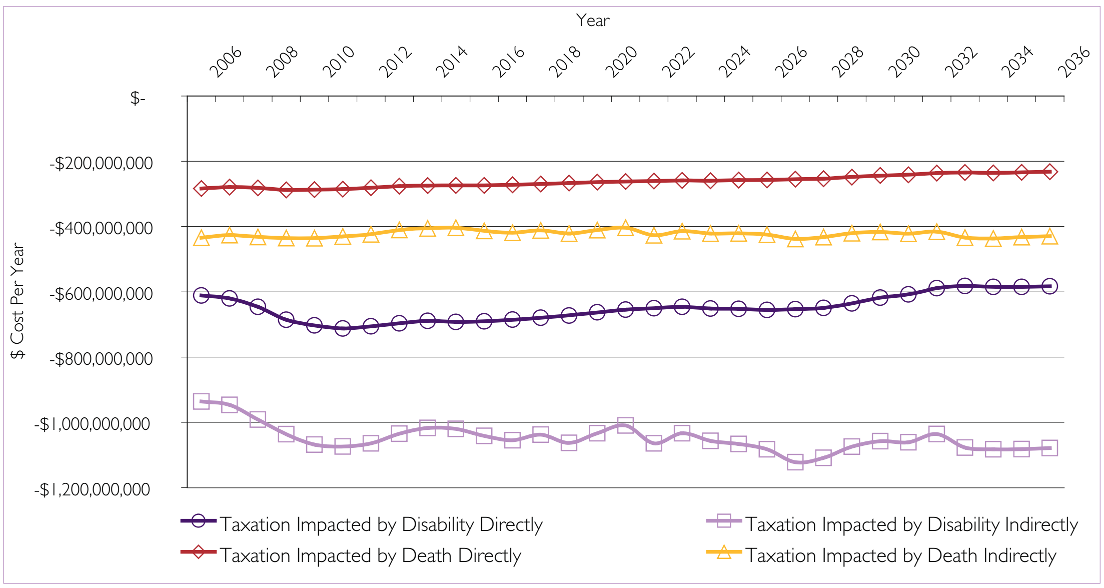
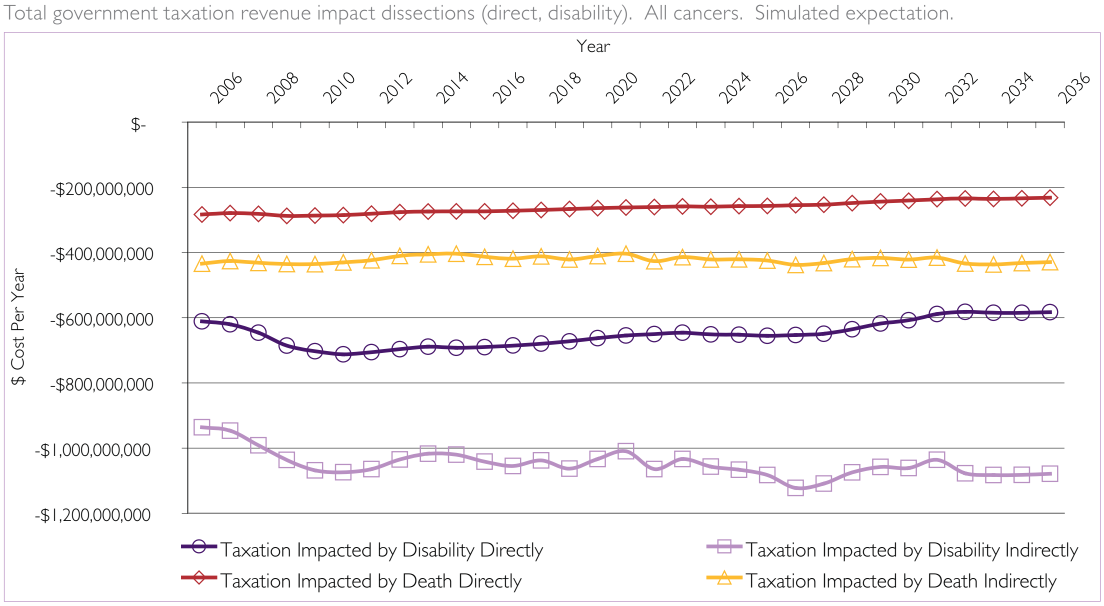


Figure 30 NSW Cancers, Taxation Revenue Impact (2006–2036)

Total government taxation revenue impact dissections (direct, disability). All cancers. Simulated expectation.



2006 present is the estimated value in the year specified as viewed by a person living in 2006 after adjusting for the interest rate value of money as derived from a NSW Government zero coupon bond curve. Corporate profits are defined as gross operating surplus based on ABS Series 5220.0 Table 24. Total Factor Income by Industry and Principal Components, NSW – current prices. Taxation Revenue is defined as a net compulsory levy imposed by a government based on ABS Series 5506.0 Taxation Revenue, 2004–05, Commonwealth and State Governments. Total impact is the sum of all impacts related to the cancer assessed for the economic variable considered. Incudes: direct and indiect impacts from diability and death from the cancer assessed. A direct impact is defined as an immediate consequence of the health effect of the cancer assessed. An indirect impact is defined as a follow on consequence of the health effect of the cancer assessed. Impact from Disability is defined as the net opportunity-cost of the reduced ability of a person with cancer to perform duties that otherwise were performed before the affliction of cancer. Impact from Death is defined as the net opportunity-cost of a person who had died from the cancer assessed.

11. Cancer in New South Wales – Summary

> The total number of people diagnosed with cancer in New South Wales will increase by about 30 per cent over the next 10 years.

11.1 Incidence

2007–2016 (10-Year Simulation Period)

It is predicted that in 2016 the number of people diagnosed with cancer will represent a 23.5% increase (24.9% increase for males and 21.9% increase for females) from what was expected in 2007.

The total number of people diagnosed with cancer in the 10-year period from 2007 to 2016 will be about 31.7% (30.4% increase for males and 33.2% increase for females) higher than what was observed in the previous 10 years (1997–2006).

It is estimated that about 412,000 may be diagnosed with cancer in the 10-year period between 2007–2016. Of these, approximately 222,450 will be males (54% of cumulative total 10-year incidence) and 189,550 will be females (46% of cumulative total 10-year incidence).

2007–2036 (30 Year Simulation Period)

It is predicted that in 2036 the number of people diagnosed with cancer will represent a 70.0% increase (66.6% increase for males and 74.1% increase for females) from what was expected in 2007.

The total number of people diagnosed with cancer in the 30-year period from 2007 to 2036 will be 107.8% (105.9% increase for males and a 109.8% increase for females) higher than what was observed in the previous 30 years (1977–2006).

It is predicted that over 1.48 million may be diagnosed with cancer in the 30-year period between 2007 to 2036. Of these approximately 800,590 will be males (54% of cumulative total 30-year incidence) and 682,930 will be females (46% of cumulative total 30-year incidence).

11.2. Mortality

2007–2016 (10 Year Simulation Period)

It is predicted that in 2016 the deaths due to cancer will represent a 15.5% increase (16.4% increase for males and a 14.3% increase for females) from what was expected in 2007.

The 10-year (2007–2016) cumulative number of deaths represent a 16.2% increase in the number of deaths (14.5% increase for males and an 18.3% increase for females) from the previous 10 years (1997–2006).

The total number of NSW residents expected to prematurely die from cancer from 2007 through to 2016 is predicted at about 145,700 (cumulative) of which approximately 80,780 will be males (55.5% of cumulative total 10-year mortality) and 64,890 will be females (44.5% of cumulative total 10-year mortality).

2007–2036 (30 Year Simulation Period)

It is predicted that in 2036 the deaths due to cancer will represent a 46.5% increase (46.5% increase for males and a 46.5% increase for females) from what was expected in 2007.

The 30-year (2007–2036) cumulative number of deaths represent a 52.8% increase (50.1% increase for males and a 56.4% increase for females) from the previous 30 years (1977–2006).

The total number of NSW residents expected to prematurely die from cancer from 2007 through to 2036 is predicted at about 497,120 (cumulative) of which approximately 276,470 will be males (55.5%) and 220,650 will be females (44.5%).

11.3. Prevalence

2007–2016 (10 Year Simulation Period)

The total number of NSW residents expected to be living with cancer in 2016 is predicted to be about 379,820 of which approximately 186,780 will be males (49.2% of total prevalence) and 193,040 will be females (50.8% of total prevalence). The total prevalence for 2016 represents a 44.5% increase (47.0% increase for males and a 42.1% increase for females) from what was expected in 2007.

2007–2036 (30 Year Simulation Period)

The total number of NSW residents expected to be living with cancer in 2036 is predicted to be about 694,640 of which approximately 353,340 will be males (51% of total prevalence) and 341,300 will be females (49% of total prevalence). The annual total prevalence for 2036 represent a 164.2% increase (178.1% increase for males and a 151.3% increase for females) from what was expected in 2007.

11.4. Labour Force

2007–2016 (10 Year Simulation Period)

It is predicted that in 2016 the number of labour force with cancer will be 22.2% higher (16.9% increase for males and a 29.2% increase for females) than what was expected in 2007.

The total number of NSW labour force members expected to be diagnosed with cancer from 2007 through to 2016 is predicted to be approximately 116,952 (cumulative) of which approximately 65,626 will be males (56.1%) and 51,326 will be females (43.9%). This represents a 23.0% increase (15.8% increase for males and a 32.9% increase for females) from the previous 10 years (1997–2006).

Selected cancers 2007–2016[xv]

<u>Breast cancer</u>: 19,413 (cumulative) NSW members of the labour force are expected to be diagnosed with breast cancer. The 10-year cumulative number of new cases (2007–2016) represent a 39% increase from the previous 10 years (1997–2006)

<u>Prostate cancer</u>: 16,793 (cumulative) NSW members of the labour force are expected to be diagnosed with prostate cancer. The 10-year cumulative number of new cases (2007–2016) represent a 52.5% increase from the previous 10 years (1997–2006).

<u>Melanoma</u>: 16,467 (cumulative) NSW members of the labour force are expected to be diagnosed with melanoma. The 10-year cumulative number of new cases (2007–2016) represent a 25% increase from the previous 10 years (1997–2006).

<u>Colorectal cancer</u>: 13,946 (cumulative) NSW members of the labour force are expected to be diagnosed with colorectal cancer. The 10-year cumulative number of new cases (2007–2016) represent a 28% increase from the previous 10 years (1997–2006).

<u>Lung cancer</u>: 7,323 (cumulative) NSW members of the labour force are expected to be diagnosed with lung cancer. The 10-year cumulative number of new cases (2007–2016) represent an 11% increase from the previous 10 years (1997–2006).

2007–2036 (30 Year Simulation Period)

It is predicted that in 2036 the number of labour force with cancer will be 42.3% higher (26.6% increase for males and a 63.5% increase for females) than what was expected in 2007.

The total number of NSW labour force members expected to be diagnosed with cancer from 2007 through to 2036 is predicted at 400,282 (cumulative) of which approximately 215,192 will be males (53.8%) and 185,091 will be females (46.2%). This represents an 89.5% increase (62.4% increase for males and 135.0% increase for females) from the previous 30 years (1977–2006).

xv. Due to data limitations, the selected cancer results have been simulated without taking into account co-morbidity (i.e. a cancer patient having more than one cancer type). This means that the individual results cannot be added together to achieve a total result for the selected cancer group. However, the results do show the relative comparison between the consequences of each selected cancer.

Selected cancers 2007–2036[xvi]

Breast cancer: 77,605 (cumulative) NSW members of the labour force are expected to be diagnosed with breast cancer. The 30-year cumulative number of new cases (2007–2036) represent a 179.5% increase from the previous 30 years (1977–2006).

Prostate cancer: 65,772 (cumulative) NSW members of the labour force are expected to be diagnosed with prostate cancer. The 30-year cumulative number of new cases (2007–2036) represent a 252.2% increase from the previous 30 years (1977–2006).

Melanoma: 58,104 (cumulative) NSW members of the labour force are expected to be diagnosed with melanoma. The 30-year cumulative number of new cases (2007–2036) represent a 94.1% increase from the previous 30 years (1977–2006).

Colorectal cancer: 47,385 (cumulative) NSW members of the labour force are expected to be diagnosed with colorectal cancer. The 30-year cumulative number of new cases (2007–2036) represent an 82.3% increase from the previous 30 years (1977–2006).

Lung cancer: 22,625 (cumulative) NSW members of the labour force are expected to be diagnosed with lung cancer. The 30-year cumulative number of new cases (2007–2036) represent a 13.5% increase from the previous 30 years (1977–2006).

11.5. Total Economic Impact of Cancer in NSW

2007–2016 (10 Year Simulation Period)

Over the 10 years from 2007 to 2016, the cumulative total cost of cancer in NSW is estimated to be $106 billion. The total economic costs associated with cancer are expected to rise over the next 10 years by about 6.5% from $10.1 billion in 2007 to $10.7 billion in 2016. While the largest increase is expected to occur in respect to direct health care costs, all of the considered categories of the economic costs are projected to increase.

The 10-year changes are expected to be as follows:

- Direct health care costs are expected to account for a larger share of the economic costs in 2016 (17.6%) than in 2007 (17.3%). These costs are expected to increase by 7.9% from $1.8 billion in 2007 to $1.9 billion in 2016. Cumulatively over the next 10 years, cancer is expected to directly impact health care in excess of $18.2 billion.
- The wage impacts are expected to account for the same share of the economic costs in 2016 and in 2007 (35.3%). Actual wage impacts are expected to increase by 5.7% from $3.6 billion in 2007 to $3.8 billion in 2016. Cumulatively over the next 10 years, cancer is expected to negatively impact wages in excess of $37.6 billion.
- The corporate profit impacts are expected to account for a lesser share of the economic costs in 2016 (24.5%) than in 2007 (25%). Corporate profit impacts are expected to increase by 3.3% from $2.5 billion in 2007 to $2.6 billion in 2016. Cumulatively over the next 10 years, cancer is expected to negatively impact corporate profits in excess of $26.1 billion.
- The taxation revenue impacts are expected to account for a larger share of the economic costs in 2016 (22.6%) than in 2007 (22.4%). Taxation revenue impacts are expected to increase by 6.5% from $2.3 billion in 2007 to $2.4 billion in 2016. Cumulatively over the next 10 years, cancer is expected to negatively impact taxation revenue in excess of $24.1 billion.

2007–2036 (30 Year Simulation Period)

The total cumulative cost of cancer over the 30-year period for 2007 to 2036 is estimated to be about $325 billion. The total economic costs associated with cancer are expected to rise over the next 30 years by about 9% from $10.1 billion in 2007 to $11 billion in 2036. The largest increase is expected to occur in respect to health care costs with corporate profit impacts also expected to rise. On the other hand, wage impacts and taxation revenue impacts are projected to decline.

xvi. Due to data limitations, the selected cancer results have been simulated without taking into account co morbidity (i.e. a cancer patient having more than one cancer type). This means that the individual results cannot be added together to achieve a total result for the selected cancer group. However, the results do show the relative comparison between the consequences of each selected cancer.

The 30-year changes are expected to be as follows:

- The health care costs are expected to account for a larger share of the economic costs in 2036 (23.9%) than in 2007 (17.3%). These costs are expected to increase by 50.1% from $1.8 billion in 2007 to $3.6 billion in 2036. Cumulatively over the next 30 years, cancer is expected to directly impact health care in excess of $64.4 billion.
- The wage impacts are expected to account for a lesser share of the economic costs in 2036 (31.4%) than in 2007 (35.3%). Wage impacts are expected to decrease by 3% from $3.6 billion in 2007 to $3.5 billion in 2036. Cumulatively over the next 30 years, cancer is expected to negatively impact wages in excess of $110 billion.
- The corporate profit impacts are expected to account for a lesser share of the economic costs in 2036 (23.6%) than in 2007 (25%). Corporate profit impacts are expected to increase by 4% from $2.5 billion in 2006 to 2.6 billion in 2036. Cumulatively over the next 30 years, cancer is expected to negatively impact corporate profits in excess of $78.2 billion.
- The taxation revenue impacts are expected to account for a lesser share of the economic costs in 2036 (21.1%) than in 2007 (22.4%). Taxation revenue impacts are expected to decrease by 2.3% from $2.27 billion in 2007 to $2.32 billion in 2016. Cumulatively over the next 30 years, cancer is expected to negatively impact the taxation generating capacity of the NSW economy in excess of $71.6 billion.

The following sections review top five cancers in NSW. Due to data limitations, the selected cancer results have been simulated without taking into account co-morbidity (i.e. a cancer patient having more than one cancer type). This means that the individual results cannot be added together to achieve a total result for the selected cancer group. However, the results do show the relative comparison between the consequences of each selected cancer.

12. Prostate Cancer

- Prostate cancer numbers will continue to rise in NSW and because survival is high, prevalence will also increase.
- Disability due to prostate cancer will continue to increase as the major contributor to burden of disease in prostate cancer.
- Prostate cancer is estimated to cost the New South Wales economy about $27 billion in the next 10 years and $77 billion in the next 30 years.

12.1 Prostate cancer – new cases

Historical incidence of prostate cancer between 1972 and 2003 were obtained from NSW CCR and incidence from 2004 through to 2036 was simulated (**Figure 31**). Historic trends as well as prevalence of physical inactivity and population age structure were used to assist in the simulation of prostate cancer incidence, mortality and subsequent economic costs. Age breakdown of historical and simulated prostate cancer incidence in the NSW population was further projected (**Figure 32**).

The number of new prostate cancer cases in NSW is predicted to increase throughout the simulation period. The primary driver of new prostate cancer cases is an increase in population aged 50 years and over.

12.2 Prostate cancer – deaths

Historical prostate cancer mortality between 1972 and 2003 were obtained from GRIM Books 2003 and mortality from 2004 through to 2036 was simulated (**Figure 33**). Age breakdown of historical and simulated prostate cancer mortality in the NSW population were further projected (**Figure 34**).

The number of deaths due to prostate cancer in NSW is expected to increase until 2033. The primary driver of prostate cancer mortality is the increase in population aged 50 years and over.

Historical incidence and mortality between 1972 and 2003 and simulated incidence and mortality from 2004 through to 2036 for prostate cancer was analysed (**Figure 35**). The number of new cases and deaths are predicted to increase throughout the simulation period. The number of new cases is expected to be increasing at a substantially higher rate than the mortality, suggesting that the number of people in NSW living with prostate cancer (prevalence) will increase in the future.

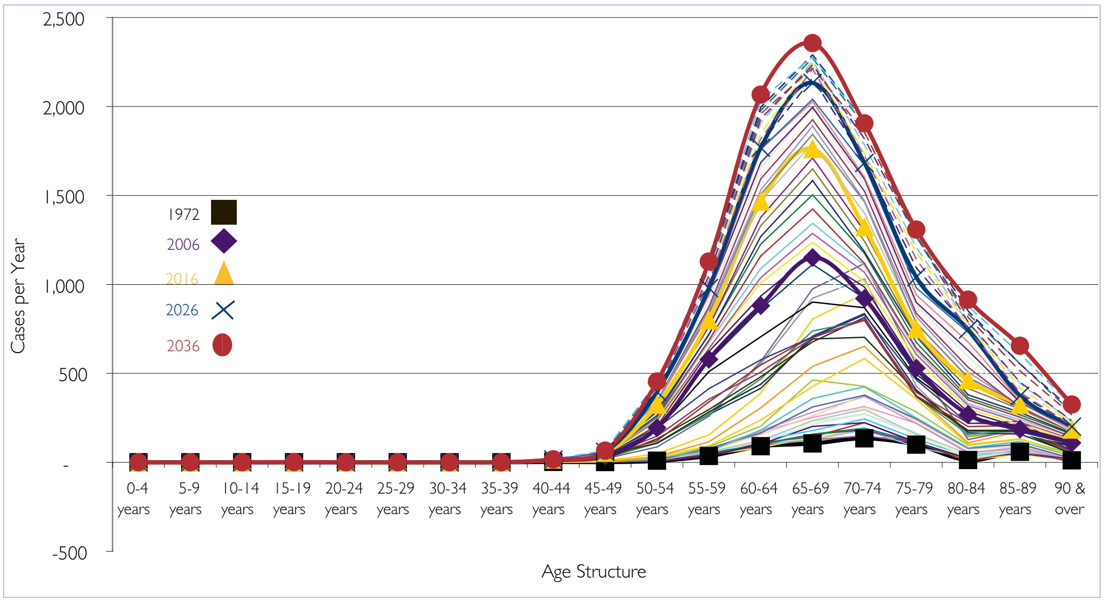
Figure 31 NSW New Prostate Cancer Cases (1972–2036)

Total population, males, all ages. Simulated expectation.

Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 32 NSW New Prostate Cancer Cases, Population Age Distribution (1972–2036)

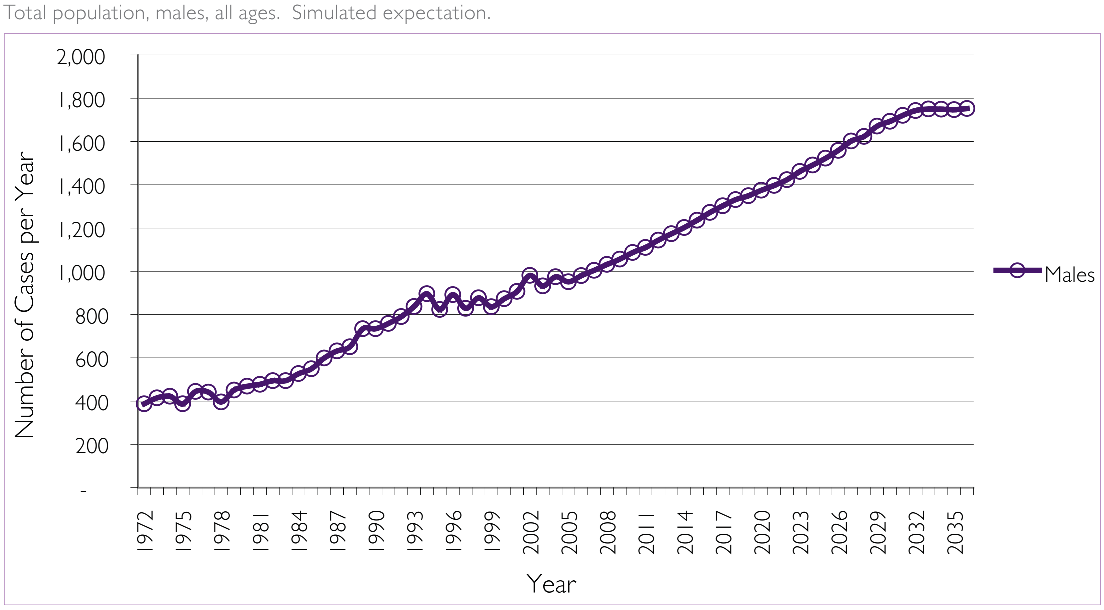
Simulated expected age structure of New South Wales males.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 33 NSW Prostate Cancer Deaths (1972–2036)

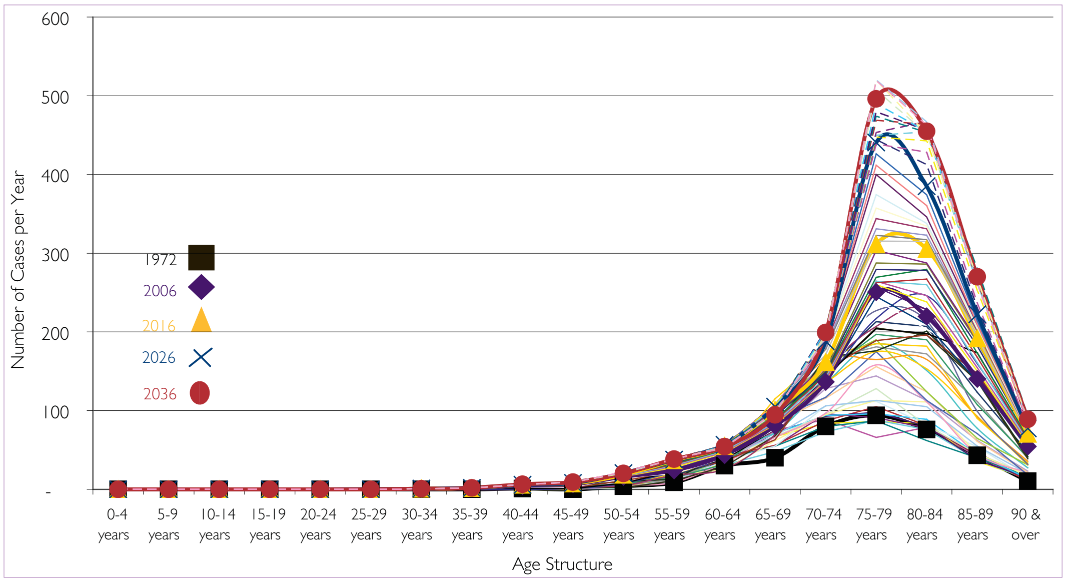
Total population, males, all ages. Simulated expectation.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 34 NSW Prostate Cancer Deaths, Population Age Distribution (1972–2036)

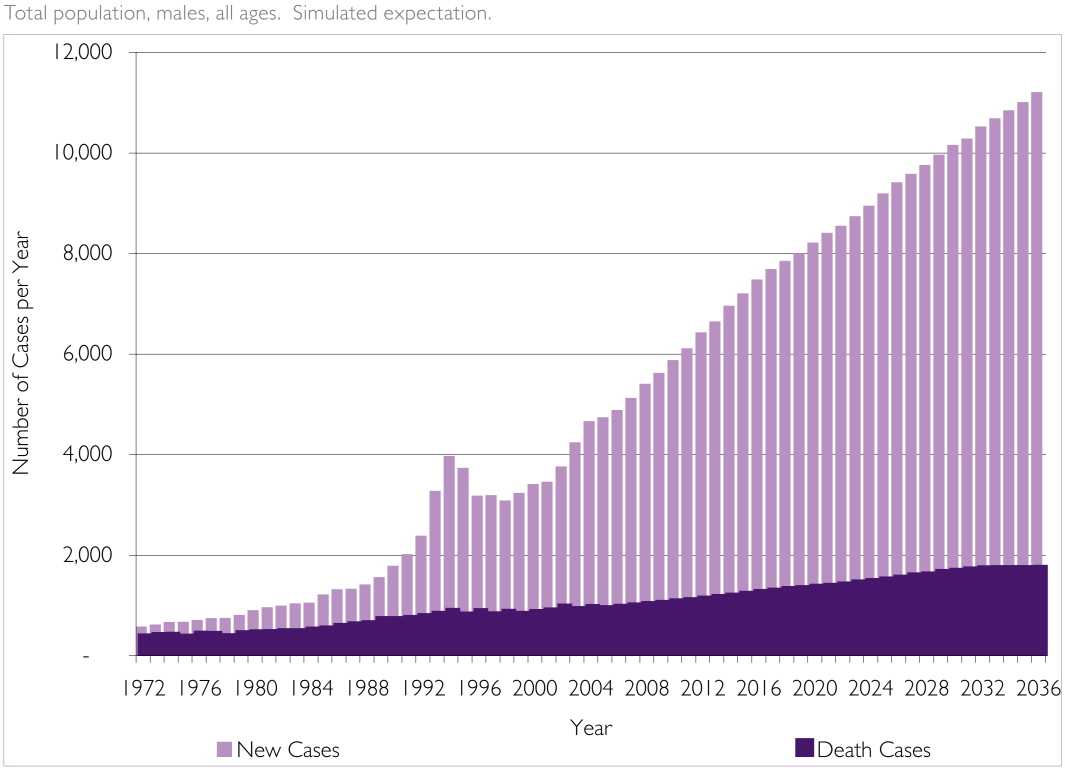
Simulated expected age structure of New South Wales, males.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 35 NSW New Prostate Cancer Cases and Deaths (1972–2036)

Total population, males, all ages. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

12.3 Prostate cancer – prevalence

Historical prostate cancer prevalence between 1972 and 2003 was calculated as a function of annual incidence as well as the number of deaths at the end of a given year; and prevalence from 2004 through to 2036 was simulated (**Figure 36**). Age breakdown of historical and simulated prostate cancer prevalence in the NSW population were further projected (**Figure 37**).

Prostate cancer prevalence in NSW is expected to increase throughout the simulation period.

12.4 Prostate cancer – DALYs

Prostate cancer burden in NSW measured in DALYs for all age groups and both genders between 2003 and 2036 was simulated (**Figure 38**).

Burden of disease due to prostate cancer in NSW is expected to rise through out the simulation period with disability the major contributor to the predicted burden.

The simulation results indicated that in NSW (**Table 8**):

YLLs:

- Between 2006 and 2016, the average growth rate is estimated to be 2.78% per annum.
- Between 2017 and 2036, the average growth rate is estimated to be 1.27% per annum.

YLDs:

- Between 2006 and 2016, the average growth rate is estimated to be 5.33% per annum.
- Between 2017 and 2036, the average growth rates will be 4.55% per annum.

DALYs:

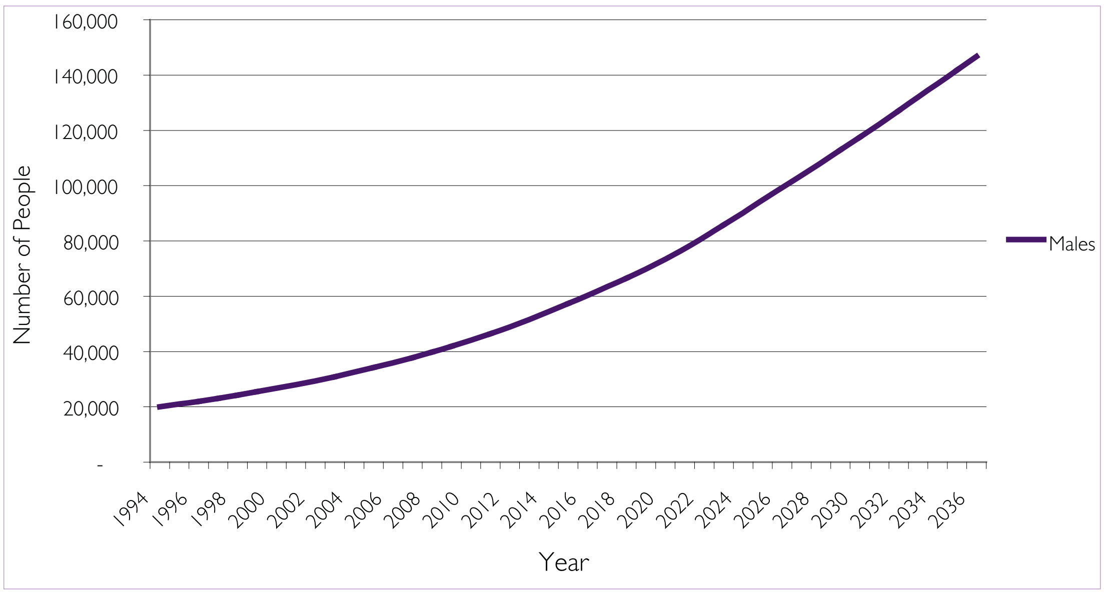
- Between 2006 and 2016, the average growth rate is estimated to be 4.61% per annum.
- Between 2017 and 2036, the average growth rate is estimated to be 3.89% per annum.

Table 8 Burden of Disease caused by Prostate Cancer

	Year	Number
YLL		
	2007	10,975
	2016	13,866
	2036	17,837
YLD		
	2007	25,501
	2016	40,759
	2036	99,213
DALY		
	2007	36,476
	2016	54,625
	2036	117,050

Figure 36 NSW Prostate Cancer Prevalence (1994–2036)

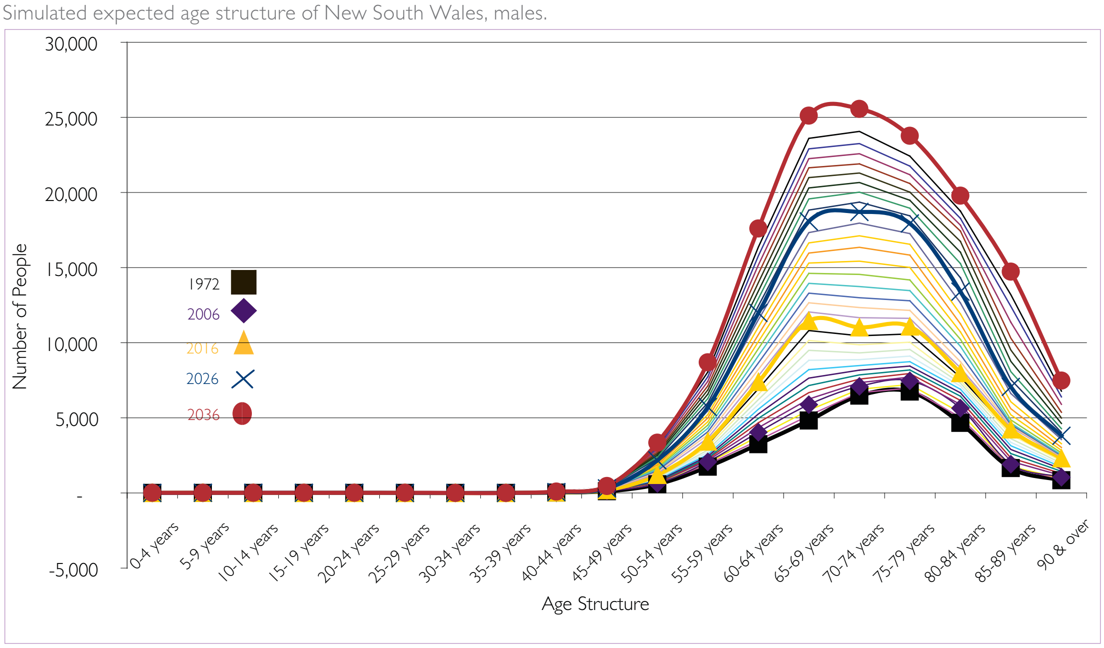
Total population, males, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 37 NSW Prostate Cancer Prevalence, Population Age Distribution (2003–2036)

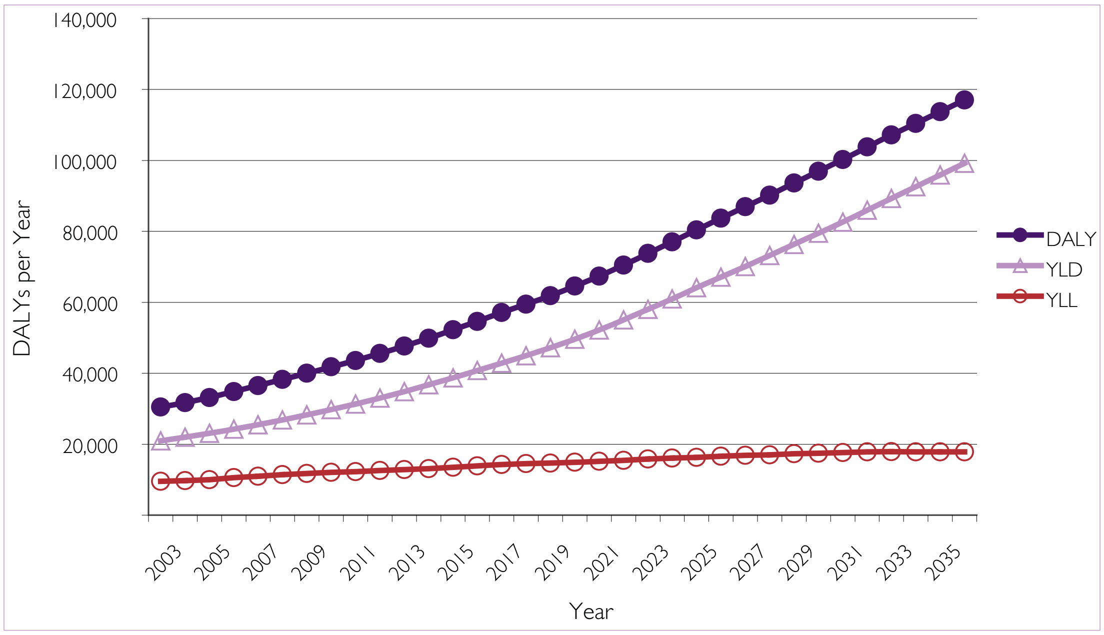
Simulated expected age structure of New South Wales, males.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 38 NSW Prostate Cancer DALYs (2006–2036)

Total population, males, all age groups.



Disability data: Colin Mathers, Chris Stevenson, Simon Eckermann (1999) AIHW, Disability Coefficients for different cancer types; and Males JM, Essink-Bot, Kramers PG, et al: A national burden of disease calculation: Dutch disability-adjusted life-years. American Journal of Public Health 90(8): 121-1247, 2000.

12.5 Prostate cancer in NSW – Summary

Prostate Cancer Incidence

2007–2016 (10-year simulation period)

The number of new cases diagnosed in 2016 represent a 46.1% increase from what was expected in 2007. The total number of NSW residents expected to be diagnosed with prostate cancer from 2007 through to 2016 is about 62,707 (cumulative). These cumulative number of new cases represent a 62.8% increase from the previous 10 years (1997–2006).

2007–2036 (30-year simulation period)

The incidence counts for 2036 represent a 119.2% increase from what was expected in 2007. The total number of NSW residents expected to be diagnosed with prostate cancer from 2007 through to 2036 is 251,437 (cumulative). These cumulative number of new cases represent a 246.0% increase from the previous 30 years (1977–2006).

Prostate Cancer Mortality

2007–2016 (10-year simulation period)

The number of deaths in 2016 represent a 26.7% increase from what was expected in 2007. The total number of NSW residents expected to prematurely die from prostate cancer from 2007 through to 2016 is about 11,318 (cumulative). These cumulative number of deaths represent a 23.8% increase from the previous 10 years (1997–2006).

2007–2036 (30-year simulation period)

The number of deaths in 2036 represent a 74.5% increase from what was expected in 2007. The total number of NSW residents expected to prematurely die from prostate cancer from 2007 through to 2036 is about 42,580 (cumulative). These cumulative number of deaths represent a 95.4% increase from the previous 30 years (1977–2006).

Prostate Cancer Prevalence

2007–2016 (10-year simulation period)

The total number of NSW residents expected to be living with prostate cancer in 2016 is estimated to be about 60,300 which is about 59.7% higher than estimations for 2007.

2007–2036 (30-year simulation period)

The total number of NSW residents expected to be living with prostate cancer in 2036 is about 146,700 which is about 288.2% higher than estimations for 2007.

12.6 Total economic cost of prostate cancer

2006–2016 (10-year simulation):

Prostate cancer is estimated to cost the economy a total of about $27 billion in the next 10 years:

- Health cost impacts amount to over $1.5 billion.
- Net wage impacts amount to over $11.8 billion.
- Net corporate profit impacts amount to over $6.6 million.
- Net taxation revenue impacts amount to over $7.1 billion.

2006–2036 (30-year simulation):

Prostate cancer is estimated to cost the economy a total of about $77 billion in the next 30 years:

- Health cost impacts amount to over $6.49 billion.
- Net wage impacts amount to over $31.9 billion.
- Net corporate profit impacts amount to over $18.9 billion.
- Net taxation revenue impacts amount to over $19.6 billion.

13. Breast Cancer

- Breast cancer numbers will continue to rise in New South Wales and because survival is high, prevalence will increase.
- Disability due to breast cancer will continue to increase as the main contributor to burden of disease in breast cancer.
- Breast cancer is estimated to cost the New South Wales economy more than $11 billion in the next 10 years and about $40 billion in the next 30 years.

13.1 Breast cancer – new cases

Historical incidence of breast cancer between 1972 and 2003 were obtained from NSW CCR and incidence from 2004 through to 2036 were simulated (**Figure 39**). Historic trends as well as prevalence of physical inactivity and population age structure were used for simulation of breast cancer incidence, mortality and subsequent economic costs. Age breakdown of historical and simulated breast cancer incidence in the NSW population were further projected (**Figure 40**).

The number of new breast cancer cases in NSW will increase throughout the simulation period. The primary driver of new breast cancer cases is an increase in population aged 50 years and over.

13.2 Breast cancer – deaths

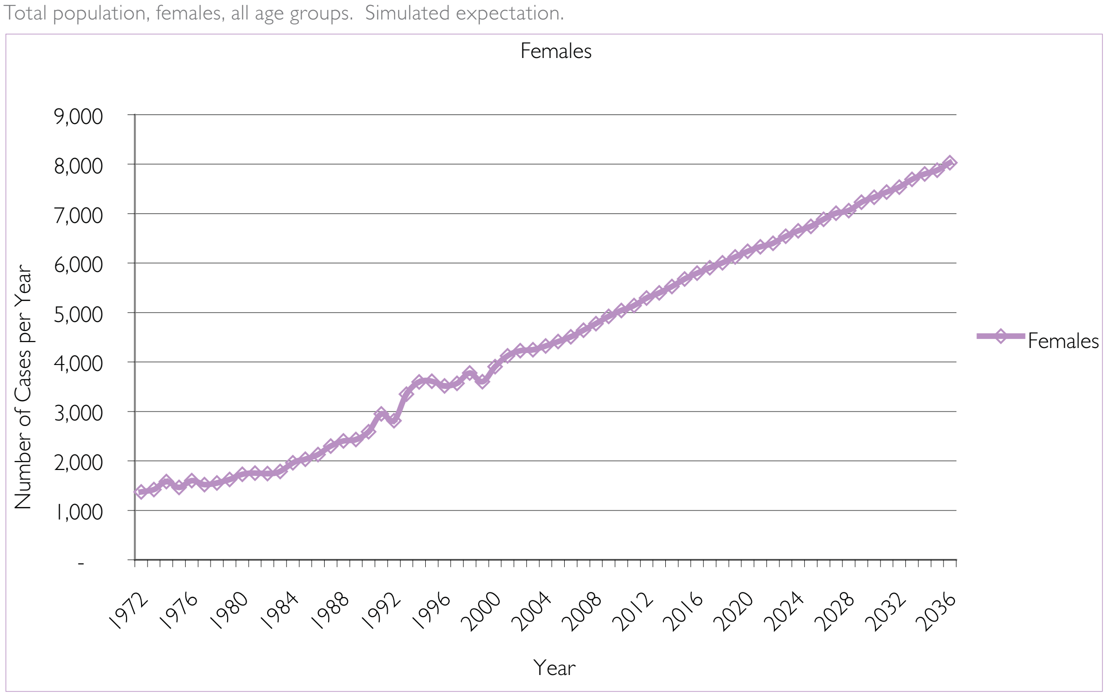
Historical breast cancer mortality between 1972 and 2003 were obtained from GRIM Books 2003 and mortality from 2004 through to 2036 was simulated (**Figure 41**). Age breakdown of historical and simulated breast cancer mortality in the NSW population were further projected (**Figure 42**).

The number of deaths due to breast cancer in NSW is predicted to rise through out the simulation period. The primary driver of breast cancer mortality in NSW is an increase in population aged 50 years and over.

Historical incidence and mortality between 1972 and 2003 and simulated incidence and mortality from 2004 through to 2036 for breast cancer in NSW were compared (**Figure 43**). Breast cancer numbers and number of deaths attributed to breast cancer are expected to increase throughout the simulation period. The of new cases is expected to increase at a substantially higher rate than deaths, suggesting that the number of people in NSW living with breast cancer (prevalence) will increase in the future.

Figure 39 NSW New Breast Cancer Cases (1972–2036)

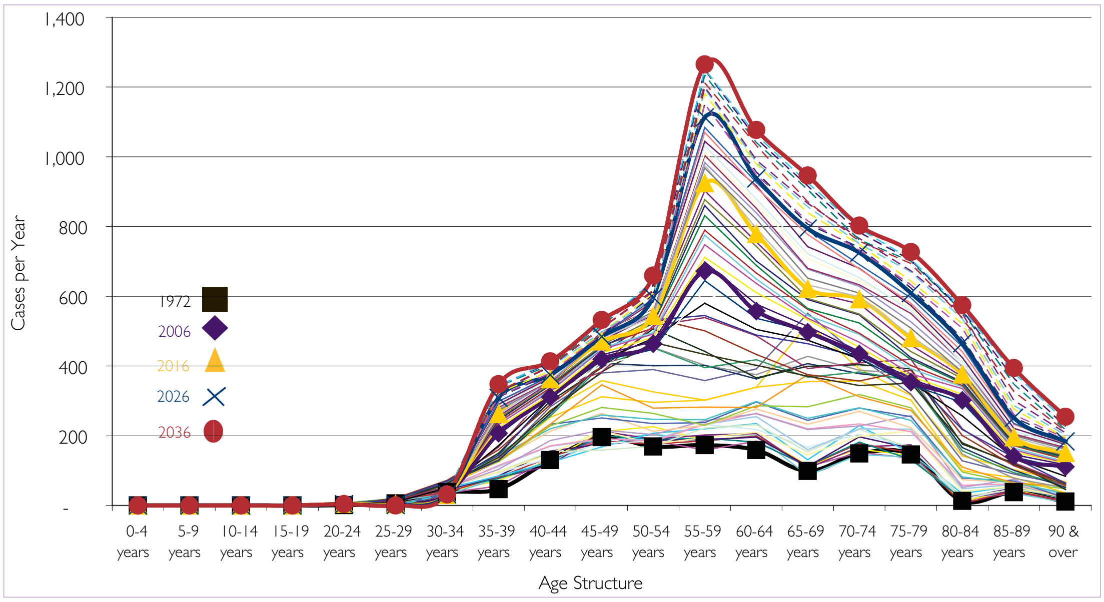
Total population, females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 40 NSW New Breast Cancers, Population Age Distribution (1972–2036)

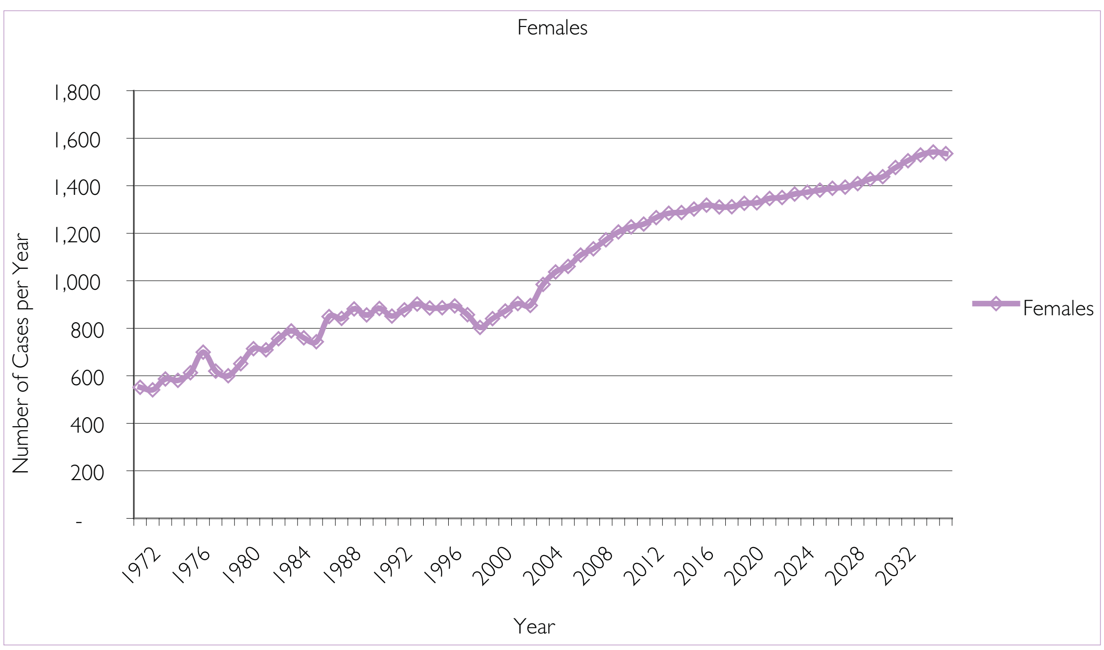
Simulated expected age structure of New South Wales, females.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 41 NSW Breast Cancer Deaths (1972–2036)

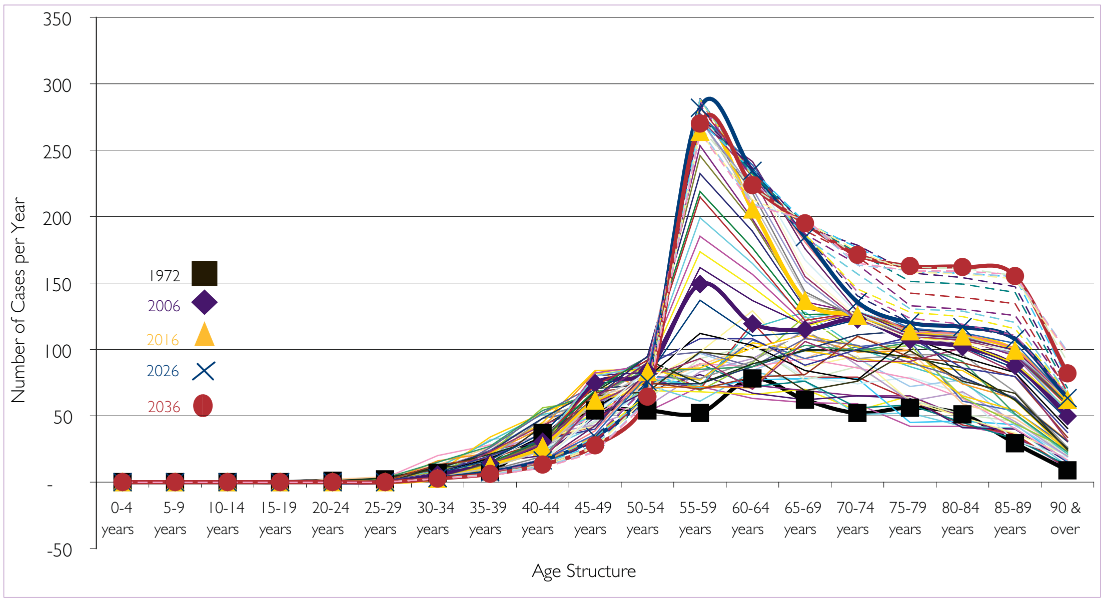
Total population, females, all age groups. Simulated expectation.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 42 NSW Breast Cancer Deaths, Population Age Distribution (1972–2036)

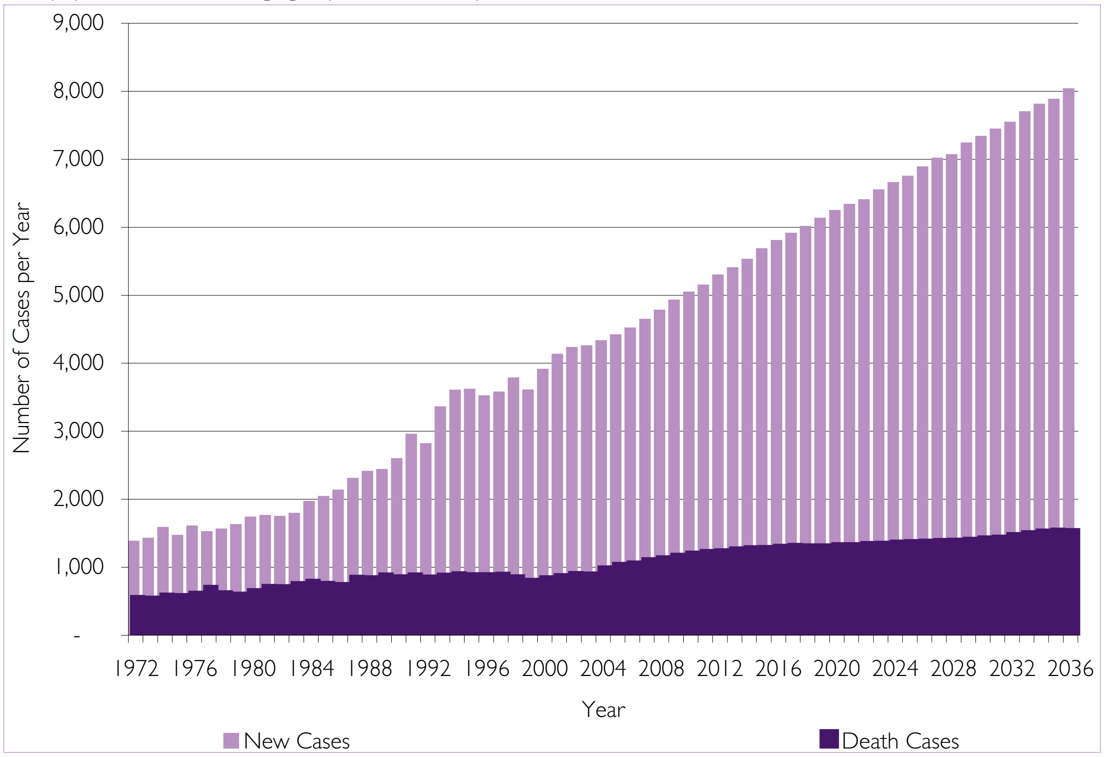
Simulated expected age structure of New South Wales, females.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 43 NSW New Breast Cancer Cases and Deaths (1972–2036)

Total population, females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

13.3 Breast cancer – prevalence

Historical breast cancer prevalence between 1994 and 2003 was calculated as a function of incidence as well as the number of deaths at the end of a given year, and prevalence from 2004 through to 2036 was projected (**Figure 44**). Age breakdown of historical and simulated breast cancer prevalence in the NSW population were further projected (**Figure 45**).

Breast cancer prevalence in NSW is predicted to increase throughout the simulation period.

13.4 Breast cancer – DALYs

Breast cancer burden in NSW measured in DALYs for all age groups between 2003 and 2036 were simulated (**Figure 46**).

The burden of disease due to breast cancer is predicted to increase over the entire simulation period with disability as the main contributor to the increasing burden.

The simulation results indicated that in NSW (**Table 9**):

YLLs:

- Between 2006 and 2016, the average growth rate is estimated to be 2.17% per annum.
- Between 2017 and 2036, the average growth rate is estimated to be 0.18% per annum.

YLDs:

- Between 2006 and 2016, the average growth rate is estimated to be 3.80% per annum.
- Between 2017 and 2036, the average growth rate is estimated to be 3.68% per annum.

DALYs:

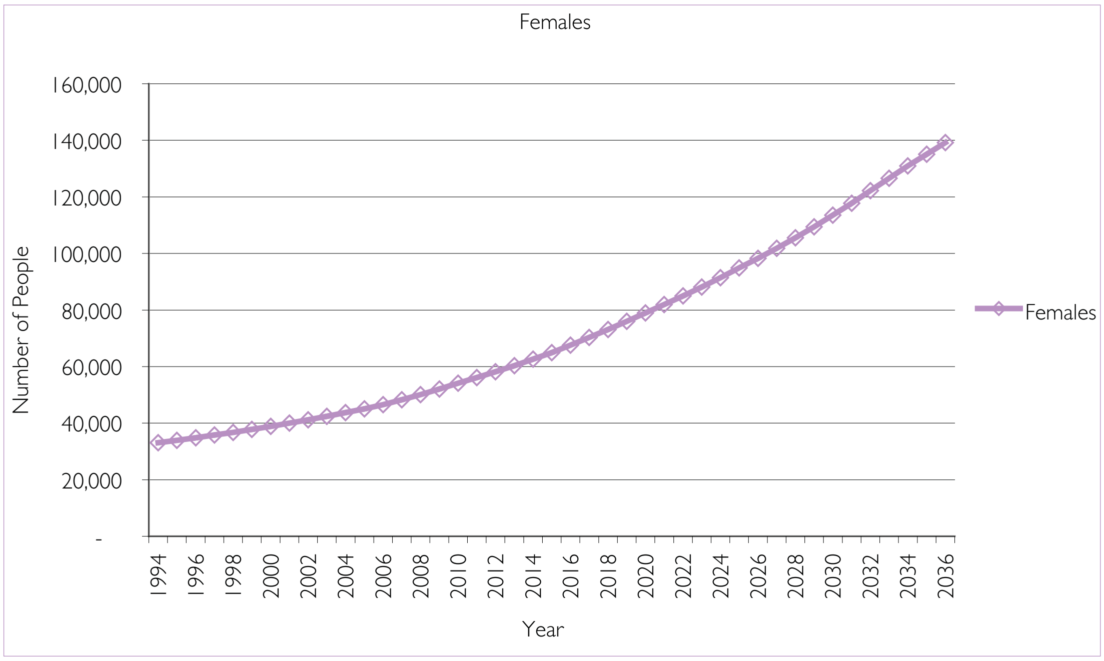
- Between 2006 and 2016, the average growth rate is estimated to be 3.06% per annum.
- Between 2017 and 2036, the average growth rate is estimated to be 2.44% per annum.

Table 9 Burden of Breast Cancer in NSW

	Year	Number
YLL		
	2007	22,949
	2016	27,167
	2036	28,137
YLD		
	2007	25,710
	2016	36,023
	2036	74,266
DALY		
	2007	48,659
	2016	63,189
	2036	102,403

Figure 44 NSW Breast Cancer Prevalence (1994–2036)

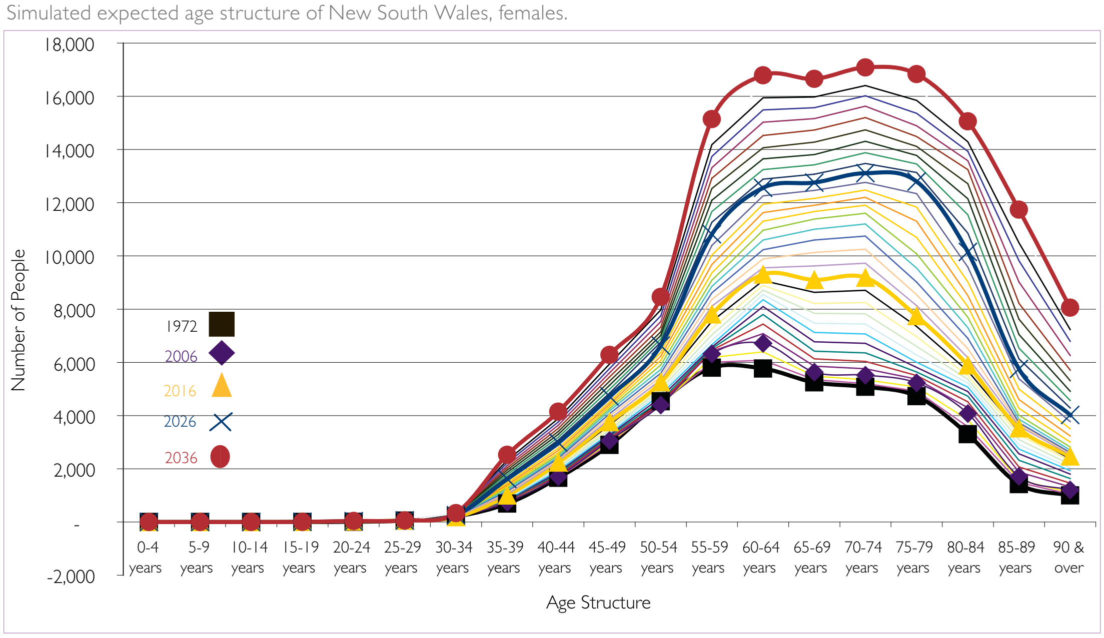
Total population, females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 45 NSW Breast Cancer Prevalence, Population Age Distribution (2003–2036)

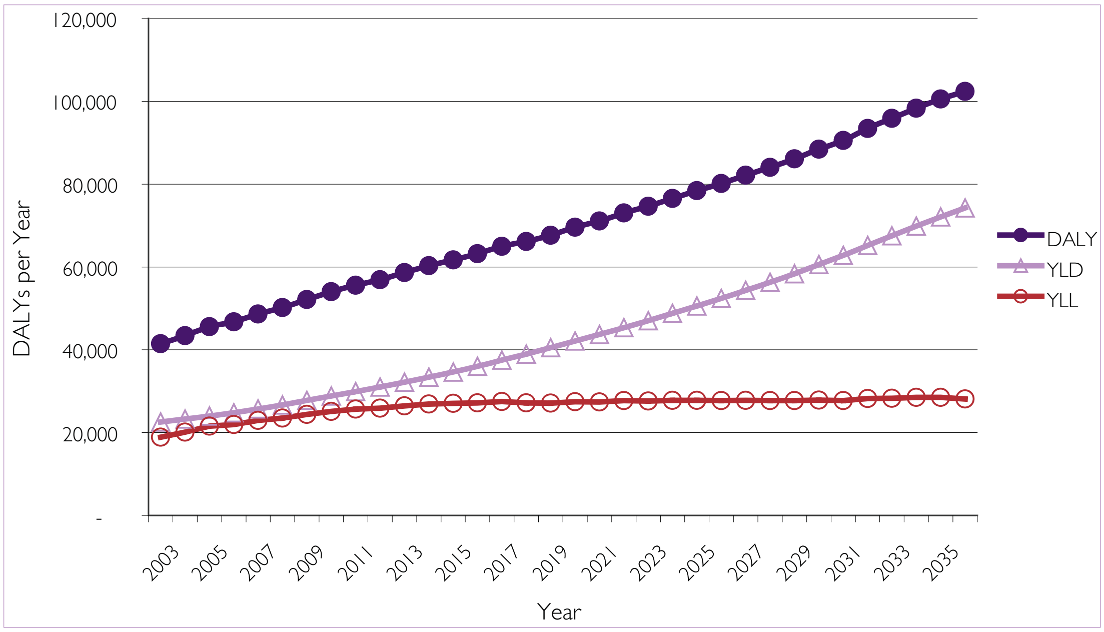
Simulated expected age structure of New South Wales, females.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 46 NSW Breast Cancer DALYs (2003–2036)

Total population, females, all age groups. Simulated expectation.



Disability data: Colin Mathers, Chris Stevenson, Simon Eckermann (1999) AIHW, Disability Coefficients for different cancer types; and Males JM, Essink-Bot, Kramers PG, et al: A national burden of disease calculation: Dutch disability-adjusted life-years. American Journal of Public Health 90(8): 121-1247, 2000.

13.5 Breast cancer in NSW – Summary

Breast Cancer Incidence

2007–2016 (10-year simulation period)

The number of new cases diagnosed in 2016 represent a 24.9% increase from what was expected in 2007. The total number of NSW residents expected to be diagnosed with breast cancer from 2007 through to 2016 is about 52,214 (cumulative). These cumulative number of new cases represent a 28.3% increase from the previous 10 years (1997–2006).

2007–2036 (30-year simulation period)

The number of new cases diagnosed in 2036 represent a 73.0% increase from what was expected in 2007. The total number of NSW residents expected to be diagnosed with breast cancer from 2007 through to 2036 is 191,061 (cumulative). These cumulative number of new cases represent a 116.8% increase from the previous 30 years (1977-2006).

Breast Cancer Mortality

2007–2016 (10-year simulation period)

The number of deaths in 2016 represent a 17.4% increase from what was expected in 2007. The total number of NSW residents expected to prematurely die from breast cancer from 2007 through to 2016 is over 12,226 (cumulative). These cumulative number of deaths represent a 33.6% increase from the previous 10 years (1996–2005).

2007–2036 (30-year simulation period)

The number of deaths in 2036 represent a 38.4% increase from what was expected in 2007. The total number of NSW residents expected to prematurely die from breast cancer from 2007 through to 2036 is over 40,285 (cumulative). These cumulative number of deaths represent a 61.7% increase from the previous 30 years (1976–2005).

Breast Cancer Prevalence

2007–2016 (10-year simulation period)

The total number of NSW residents expected to be living with breast cancer (prevalence) in 2016 is estimated to be over 67,542 which is about 40.0% higher than estimations for 2007.

2007–2036 (30-year simulation period)

The total number of NSW residents expected to be living with breast cancer (prevalence) in 2036 is estimated to be over 139,197 which is about 188.5% higher than estimations for 2007.

13.6 Total economic cost of breast cancer in NSW

2007–2016 (10-year simulation)

Breast cancer is estimated to cost the economy a total of about $11.4 billion in the next 10 years:

- Health cost impacts amount to over $1.2 billion.
- Net wage impacts amount to over $4.7 billion.
- Net corporate profit impacts amount to over $2.7 billion.
- Net taxation revenue impacts amount to over $2.8 billion.

2007–2036 (30-year simulation)

Breast cancer is estimated to cost the economy a total of about $40 billion in the next 30 years:

- Health cost impacts amount to over $3.5 billion.
- Net wage impacts amount to over $16.6 billion.
- Net corporate profit impacts amount to over $9.7 billion.
- Net taxation revenue impacts amount to over $10.2 billion.

14. Colorectal Cancer

- Colorectal cancer numbers will continue to rise in New South Wales and because survival is high, prevalence will increase.

- Disability due to colorectal cancer will become a more important contributor to burden of disease than mortality later in the period.

- Colorectal cancer is estimated to cost the New South Wales economy about $13 billion in the next 10 years and $37 billion in the next 30 years.

14.1 Colorectal cancer – new cases

Historical incidence of colorectal cancer between 1972 and 2003 were obtained from NSW CCR and the incidence from 2004 through to 2036 was simulated (**Figure 47**). Historic trends as well as attributable influence of high BMI and population age structure were used for simulation of colorectal cancer incidence, mortality and subsequent economic costs. Age and gender breakdown of historical and simulated colorectal cancer incidence in the NSW population were further projected (**Figure 48**).

It is predicted that the number of new colorectal cancer cases in NSW will increase for both genders throughout the simulation period. The primary driver of new colorectal cancer cases in NSW is an increase in population aged 50 years and over.

14.2 Colorectal cancer – deaths

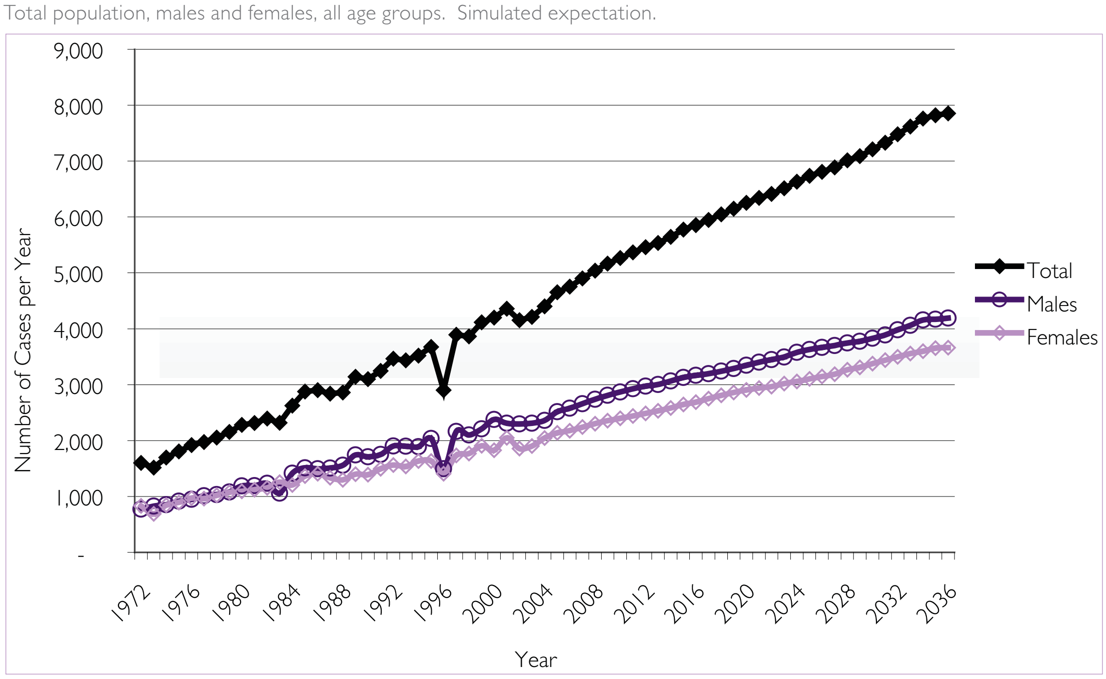
Historical mortality for colorectal cancer between 1972 and 2003 were obtained from GRIM Books 2003 and mortality from 2004 through to 2036 was simulated (**Figure 49**). Age and gender breakdown of historical and simulated colorectal cancer mortality in the NSW population was further projected (**Figure 50**).

It is predicted that the number of deaths due to colorectal cancer in NSW will increase throughout the simulation period for both genders. The primary driver for colorectal cancer mortality in NSW is an increase in population aged 50 years and over.

Historical incidence and mortality between 1972 and 2003 and simulated incidence and mortality from 2004 through to 2036 for colorectal cancer in NSW were compared (**Figure 51**). The number of new colorectal cancers and deaths are expected to increase throughout the simulation period. The incidence is expected to increase at a higher rate than deaths, suggesting that the number of people in NSW living with colorectal cancer (prevalence) will increase in the future.

Figure 47 NSW New Colorectal Cancer Cases (1972–2036)

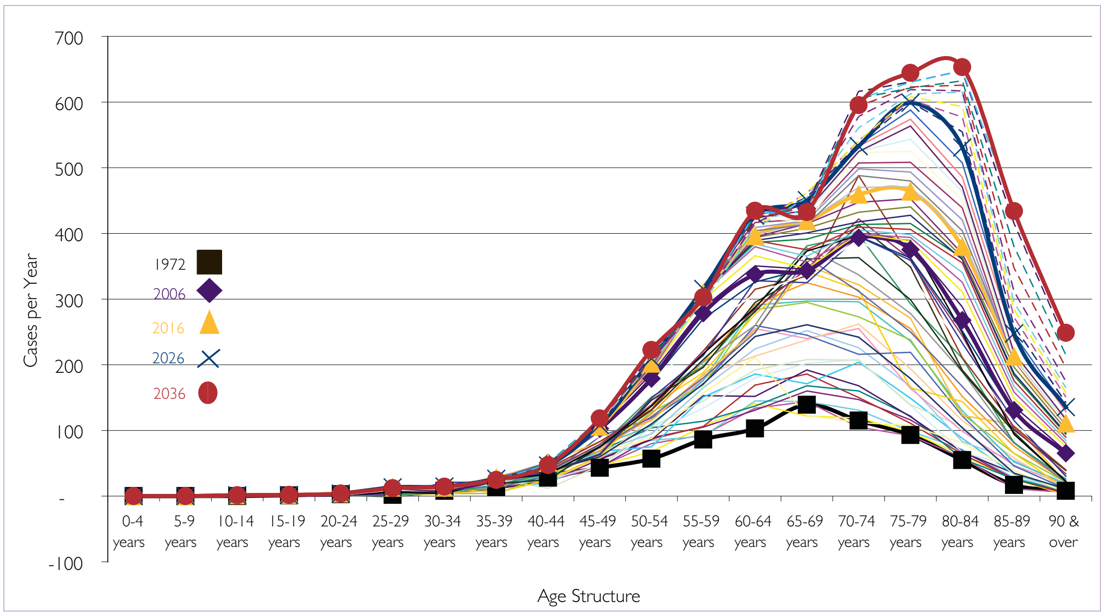
Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 48a NSW New Colorectal Cancers, Population Age Distribution, males (1972–2036)

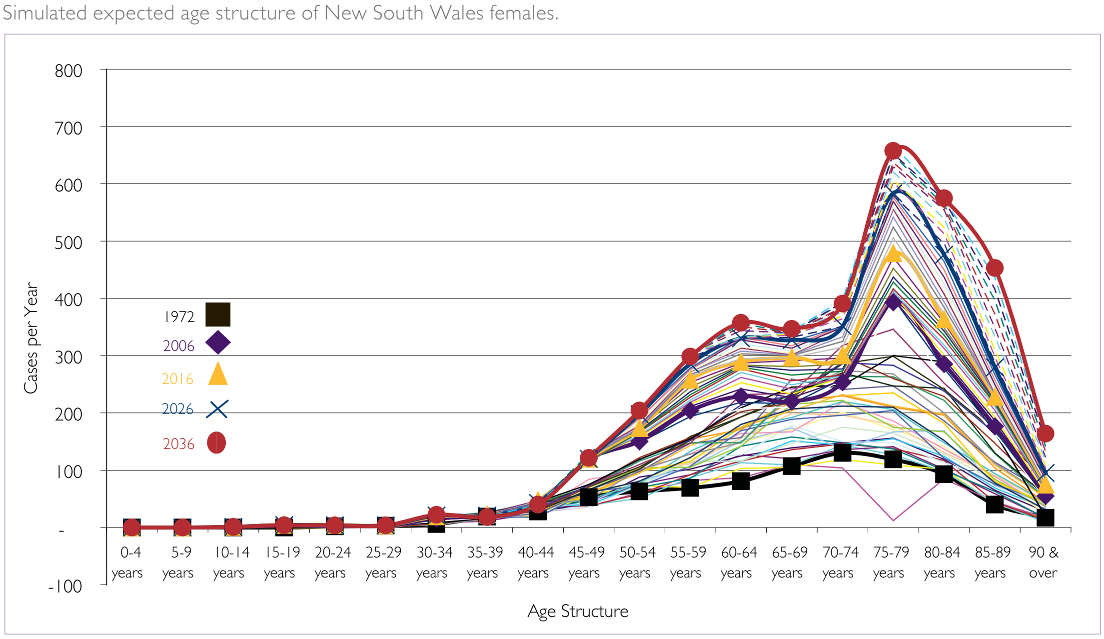
Simulated expected age structure of New South Wales males.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 48b NSW New Colorectal Cancers, Population Age Distribution, females (1972–2036)

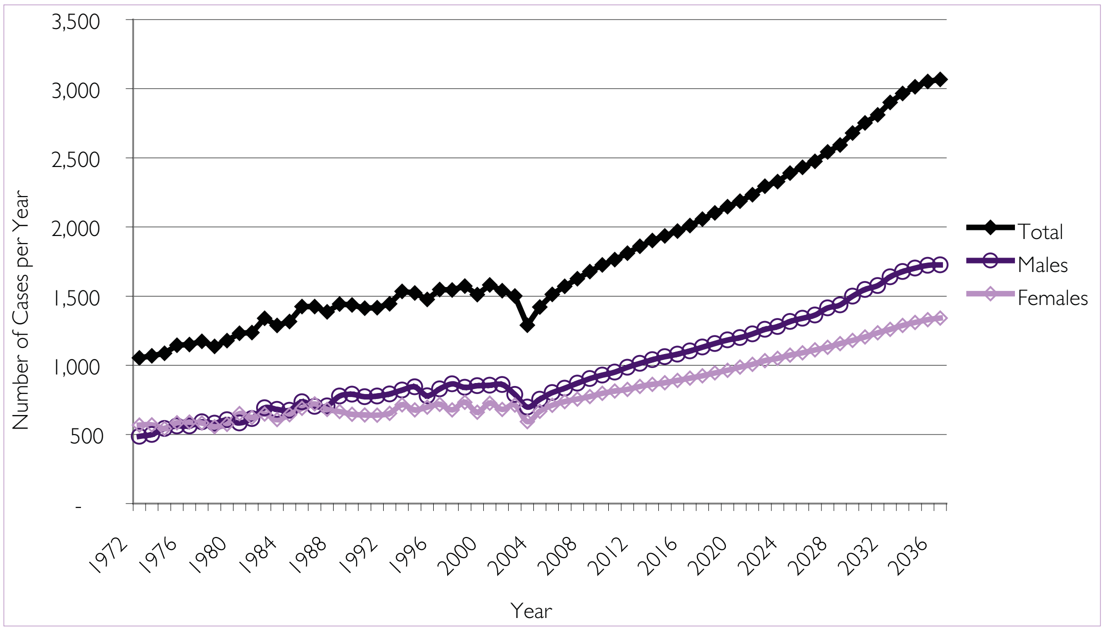
Simulated expected age structure of New South Wales females.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 49 NSW Colorectal Cancer Deaths (1972–2036)

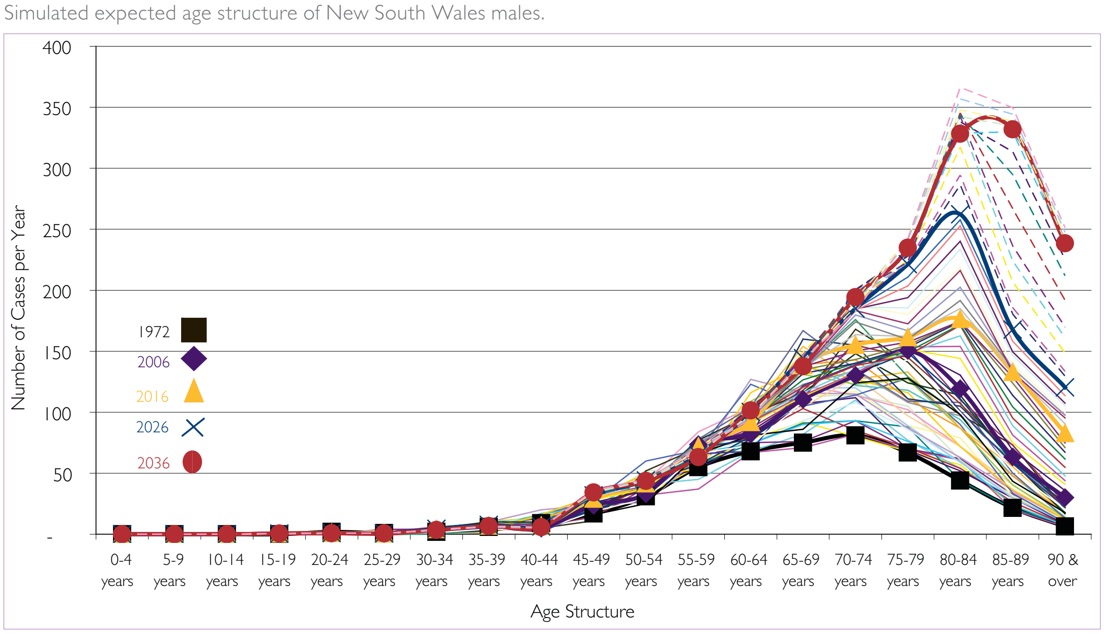
Total population, males and females, all age groups. Simulated expectation.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 50a NSW Colorectal Cancer Deaths, Population Age Distribution, males (1972–2036)

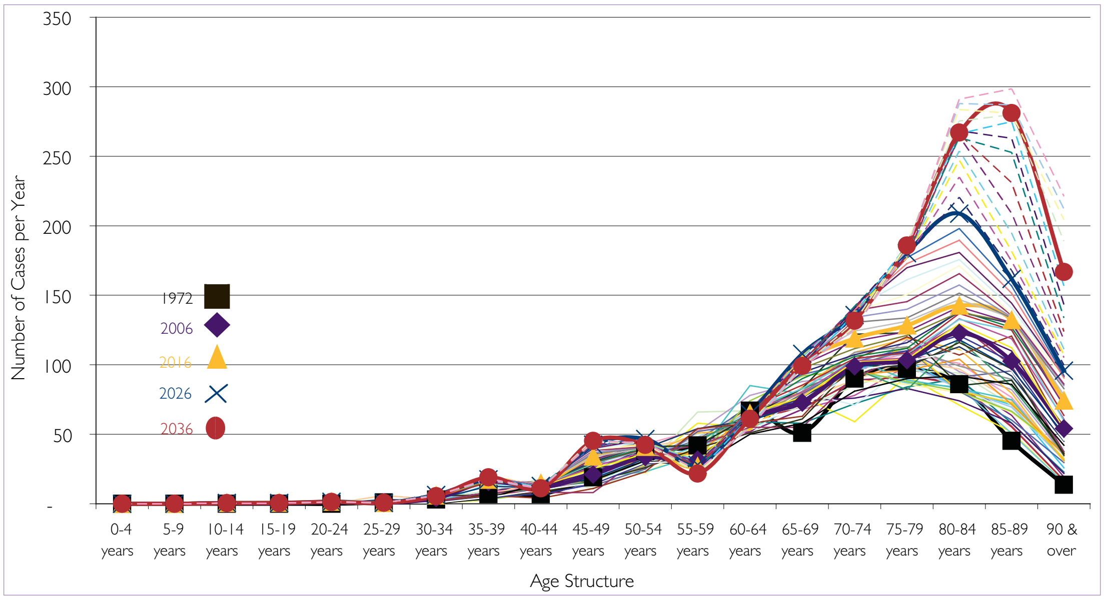
Simulated expected age structure of New South Wales males.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 50b NSW Colorectal Cancer Deaths, Population Age Distribution, females (1972–2036)

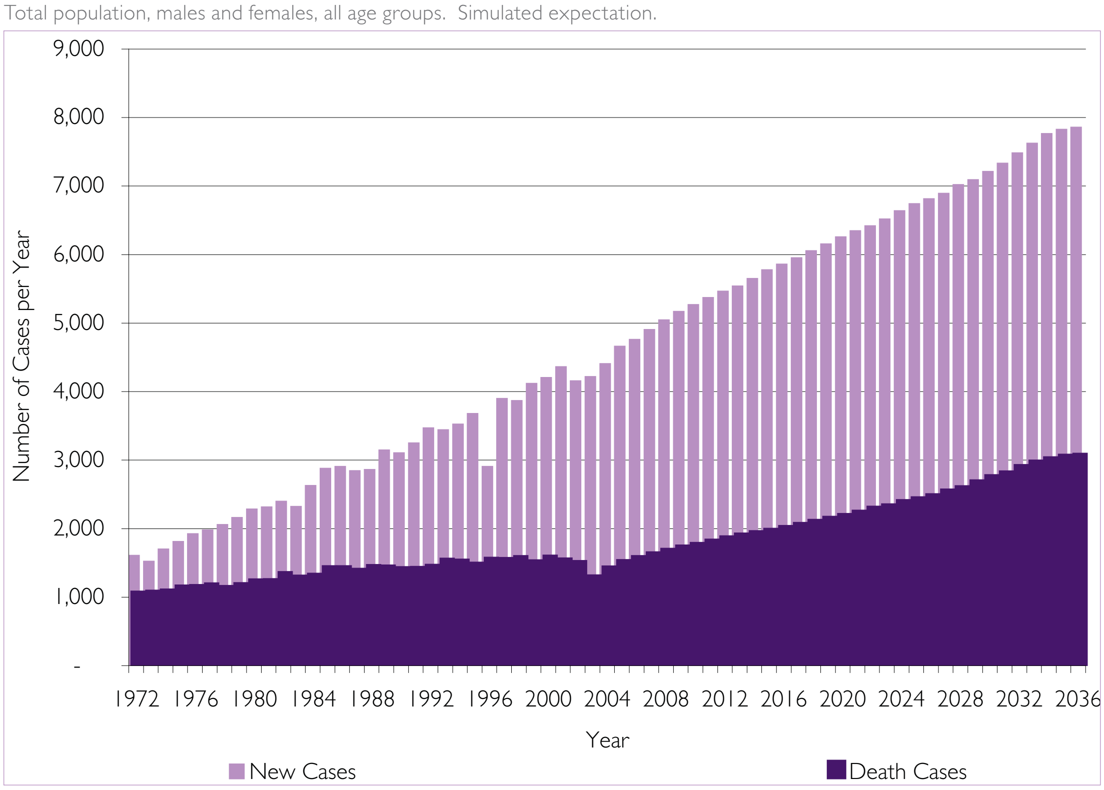
Simulated expected age structure of New South Wales females.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 51 NSW New Colorectal Cancer Cases and Deaths (1972–2036)

Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

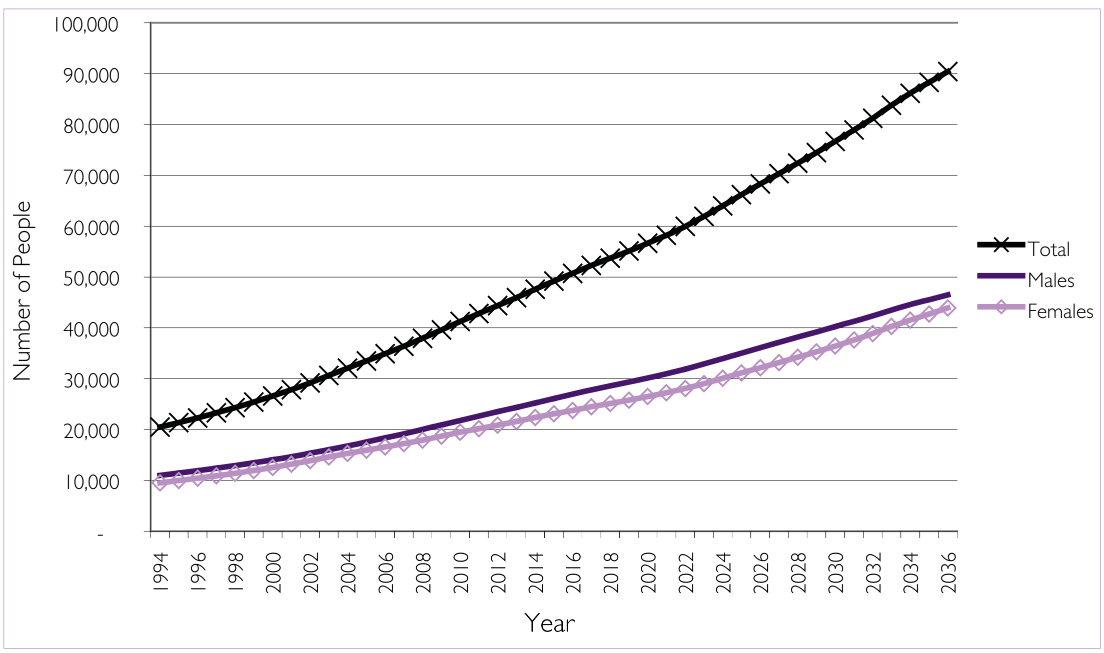
14.3 Colorectal cancer – prevalence

Historical colorectal cancer prevalence between 1994 and 2003 was calculated as a function of incidence as well as the number of deaths at the end of a given year, and prevalence from 2004 through to 2036 was simulated (**Figure 52**). Age and gender breakdown of historical and simulated colorectal cancer prevalence in the NSW population were projected (**Figure 53**).

It is predicted that colorectal cancer prevalence in NSW will increase throughout the simulation period.

Figure 52 NSW Colorectal Cancer Prevalence (1994–2036)

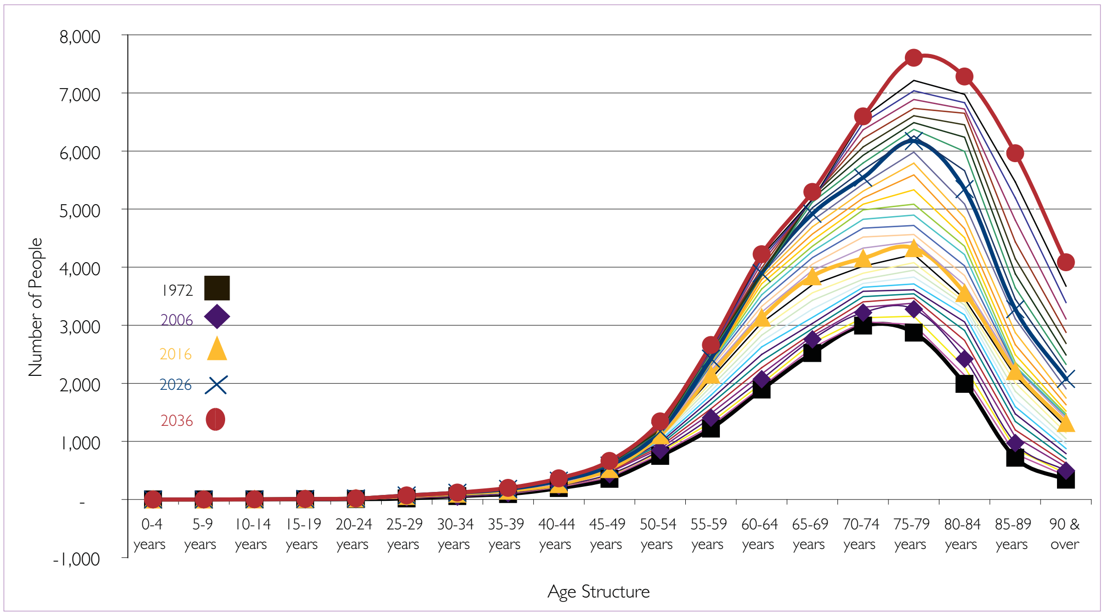
Total Population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 53a NSW Colorectal Cancer Prevalence, Population Age Distribution, males (2003–2036)

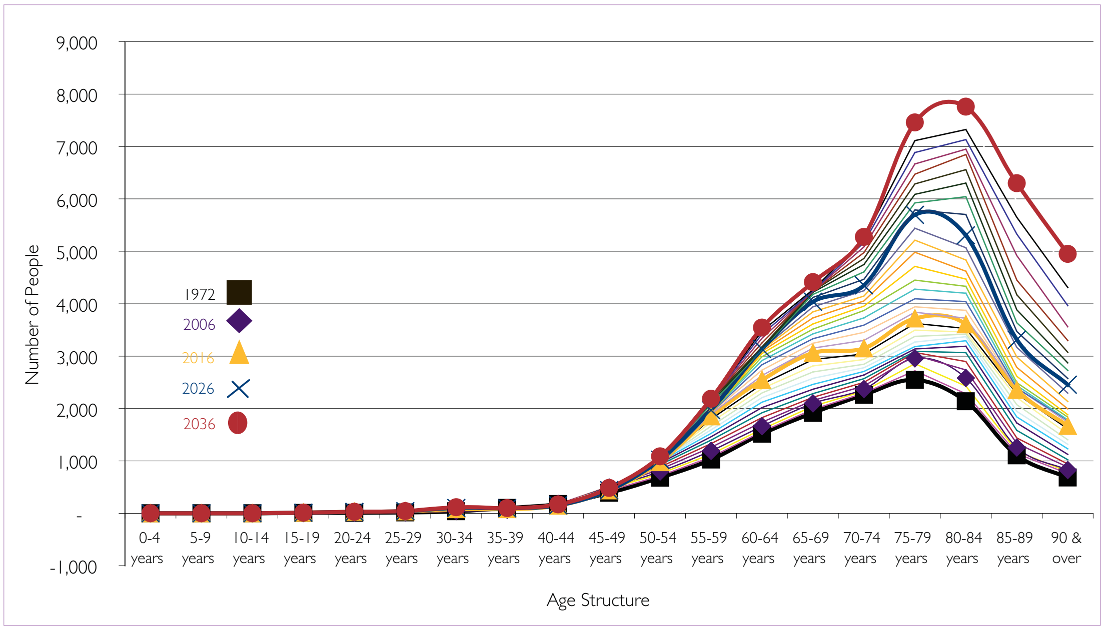
Simulated expected age structure of New South Wales males.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 53b NSW Colorectal Cancer Prevalence, Population Age Distribution (2003–2036)

Simulated expected age structure of New South Wales females.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

14.4 Colorectal cancer – DALYs

Colorectal cancer burden in NSW measured in DALYs for all age groups for both genders between 2007 and 2036 were simulated (**Figure 54**).

Burden of disease due to colorectal cancer is predicted to increase through-out the simulation period. In the first 10 years of the simulation, colorectal cancer death will be the main contributor to the projected burden after which disability will become the main contributor to burden of colorectal cancer in the State.

The simulation results indicated that in NSW (**Table 10**):

YLLs:

- Between 2006 and 2016, the average growth rate is estimated to be 2.09% per annum (2.16% per annum for males and 2.03% per annum for females).
- Between 2017 and 2036, the average growth rate is estimated to be 1.05% per annum (1.12% per annum for males and 0.98% per annum for females).

YLDs:

- Between 2006 and 2016, the average growth rate is estimated to be 3.80% per annum for (3.92% per annum for males and 3.66% per annum for females).
- Between 2017 and 2036, the average growth rate is estimated to be 2.94% per annum (2.77% per annum for males and 3.12% per annum for females).

DALYs:

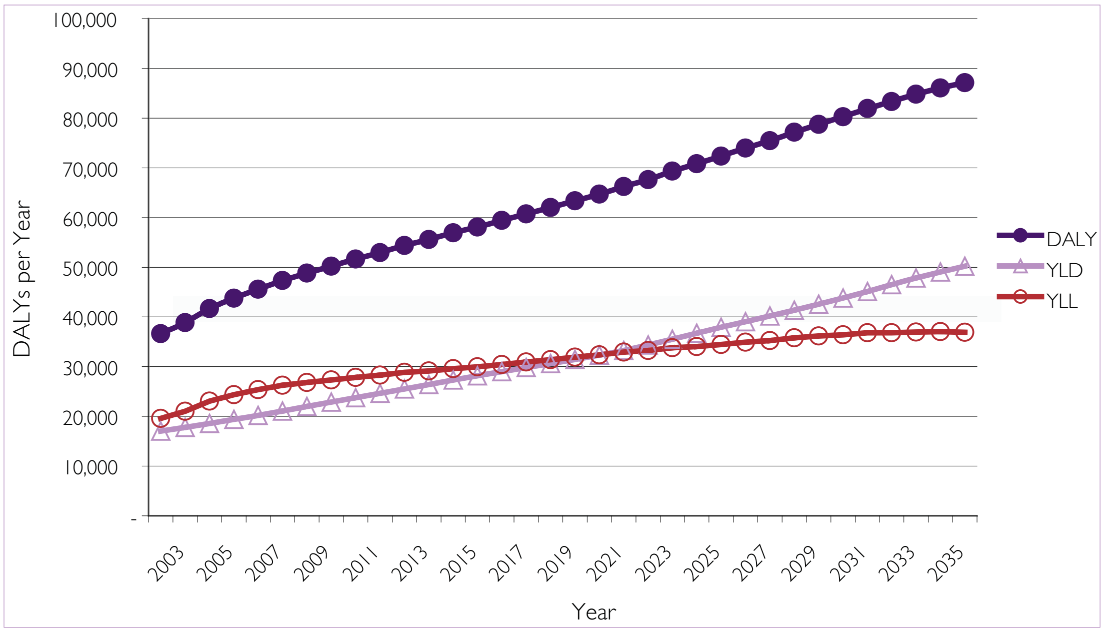
- Between 2006 and 2016, the average growth rate is estimated to be 2.88% per annum (2.99% per annum for males and 2.77% per annum for females).
- Between 2017 and 2036, the average growth rates will be 2.05% per annum (2.00% per annum for males and 2.10% per annum for females).

Table 10 Burden of Colorectal Cancer in NSW

	Year	All	Males	Females
YLL				
	2007	25,376	13,005	12,370
	2016	29,953	15,319	14,633
	2036	36,932	19,147	17,786
YLD				
	2007	20,208	10,624	9,584
	2016	28,153	14,942	13,211
	2036	50,212	25,813	24,399
DALY				
	2007	45,583	23,629	21,954
	2016	58,105	30,261	27,844
	2036	87,145	44,960	42,185

Figure 54 NSW Colorectal Cancer DALYs (2003–2036)

Total population, males and females, all age groups. Simulated expectation.



Disability data: Colin Mathers, Chris Stevenson, Simon Eckermann (1999) AIHW, Disability Coefficients for different cancer types; and Males JM, Essink-Bot, Kramers PG, et al: A national burden of disease calculation: Dutch disability-adjusted life-years. American Journal of Public Health 90(8): 121-1247, 2000.

14.5 Colorectal cancer in NSW – Summary

Colorectal Cancer Incidence

2007–2016 (10-year simulation period)

The number of new colorectal cancer cases in 2016 represent a 19.5% increase (19.2% increase for males and 19.8% increase for females) from what was expected in 2007.

The total number of NSW residents expected to be diagnosed with colorectal cancer from 2007 through to 2016 is about 54,004 (cumulative), of which approximately 29,338 (54.3%) will be males and 24,665 will be females (45.7%). These cumulative number of new cases represent a 26.7% increase from the previous 10 years (1997–2006), which represents a 26.4% increase for males and a 27.2% increase for females.

2007–2036 (30-year simulation period)

The number of new colorectal cancer in 2036 represent a 60.3% increase (57.7% increase for males and 63.2% increase for females) from what was expected in 2007.

The total number of NSW residents expected to be diagnosed with colorectal cancer from 2007 through to 2036 is about 191,906 (cumulative), of which approximately 103,133 will be males (53.7%) and 88,773 will be females (46.3%). These cumulative number of cases represent a 94.5% increase from the previous 30 years (1977–2006), which represents a 94.8% increase for males and a 94.0% increase for females.

Colorectal Cancer Mortality

2007–2016 (10-year simulation period)

The total number of NSW residents expected to prematurely die from colorectal cancer from 2007 through to 2016 is about 18,287 (cumulative) of which approximately 9,939 will be males (54.3%) and 8,348 will be females (45.7%). These cumulative number of deaths represent a 21.5% increase from the previous 10 years (1997–2006), which represents a 21.9% increase for males and a 21.0% increase for females.

2007–2036 (30-year simulation period)

The total number of NSW residents expected to prematurely die from colorectal cancer from 2007 through to 2036 is about 69,310 (cumulative mortality counts) of which approximately 38,341 will be males (55.3% of cumulative total 30 year mortality) and 30,969 will be females (44.7% of cumulative total 10 year mortality). These cumulative mortality counts represent a 63.4% increase from the previous 30 years (1977–2006) which represents a 70.4% increase for males and a 55.5% increase for females.

Colorectal Cancer Prevalence

2007–2016 (10-year simulation period)

The total number of NSW residents expected to be living with colorectal cancer in 2016 is estimated to be about 50,706 which is about 39.3% higher than prevalence in 2007 (40.5% increase for males and 37.9% increase for females).

2007–2036 (30-year simulation period)

The total number of NSW residents expected to be living with colorectal cancer in 2036 is estimated to be about 90,407 which is about 148.4% higher than prevalence in 2007 (142.5% increase for males and 154.9% increase for females).

14.6 Total economic cost of colorectal cancer in NSW

2006–2016 (10-year simulation):

Colorectal cancer is estimated to cost the economy total of about $12.8 billion in the next 10 years.

- Health cost impacts amount to over $1.1 billion.
- Net wage Impacts amount to over $4.9 billion.
- Net corporate profit impacts amount to over $3.6 billion.
- Net taxation revenue impacts amount to over $3.2 million.

2006–2036 (30-year simulation):

Colorectal cancer is estimated to cost the economy total of about $36.7 billion in the next 30 years.

- Health cost impacts amount to over $3.1 billion.
- Net wage Impacts amount to over $13.8 billion.
- Net corporate profit impacts amount to over $10.6 billion.
- Net taxation revenue impacts amount to over $9.2 million.

15. Melanoma

- Melanoma numbers will continue to rise in New South Wales and because survival is high, prevalence will increase.
- Disability due to melanoma will continue to increase as the main contributor to burden of disease in melanoma.
- The numbers of melanoma will be higher in males.
- Melanoma is estimated to cost the New South Wales economy about $15 billion in the next 10 years and $39 million in the next 30 years.

15.1 Melanoma – cases

Historical incidence of melanoma between 1972 and 2003 were obtained form NSW CCR and incidence from 2004 through to 2036 were simulated (**Figure 55**). Historic trends as well as prevalence of excessive sun exposure was used as a lifestyle risk factor for the on-set of melanoma. Age and gender breakdown of historical and simulated melanoma incidence in the NSW population were further projected (**Figure 56**).

The number of new melanoma cases in NSW is expected to increase throughout the simulation period for both genders. The primary driver of new melanoma cases is an increase in population aged 50 years and over.

15.2 Melanoma – deaths

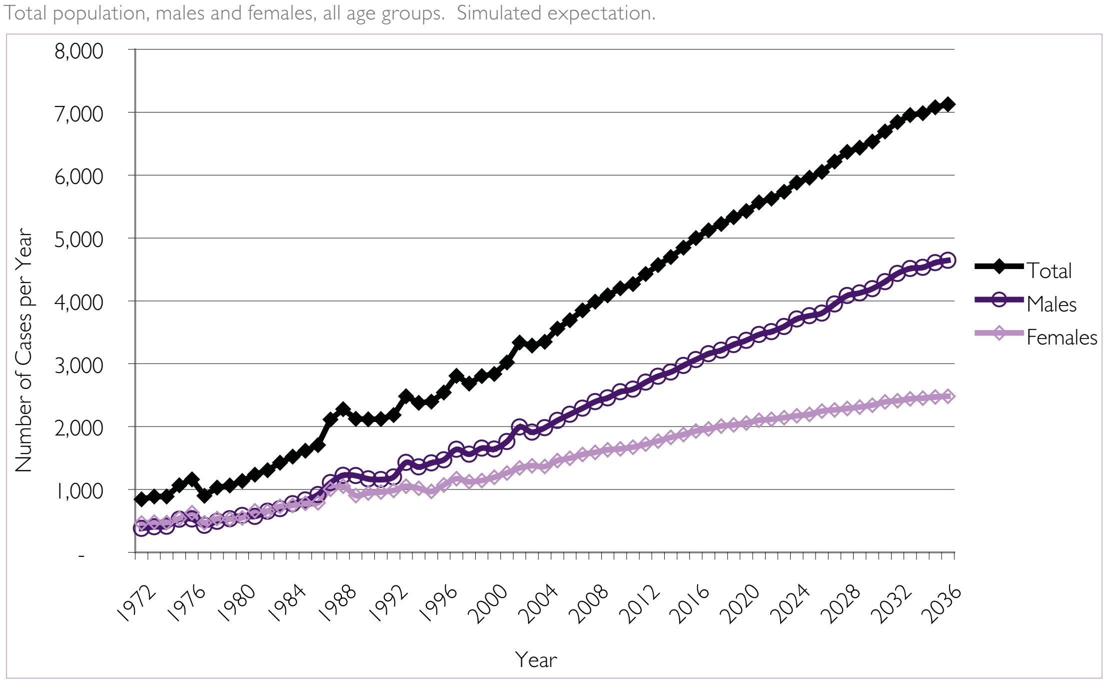
Historical mortality of melanoma between 1972 and 2003 were obtained from GRIM Books 2003 and mortality from 2004 through to 2036 was simulated (**Figure 57**). Age and gender breakdown of historical and simulated melanoma mortality in the NSW population were further projected (**Figure 58**).

Number of deaths due to melanoma is expected to increase in NSW throughout the simulation period for both genders. The primary driver of melanoma mortality in NSW is an increase in population aged 50 years and over.

Historical melanoma incidence and mortality between 1972 and 2003 and simulated incidence and mortality from 2004 to 2036 in NSW were compared (**Figure 59**). The number of new cases diagnosed and deaths due to melanoma are expected to increase throughout the simulation period. The number of new cases is expected to increase at a higher rate than deaths, suggesting that the number of people in NSW living with melanoma (prevalence) will increase in the future.

Figure 55 NSW New Melanoma Cases (1972–2036)

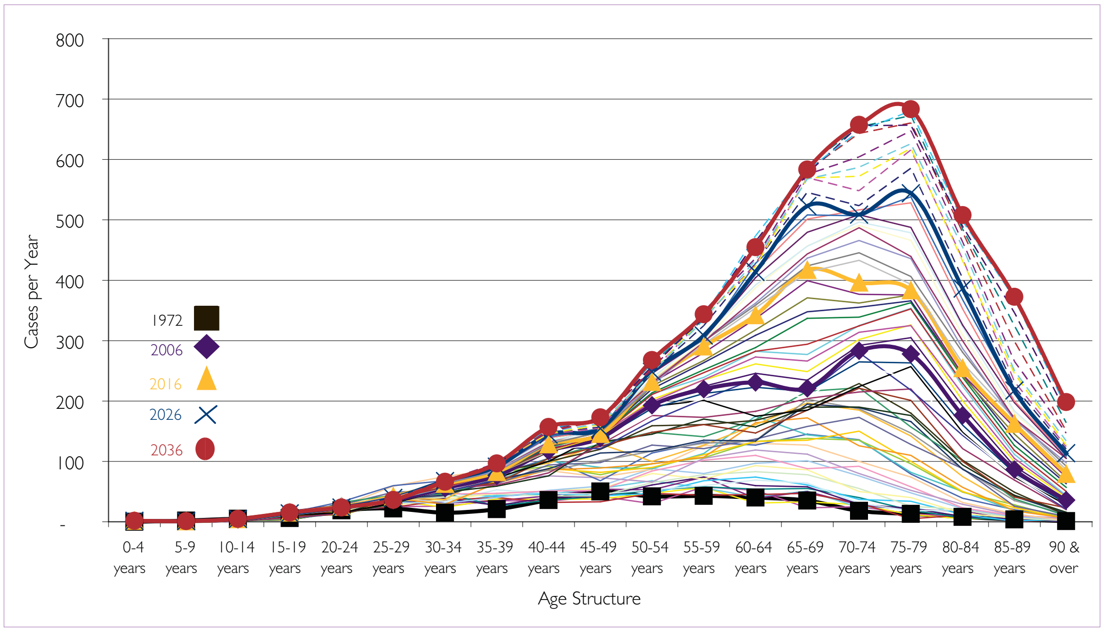
Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 56a NSW New Melanoma Cases, Population Age Distribution, males (1972–2036)

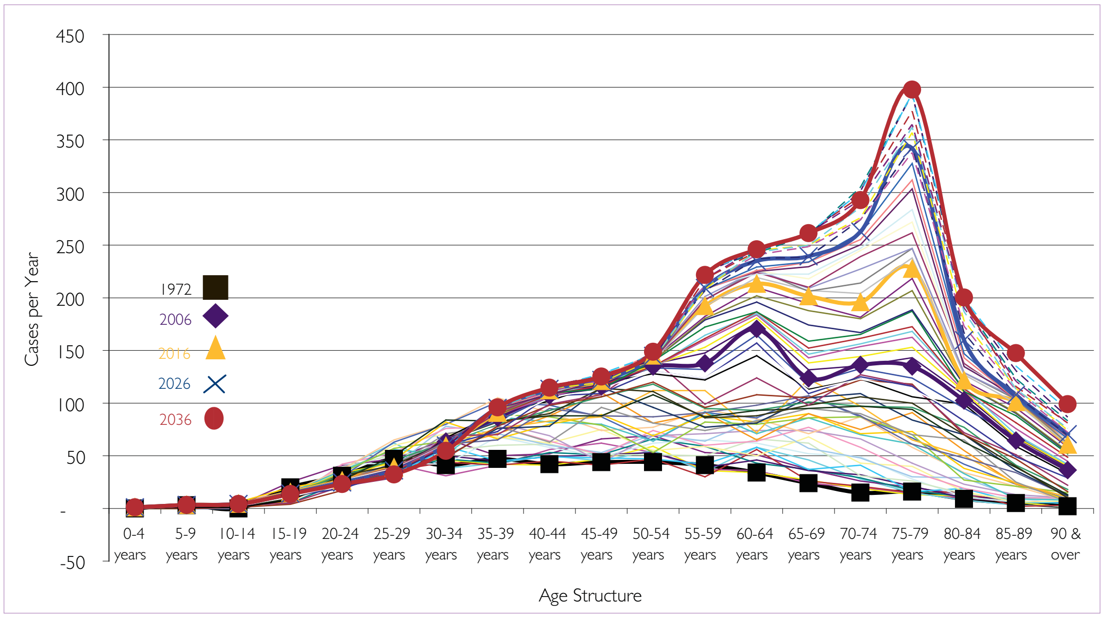
Simulated expected age structure of New South Wales males.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 56b NSW New Melanoma Cases, Population Age Distribution, females (1972–2036)

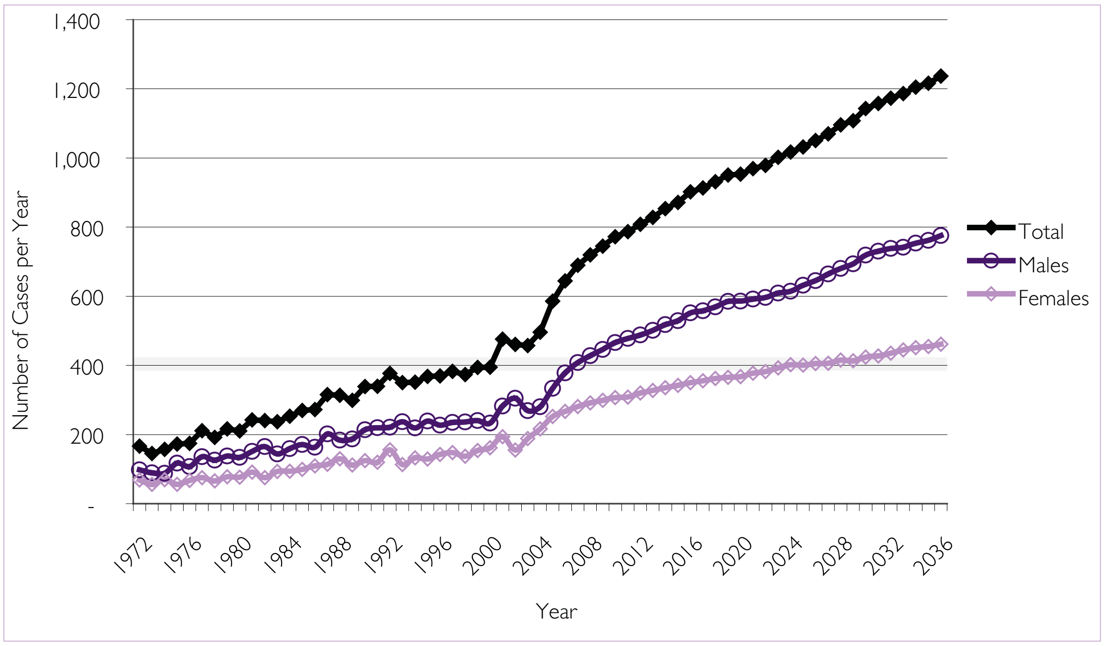
Simulated expected age structure of New South Wales females.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 57 NSW Melanoma Deaths, History and Expectation Values, Total Population, Males, Females, All Age Groups: 1972–2036

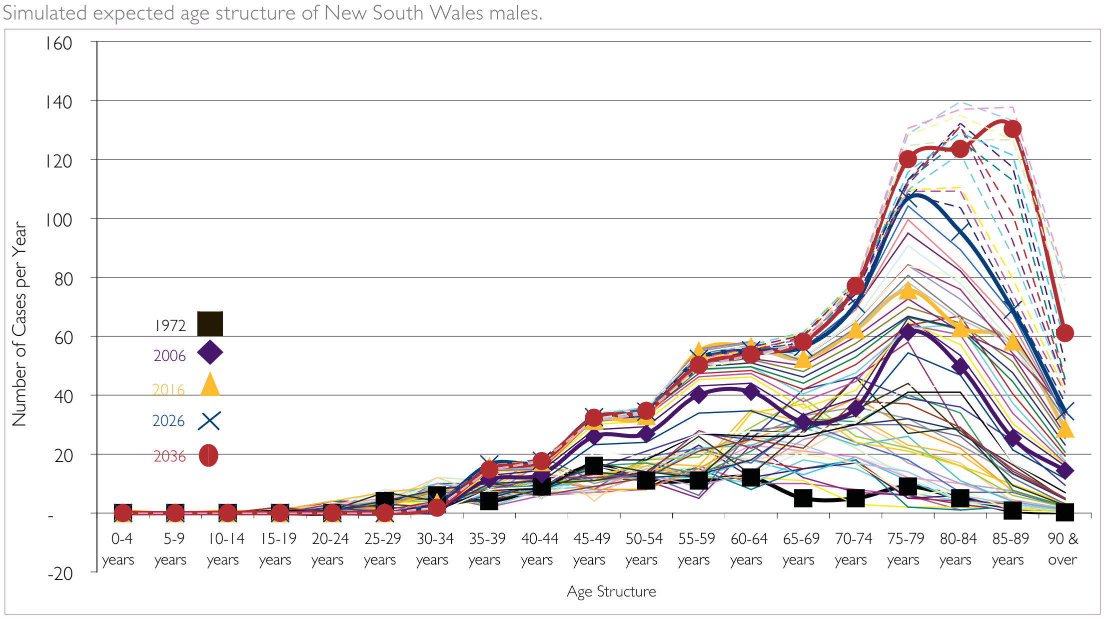
Simulated expectation.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 58a NSW Melanoma Deaths, Population Age Distribution, males (1972–2036)

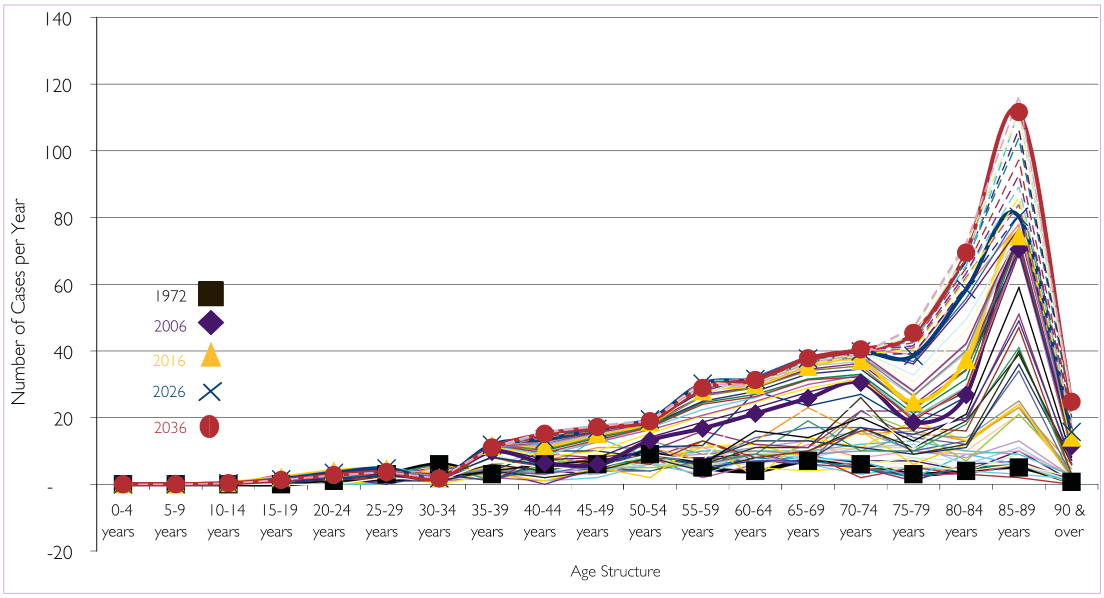
Simulated expected age structure of New South Wales males.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 58b NSW Melanoma Deaths, Population Age Distribution, females (1972–2036)

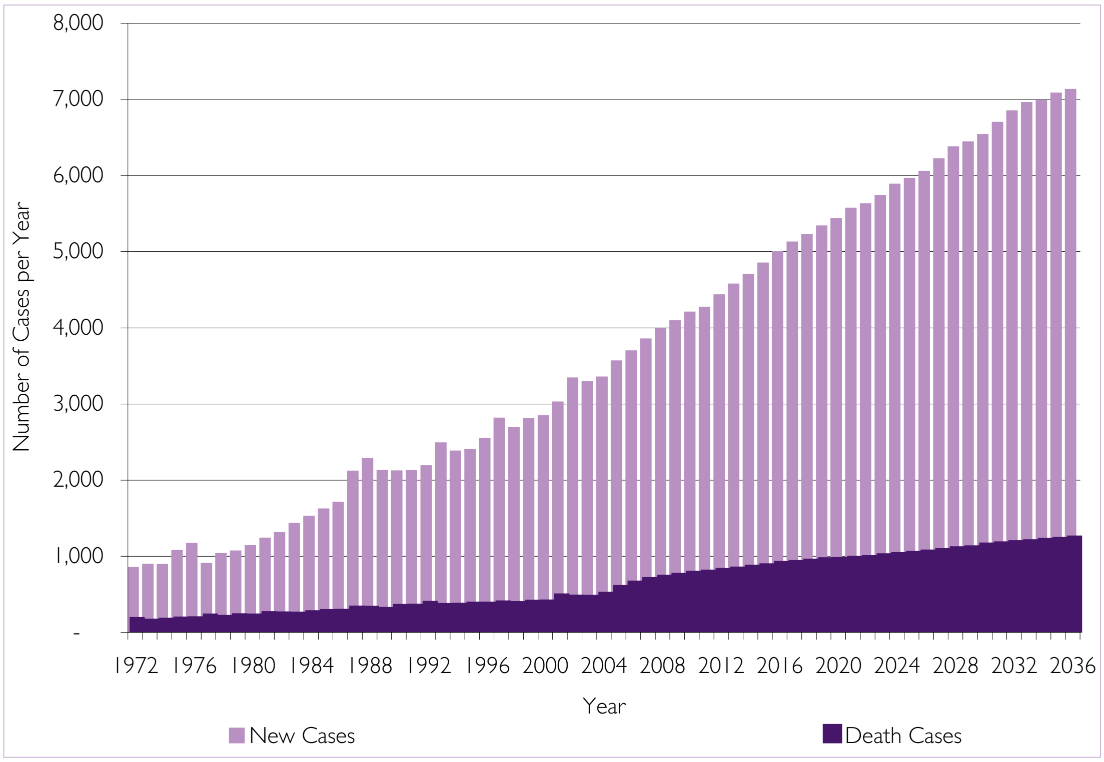
Simulated expected age structure of New South Wales females.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 59 NSW New Melanoma Cases and Deaths (1972–2036)

Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

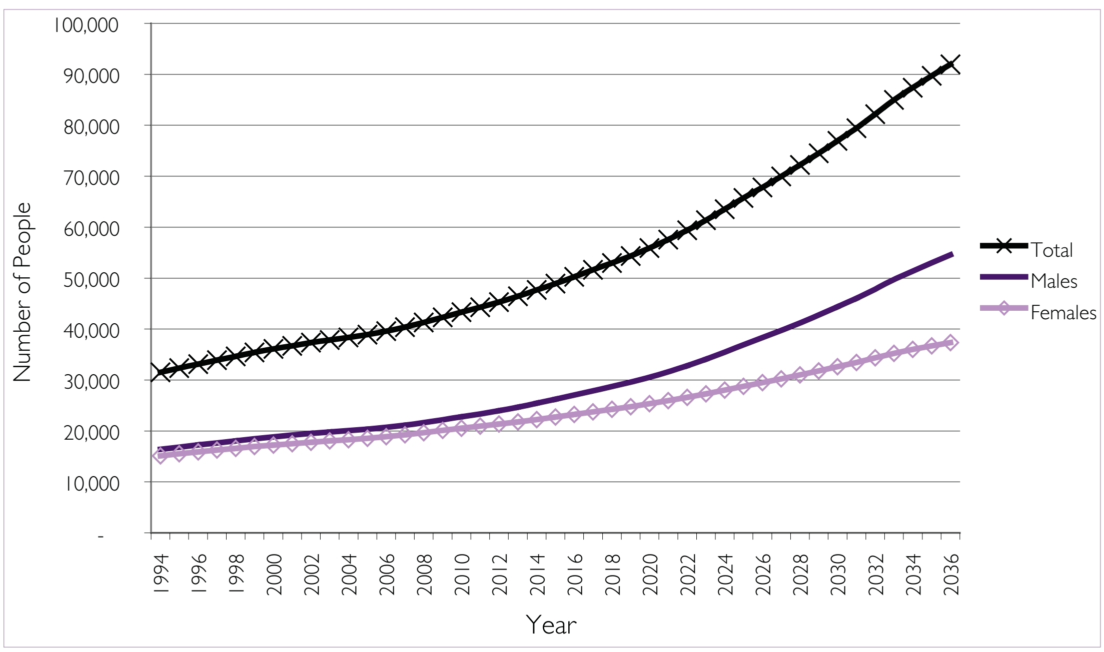
15.3 Melanoma – prevalence

Historical prevalence of melanoma between 1994 and 2003 was calculated as a function of incidence as well as the number of deaths at the end of a given year, and prevalence from 2004 through to 2036 was projected (**Figure 60**). Age and gender breakdown of historical and simulated melanoma prevalence in the NSW population were further projected (**Figure 61**).

Melanoma prevalence in NSW is expected to increase throughout the simulation period in both sexes.

Figure 60 Melanoma Prevalence in NSW (1994–2036)

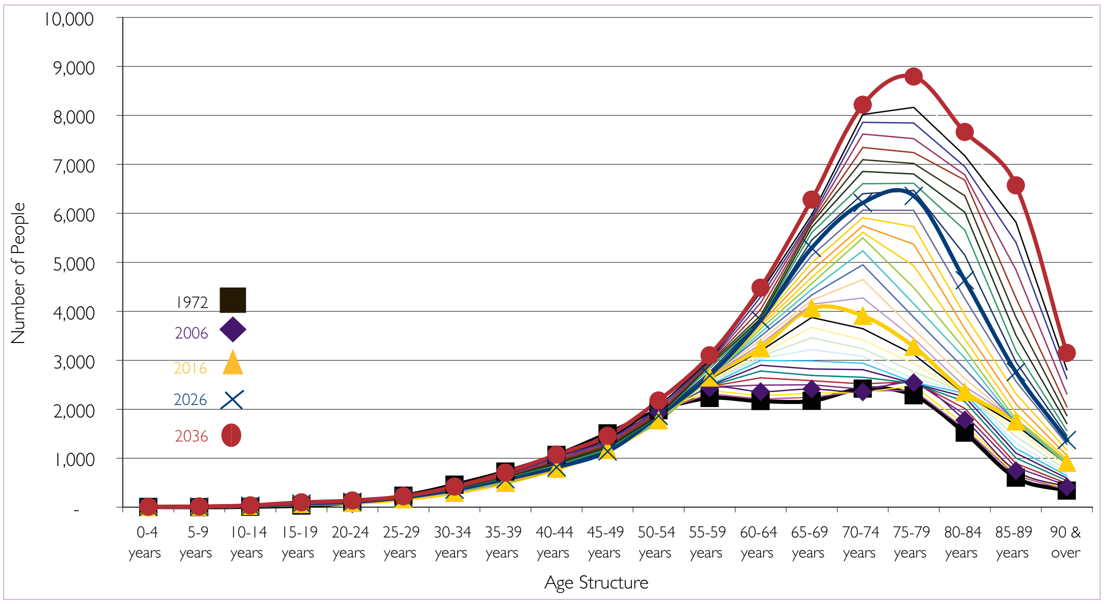
Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 61a Melanoma Prevalence in NSW, Population Age Distribution, males (2003–2036)

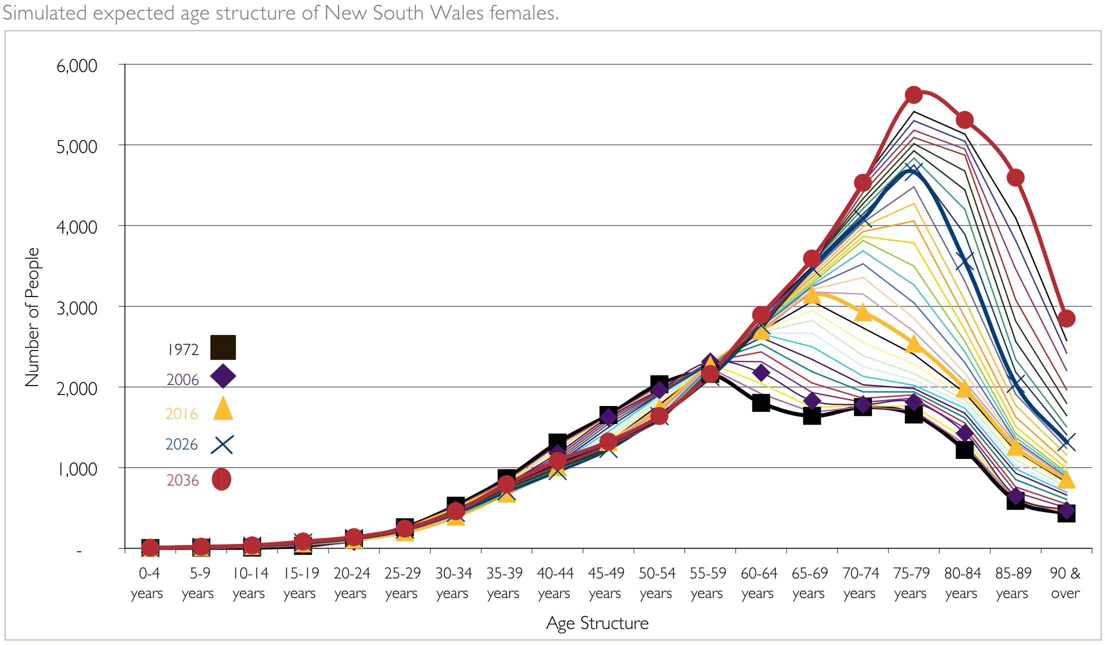
Simulated expected age structure of New South Wales males.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 61b Melanoma Prevalence in NSW, Population Age Distribution, females (2003–2036)

Simulated expected age structure of New South Wales females.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

15.4 Melanoma – DALYs

Melanoma burden in NSW measured in DALYs for all age groups for both sexes between 2003 and 2036 were simulated (**Figure 62**).

Burden of disease attributed to melanoma is expected to increase over the entire simulation period with disability as the major contributing factor to DALYs expected.

The simulation results indicated that in NSW (**Table 11**):

YLLs:

- Between 2006 and 2016, the average growth rate is estimated to be 3.56% per annum (3.55% per annum for males and 3.57% per annum for females).
- Between 2017 and 2036, the average growth rate is estimated to be 0.67% per annum (0.69% per annum for males and 0.65% per annum for females).

YLDs:

- Between 2006 and 2016, the average growth rate is estimated to be 2.40% per annum (2.68% per annum for males and 2.08% per annum for females).
- Between 2017 and 2036, the average growth rate is estimated to be 3.06% per annum (3.58% per annum for males and 2.40% per annum for females).

DALYs:

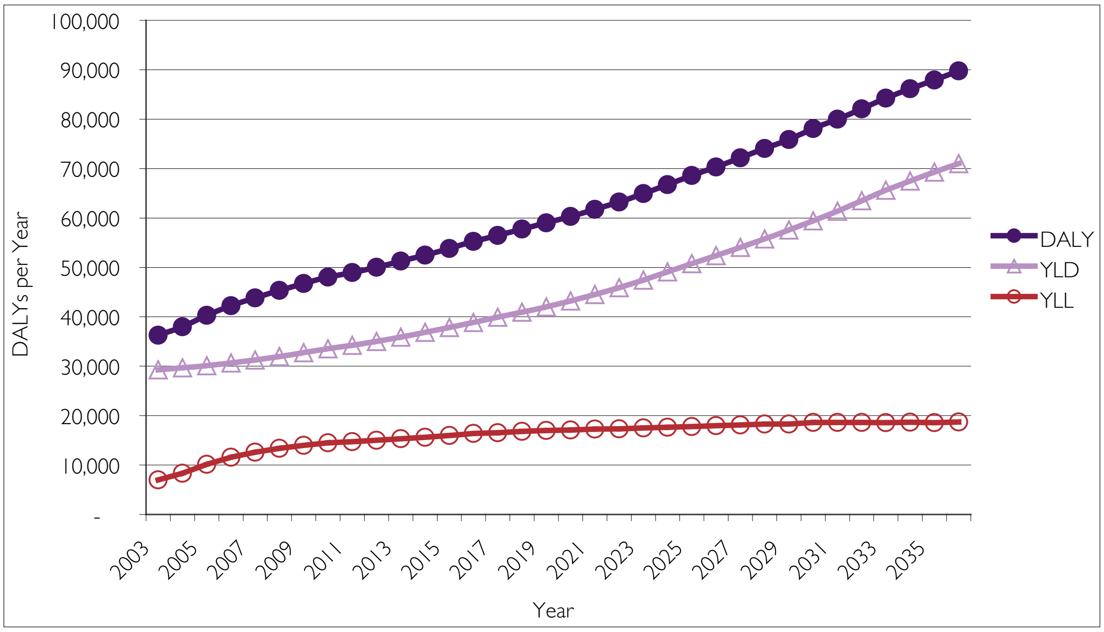
- Between 2006 and 2016, the average growth rate is estimated to be 2.72% per annum (2.94% per annum for males and 2.47% per annum for females).
- Between 2017 and 2036, the average growth rate is estimated to be 2.45% per annum (2.82% per annum for males and 1.97% per annum for females).

Table 11 Burden of Melanoma ain NSW

	Year	All	Males	Females
YLL				
	2007	12,581	7,260	5,321
	2016	16,404	9,517	6,887
	2036	18,734	10,906	7,828
YLD				
	2007	31,256	16,295	14,962
	2016	38,856	20,818	18,038
	2036	71,014	42,034	28,979
DALY				
	2007	43,837	23,554	20,283
	2016	55,260	30,335	25,385
	2036	89,474	52,940	36,807

Figure 62 NSW Melanoma DALYs (2003–2036)

Total population, males and females, all age groups. Simulated expectation.



Disability data: Colin Mathers, Chris Stevenson, Simon Eckermann (1999) AIHW, Disability Coefficients for different cancer types; and Males JM, Essink-Bot, Kramers PG, et al: A national burden of disease calculation: Dutch disability-adjusted life-years. American Journal of Public Health 90(8): 121-1247, 2000.

15.5 Melanoma – Summary

Melanoma Incidence

2007–2016 (10-year simulation period)

The number of new melanoma cases in 2016 represent a 29.9% increase from what was expected in 2007 (33.8% increase for males and 24.2% increase for females).

The total number of NSW residents expected to be diagnosed with melanoma from 2007 through to 2016 is about 43,921 (cumulative) of which approximately 26,702 will be males (60.8%) and 17,219 will be females (39.2%). These cumulative number of new cases represent a 40.0% increase from the previous 10 years (1997–2006) which represent a 44.8% increase for males and a 33.1% increase for females.

2007–2036 (30-year simulation period)

The number of new melanoma cases in 2036 represent an 85.3% increase from what was expected in 2007 (102.7% increase for males and 60.0% increase for females).

The total number of NSW residents expected to be diagnosed with melanoma from 2007 through to 2036 is about 167,072 (cumulative) of which approximately 104,967 will be males (62.8%) and 62,105 will be females (37.2%). These cumulative number of new cases represent a 149.2% increase from the previous 30 years (1977–2006) which represents a 178.5% increase for males and 111.6% increase for females.

Melanoma Mortality

2007-2016 (10-year simulation period)

The total number of NSW residents expected to prematurely die from melanoma from 2007 through to 2016 is about 7,976 (cumulative) of which approximately 4,815 will be males (60.4%) and 3,162 will be females (39.6%). These cumulative number of deaths represent a 71.0% increase from the previous 10 years (1997–2006) which represent a 70.8% increase for males and a 68.8% increase for females.

2007–2036 (30-year simulation period)

The total number of NSW residents expected to prematurely die from melanoma from 2007 through to 2036 is about 29,367 (cumulative) of which approximately 18,059 will be males (61.5%) and 11,308 will be females (38.5%) will die from melanoma. These cumulative number of deaths represent a 181.5% increase from the previous 30 years (1977–2006) which represent a 180.9% increase for males and a 182.4% increase for females.

Melanoma Prevalence

2007–2016 (10-year simulation period)

The total number of NSW residents expected to be living with melanoma in 2016 is estimated to be about 50,260 which is about 24.4% higher than estimations for 2007 (27.8% increase for males and 20.7% increase for females).

2007–2036 (30-year simulation period)

The total number of NSW residents expected to be living with melanoma in 2036 is estimated to be about 91,949 which is about 127.6% higher than estimations for 2007 (158.1% increase for males and 94.1% increase for females).

15.6 Total economic cost of melanoma in NSW

2007–2016 (10-year simulation):

Melanoma is estimated to cost the economy total of about $14.8 billion in the next 10 years:

- Health cost impacts amount to over $130 million.
- Net wage impacts amount to over $6.9 billion.
- Net corporate profit impacts amount to over $3.7 billion.
- Net taxation revenue impacts amount to over $4.1 billion.

2007–2036 (30-year simulation):

Melanoma is estimated to cost the economy total of about $39.3 billion in the next 30 years:

- Health cost impacts amount to over $369 million.
- Net wage impacts amount to over $18.1 billion.
- Net corporate profit impacts amount to over $9.9 billion.
- Net taxation revenue impacts amount to over $10.9 billion.

16. Lung Cancer

- Lung cancer numbers will continue to rise in NSW over the next 30 years.
- Lung cancer in females will continue to rise at a higher rate than in males.
- Prevalence of lung cancer will be higher in males until 2020, after which point prevalence in females will become higher.
- Premature death will continue to be the main contributing factor in burden of disease in lung cancer.
- Lung cancer is estimated to cost the New South Wales economy about $8 billion in the next 10 years and $19 billion in the next 30 years.

16.1 Lung cancer – new cases

In this report smoking has been used as the major modifiable risk factor for the onset of lung cancer. The prevalence figures for smoking in NSW and population age distribution estimated previously were used for projection of lung cancer incidence, mortality, prevalence and subsequent economic costs.

Historical incidence of lung cancer between 1972 and 2003 were obtained from NSW CCR and incidence from 2004 through to 2036 in NSW were simulated (**Figure 63**). Age and gender breakdown of historical and simulated lung cancer incidence in the NSW population was further analysed (**Figure 64**).

The number of new lung cancer cases in NSW is expected to increase throughout the simulation period with the primary driver due to an increase in population aged 50 years and over.

16.2 Lung cancer – deaths

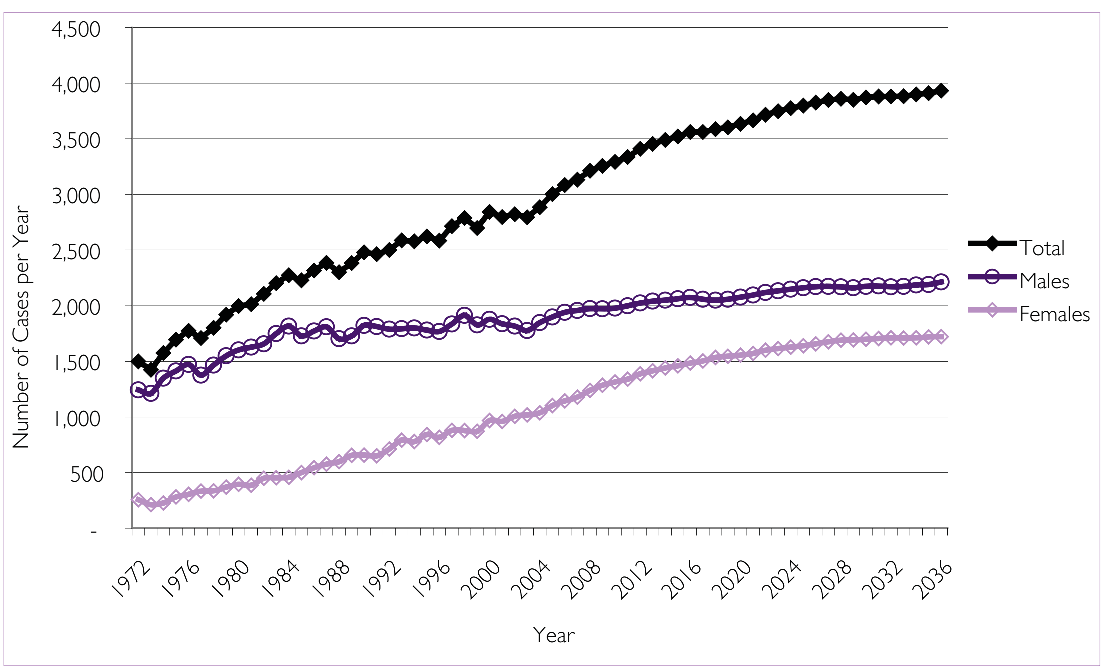
Historical mortality for lung cancer between 1972 and 2003 were obtained from GRIM Books 2003 and mortality from 2004 through to 2036 was simulated (**Figure 65**). Age and gender breakdown of historical and simulated lung cancer mortality in the NSW population was further projected (**Figure 66**).

The number of deaths attributed to lung cancer in NSW is expected to fluctuate slightly throughout the simulation period, with an overall upward trend. It is expected that lung cancer mortality among older people will continue to remain higher in the future for both genders with major contribution attributed to those aged 50 years and over.

Historical and projected incidence and mortality between 1972 and 2036 were compared (**Figure 67**). The number of lung cancers diagnosed and deaths are expected to increase throughout the simulation period. Incidence is expected to increase at a slightly higher rate than deaths, suggesting that the number of people in NSW living with lung cancer (prevalence) will increase in the future.

Figure 63 NSW New Lung Cancer Cases (1972–2036)

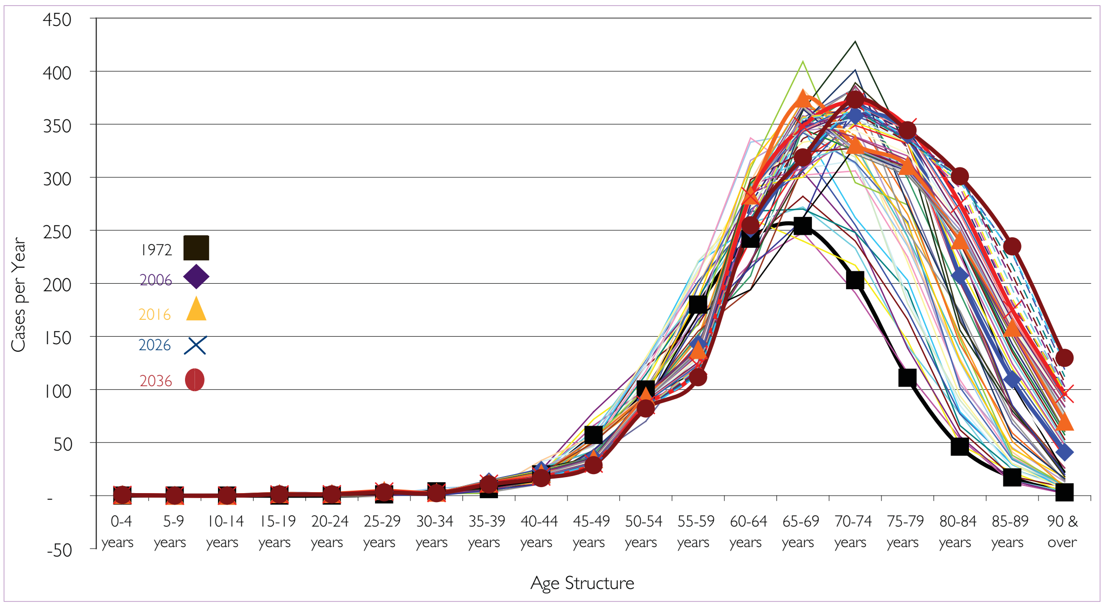
Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 64a NSW New Lung Cancer Cases, Population Age Distribution, males (1972–2036)

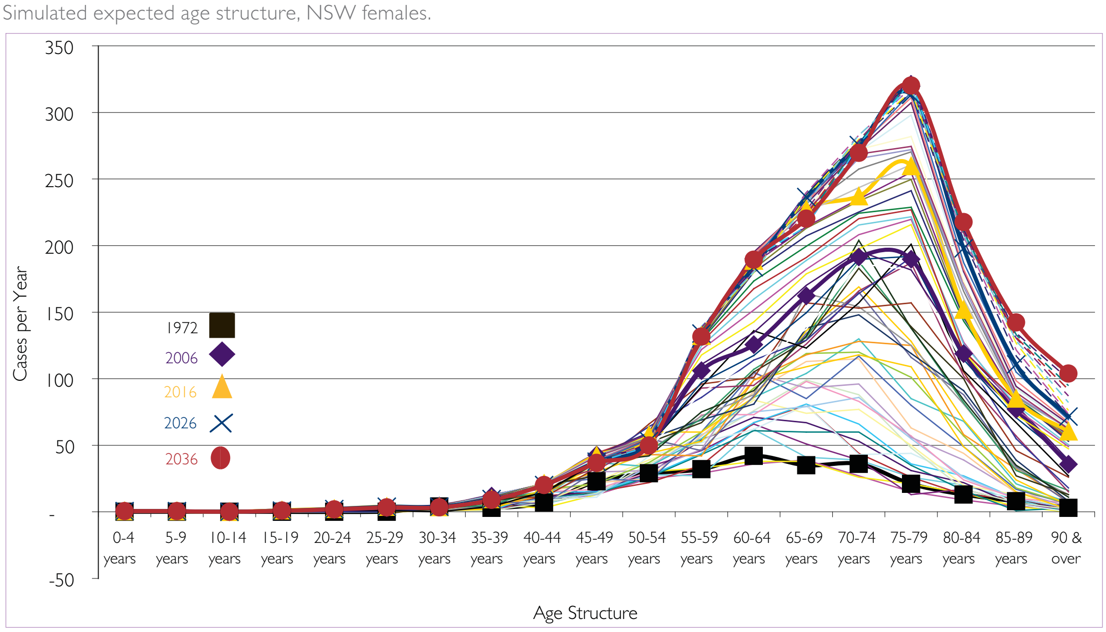
Simulated expected age structure, NSW males.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 64b NSW New Lung Cancer Cases, Population Age Distribution, females (1972–2036)

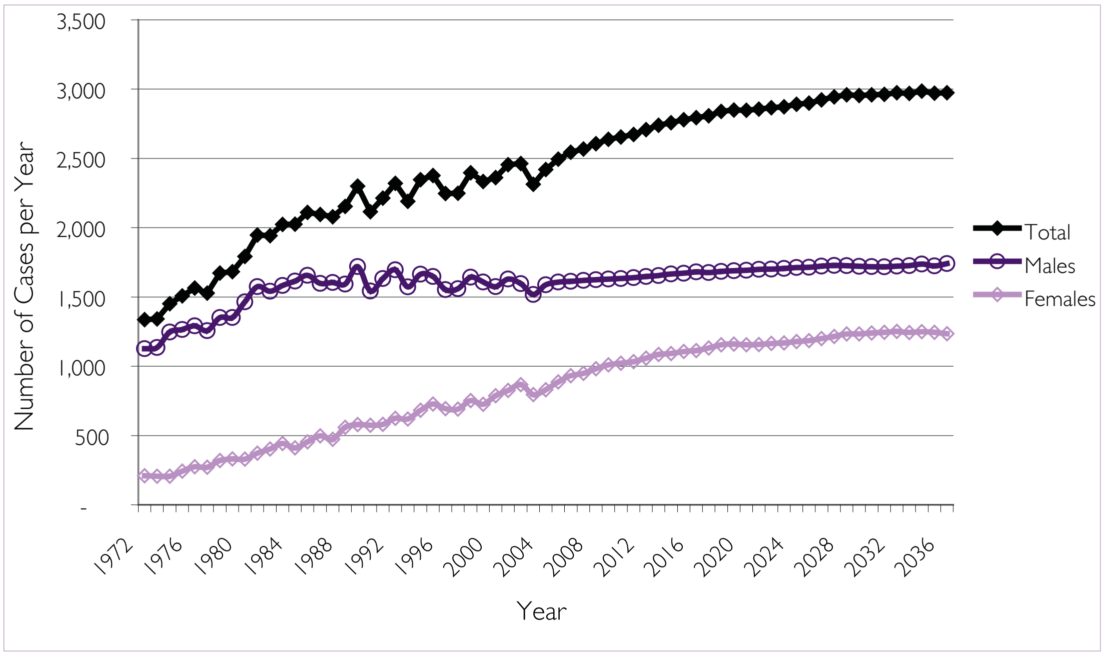
Simulated expected age structure, NSW females.



Historical incidence data up to 2003: NSW Central Cancer Registry.

Figure 65 NSW Lung Cancer Deaths (1972–2036)

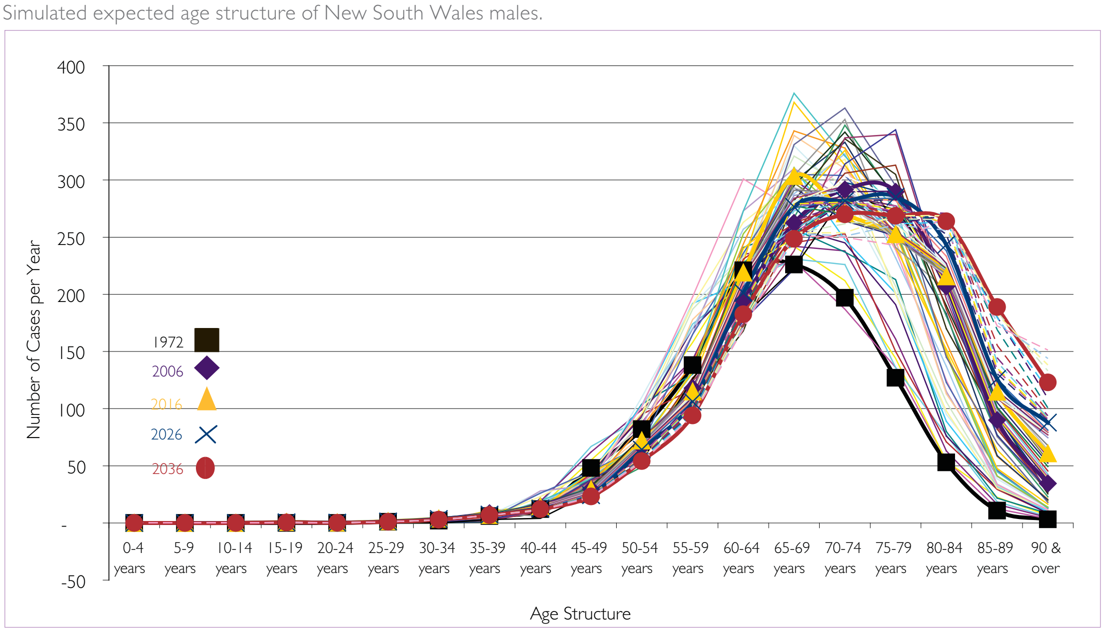
Total population, males and females, all age groups. Simulated expectation.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books) 2003.

Figure 66a NSW Lung Cancer Deaths, Population Age Distribution, males (1972–2036)

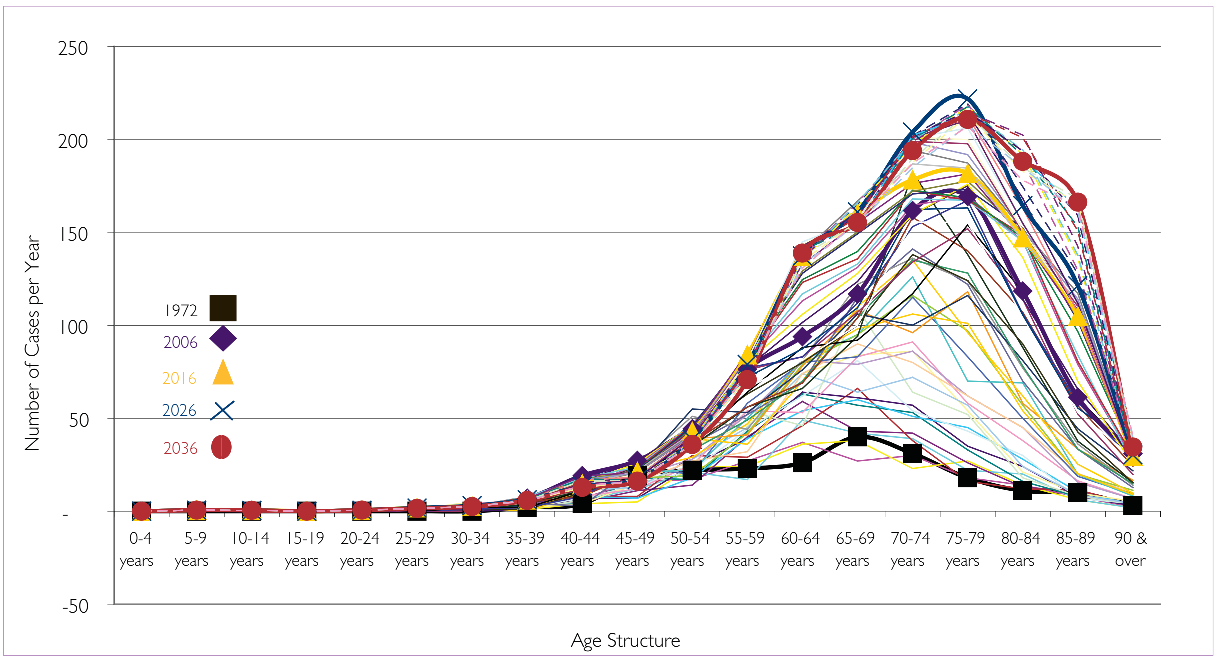
Simulated expected age structure of New South Wales males.



Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books) 2003.

Figure 66b NSW Lung Cancer Deaths, Population Age Distribution, females (1972–2036)

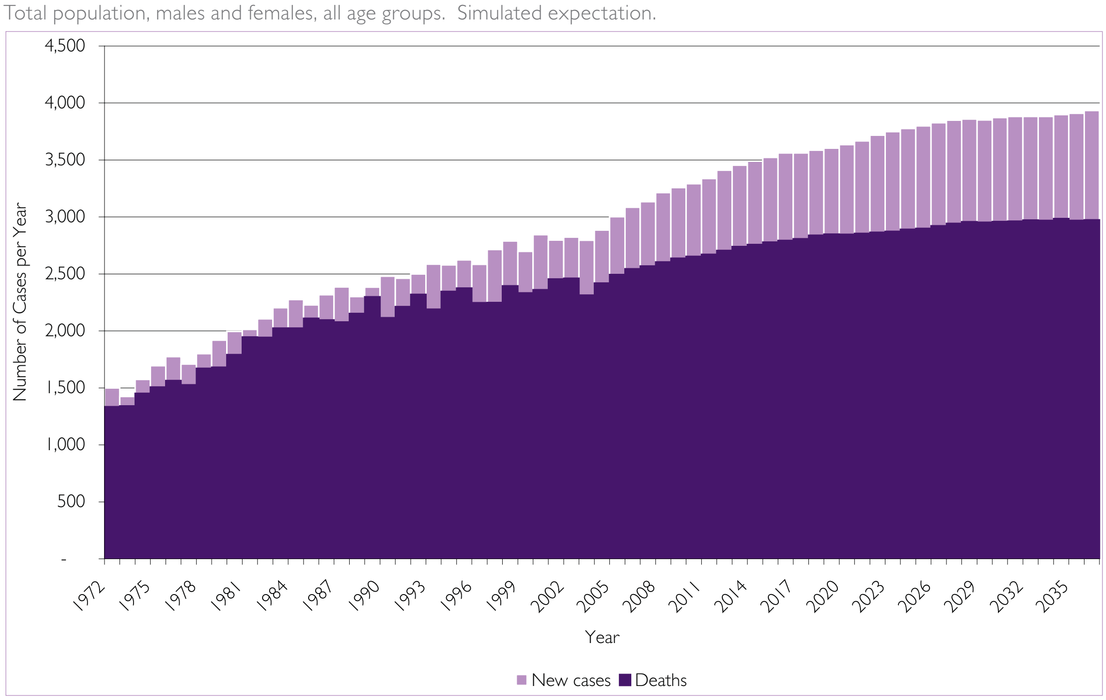
Simulated expected age structure of New South Wales females.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 67 NSW New Lung Cancer Cases and Deaths (1972–2036)

Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

16.3 Lung cancer – prevalence

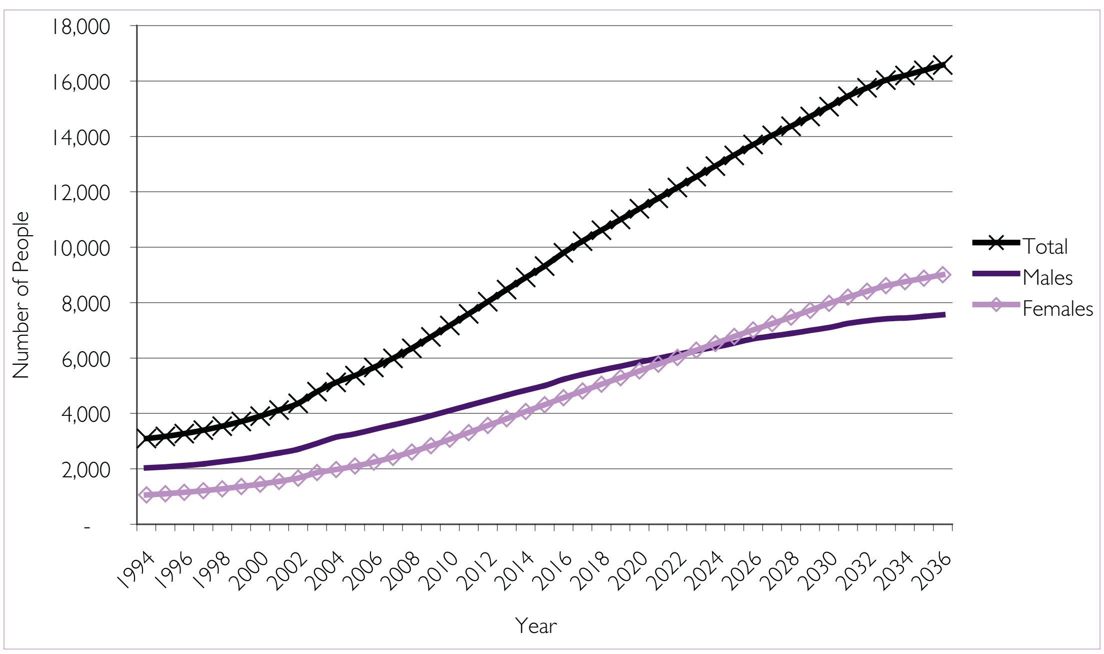
Historical prevalence of lung cancer between 1994 and 2003 was obtained and prevalence from 2004 through to 2036 were simulated (**Figure 68**). Age and gender breakdown of historical and simulated lung cancer prevalence in the NSW population was further projected (**Figure 69**).

Lung cancer prevalence in NSW is expected to increase throughout the simulation period in males and females.

The prevalence of lung cancer is projected to be higher in males until early 2020s after which point the prevalence in females is projected to become higher.

Figure 68 NSW Lung Cancer Prevalence (1994–2036)

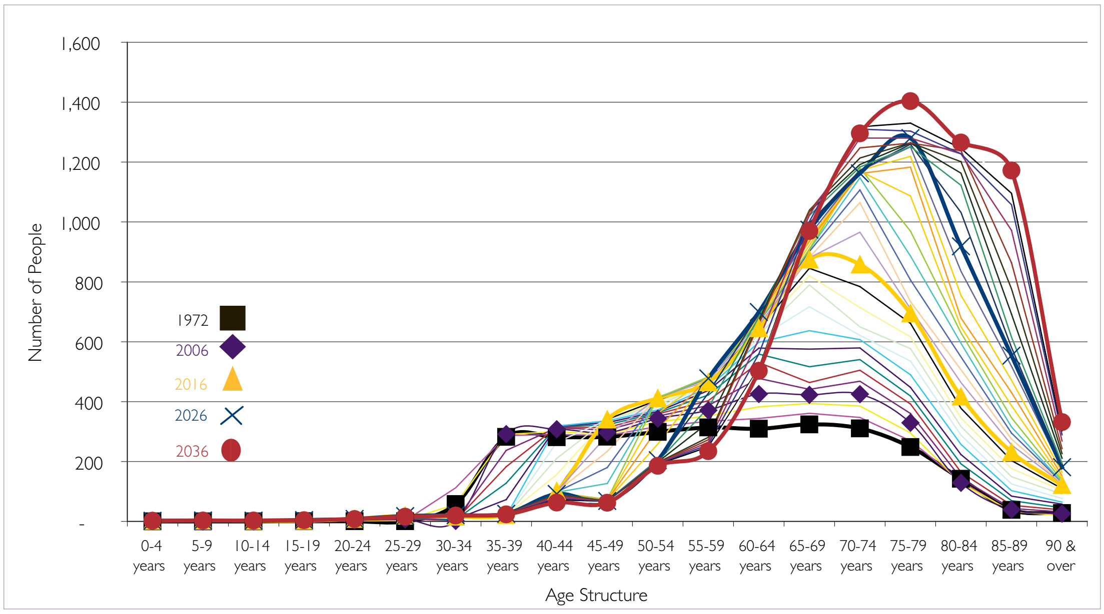
Total population, males and females, all age groups. Simulated expectation.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 69a NSW Lung Cancer Prevalence (2003–2036)

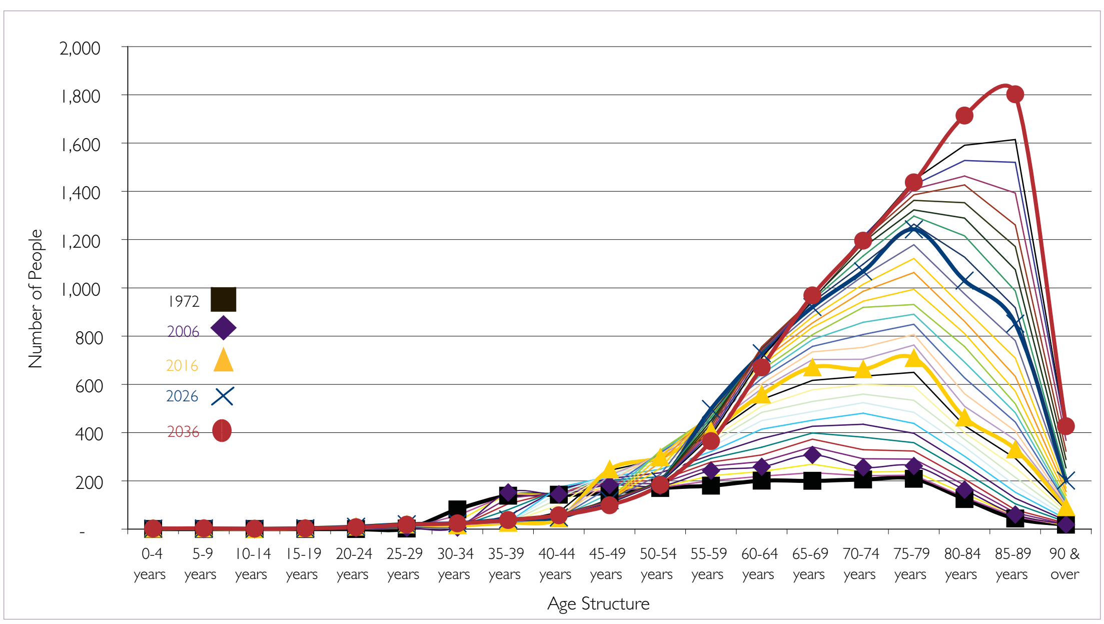
Simulated expected age structure of New South Wales males.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

Figure 69b NSW Lung Cancer Prevalence (2003–2036)

Simulated expected age structure of New South Wales females.



Historical incidence data up to 2003: NSW Central Cancer Registry. Historical mortality data up to 2003: AIHW General Record of Incidence of Mortality (GRIM Books), 2003.

16.4 Lung cancer – DALYs

Burden of lung cancer in NSW measured in DALYs for all age groups of both genders between 2003 and 2036 was simulated (**Figure 70**).

It is expected that the DALYs will increase in the first 10 year period with a plateau reached in the next 20 years. Number of years lost due to lung cancer remains to be the main contributing factor in number of DALYs through-out the simulation period. The contribution from disability is expected to be increasing later in the simulation period but the contribution toward DALYs will remain low attributed to low survival for this disease.

The simulated DALYs indicated that in NSW (**Table 12**):

YLLs:

- Between 2006 and 2016, the average growth rate is estimated to be 0.94% per annum (0.58% per annum for males and 1.46% per annum for females).
- Between 2017 and 2036, the average growth rate is estimated to be -0.23% per annum (-0.47% per annum for males and 0.06% per annum for females).

YLDs:

- Between 2006 and 2016, the average growth rate is estimated to be 5.70% per annum (4.42% per annum for males and 7.42% per annum for females).
- Between 2017 and 2036, the average growth rate is estimated to be 2.70% per annum (1.89% per annum for males and 3.49% per annum for females).

DALYs:

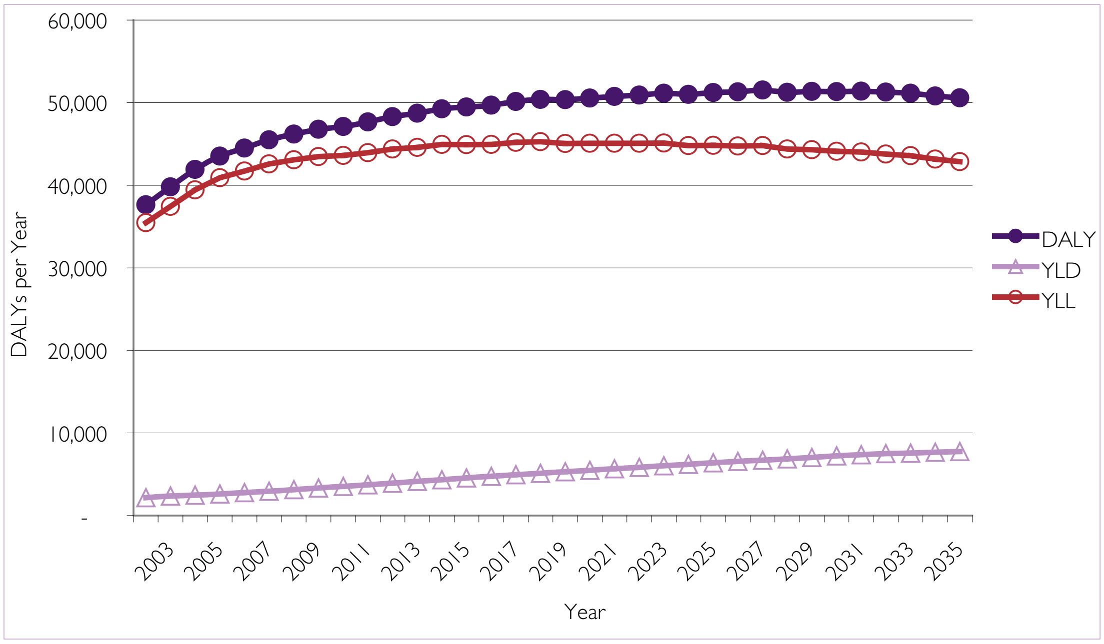
- Between 2006 and 2016, the average growth rate is estimated to be 1.29% per annum (0.85% per annum for males and 1.91% per annum for females).
- Between 2017 and 2036, the average growth rate is estimated to be 0.11% per annum (-0.22% per annum for males and 0.52% per annum for females).

Table 12 Burden of Lung Cancer in NSW

	Year	All	Males	Females
YLL				
	2007	41,711	24,686	17,025
	2016	44,918	25,638	19,280
	2036	42,847	23,339	19,508
YLD				
	2007	2,769	1,648	1,121
	2016	4,554	2,425	2,129
	2036	7,746	3,525	4,220
DALY				
	2007	44,480	26,334	18,146
	2016	49,472	28,063	21,409
	2036	50,593	26,864	23,728

Figure 70 NSW Lung Cancer DALYs (2003–2036)

Simulated expected age structure of New South Wales females.



Disability data: Colin Mathers, Chris Stevenson, Simon Eckermann (1999) Australian Institute for Health and Welfare, Disability Coefficients for different cancer types; and Males JM, Essink-Bot ML, Kramers PG, et al: A national burden of disease calculation: Dutch disability-adjusted life-years. Amercian Journal of Public Health 90(8): 1241-1247, 2000.

16.5 Lung cancer in NSW – Summary

Lung Cancer Incidence

2007–2016 (10-year simulation period)

The number of new cases of lung cancer in 2016 represent a 13.6% increase (6.1% increase for males and 26.0% increase for females) from what was expected in 2007.

The total number of NSW residents expected to be diagnosed with lung cancer from 2007 through to 2016 is expected to be about 33,673 (cumulative) of which approximately 20,131 will be males (59.8%) and 13,543 will be females (40.2%). These cumulative number of new cases represent an 18.4% increase (8.4% increase for males and a 37.2% increase for females) in the number of lung cancer cases from the previous 10 years (1997–2006).

2007–2036 (30-year simulation period)

The number of new cases of lung cancer in 2036 represent a 25.5% increase (13.1% increase for males and 46.1% increase for females) from what was expected in 2007.

The total number of NSW residents expected to be diagnosed with lung cancer from 2007 through to 2036 is 109,413 (cumulative) of which approximately 62,985 will be males (57.6%) and 46,429 will be females (42.4%). These cumulative number of new cases represent a 48.1% increase (19.5% increase for males and 119.3% increase for females) in the number of lung cancer cases from the previous 10 years (1997–2006).

Lung Cancer Mortality

2007–2016 (10-year simulation period)

The number of deaths due to lung cancer in 2016 represent an 8.8% increase (3.8% increase for males and a 17.3% increase for females) from what was expected in 2007.

The total number of NSW residents expected to prematurely die from lung cancer from 2007 through to 2016 is predicted at about 26,918 (cumulative) of which approximately 16,464 will be males (61.2%) and 10,453 will be females (38.8%). These cumulative number of deaths represent a 12.0% increase from the previous 10 years (1997–2006), which represent a 3.3% increase for males and a 29.1% increase for females.

2007–2036 (30-year simulation period)

The number of deaths due to lung cancer in 2036 represent a 15.8% increase (7.4% increase for males and 30.0% increase for females) from what was expected in 2007.

The total number of NSW residents expected to prematurely die from lung cancer from 2007 through to 2036 is about 85,220 (cumulative) of which approximately 50,725 will be males (59.5%) and 34,495 will be females (40.5%). These cumulative number of deaths represent a 30.7% increase from the previous 30 years (1977–2006) which represents a 7.6% increase for males and a 91.2% increase for females.

Lung Cancer Prevalence

2007–2016 (10-year simulation period)

The total number of NSW residents expected to be living with lung cancer in 2016 is estimated to be about 9,799 which is about 63.5% higher than prevalence in 2007 (46.3% increase for males and 89.1% increase for females).

2007–2036 (30-year simulation period)

The total number of NSW residents expected to be living with lung cancer in 2036 is estimated to be about 16,575 which is about 176.6% higher than prevalence in 2007 (111.3% increase for males an 271.0% increase for females).

16.6 Total economic cost of lung cancer in NSW

2006–2016 (10-year simulation)

Lung cancer is estimated to cost the economy total of about $8.1 billion in the next 10 years:

- Health cost impacts amount to over $537 million.
- Net wage impacts amount to over $2.9 billion.
- Net corporate profit impacts amount to over $2.7 billion.
- Net taxation revenue impacts amount to over $2.0 billion.

2006–2036 (30-year simulation)

Lung cancer is estimated to cost the economy total of about $19.4 billion in the next 30 years:

- Health cost impacts amount to over $1.3 billion.
- Net wage impacts amount to over $6.8 billion.
- Net corporate profit impacts amount to over $6.4 billion.
- Net taxation revenue impacts amount to over $4.9 billion.

17. Discussion

Latest Australian cancer predictions indicate an increase of about 30% in number of patients diagnosed in the 10-year period between 2001 to 2011 compared to the decade before.[16] Projections for NSW population also indicate similar trends.[17]

The number of new cancer cases is expected to increase at a higher rate than mortality, suggesting an increase in cancer prevalence in the future with more cancer survivors with an associated increased need for health care. The projected rise in cancer numbers is expected to be due to the ageing of the population in Australia and NSW with more cancers expected in older people. The growing population is also expected to drive cancer numbers up.

In addition to changes in population demographics, lifestyle factors, also referred to as modifiable risk factors, will substantially influence the onset and number of cancers detected. The most important modifiable risk factor for cancer is tobacco. Smoking has been shown to increase tobacco related cancers, most importantly lung cancer followed by many others such as bladder, head and neck, pancreas and kidney cancer.[18] Other modifiable risk factors including lack of physical activity, excessive sun exposure and overweight or obesity are expected to substantially influence the number of cases of cancer detected in the future.[19]

According to the current study and others, age standardised lung cancer rates are expected to decrease due to future reduction in smoking prevalence.[16] This drop is expected to be more prevalent initially in males. This expected difference in lung cancer prevalence between males and females is primarily due to the differences in smoking exposure dynamics between the two sexes. Smoking rates, daily and occasional, are currently at around 18% in NSW (19.2% for males and 16.2% for females).[xvii] Since smoking remains the largest risk factor for lung cancer, even slight changes between male and female quitting rates is predicted to have a large impact on the long term annual incidence of lung cancer. According to this study females have a later peak in tobacco consumption compared to males which in turn will influence the number of lung cancers detected in the future.

Obesity is another important risk factor expected to rise resulting in an increase of risk for several cancers.[20]

Cancer numbers will increase with the ageing population, thus having substantial financial implications for the New South Wales economy.

Australian obesity is now at record high with about 50% of the population overweight or obese (58% males and 40% females).[xviii] Overweight and obesity has been shown to be directly related to increasing risk of several cancers including, cancer of the bowel, prostate and breast.[21]

Prostate cancer is expected to be the largest type of cancer diagnosed in the next 10 and 30 years with about 18% of cases attributed to this cancer by 2016. The number of prostate cancers detected is highly influenced by the uptake of Prostate Specific Antigen (PSA) in the population. There is currently no conclusive evidence available about the benefit of PSA in reducing prostate cancer mortality and as such large-scale population screening using this technique is not currently recommended pending the results of large ongoing international clinical trials.

The predicted rise in cancer numbers is expected to have both direct and indirect impacts on the economy. The direct effects include the cost of health care associated with the disease. This is expected to rise by around 8% over the next 10 years and 50% over the next 30 years. Cancer is also expected to have significant indirect impact on the economy. Estimating such indirect costs is difficult and may be an underestimate. This report estimates the impact that premature death and disability will have on tangible variables such as wages, corporate profits and government taxation revenue.

It is expected that cancer will cost NSW around $106 billion and $325 billion in the next 10 and 30 years respectively. These costs however, do not measure the intangible but significant costs of pain and suffering associated with cancer in our community.

xvii. Cancer Institute NSW

xviii. ABS,National Health Survey, Australia2004–2005

Prostate and breast cancer combined will represent more than 15% of the total cost of cancer care in NSW. However, the cost component of prostate cancer will increase over time while the cost component of breast cancer will decrease over time. Prostate cancer is expected to become the most expensive cancer to manage. It is expected that prostate cancer will cost the NSW health system over $1.6 billion and $6.5 billion in the next 10 and 30 years respectively. The total costs of managing and living with prostate cancer is expected to cost the NSW economy over $27 billion and $77 billion over the next 10 years and 30 years respectively.

The cost per lung cancer case per year is relatively high (35% above the average) associated with the high cost of end-of-life care. This is considered to be primarily due to high mortality rate amongst lung cancer patients which increases the palliative portion of health costs for lung cancer patients, which are generally higher than not palliative health care costs.

It is further predicted that in the next 10 and 30 years there will be significant shifts in labour force demographics. The rise in labour force affected by cancer is expected to be primarily due to an increased reliance on an older workforce (most predominantly for women) which increases the risk of lost labour force productivity as a consequence of cancer. This is further predicted to have significant impact on key economic variables such as generation and use of wages, corporate profitability and the ability to raise revenues through government taxation to provide necessary services such as health care, infrastructure and other services. These other changes discussed above are expected to have a 'double dipping' influence on the NSW economy with cancer numbers rising and our ability to pay for cancer costs diminishing in return.

The large expected numbers of cancers and deaths documented in this report assumes that we will continue as we have to prevent, detect and manage cancer. The opportunity is now to radically improve prevention and early detection so that the future of cancer we have predicted is substantially modified and improved. Control of cancer through prevention activities such as reducing smoking rates and reducing rates of overweight and obesity, alcohol use, sun exposure, and lack of physical activity in the population are expected to provide new opportunities to avoid cancer and cancer deaths. Earlier detection of cancer through effective population awareness and screening could both lower cancer mortality rates and the cost of providing health care. In NSW the survival for localised cancer is 82.8% or around 20% better than the current experience with all cancers at diagnosis.[3] Population screening programs such as breast screening and cervical screening have helped reduce mortality from breast and cervical cancer. For breast cancer, the age-standardised mortality rate for the target age group (50–69 years) declined from 66.7 in 1989 to 54.1 per 100,000 women in 2003. [22] Between 1972–2003 incidence rate for cervical cancer in NSW decreased by 58% and mortality rates decreased by 67%.[xix] The implementation of the universal population bowel screening program would be expected to reduce mortality rates by about 17% or more among those screened.[23-25]

The influence of research and the translation of research into clinical practice is expected to have a significant impact on how we manage and pay for cancer in the future. A review conducted by the Cancer Institute NSW demonstrates that investment in cancer research has contributed in reducing cancer mortality by 16% in men and 10% in women in the last decade.[26] It is estimated that for every dollar spent on research we can expect about $3.5 return in health benefits. It is predicted that the health benefits of reductions already seen in cancer should deliver about $170 billion in health returns in the next 10 years for NSW.[26] This report provides a strong argument for the importance of research investment and the likely financial benefits expected in years to come in reducing the expected incidence and death rate from cancer.

xix. Cancer Institute NSW, www.cancerinstitute.org.au

Appendixes

18. Appendix A Definitions

18.1 1993/1994 Cost Category definitions

The 1993/94 estimates of health sector cancer expenditures included the following expenditure categories: hospital inpatients and outpatients; nursing homes; medical services; allied health professional services; pharmaceuticals; research; certain public health programs relating to cancer prevention (national breast and cervical cancer screening programs, and lung and skin cancer prevention programs) and 'other', which includes other institutional (not elsewhere classified), administration, and other non-institutional. These expenditure categories are defined as follows.

Hospital inpatient

Inpatient (admitted patient) total expenditures of public and private hospitals. Also included are private medical costs for private patients in public and private hospitals.

Hospital non-inpatients

Total hospital expenditures on outpatient services.

Medical services

Total expenditures on all private medical services except those to hospital inpatients (medical services for private patients in hospital are included under hospital inpatients). This category includes consultations with general practitioners and specialists as well as pathology tests and screening and diagnostic imaging services.

Pharmaceuticals

Total expenditures on prescription drugs (whether listed in the PBS or not) and non-prescription (over-the-counter) medicines apart from those dispensed in hospitals (included in estimates of hospital costs).

Nursing homes

Total expenditures of nursing homes for the aged but not institutions caring for the young disabled (considered as a "welfare" rather than health expenditure).

Allied health services

Total expenditures on visits to allied health practitioners excluding pharmacists but including dentists, apart from allied health services provided by hospitals.

Other

Total expenditures on certain cancer prevention programs (national screening programs for breast and cervical cancer, and lung and skin cancer prevention programs), for health and medical research, and for administration and other institutional and non-institutional health expenditure.

18.2 2000/2001 Category definitions

The 2000/01 estimates of health sector expenditures included the categories of hospital admitted patients, out-of-hospital medical services, pharmaceuticals requiring prescription and other professional services. Not included are research costs and over-the-counter drugs. The included expenditure categories are defined as follows.

Hospital admitted patients

The proportions of total expenditures in public acute–hospitals that relate to admitted patients, as estimated from Australian Hospital Statistics 2001–02 (AIHW 2003a). Also included are private hospital expenditure data derived from Australian Bureau of Statistics Private Health Establishments Survey.

Out-of-hospital medical services

Total expenditures on private medical services provided by both general practitioners and specialists. Also included are general practitioner, imaging, pathology, un-referred attendances and other medical services. 'Out-of-hospital medical' includes un-referred attendances, imaging, pathology and other medical services. Expenditures on the out-of-hospital medical services include un-referred attendances, and all other out-of-hospital medical services.

Pharmaceuticals

Total expenditures on pharmaceuticals issued under the Pharmaceutical Benefits Scheme and the Department of Veterans' Affairs Repatriation Pharmaceutical Benefits Scheme. Pharmaceuticals that are dispensed in hospitals are included in the estimates of hospital costs.

Other professional services obtained from Health Expenditure Australia 2001–02 (AIHW 2003b) and allocated to disease by adjusting 1993–94 disease figures for demographic change. The 2000–01 disease expenditure estimates for 'Other professional services' are therefore approximations and should be used with caution.

19. Appendix B Glossary

2006 PRESENT VALUE

The estimated value in the year specified as viewed by a person living in 2006. That is, it takes into account the time value of money and does not represent the actual estimated cost for the year specified. Time value of money is derived from a NSW Govt. zero coupon bond curve.

CANCER CORPORATE PROFIT IMPACT

Economic measure (opportunity cost) of cancer life impacts on the gross operating surplus of the businesses operating in NSW.

CANCER ECONOMIC INDICATORS

These indicators (wage impacts, corporate profit impacts and taxation revenue impacts) measure the economic (opportunity) costs associated with life impacts of caner in NSW.

CANCER LIFE IMPACTS

These indicators (cancer incidence, mortality and prevalence) measure the overall burden of cancer on the NSW health care system and the quality of life in the state.

CANCER TAXATION REVENUE IMPACT

Economic measure (opportunity costs) of cancer life impacts on the NSW budgetary revenue from payroll and income taxes levied on the individuals in the state.

CANCER WAGE IMPACT

Economic measure (opportunity costs) of cancer life impacts on wages of NSW employees.

CORPORATE PROFIT

Gross operating surplus based upon Australian Bureau of Statistics Series 5220.0 Table 24. Total Factor Income by Industry and Principal Components, New South Wales – Current prices.

DALY

The Disability Adjusted Life Years (DALY) index measures the total number of healthy life years lost due to cancer. It measures the burden of cancer within the population using a measure of mortality (YLL) and a measure of morbidity (YLD). That is, DALY index depends on the total amount of years lost due to mortality (YLL) and the number of healthy life years lost due to disability (YLD): where the time index *t* refers to the year of the simulation.

DEATH IMPACT

The net opportunity cost of a person who had died from the cancer assessed.

DIRECT IMPACT

An immediate consequence of the health effect of the cancer assessed.

DISABILITY IMPACT

The net opportunity costs of the reduced ability of a person with cancer to perform duties that otherwise were performed before the affliction of cancer.

HIGH BMI RISK FACTOR

In this report a BMI (Body Mass Index) above 25 (kg/m2) is considered as high.

INCIDENCE (OF CANCER)

The number of instances of cancer disease commencing during a given time in a specified population.

INDIRECT IMPACT

A follow-on consequence of the health effect of the cancer assessed.

LABOUR FORCE

Number of people in NSW 15 years of age and older.

NET PRESENT VALUE

Compares the value of a dollar today to the value of that same dollar in the future, taking inflation and returns into account.

NEW CANCER CASE

New diagnosed case of a cancer disease in a defined population.

PHYSICAL INACTIVITY RISK FACTOR

Prevalence of persons reporting inadequate physical activity (less than 150 minutes of physical activity, less than five sessions per week).

PREVALENCE (OF CANCER)

The instances of cancer in a given population at a designated time.

RISK FACTOR, CANCER

An aspect of personal behaviour, or life style, an environmental exposure, or an inborn or inherited characteristic known to be associated with a generic or a specific cancer.

SMOKING RISK FACTOR

Risk of Cancer incidence due to daily smoking. There is no differentiation made within this report between the severities of smoking.

TAXATION REVENUE

A net compulsory levy imposed by a government based upon Australian Bureau of Statistics Series 5506.0 Taxation Revenue, 2004–2005, Commonwealth and State Governments.

TOTAL CANCER IMPACT

The sum of all impacts related to the cancer assessed for the economic variable considered. Total impact includes direct and indirect impacts from disability and death from the cancer assessed.

TOTAL CORPORATE INCOME TAXATION

Australian Federal Income taxes levied on enterprises.

TOTAL HEALTH CARE EXPENDITURE

The sum of Hospital Admitted Patients, Out-of-Hospital Medical Services, Pharmaceutical Required Prescriptions and Other Professional Services. Not included are Research Costs, Over-the-Counter Drugs.

TOTAL PAYROLL TAXATION

Australian Federal and NSW Employers payroll taxes.

TOTAL PERSONAL INCOME TAXATION

Australian Federal Income taxes levied on individuals.

WAGE

Compensation to employees based upon Australian Bureau of Statistics Series 5220.0 Table 24. Total Factor Income by Industry and Principal Components, New South Wales – Current prices.

YLD

Years lived with disability (YLD) index calculates a burden of a disease due to morbidity (quality of life lost). YLD is calculated as the incidence multiplied by the average time spent with a disease, weighted for the extent of associated disability caused by the disease.

YLL

Total number of years of life lost (YLL) index calculates a burden of a disease due to mortality (quantity of life lost). YLL is calculated as the age-specific mortality multiplied by age-specific life expectancy.

20. Appendix C Risk factor literature review

The chronic disease module simulated the incidence and mortality of the various cancers associated with smoking, obesity, physical activity and sun exposure. Relative risk estimates for incidence and mortality were obtained from a literature review. This section provides a summary of the literature review which includes a brief study description and relative risk estimates for cancers associated with each risk factor.

20.1 Risk factor: smoking

Lung Cancer Incidence – Males

Shaper et al. (2003) studied the association of smoking and the risk of lung cancer in a prospective cohort study of 7,121 men aged 40–59 from 24 British towns.[27] The mean follow-up period was 21.8 years. Primary pipe/cigar smokers were defined as never smoking cigarettes and currently smoke a pipe or cigar. Secondary pipe/cigar smokers were former cigarette smokers who then smoked a pipe or cigar. Ex-smokers were those who used to smoke cigarettes and did not smoke pipe/cigar. In this study the relative risk estimates were adjusted for physical activity, social class, alcohol intake, antihypertensive treatment, age, BMI, systolic blood pressure and serum total cholesterol (**Table A1**).

Table A1[27]
Risk of lung cancer incidence associated with smoking habits for males

Smoking Status	RR	95% C.I.
Never	1.00	(reference)
Ex-Cigarette Smoker	1.32	(0.64, 2.70)
Primary Pipe/Cigar Smoker	5.52	(2.21, 13.78)
Secondary Pipe/Cigar Smoker	3.99	(1.90, 8.39)
Cigarettes/day		
1-19	4.54	(2.32, 8.85)
20	6.46	(3.30, 12.63)
≥21	11.25	(5.96, 21.26)

Relative risk estimates for the association between cigarette consumption (cigarettes per day) and lung cancer incidence from a cohort of 7,055 men aged 45–64 was reported by Renfrew and Paisley in the West of Scotland (**Table A2**).[28] The follow-up period was 10.5 years. No information was provided on adjustment factors.

Table A2[28]
Risk of lung cancer incidence associated with the number of cigarettes smoked per day for males

Cigarettes/day	RR
1-14	6.5
15-24	9.5
25-34	10.5
35+	9.7

The British Doctors' Study reported relative risk estimates for male smokers in the memorandum by British American Tobacco (**Table A3**).[29]

Table A3[29]
Risk of lung cancer incidence associated with smoking for males

Cigarettes/day	RR
1-14	8
≥25	25

Dosemeci et al. (1997) studied the effects of smoking on the risk of lung cancer incidence in a case-control study of men from an oncology treatment centre in Istanbul Turkey.[30] Only odds ratios were available due to study type. There were 1,210 lung cancer cases and 829 controls (**Table A4**). There was no information provided on adjustment factors.

Table A4[30]
Risk of lung cancer incidence associated with the number of cigarettes smoked per day for males

Smoking Status	OR	95% C.I.
Ever Smoked	3.3	(2.6, 4.4)
Cigarettes/day		
1-10	2.2	(1.4, 3.3)
11-20	3.1	(2.3, 4.1)
21+	6.6	(4.4.10.2)

The association between smoking and the risk of lung cancer incidence was also investigated in a study by Kabat in 1996.[31] The data were collected from hospital-based case-control studies conducted by the American Health Foundation in the US. Cases and controls were matched on age, sex, race, hospital and date of admission. Due to the type of study only odds ratios can be calculated (**Table A5**). The subjects were aged 20–80. There were 2,085 lung cancer cases and 3,951 controls. K1 – Kreyberg 1 is defined as squamous cell, small cell, and large cell lung carcinoma; and K2 – Kreyberg 2 is defined as adenocarcinoma, bronchiolar and alveolar carcinoma.

Table A5[31]
Odds ratio estimates for lung cancer associated with the number of cigarettes smoked per day for males

Cigarettes/day	OR (K1)	OR (K2)
1-10	13.3	2.4
11-20	15.8	8.4
21-30	29.6	15.4
31-40	37.7	11.1
41+	64.1	28.4

Mao et al. (2001) also studied the effects of smoking and smoking cessation on the risk of lung cancer incidence in a Canadian case-control study.[32] There were a total of 1,722 male lung cancer cases and 5,073 controls (male and female). Cases were selected from eight Canadian provinces' Provincial Cancer Registries. The controls were drawn from a random sample of individuals within the province. Due to the type of study only odds ratios were available (**Table A6**). The estimates were adjusted for the 10 year age group, province, and total years exposure to SHS, total consumption of vegetables, of vegetable juices and of meat. Smokers were defined as those who smoked at least 100 cigarettes in a lifetime.

Table A6[32]
Odds ratio estimates for lung cancer incidence associated with smoking habits and cessation for males

Smoking Pack-years	OR	95% C.I.
≤8	2.1	(1.4, 3.2)
9-18	3.6	(2.4, 5.2)
19-32	12.7	(9.0, 17.9)
≥33	27.9	(19.8, 39.4)
Smoking Status		
Never-smoker	1.00	(reference)
Ex-smoker	6.4	(4.6, 8.8)
Current smoker	17.3	(12.4, 24.2)
Years since Quitting		
≥29	1.5	(1.0, 2.4)
20-28	3.5	(2.4, 5.2)
11-19	7.3	(5.0, 10.5)
≤10	14.5	(10.2, 20.6)

Lung Cancer Incidence – Females

Rachtan and Sokolowski (1997) studied the effects of smoking on the risk of lung cancer in a case-control study of women in Cracow Poland.[33] There were 118 lung cancer cases and 141 controls. Due to the nature of the study only odds ratios can be calculated (**Table A7**).

Table A7[33]
Odds ratio estimates for lung cancer incidence associated with the number of cigarettes smoked for females

Cigarettes/day	OR	95% C.I.
< 10	3.64	(1.08, 12.32)
10-19	3.55	(1.75, 7.23)
≥ 20	13.77	(6.50, 29.16)

The association between passive and active smoking and lung cancer incidence among women in Poland was studied by Rachtan in 2002.[34] The relative risk estimates were age adjusted (**Table A8**). Ex-smokers were defined as those who have not smoked for 3 years prior to the interview.

Table A8[34]
Risk of lung cancer incidence associated with smoking for females

Smoking Status	RR	95% C.I.
Never	1.00	
Ex	3.29	(1.85, 5.87)
Current	13.98	(9.01, 21.68)
Cigarettes/day		
≤ 10	4.05	(2.35, 6.97)
11-20	11.16	(7.08, 17.58)
21-30	23	(8.22, 17.58)
≥ 30	45.84	(10.3, 204.66)

The British Doctors' Study and the American Cancer Society Study CPS-II, have reported the relative risk estimates for lung cancer in the memorandum by British American Tobacco (**Table A9**).[29]

Table A9[29]
Risk of lung cancer incidence associated with the number of cigarettes smoked per day for females

Study	Cigarettes/day	RR
British Doctors	1-10	3 (for smoking 21-30 years)
	31+	39 (for smoking 41-70 years)
CPS-II	1-14	1.3
	≥25	30

Kabat (1996) investigated the association between smoking consumption and the risk of lung cancer incidence.[31] The data were collected from hospital-based case-control studies conducted by the American Health Foundation in the US. Cases and controls were matched on age, sex, race, hospital and date of admission. Due to the type of study only odds ratios can be calculated. The subjects were aged 20–80. There were 2,085 lung cancer cases and 3,951 controls. This study estimated the odds ratios associated with the number of cigarettes smoked per day (**Table A10**). K1 – Kreyberg 1 is defined as squamous cell, small cell, and large cell lung carcinoma; and K2 – Kreyberg 2 is defined as adenocarcinoma, bronchiolar and alveolar carcinoma.

Table A10[31]
Risk of lung cancer incidence associated with the number of cigarettes smoked per day for females

Cigarettes/day	OR (K1)	OR (K2)
1-10	6.6	3.1
11-20	18.2	4.5
21-30	26.5	9.4
31-40	95.2	13.4
41+	88.7	20.7

Mao et al. (2001) also studied the effects of smoking and smoking cessation on the risk of lung cancer incidence in a Canadian case-control study.[32] There were a total of 1,558 female lung cancer cases and 5,073 controls (male and female). Cases were selected from eight Canadian provinces' Provincial Cancer Registries. The controls were drawn from a random sample of individuals within the province. Due to the type of study only odds ratios were available (**Table A11**). The estimates were adjusted for the 10 year age group, province, and total years exposure to SHS, total consumption of vegetables, of vegetable juices and of meat. Smokers were defined as those who smoked at least 100 cigarettes in a lifetime.

Table A11[32]
Risk of lung cancer incidence associated with smoking habits and years since cessation for females

Smoking Pack-years	OR	95% C.I.
≤8	1.5	(1.2, 2.1)
9-18	4.1	(3.1, 5.4)
19-32	13.0	(10.2, 16.6)
≥33	29.0	(22.1, 38.0)
Smoking Status		
Never-smoker	1.00	(reference)
Ex-smoker	4.3	(3.5, 5.4)
Current smoker	13.2	(10.6, 16.4)
Years since Quitting		
≥29	1.5	(1.0, 2.3)
20-28	1.6	(1.0, 2.3)
11-19	3.3	(2.4, 4.6)
≤10	11.8	(9.0, 15.4)

The association between smoking, cessation, and lung cancer in a cohort of 121,700 American women from the Nurses' Health Study was studied by Speizer et al. in 1999.[35] Subjects were between the ages of 30–55. The risk of lung cancer was decreased after cessation and it took approximately 15 years to reach the level of a non-smoker. The relative risk estimates were adjusted for age, and the number of years of smoking (**Table A12**).

Table A12[35]
Risk of lung cancer incidence associated with smoking habits and years since cessation for females

Smoking Status	RR	95% C.I.
Current	1.0	(reference)
Years since Cessation		
< 2	0.4	(0.2, 0.7)
2 - 4.9	0.6	(0.4, 1.0)
5 - 9.9	0.6	(0.4, 0.9)
10 - 14.9	0.1	(0.1, 0.3)
> 15	0.1	(0.1, 0.2)
Never	0.1	(0.1, 0.1)

Lung Cancer Incidence – male & females combined

Godtfredsen et al. (2005) studied the effects of smoking cessation on the risk of lung cancer incidence.[36] The data was collected from the Copenhagen Centre for Prospective Population studies which includes data from the Copenhagen City Heart Study, the Copenhagen Male Study, and the Glostrup Population Studies. Subjects included 11,151 men and 8563 women aged 20 to 93. Heavy smokers were defined as those smoking more than 15 cigarettes/day, reducers were those who reduced smoking from heavy smoking by a minimum of 50% without quitting, continued light smokers smoked 1–14 cigarettes/day, and quitters stopped smoking part way through the study. The relative risk estimates were adjusted for sex, cohort of origin, inhalation habits, tobacco type, and years as smokers (**Table A13**).

Table A13[36]
Risk of lung cancer incidence associated with smoking habits for males and females pooled

Smoking Status	RR	95% C.I.
Heavy smokers	1.00	(reference)
Reducers	0.73	(0.54, 0.98)
Light Smokers	0.44	(0.35, 0.56)
Quitters	0.50	(0.36, 0.69)
Ex-smokers	0.17	(0.13, 0.23)
Never Smokers	0.09	(0.06, 0.13)

Lung Cancer Mortality – Males

Marang-van de Mheen et al. (2001) studied the effects of smoking and lung cancer mortality in a cohort of 15,406 adults aged 45-64.[37] The subjects were from the Renfew and Paisley study in the West of Scotland. The relative risk estimates were adjusted for age (**Table A14**). There were 7,045 male subjects.

Table A14[37]
Risk of lung cancer mortality associated with cigarette consumption for males

Cigarettes/day	RR	95% C.I.
1-14	11.10	(5.89, 20.92)
15-24	16.42	(8.96, 30.06)
25+	17.99	(9.71, 33.32)

The association between smoking and the risk of lung cancer mortality was studied by Wen et al. (2004).[38] Two prospective cohorts in Taiwan were used to assess risk. The 1st cohort was a community-based cohort with 37,196 males and the 2nd cohort consisted of 39,147 male teachers and civil servants. The relative risk estimates were adjusted for age (**Table A15**).

Table A15[38]
Risk of lung cancer mortality associated with cigarette consumption for males

Cigarettes/day	RR	5% C.I.
≤ 10	2.06	(1.45, 2.94)
11-20	2.97	(2.21, 3.98)
>20	4.99	(3.29, 7.57)

The association between smoking habits and lung cancer mortality in a cohort of 1,268 retired male military cadres from 22 retirement centers in Xi'an China was investigated by Lam et al. (2002).[39] An ever smoker was defined as someone who smoked at least 1 cigarette per day for at least one year. A former smoker was defined as someone who had quit for at least 2 years. The relative risk estimates were adjusted for age, blood pressure, BMI, total cholesterol, triglycerides, alcohol consumption, exercise and existing disease (**Table A16**).

Table A16[39]
Risk of lung cancer mortality associated with smoking habits for males

Smoking Status	RR	95% C.I.
Never smoker	1.00	(reference)
Former Smoker	2.26	(0.87, 5.83)
Current Smoker	2.36	(0.90, 6.21)
Ever Smoker	2.31	(0.95, 5.61)
Cigarettes/day		
≤ 14	1.17	(0.33, 4.13)
15-24	2.97	(1.09, 5.09)
≥ 25	3.65	(1.21, 11.02)
Duration in years		
0	1.00	(reference)
≤ 19	0.88	(0.17, 4.61)
20-29	2.03	(0.61, 6.83)
30-39	2.79	(0.97, 8.00)
≥ 40	3.57	(1.25, 10.20)

The relative risks for the association between smoking and lung cancer mortality was estimated for a cohort of 7,055 men aged 45–64 in the West of Scotland (**Table A17**).[28] The follow up period was 10.5 years. No information was provided on adjustment factors.

Table A17[28]
Risk of lung cancer mortality associated with cigarette consumption for males

Cigarettes/day	RR
1-14	5.5
15-24	8.9
25-34	10.7
35+	7.5

Prescott et al. (1998) studied the effects of cigarette consumption and lung cancer mortality in a large cohort consisting of three longitudinal population studies in Copenhagen.[40] The studies included were the Copenhagen City Heart Study (CCHS), the Glostrup Population Studies (GPS) and the Copenhagen Male Study (CMS). The CCHS had 14,205 males and females over the age 20; the GPS study had 10,074 males and females; and the CMS had 5,076 males aged 40–59. The combined study population had a total of 30,917 subjects (13,465 females and 17,452 males). Cigarette consumption was measured in grams per day (there is approximately one gram of tobacco in one cigarette). The relative risk estimates for males were adjusted for age, study cohort and calendar period (**Table A18**).

Table A18[40]
Risk of lung cancer mortality associated with smoking habits for males

Smoking Status	RR
Never Smokers	1.0
Ex Smokers	5.5
Grams per day	
< 15	8.1
15+	17.3

Lung Cancer Mortality – Females

Marang-van de Mheen et al. (2001) studied the effects of smoking and lung cancer mortality in a cohort of 15,406 adults aged 45-64.[37] The female subjects (8,348) were from the Renfew and Paisley study in the West of Scotland.[28] The relative risk estimates were adjusted for age (**Table A19**).

Table A19[37]
Risk of lung cancer mortality associated with the number of cigarettes smoked per day for females

Cigarettes/day	RR	95% C.I.
1-14	4.73	(2.99, 7.50)
15-24	9.04	(5.97, 13.68)
25+	19.22	(11.55, 31.99)

The association between smoking and the risk of lung cancer mortality was studied by Wen et al. (2004).[38] Two prospective cohorts in Taiwan were used to assess risk. The first cohort was a community-based cohort of 28,965 females and the second cohort consisted of 32,204 female teachers and civil servants. The relative risk estimates were adjusted for age (**Table A20**).

Table A20[38]
Risk of lung cancer mortality associated with cigarette consumption for females

Cigarettes/day	RR
≤ 10	2.69
10-20	6.41
≥ 20	32.09

The population described previously by Prescott et al. (1998) was further used to study the effects of cigarette consumption and lung cancer mortality in the female population.[40] The relative risk estimates for females were adjusted for age, study cohort and calendar period (**Table A21**).

Table A21[40]
Risk of lung cancer mortality associated with smoking habits for females

Smoking Status	RR
Never Smokers	1.0
Ex Smokers	2.7
Grams per day	
< 15	6.2
15+	9.6

The impact of smoking cessation on lung cancer mortality was studied in a cohort of 49,165 Canadian women from the Canadian National Breast Screening Study, aged 40–59.[41] The relative risk estimates for lung cancer mortality was compared to never smokers (**Table A22**). Relative risk estimates were adjusted for age, university education, BMI, physical activity, alcohol consumption, hormone replacement therapy use, total fat, cereal fiber, beta carotene, vitamin A, vitamin C, and vitamin E.

Table A22[41]
Risk of lung cancer mortality associated with smoking cessation for females

Smoking Status	RR	Compared to Never Smokers 95% C.I	RR	Compared to Current Smokers 95% C.I.
Never	1.00	(reference)	0.07	(0.04, 0.13)
Current	14.04	(7.56, 26.07)	1.00	(reference)
Cessation (years)				
1-9	5.48	(2.52, 11.89)	0.39	(0.22, 0.69)
10-19	2.67	(1.00, 7.14)	0.19	(0.08, 0.44)
≥20	0.55	(0.07, 4.23)	0.04	(0.01, 0.28)

Lung Cancer Mortality – Males / Females

Ebbert et al. (2005) studied the impact of smoking cessation on lung cancer mortality in a cohort of 5,229 males and females from the Mayo Clinic in Minnesota with non-small cell and small cell lung cancers.[42] Relative risk estimates were given per 10 years and per 5 years of quitting for non-small cell lung cancer (NSCLC) and small-cell lung cancer (SCLC) respectively. The estimates were adjusted for age at diagnosis, packs/day smoked, years smoked, stage, and treatment (**Table A23**).

Table A23[42]
Risk of lung cancer mortality associated with smoking cessation

NSCLC	RR	95% C.I.
Females	0.85	(0.75, 0.97)
Males	1.00	(0.91, 1.10)
All patients	0.96	(0.88, 1.04)
SCLC		
Females	1.04	(0.84, 1.28)
Males	1.02	(0.89, 1.16)
All patients	1.04	(0.84, 1.28)

Previous evidence shows that endotoxin, which is contained in cigarettes, has a protective effect against cancer. When an individual quits smoking their risk of lung cancer increases for a short period of time then begins to decrease. A review by Lange et al. (2005) provided the relative risk estimates examining the association between smoking cessation and lung cancer (**Table A24**).[43]

Table A24[43]
Risk of lung cancer mortality associated with smoking cessation for males and females

Study	cessation (in years)	1-19 cig/day	20+ cig/day	Any
CPS-I	Current Smoker	6.5	13.7	
USA	<1	7.2	29.1	
	1-4	4.6	12.0	
	5-9	1.0	7.2	
	10+	0.4	1.1	
	Non-Smoker	1.0	1.0	
CPS-II	Current Smoker	10.3	21.2	
Women only	<2	13.6	32.4	
USA	3-5	8.4	20.3	
	6-10	3.3	11.4	
	11-15	3.0	4.1	
	16+	1.6	4.0	
	Non-Smoker	1.0	1.0	
US Veterans Study	Current Smoker			11.3
Men only	1-4			18.8
	5-9			7.5
	10-14			5.0
	15-19			5.0
	20+			2.1
	Non-Smoker			1.0
British Doctors Study	Current			15.8
UK	1-4			16.0
	5-9			7.5
	10-14			5.3
	15+			2.0
Nurses' Health Study	Current			1.0
Women only	<2			0.4
USA	2-4.9			0.6
	5-9.9			0.6
	10-14.9			0.1
	15+			0.1

Nia et al. (2005) studied the association between smoking, smoking cessation, and lung cancer mortality in a cohort of 321 patients from the University Hospital of Antwerp in Belgium.[44] The cohort (276 men and 45 women) were undergoing curative surgical resection for primary non-small cell lung cancer. Information was collected on smoking status. Patients were categorized into current, non-smokers, former smokers, and recent quitters. Non-smokers included patients that never smoked and patients that smoked cigars or pipes, former smokers were patients that quit smoking prior to their diagnosis with lung cancer, and recent quitters were patients that quit after their diagnosis and before the operation. The risk estimates were adjusted for age, sex, type of operation, histiotype, postoperative radiotherapy, localization, N-status, T-Status, previous malignancies, smoking status and interaction between stage and smoking status (**Table A25**).

Table A25[44]
Risk of lung cancer mortality associated with smoking and smoking cessation for males and females

Smoking Status	RR	95%C.I.
Current	1.00	(reference group)
Non-smokers	0.45	(0.21, 0.97)
Former smokers	0.54	(0.35, 0.84)
Recent quitters	0.34	(0.16, 0.71)

Breast Cancer Incidence

Terry et al. (2002) studied the association between smoking and breast cancer incidence in a cohort of 89,835 women aged 40–59 from the Canadian National Breast Screening Study.[45] The risk estimates were adjusted for age, treatment center, Quetelet Index, education, physical activity, oral contraceptive use, hormone replacement therapy use, age at menarche, history of benign breast disease, practice breast self-examination, breast cancer familial history, menopausal status, and alcohol use (**Table A26**). The number of years since cessation did not reduce the incidence of breast cancer. There was a significant association between heavy smoking and breast cancer.

Table A26[45]
Risk of breast cancer incidence associated with smoking and smoking cessation

Smoking Status	RR	95% C.I.
Never Smoker	1.00	(reference)
Cigarettes/day		
1-9	0.97	(0.85, 1.11)
10-19	0.98	(0.86, 1.11)
20-29	1.10	(0.99, 1.23)
30-39	0.90	(0.71, 1.16)
40+	1.34	(1.06, 1.69)
Trend test	p-value = 0.05	
Years since Cessation		
Current Smoker	1.00	(reference)
1-9	0.94	(0.81, 1.10)
10-19	1.06	(0.88, 1.28)
20+	0.93	(0.77, 1.22)
Trend test	p-value = 0.98	

The association between smoking and smoking cessation, and the risk of breast cancer incidence was also studied by Manjer et al. (2000).[46] This cohort consisted of 10,902 women from Sweden. The relative risk estimates were adjusted for age, height, BMI, parity, oral contraceptive use, hormone replacement therapy use, alcohol consumption, and menstrual status (**Table A27**).

Table A27[46]

Risk of breast cancer incidence associated with smoking and smoking cessation

Menopausal Status	Smoking Status	RR	95% C.I.
Premenopausal	never	1.00	(reference)
	Current	1.19	(0.85, 1.68)
	≤ 19 cig/day	1.10	(0.75, 1.60)
	≥ 20 cig/day	1.42	(0.85, 2.36)
	Ex-smokers	1.57	(1.07, 2.30)
	Cessation in years		
	>5	1.19	(0.70, 2.03)
	1-5	1.26	(0.58, 2.76)
	< 1	2.76	(1.55, 4.91)
Postmenopausal	never	1.00	(reference)
	Current	1.00	(0.74, 1.35)
	≤ 19 cig/day	0.99	(0.71, 1.40)
	≥ 20 cig/day	0.92	(0.58, 1.45)
	Ex-smokers	1.15	(0.82, 1.62)
	Cessation in years		
	>5	1.14	(0.75, 1.72)
	1-5	1.18	(0.55, 2.55)
	<1	N/A	
All women	never	1.00	(reference)
	Current	1.08	(0.86, 1.35)
	≤ 19 cig/day	1.03	(0.80, 1.33)
	≥ 20 cig/day	1.11	(0.79, 1.56)
	Ex-smokers	1.31	(1.02, 1.69)
	Cessation in years		
	>5	1.16	(0.83, 1.60)
	1-5	1.20	(0.70, 2.07)
	< 1	1.58	(0.95, 2.65)

Lash et al. (2002) studied the association between smoking and the risk of breast cancer in a case-control study with residents of Cape Cod.[47] Risk estimates were adjusted for history of radiation therapy, BMI, breast cancer familial history, history of breast cancer, history of benign breast disease, alcohol consumption, and age at first birth. There were no significant associations between smoking or smoking severity and breast cancer. The number of years since cessation did not reduce breast cancer incidence. Due to the nature of the study only odds ratios were available (**Table A28**).

Table A28[47]
Odds ratio estimates for the risk breast cancer incidence associated with smoking and smoking cessation

Smoking Status	OR	95% C.I.
Never	1.00	(reference)
Ever	0.72	(0.55, 0.95)
Cigarettes/day		
Never	1.00	(reference)
<1	0.77	(0.57, 1.00)
1<2	0.69	(0.50, 0.94)
≥ 2	0.57	(0.33, 0.98)
Cessation (years)		
Never	1.00	(reference)
Current to < 5	0.74	(0.52, 1.00)
5-15	0.77	(0.54, 1.10)
>15	0.75	(0.54, 1.00)

Manjer et al. (2004) studied the association between smoking and the risk of breast cancer in two Swedish cohorts.[48] When controlling for estradiol and estrone levels there was no association between smoking or smoking severity and breast cancer incidence (**Table A29**). The number of years since cessation did not reduce the risk of breast cancer. In this study high estrogen levels in combination with smoking increased the risk of breast cancer.

Table A29[48]
Odds ratio estimates for the risk of breast cancer incidence associated with smoking and smoking cessation

Smoking Status	OR	95% C.I.
Never	1.00	(reference)
Current	0.97	(0.67, 1.42)
Ex	1.14	(0.78, 1.65)
Current + Ex	1.05	(0.77, 1.43)
Cigarettes/day		
Never	1.00	(reference)
≤ 14	0.74	(0.45, 1.21)
≥ 14	1.30	(0.78, 2.16)
Cessation (Years)		
Never Smoker	1.00	(reference)
0-5	1.32	(0.66, 2.61)
5-14	1.32	(0.71, 2.46)
>14	0.99	(0.61, 1.63)

The association between exposure to environmental tobacco smoke, and active smoking on breast cancer incidence was studied by Johnson (2005).[49] The relative risk of breast cancer for active smokers compared to never smokers and women who were never exposed to second-hand smoke was estimated (**Table A30**).

Table A30[49]
Risk of breast cancer incidence associated with smoking

Author	RR	95%C.I.
Hirayama (1992)	1.59	(1.01, 2.52)
Reynolds et al. (2004)	1.06	(0.92, 1.21)
Hanaoka et al. (2004)	1.7	(1.0, 3.0)
Sandler et al. (1985)	1.21	(0.58, 2.52)
Lash et al. (2000)	2.0	(1.1, 3.6)
Delfino et al. (2000)	0.97	(0.50, 1.87)
Lash et al. (2002)	0.72	(0.55, 0.95)
Gammon et al. (2004)	1.13	(0.91, 1.42)
Smith et al. (1994)	2.69	(0.98, 4.12)
Morabia et al. (1996)	3.0	(1.9, 4.8)
Zhao et al. (1999)	3.54	(1.36, 9.18)
Johnson et al. (2000)	1.7	(1.2, 2.4)
Kropp et al. (2002)	1.31	(0.91, 1.89)

Breast Cancer Mortality

Fentiman et al. (2005) studied the association between smoking and the risk of breast cancer mortality in a cohort of 229 women.[50] The risk estimates were calculated controlling for disease stage, and age at diagnosis (**Table A31**). There was no significant association between smoking and breast cancer mortality.

Table A31[50]
Risk of breast cancer mortality associated with smoking

Smoking Status	RR	95%C.I.
Non-Smoker	1.00	(reference)
Current Smoker	0.62	(0.34, 1.14)
Ex-Smoker	1.41	(0.77, 2.59)

The association between smoking and breast cancer mortality in a cohort of 792 women in Malmö Sweden was investigated by Manjer et al. (2000).[46] Smoking habits were obtained through hospital records and categorized into never, current and ex-smokers. For ex-smokers no information was provided on the length of time since cessation. The relative risk estimates for the first model were adjusted for age and disease status. For the second model, the relative risk estimates were adjusted for anthropometric measures, menstrual status, parity, oophorectomy and hormone replacement therapy use (**Table A32**).

Table A32[46]
Risk of breast cancer mortality associated with smoking

Smoking Status	Model 1 RR (95% C.I.)	Model 2 RR (95% C.I.)
Never	1.00 (reference)	1.00 (reference)
Current	2.14 (1.47, 3.10)	1.95 (1.22, 3.13)
Ex	1.05 (0.60, 1.83)	1.28 (0.60, 2.47)

Tomigana et al. (1998) studied the survival of breast cancer in relation to lifestyle hobbies and habits such as alcohol and smoking.[51] The patients were from the Tochigi Cancer Center Hospital, Utsunomiya Japan. The total study population included 398 patients with histologically confirmed breast cancer. Information on habits and hobbies was obtained during an interview upon admission to the hospital. Smoking status was categorized as 'yes' or 'no'. The relative risk estimates were adjusted for age, stage of disease at diagnosis and curability (**Table A33**).

Table A33[51]
Risk of breast cancer mortality associated with smoking

Smoking Status	RR	95% C.I.
No	1.00	(reference)
Yes	2.08	(1.02, 4.26)

An analysis of the Erie County Study on Smoking and Health in Pennsylvania was conducted by Miller (2002) to assess the effects of smoking on the risk of breast cancer mortality (**Table A34**).[52] Information on smoking habits was obtained from 12,580 relatives of the deceased. Non smokers were women who had smoked less than 100 cigarettes their entire lives. Smokers were women who smoked their entire lives and quit before death or women who started smoking later in life.

Table A34[52]
Risk of breast cancer mortality associated with smoking

Smoking Status	RR
Non Smoker	1.00
Smoker	1.22

Fentiman et al. (2005) studied the association between smoking and breast cancer mortality in a cohort of 166 women.[50] Smoking status was categorized as never, current and ex smokers. The relative risk estimates were adjusted for age at diagnosis, menopausal status, stage of disease, tumor grade and tumor size (**Table A35**).

Table A35[50]
Risk of breast cancer mortality associated with smoking

Smoking Status	RR	95% C.I.
Never	1.00	reference
Ex Smoker	0.59	(0.42, 1.15)
Current	1.18	(0.68, 2.06)

Prostate Cancer Incidence

Villeneuve et al. (1999) studied the relationship between prostate cancer and various risk factors including smoking, in a large case-control study.[53] The study included subjects from eight Canadian provinces. There were 1,623 prostate cancer cases and 1,623 controls aged 50–74. Due to the nature of the study only odds ratios are calculable. The risk estimates were adjusted for age, province, race, the number of years since cessation, cigarette pack-years, BMI, income, familial history, and consumption of rice and pasta, coffee, alcohol, grains and cereals, fruit and fruit juices, tofu and meat (**Table A36**).

Table A36[53]
Risk of prostate cancer incidence associated with smoking habits and cessation

Smoking Status	OR	95% C.I.
Cigarettes/day		
0	1.00	(reference)
≤ 10	0.8	(0.5, 1.4)
10-20	0.7	(0.4, 1.3)
20-30	0.6	(0.3, 1.0)
30+	0.6	(0.3, 1.1)
Cigarette Pack-Years		
< 10	0.9	(0.6, 1.2)
10-24	0.8	(0.6, 1.1)
25-39	0.7	(0.5, 0.9)
40+	0.6	(0.5, 0.8)
Years since quitting		
< 5	1.0	(reference)
5-9	1.2	(0.8, 1.7)
10-19	1.1	(0.8, 1.5)
20+	1.1	(0.8, 1.5)
Never Smoker	1.3	(1.0, 1.8)

The associations between smoking, obesity, alcohol, and physical activity and the risk of prostate cancer incidence were studied by Cerhan et al. (1996).[54] The study included a cohort of men enrolled in the Iowa 65+ Rural Health Study.

The relative risk associated with smoking habits and cessation and prostate cancer incidence was estimated (**Table A37**).

Table A37[54]
Risk of prostate cancer incidence associated with smoking and smoking cessation

Smoking Status	RR	95% C.I.
Never	1.00	(reference)
Former	1.2	(0.7, 2.1)
Current	2.2	(1.2, 4.4)
Cigarettes/day		
Never	1.00	(reference)
Former	1.2	(0.7, 2.1)
< 20 /day	1.8	(0.7, 4.4)
≥ 20/day	2.7	(1.2, 6.0)
Years since cessation		
≥ 15	1.3	(0.7, 2.5)
<15	1.1	(0.6, 2.2)
Current	2.2	(1.2, 4.4)
Cigar Smokers		
Never	1.00	(reference)
Ever	1.5	(0.9, 2.6)
Pipe Smokers		
Never	1.00	(reference)
Ever	1.00	(0.6, 1.6)

Hsing et al. (1991) also studied the association of smoking and the risk of prostate cancer incidence in a cohort of 250,000 US veterans (**Table A38**).[55]

Table A38[55]
Risk of prostate cancer incidence associated with smoking

Smoking Status	RR	95% C.I.
Never	1.00	(reference)
Smokers	1.18	(1.09, 1.28)
Cigarettes/day		
40+	1.51	

The relationship between smoking and prostate cancer incidence was studied by Hayes et al. (1994).[56] The case-control study included 981 prostate cancer cases (479 Black and 502 White) and 1,315 controls (594 Black and 721 White). The subjects were aged 40-79 from Atlanta, Detroit and New Jersey. The odds ratio estimates were adjusted for age and study site (**Table A39**).

Table A39[56]
Odds ratio estimates for the risk of prostate cancer incidence associated with smoking habits

Smoking Status	Black Men OR	(95% C.I)	White Men OR	(95% C.I)
Never	1.00	reference	1.00	reference
Duration in years				
<20	0.9	(0.5-1.5)	0.9	(0.5-1.5)
20-39	1.1	(0.8-1.6)	1.3	(0.9-1.9)
40+	1.0	(0.7-1.4)	1.2	(0.8-1.7)
Pack-Years				
<20	1.0	(0.7-1.6)	1.0	(0.7-1.6)
20-44	0.9	(0.6-1.3)	1.4	(1.0-2.0)
45+	1.2	(0.8-1.8)	1.2	(0.8-1.7)
Smoking Status	**All Men OR**	**(95% C.I.)**		
Never	1.00	(reference)		
Duration in years				
<20	0.9	(0.7-1.3)		
20-44	1.2	(1.0-1.6)		
45+	1.1	(0.9-1.5)		
Pack-Years				
<20	1.1	(0.8-1.4)		
20-44	1.1	(0.9-1.5)		
45+	1.2	(0.9-1.6)		

The association between smoking and prostate cancer (incidence and mortality) was studied by Lotufo et al (2000).[57] The study included a cohort of 22,071 men aged 40 to 84 from the Physicians' Health Study. The relative risk estimates were adjusted for age, aspirin use, beta-carotene use, BMI, height, physical activity, and alcohol use. The relative risk between smoking and prostate cancer incidence and mortality were estimated (**Tables A40 & A42**).

Table A40[57]
Risk of prostate cancer incidence associated with smoking

Smoking Status	RR	95% C.I.
Never	1.00	reference
Former	1.11	(0.98, 1.28)
Current Cigarettes/day		
<20	1.04	(0.73, 1.48)
≥ 20	1.07	(0.82, 1.41)

Prostate Cancer Mortality

Meyer et al. (1999) studied the association between dietary intake and prostate cancer survival in men age 45 or older from Quebec.[58] The risk estimates were adjusted for age, clinical stage, grade and initial treatment, familial history, education level, and BMI (**Table A41**).

Table A41[58]
Risk of prostate cancer mortality associated with smoking

Smoking Status	RR	95% C.I.
Never	1.00	
Current	2.0	(0.9, 4.5)

Table A42[57]
Risk of prostate cancer mortality associated with smoking

Smoking Status	RR	95% C.I.
Never	1.00	reference
Former	1.30	(0.87, 1.95)
Current Cigarettes/day		
<20	1.25	(0.45, 3.49)
≥ 20	1.22	(0.54, 2.74)

Colorectal Cancer Incidence and Mortality

Limburg et al. (2003) studied the association between smoking, smoking severity, and cessation and the risk of colorectal cancer in a cohort of 41,836 women. Subjects were from the Iowa Women's Health Study and were ages 55-69 (all postmenopausal).[59] The relative risk estimates were adjusted for age, BMI, waist-to-hip ratio, physical activity, alcohol, hormone replacement therapy use, methionine, total calorie intake, total fat intake, sucrose intake, red meat consumption, calcium intake, folate intake, and vitamin E intake (**Table A43**).

Table A43[59]
Risk of colorectal cancer incidence and mortality associated with smoking habits and cessation for females

Incidence Smoking Status	RR	95% C.I.
Never	1.00	(reference)
Ever	1.17	(1.00, 1.36)
Current	1.10	(0.89, 1.37)
Former	1.21	(1.01, 1.45)
Cigarettes/day		
1-19	1.15	(0.95, 1.38)
20	1.23	(0.97, 1.54)
>20	1.12	(0.82, 1.54)
Cessation (years)		
>30	1.07	(0.71, 1.62)
20-29	1.51	(1.09, 1.62)
10-19	1.08	(0.77, 1.51)
<10	1.21	(0.93, 1.56)
Mortality Smoking Status	RR	95% C.I.
Never	1.00	(reference)
Ever	1.31	(0.98, 1.74)
Current	1.58	(1.09, 2.29)
Former	1.14	(0.80, 1.62)
Cigarettes/day		
1-19	1.27	(0.89, 1.80)
20	1.50	(0.99, 2.28)
>20	1.07	(0.57, 2.00)

D'Avanzo et al. (1995) studied the association between smoking and the risk of colorectal cancer incidence.[60] The subjects were from a case-control study in Northern Italy. There were 457 female colorectal cancer cases aged 20–74 and 1,016 female controls aged 19–74. The Male study consisted of 498 male colorectal cases aged 20–74 and 1,863 male controls aged 19–74. Ex-smokers were defined as those who had quit for at least one year. Odds ratios were only calculable and were adjusted for age, education, food score, fat intake, calorie intake, meat intake, alcohol consumption, and familial history (**Tables A44 & A45**).

Table A44[60]
Odds ratio estimates for colorectal cancer incidence associated with smoking for females

Smoking Status	OR	95% C.I.
Never Smoker	1.00	(reference)
Current Smoker	0.7	(0.5, 0.9)
Ex-Smoker	1.3	(0.8, 1.9)
Cigarettes/day		
<15	0.8	(0.5, 1.9)
15-24	0.6	(0.4, 1.0)
≥ 25	0.8	(0.4, 1.8)

Table A45[60]
Odds ratio estimates for colorectal cancer incidence associated with smoking for males

Smoking Status	OR	95% C.I.
Never Smoker	1.00	(reference)
Current Smoker	0.6	(0.5, 0.8)
Ex-Smoker	0.8	(0.6, 1.0)
Cigarettes/day		
<15	0.6	(0.4, 0.8)
15-24	0.7	(0.5, 0.9)
≥ 25	0.7	(0.5, 1.0)

The relationship between smoking and colorectal cancer incidence was studied in a prospective cohort of males and females from the Swedish Twin Registry.[61] There were a total of 17,118 males and females in the cohort. The relative risk estimates were adjusted for age, BMI, sex, and physical activity level (**Table A46**).

Table A46[61]
Risk of colorectal cancer incidence associated with smoking for males and females pooled

Smoking Status	RR	95% C.I.
Never	1.0	(reference)
Former	1.0	(0.8, 1.4)
Pipe/Cigar	0.9	(0.6, 1.3)
Cigarettes/day		
1-10	1.0	(0.7, 1.3)
10-20	1.1	(0.7, 1.7)
21+	3.1	(1.4, 7.1)

Hsing et al. (1998) estimated the risk of colorectal cancer mortality due to smoking in a US cohort of 17,633 men aged 35 and over from the Lutheran Brotherhood Insurance Society (**Table A47**).[62] There was a 20 year follow-up period. Occasional smokers were defined as generally smoking less than one cigarette, pipe or cigar per day.

Table A47[62]
Risk of colorectal cancer mortality associated with smoking for males

Smoking Status	Colon RR (95% C.I)	Rectal RR (95% C.I)
Never	1.00 (reference)	1.00 (reference)
Tobacco (no cig)	1.6 (0.8, 3.2)	1.0 (0.5, 1.9)
Occasional	1.4 (0.7, 2.9)	1.1 (0.6, 2.0)
Ex-Smoker	1.5 (0.8, 2.7)	1.1 (0.7, 1.8)
Current Smoker	1.4 (0.7, 2.7)	1.0 (0.6, 1.7)
Cigarettes/day		
1-19	1.1 (0.5, 2.5)	0.8 (0.4, 1.6)
20-29	1.6 (0.7, 3.4)	1.1 (0.5, 2.1)
30+	2.3 (0.9, 5.7)	1.7 (0.7, 3.8)

The relationship between smoking and smoking cessation, and colorectal cancer mortality was studied in a cohort of 56,837 women aged 40–59 enrolled in the Canadian National Breast Cancer Study.[63] The relative risk estimates were adjusted for age, BMI, hours per week of vigorous activity, dietary fibre, calcium, alcohol and energy (**Table A48**).

Table A48[63]
Risk of colorectal cancer mortality associated with smoking habits and cessation for females

Smoking status	RR	95% C.I.
Never Smoked	1.00	(reference)
Ever Smoked	1.37	(0.86, 2.18)
Ex-Smoker	1.52	(0.91, 2.56)
Current Smoker	1.15	(0.61, 2.16)
Cigarettes/day		
1-9	1.78	(0.94, 3.38)
10-19	1.21	(0.60, 2.47)
≥20	1.21	(0.66, 2.20)
p-value for trend test = 0.513		
Years Since Quitting		
1-10	1.74	(0.91, 3.33)
≥11	1.33	(0.70, 2.57)

Limburg et al. (2003) studied the association between smoking and the risk of colorectal cancer mortality in a cohort of 41,836 women aged 55–59 from the Iowa Women's Health Study.[59] The relative risk estimates were adjusted for age, BMI, waist-to-hip ratio, physical activity level, alcohol consumption, HRT, methionine intake, total calories, total fat, sucrose, red meat, calcium, folate and vitamin E (**Table A49**).

Table A49[59]
Risk of colorectal cancer mortality associated with smoking habits for females

Smoking Status	RR	95% C.I.
Ever	1.31	(0.98, 1.74)
Current	1.58	(1.09, 2.29)
Former	1.14	(0.80, 1.62)
Cigarettes/day		
1-19	1.27	(0.89, 1.80)
20	1.50	(0.99, 2.28)
>20	1.07	(0.57, 2.00)

Incidence of 'Other' Smoking Related Cancers (not including lung) for Males

Shaper et al. (2003) studied the association between smoking and the risk of smoking related cancers, not including lung cancer, in the cohort of 7,121 British men aged 40–69.[27] Primary pipe/cigar smokers were defined as never smoking cigarettes that currently smoke a pipe or cigar. Secondary pipe/cigar smokers are former cigarette smokers that currently smoke a pipe or cigar. Ex-smokers were those who used to smoke cigarettes and did not smoke pipe/cigar. The relative risk estimates were adjusted for physical activity, social class, alcohol intake, antihypertensive treatment, age, BMI, systolic blood pressure and serum total cholesterol (**Table A50**). The smoking related cancers include cancer of the lip, tongue, oral cavity and larynx, oesophagus, pancreas, respiratory tract, bladder and kidney.

Table A50[27]
Risk of smoking-related cancer incidence (excluding lung cancer) associated with smoking for males

Smoking Status	RR	95% C.I.
Never	1.00	(reference)
Ex-Cigarette Smoker	1.77	(1.05, 2.98)
Primary Pipe/Cigar Smoker	1.57	(0.53, 4.60)
Secondary Pipe/Cigar Smoker	1.91	(0.97, 3.76)
Cigarettes/day		
1-19	2.21	(1.26, 3.92)
20	3.24	(1.83, 5.74)
≥21	3.62	(2.11, 6.21)

Pancreas Cancer Incidence

Harnack et al. (1997) studied the association between various risk factors, including smoking and cancer of pancreas in a cohort of 41,837 women aged 55–69 from the Iowa Women's Health Study.[65] The relative risk estimates were age adjusted (**Table A51**).

Table A51[65]
Risk of pancreas cancer incidence associated with smoking for females

Smoking Status	RR	95% C.I.
Non-Smoker	1.00	(reference)
Ex- Smoker	1.08	(0.55, 2.11)
Current Smoker	2.35	(1.32, 4.17)
Pack-Years		
≤ 20	1.14	(0.53, 2.45)
≥ 20	1.92	(1.12, 2.30)

The association between active smoking, passive household smoke exposure and pancreatic cancer risk was studied by Gallicchio et al. in 2006 (**Table A52**).[66] The subjects were two cohorts from Washington County, Maryland.

Table A52[66]
Risk of pancreas cancer incidence associated with smoking habits for males and females pooled

Smoking Status	RR	95% C.I.
Cohort 1963		
Never	1.0	
Former	2.1	(0.9, 4.6)
Current	2.1	(1.0, 4.3)
# cigarettes/day		
≤ 10	0.8	(0.2, 3.3)
11-19	2.9	(1.4, 6.2)
≥ 20	1.9	(0.7, 5.5)
Cohort 1957		
Never	1.0	
Former	1.6	(0.9, 2.8)
Current	1.8	(1.1, 3.1)
# cigarettes/day		
≤ 10	1.4	(0.4, 4.7)
11-19	1.3	(0.7, 2.5)
≥ 20	3.5	(1.8, 6.8)

Incidence of various cancers – Females

Norland et al. (1997) studied the effects of smoking on the incidence of various cancers in a Swedish cohort study of 26,000 women aged 18–69.[67] Women were from a Swedish Population Registry. There was a 26-year follow-up period. Former smokers were defined as those who used to smoke daily and have quit for at least one year. The relative risk estimates were adjusted for age and place or residence (**Table A53**).

Table A53[67]
Risk of cancer incidence associated with smoking severity for females

Cancer Site	Former	Current	1–7cig/day	8–15 cig/day	16+ cig/day
All sites	RR = 1.14	RR = 1.20	RR =1.12	RR =1.22	RR =1.51
UAS[xx]	RR = 0.93	RR = 2.14	RR =1.61	RR =3.24	RR =1.89
Stomach	RR =0.18	RR =1.25	RR =1.18	RR =1.17	RR =1.90
Colorectal	RR =1.16	RR =0.88	RR =0.90	RR =0.66	RR =1.42
Pancreas	RR =2.47	RR =1.77	RR =1.98	RR =1.38	RR =1.64
Lung	RR =1.08	RR =4.82	RR =2.83	RR = 7.74	RR = 7.75
Breast	RR =1.21	RR =0.95	RR =0.87	RR =1.04	RR =1.07
Cervix	RR =1.01	RR =2.54	RR =2.32	RR =2.39	RR =4.00
Endometrium	RR =1.02	RR =0.81	RR =0.65	RR =0.97	RR =1.04
Kidney	RR =1.86	RR =1.09	RR =0.75	RR =1.03	RR = 3.09
Bladder	RR =2.51	RR =2.34	RR =1.86	RR =2.87	RR = 3.44
OUO	RR =N/A	RR =5.17	RR =4.49	RR =4.21	RR =12.18
Thyroid	RR =0.55	RR =0.98	RR =1.14	RR =0.34	RR =2.37
NHL	RR =0.66	RR =0.87	RR =0.80	RR =0.43	RR =2.56
Leukemias	RR =1.03	RR =1.24	RR =1.52	RR =0.93	RR = 0.69
Melanoma	RR = 0.89	RR = 1.15	RR = N/A	RR=N/A	RR= N/A
All other sites	RR =0.87	RR =1.06	RR =1.04	RR =1.18	RR =0.77

xx. UAS includes total upper aerodigestive sites such as oral cavity, pharynx, esophagus, OUO are other urinary organs; and NHL is non-Hodkin's Lymphoma.

Incidence of various cancers – Males

Iribarren et al. (1999) studied the association between cigar smoking and various cancers in a cohort of 17,774 men aged 30–85 enrolled in the Kaiser Permanenthe Health Plan Program in California.[68] Cancers of upper aerodigestive tract included orpopharynx, nose, larynx, and oesophagus. Smoking related cancers included lung, pancreas, kidney, bladder, and cancers of upper aerodigestive tract. This study showed that there was an increased risk of smoking related cancers for cigar smokers. The relative risk estimates were adjusted for age, race BMI, history of diabetes millitius, alcohol consumption and occupational exposure [xxi] (**Table A54**).

Table A54[68]
Risk of cancer incidence associated with cigar smoking for males

	Non-Smoker RR	Cigar Smoker RR (95% C.I)
Oropharynx	1.00	2.61 (1.18, 5.76)
Upper Aerodigestive Tract		2.02 (1.01, 4.06)
Lung		2.14 (1.12, 4.11)
Pancreatic		1.12 (0.51, 2.88)
Kidney		1.08 (0.43, 2.71)
Bladder		1.05 (0.55, 2.01)
Smoking Related		1.42 (1.02, 1.98)
Colorectal		1.12 (0.80, 1.57)
All sites (excluding nonmelonoma)		1.07 (0.93, 1.25)

The association between smoking and incidence of various cancers in a large cohort of Korean men and women was studied by Jee et al. (2004).[69] The cohort involved 1,212,906 men and women aged 30–95. The relative risk estimates compared current smokers to never smokers as well as, former smokers to never smokers (**Table A55**). The relative risk estimates were adjusted for age.

Table A55[69]
Risk of cancer incidence associated with smoking for males and females pooled

Cancer Site	RR (Current vs. Never)	RR (Former vs. Never)
Oesophagus	3.1 (2.4, 4.0)	1.6 (1.2, 2.1)
Stomach	1.5 (1.4, 1.6)	1.4 (1.3, 1.5)
Colon	0.8 (0.7, 1.0)	1.1 (1.0, 1.3)
Liver	1.1 (1.0, 1.2)	1.3 (1.2, 1.4)
Bile duct	1.4 (1.1, 1.8)	1.4 (1.1, 1.8)
Pancreas	1.5 (1.2, 1.8)	1.4 (1.1, 1.7)
Larynx	5.4 (3.5, 8.1)	3.3 (2.1, 5.1)
Lung	4.0 (3.5, 4.4)	2.0 (1.7, 2.3)
Prostate	0.8 (0.6, 1.0)	1.0 (0.9, 1.4)
Kidney	1.3 (1.0, 1.5)	1.2 (0.9, 1.6)
Bladder	2.0 (1.7, 2.5)	1.8 (1.4, 2.2)
Brain	1.0 (0.7, 1.2)	1.3 (0.9, 1.8)
Thyroid	10.6 (0.5, 1.0)	1.0 (0.7, 1.4)
Leukemia	1.1 (0.8, 1.5)	1.4 (1.0, 2.0)

Chen and Gibb (2003) studied the lag effects of smoking cession and the risk of cancer.[70] The data used was from the British doctors' study in the UK. The relative risks of those who began smoking at age 15 and smoked at least 20 cigarettes/day were estimated (**Table A56**). The estimates compared quitting at age 30 and quitting at age 50 to that of a non-smoker.

Table A56[70]
Risk of cancer incidence associated with smoking cessation for males and females

Age	Quit at age 30 RR	Quit at age 50 RR
30	4.35	4.35
35	1.20	4.74
40	1.18	5.21
45	1.17	5.75
50	1.16	6.38
55	1.16	1.79
60	1.16	1.77
65	1.15	1.76
70	1.15	1.75
75	1.15	1.75
80	1.15	1.74

xxi. Hazardous chemicals, cleaning fluids or solvents; insect or plant sprays, ammonia, chlorine, ozone or nitrous gases; engine-exhaust fumes for more than two hours per day; plastics or resin fumes; lead or other metal fumes; asbestos or grain dusts; silica or rock dust or dust from sandblasting or grinding; and x-rays or radioactivity.

20.2 Risk factor: obesity

Breast cancer incidence

Sonnenschein et al. (1999) studied the association between obesity and breast cancer incidence in a cohort of 14,275 women aged 35 to 65 from the New York University Women's Health Study.[71] Obesity was measured by the Quetelet Index (weight kg/height(m2)). Relative risks were calculated for both premenopausal and postmenopausal women. The risk estimates were adjusted for age at enrolment, age at menarche, age at first term pregnancy, history of breast biopsy, and familial breast cancer history (**Table A57**).

Table A57[71]
Risk of breast cancer incidence associated with increased body mass

Premenopausal women	RR	95% C.I.
Quetelet Index		
<21.5		1.00 (reference)
21.5-23.25	0.9	(0.54, 1.51)
23.25-26.36	0.77	(0.44, 1.33)
>26.36	0.81	(0.45, 1.45)
Postmenopausal women		
Quetelet Index		
<22.32		1.00 (reference)
22.32-24.69	1.45	(0.84, 2.48)
24.69-27.46	2.29	(1.37, 3.82)
>27.46	2.40	(1.42, 4.08)

A thorough literature review of the association between increased BMI and breast cancer incidence was provided by Carmichael and Bates in 2004 (**Table A58**).[72]

Table A58[72]
Risk of breast cancer incidence associated with an increase in BMI

Author (year)	Age	BMI	RR (95% C.I.)
London (1989)	30-55	<21	1.00 (reference)
		>29	1.0 (0.8, 1.5)
Tretti (1989)		+1g/cm	1.1 (0.7, 0.9)
Folsom (1990)	55-69	<24.4	1.00 (reference)
		>28.35	1.1 (0.8, 1.5)
Sellers (1992)	55-69		No family history
		<22.9	1.00 (reference)
		23– 30.7	1.3 (1.0, 1.8)
		>30.7	1.5 (1.1, 2.1)
		Family history	
		<22.9	1.00 (reference)
		23 - 30.7	1.7 (0.9, 2.9)
		>30.7	2.2 (1.4, 3.6)
Tornberg (1994)	>55	<22	1.00 (reference)
		≥28	1.13 (1.01, 1.10)
Huang (1997)	30-55	<20	1.00 (reference)
		20 - 30	1.24 (0.97, 1.59)
		>31	1.13 (0.87, 1.46)
Li (1999)	50-64	≤21.5	1.00 (reference)
		≥27.6	1.5 (1.1, 2.3)
Van den Brandt (2000)	≥50	<21	1.00 (reference)
		≥28	1.26 (1.09, 1.46)
Morimoto (2002)	50-79	≤22.6	1.00 (reference)
		>31.1	2.52 (1.6, 3.9)

A review conducted by Vatten (1996) summarized the association between obesity and breast cancer incidence for both premenopausal and postmenopausal women (**Table A59**).[73]

Table A59[73]
Risk of breast cancer incidence associated with an increase in BMI

Author	BMI	RR pre	RR post
Mirra et al. (1971)	≤27 vs. 22	1.2	1.6
Staszewskit (1977)	30 vs. <24		1.4
Paffenbarger et al. (1980)	≥25 vs. <22	0.7	1.4
Helmrich et al. (1983)	≥28 vs. <21	0.5	1.3
Lubin et al. (1985)	≥27 vs. <19		2.4
Hislop et al. (1986)	≥27 vs. <21	0.8	0.9
Toti et al. (1986)	≥27 vs. <22	1.2	1.5
LaVecchia et al. (1987)	≥30 vs. <20	1.9	1.4
Schatzkin et al. (1987)	≥30 vs. <24	1.2	2.5
Ewertz (1988)	≥32 vs. <24	1.2	2.5
Swanson et al. (1989)	30 vs. 20	1.0	1.3
Bouchardy et al. (1990)	≥27 vs. <21		0.6
Francheschi et al. (1990)	≥28 vs. less	1.0	1.4
Hsieh et al. (1990)	per 4kg/m^2	1.0	1.1
Rosenberg et al. (1990)	≥26 vs. <21	0.8	1.2
Chu et al. (1991)	≥32 vs. <20	1.3	2.7
Parazzini et al. (1992)	≥27 vs. <23		1.4
Harris et al. (1992)	>27 vs. <22	0.6	1.5
Brinton and Swanson (1992)	≥26 vs. <20	0.65	0.98

Breast cancer mortality

McCullough et al. investigated the association between obesity and breast cancer mortality in an American prospective cohort study of 21,143 African American and 409,093 White women from the Cancer Prevention Study II.[74] The risk estimates were adjusted for age at first birth, age at menarche, age at menopause, use of estrogen replacement therapy, history of breast cyst, and familial breast cancer history (**Table A60**).

Table A60[74]
Risk of breast cancer mortality associated with an increased BMI

BMI	White women RR (95% C.I.)	African-American women RR (95% C.I.)
<25	1.00	1.00
25-30	1.31, (1.22, 1.40)	0.98, (0.72, 1.32)
30-35	1.54, (1.38, 1.71)	1.32, (0.93, 1.88)
≥35	1.74, (1.46, 2.07)	1.28, (0.78, 2.09)

The impact of obesity on the risk of breast cancer mortality was studied by Hombergm et al. (1997) in a cohort of 450,156 American women from the Cancer Prevention Study I.[75] The risk estimates were adjusted for familial history of breast cancer, age at menarche, age at first pregnancy, whether they did breast self-examination prior to diagnosis, and age at entry into cohort (**Table A61**).

Table A61[75]
Risk of breast cancer mortality associated with an increased BMI

BMI	RR	95% C.I.
<22	1.00	(reference)
22-27.3	1.22	(1.10, 1.35)
27.3-30	1.44	(1.24, 1.66)
≥ 30	1.51	(1.29, 1.76)

Petrelli et al. (2002) also studied the association between an increase in BMI and breast cancer mortality in a cohort of 424,168 women from the American Cancer Society's Cancer Prevention Study II.[76] The risk estimates were adjusted for age, height, race, familial history of breast cancer, breast cysts, number of live births, age at first live birth, age at menarche, age at menopause, menopausal status, oral contraceptive use, estrogen replacement therapy use, education, exercise, smoking, and alcohol (**Table A62**).

Table A62[76]

Risk of breast cancer mortality associated with obesity

BMI	RR	95% C.I.
<18.5	1.17	(0.88, 1.56)
18.5-20.49	1.00	(reference)
20.5 – 21.99	1.12	(0.94, 1.33)
22-23.49	1.24	(1.05, 1.46)
23.5-24.99	1.51	(1.28, 1.78)
25-26.49	1.49	(1.25, 1.77)
26.5-27.99	1.67	(1.40, 1.99)
28-29.99	1.85	(1.54, 2.21)
30-31.99	1.88	(1.53, 2.30)
32-34.99	2.04	(1.63, 2.54)
35-39.99	1.94	(1.47, 2.56)
≥ 40	3.08	(2.09, 4.51)

Colorectal Cancer Incidence

The risk of colorectal cancer incidence associated with obesity was investigated by Nilsen et al. (2001).[77] The cohort consisted of 75,219 men and women from Norway. The risk estimates were adjusted for age (**Table A63**).

Table A63[77]

Risk of colorectal cancer incidence associated with obesity

BMI	RR	95% C.I.
Males		
≤ 23		1.0 (reference)
23.1-24.9	0.9	(0.65, 1.24)
25.0-27.1	0.96	(0.71, 1.30)
≥ 27.2	1.07	(0.80, 1.42)
Females		
≤ 21.8		1.0 (reference)
21.9-24.2	0.89	(0.63, 1.27)
24.3-27.4	0.80	(0.57, 1.13)
≥ 27.5	0.98	(0.71, 1.34)

Bergstrom et al. (2001) conducted a meta-analysis of the effects of obesity and various cancers including colorectal cancer in Europe.[78] Studies published between 1966 and 1997 were included in the meta-analysis. The relative risks were estimated for normal, overweight and obese population (**Table A64**). A BMI of 25–29 was considered overweight; a BMI ≥ 30 was considered obese; and a normal weight was a BMI <25.

Table A64[78]

Risk of colorectal cancer incidence associated with obesity

Weight	RR
Normal	1.00
Overweight	1.15
Obese	1.33

The risk of colorectal cancer incidence associated with obesity was studied by Lin et al. (2004).[79] The cohort consisted of 37, 671 American women over 45 years old. The risk estimates were adjusted for age, randomized treatment assignment, family history, history of colon polyps, physical activity, smoking status, baseline aspirin use, red meat intake, alcohol consumption, menopausal status and baseline PMH use (**Table A65**).

Table A65[79]

Risk of colorectal cancer associated with an increase in BMI

BMI	RR	95% C.I.
<23	1.00	(reference)
23-24.9	1.45	(0.96, 2.20)
25-26.9	1.28	(0.81, 2.04)
27-29.9	1.72	(1.12, 1.67)
≥ 30	1.67	(1.08, 2.59)

Various cancers mortality

The impact of obesity on the risk of death from various cancers was investigated by Calle et al. in 2003 (**Table A66**).[80] The study involved a prospective cohort of US adults from the American Cancer Society's Cancer Prevention II Study.

Table A66[80]
Risk of cancer associated with an increased BMI

BMI	18.5-24.9	25-29.9	30-34.9	35-39.9	≥40
Men					
All Cancer	1.00	1.11(1.05, 1.18)	1.38 (1.24, 1.52)	1.31 (1.01, 1.70)	N/A
Esophageal	1.00	1.76 (1.08, 2.86)	1.91 (0.92, 3.96)	N/A	N/A
Pancreatic	1.00	1.24 (1.01, 1.54)	1.34 (0.92, 1.95)	2.61(1.27, 5.35)	N/A
Lung	1.00	1.00 (0.80, 1.24)	0.93 (0.63, 1.39)	N/A	N/A
All other	1.00	1.06 (0.89, 1.26)	1.68 (1.30, 2.18)	N/A	N/A
Women					
All Cancers	1.00	1.14 (1.09, 1.18)	1.33 (1.25, 1.41)	1.40 (1.25, 1.58)	1.88 (1.56, 2.27)
Esophageal	1.00	1.49 (0.85, 2.59)	2.64 (1.36, 5.12)	N/A	N/A
Lung	1.00	0.85 (0.73, 1.00)	0.99 (0.77, 1.26)	0.81 (0.49, 1.31)	N/A
All other	1.00	1.17 (1.04, 1.32)	1.30 (1.08, 1.56)	1.54 (1.08, 2.17)	2.51 (1.52, 4.14)

Inoue et al. (2004) studied the association between obesity and total cancer incidence and mortality in a cohort of men and women from the JPHC study in Japan (**Table A67**).[81]

Table A67[81]
Risk of cancer associated with obesity

Cancer Incidence	RR	95% C.I
BMI		
14-18.9	1.29	(1.08, 1.54)
19 -20.9	1.14	(1.01, 1.28)
21 – 22.9	1.08	(0.97, 1.19)
23-24.9	1.00	(reference)
25-26.9	0.99	(0.87, 1.12)
27-29.9	1.02	(0.87, 1.20)
30-39.9	1.22	(0.92, 1.61)
Cancer Mortality		
BMI		
14-18.9	1.96	(1.54, 2.49)
19 -20.9	1.36	(1.14, 1.64)
21 – 22.9	1.18	(0.99, 1.39)
23-24.9	1.00	(reference)
25-26.9	0.94	(0.77, 1.15)
27-29.9	1.11	(087, 1.42)
30-39.9	1.26	(0.81, 1.94)

20.3 Risk factor: physical inactivity

Cancer incidence

Wannamethee et al. (2001) studied the relationship between physical activity and cancer.[82] The prospective study assessed cancer incidence in 7,588 men aged 40–59 from the British Regional Heart Study. Physical activity was classified as none/occasional, light, moderate, moderately-vigorous, or vigorous. The risk estimates were adjusted for age, smoking, BMI, alcohol consumption, and social class. Physical activity levels were indexed as follows:

- Inactive – no regular activity
- Occasional – regular walking or recreational activity
- Light – frequent recreational activities; or sporting exercise less than once a week; or regular walking and recreational activity;
- Moderate – cycling; frequent weekend recreational activities plus regular walking; or sporting activity once a week;
- Moderately-vigorous – sporting activity at least once per week or frequent cycling plus recreational activities or walking; or frequent sporting activities;
- Vigorous – very frequent sporting exercise, or frequent sporting exercise plus other recreational activities.

The relative risk for all major cancer sites (excluding skin cancer) and specific cancer sites associated with physical activity levels was estimated (**Tables A68 & A69**).

Table A68[82]
Risk of cancer incidence associated with physical activity levels

Physical Activity	RR	(95% C.I.)
None/Occasional	1.00	(reference)
Light	0.95	(0.80, 1.11)
Moderate	1.04	(0.86, 1.24)
Moderate-vigorous	0.78	(0.62, 1.04)
Vigorous	0.76	(0.56, 1.04)

Table A69[82]
Risk of cancer incidence associated with physical activity levels

Cancer	None-Moderate	Moderate-Vigorous	Vigorous
Lung	1.00	0.77(0.49, 1.21)	0.76(0.40, 1.43)
Upper digestive	1.00	0.31(0.10, 0.99)	0.46(0.11, 1.90)
Stomach	1.00	0.40(0.12, 1.28)	0.60(0.14, 2.47)
Stomach & Upper Digestive	1.00	0.37(0.16, 0.86)	0.42(0.13, 1.32)
Colorectal	1.00	0.90(0.54, 1.49)	0.95(0.48, 1.88)
Bladder	1.00	0.90(0.45, 1.77)	2.06(1.08, 3.95)
Prostate	1.00	0.89(0.51, 1.55)	0.25(0.06, 0.99)
Lymphatic & Haematopoetic	1.00	0.73(0.33, 1.63)	0.47(0.11, 1.96)

Colorectal cancer incidence

Nilsen et al. (2001) studied the association between physical activity levels and colorectal cancer incidence in a cohort of 75,219 men and women from Norway.[77] Low frequency of activity was defined as exercising less than once per week; medium frequency as one to three times per week; and high frequency was defined as three or more times per week. The risk estimates were adjusted for age (**Table A70**).

Table A70[77]
Risk of colorectal cancer incidence associated with physical activity levels

Frequency of activity	RR	95% C.I.
Males		
Low	1.0	(reference)
Medium	0.99	(0.77, 1.27)
High	0.69	(0.50, 0.95)
Females		
Low	1.0	(reference)
Medium	0.81	(0.62, 1.05)
High	1.12	(0.83, 1.52)

The relationship between physical activity and colorectal cancer incidence was also studied on a cohort of males and females from Taiwan.[83] Subjects were questioned on their physical activity levels and categorized into light, moderate, and heavy. Furthermore, the time spent at each activity per week was multiplied by the typical energy expenditure requirements expressed in metabolic equivalents (MET) and a MET–hours/week score was calculated. The relative risk estimates were adjusted for total calories, dietary fiber, total vegetable protein and water intake (**Table A71**).

Table A71[83]
Risk of colorectal cancer incidence associated with physical activity levels

Males	Moderate (MET<20)	Active (MET≥20)
Colorectal	RR = 2.10, 95% C.I. (0.77, 5.72)	RR = 0.30, 95% C.I. (0.11, 0.81)
Colon Cancer	RR = 2.22, 95% C.I. (0.68, 7.21)	RR = 0.19, 95% C.I. (0.05, 0.77)
Rectal Cancer	RR = 1.48, 95% C.I. (0.43, 5.09)	RR = 0.44, 95% C.I. (0.13, 1.49)
Females	**Moderate (MET<20)**	**Active (MET≥20)**
Colorectal	RR = 0.86, 95% C.I. (0.34, 2.16)	RR = 0.77, 95% C.I. (0.31, 1.94)
Colon Cancer	RR = 0.52, 95% C.I. (0.13, 2.03)	RR = 0.63, 95% C.I. (0.18, 2.18)
Rectal Cancer	RR = 1.21, 95% C.I. (0.42, 3.46)	RR = 0.84, 95% C.I. (0.28, 2.46)

Breast cancer incidence

Sesso et al. (1998) studied the association between physical activity and breast cancer incidence in a cohort of 1,566 University of Pennsylvania alumnae.[84] A weekly energy expenditure index was estimated from a physical activity questionnaire and the subjects were classified into three categories, < 500 kcal/week, 500-999 kcal/week, or >1000 kcal/week. The relative risk estimates were adjusted for age and BMI (**Table A72**).

Table A72[84]
Risk of breast cancer incidence associated with physical activity levels

Physical Activity level	RR	95% C.I.
< 500 (kcal/week)	1.00	(reference)
500-999 (kcal/week)	0.92	(0.58, 1.45)
1000 (kcal/week)	0.73	(0.46, 1.14)

The relationship between physical activity levels and breast cancer incidence was also studied by Patel et al. (2003).[85] The cohort consisted of women from the American Cancer Society Cancer Prevention Study II. Subjects were categorized into MET–hours/week. Information on physical activity was recorded at the beginning of the study, at the 10 year follow-up period, and when subjects reached age 40. The relative risk estimates were adjusted for age, race, BMI, familial history, weight change over study period, history of breast cysts, oral contraceptive use and duration, hormone replacement therapy use, parity, age at menarche, age at menopause, smoking, alcohol consumption, caloric intake, education, and mammography history (**Table A73**).

Table A73[85]
Risk of breast cancer incidence associated with physical activity levels

Physical Activity	RR	95% C.I.
MET – h/week (1992)		
None	0.86	(0.70, 1.04)
0-7.0	1.00	(reference)
7.0-17.5	0.92	(0.81, 1.04)
17.5 – 31.5	0.94	(0.81, 1.09)
31.5-42	0.77	(0.56, 1.06)
>42	0.71	(0.49, 1.02)
MET – h/week at age 40		
None	1.03	(0.88, 1.21)
0-7.0	1.00	(reference)
7.0-17.5	1.05	(0.92, 1.20)
17.5 – 31.5	1.01	(0.87, 1.18)
31.5-42	1.16	(0.92, 1.46)
>42	0.79	(0.61, 1.03)
Exercise in 1982		
None	0.80	(0.51, 1.25)
Slight	1.00	(reference)
Moderate0.93	(0.83, 1.04)	
Heavy	0.87	(0.68, 1.13)

Lung cancer incidence

Lee et al. (1999) conducted a cohort study to assess the relative risk of lung cancer associated with physical activity. The cohort consisted of 13,905 male alumni from Harvard.86 Physical activity was classified into distance walked (km/week), stairs climbed (storey/week), activities < 4.5 MET (kJ/week), and activities > 4.5 MET (kJ/week). Each activity was assigned an MET (resting metabolic rate) score and the energy expenditure per week was estimated. The relative risk of lung cancer incidence associated with physical activity was estimated (**Table A74**).

Table A74[86]
Risk of lung cancer incidence associated with physical activity levels

Physical Activity	RR	95% C.I.
Distance Walked (km/week)		
<5	1.00	(reference)
5≤10	0.76	(0.54, 1.07)
10≤20	0.71	(0.51, 0.99)
≥20	0.65	(0.45, 0.94)
Stairs Climbed (storey/week)		
<10	1.00	(reference)
10≤20	0.63	(0.44, 0.92)
20≤35	0.64	(0.44, 0.93)
≥35	0.74	(0.54, 1.02)
Activities < 4.5 MET (kJ/week)		
None	1.00	(reference)
1≤1050	1.20	(0.79, 1.83)
1050≤2520	0.92	(0.57, 1.48)
2520≤5880	0.81	(0.50, 1.32)
≥5880	0.99	(0.66, 1.48)
Activities ≥ 4.5 MET (kJ/week)		
None	1.00	(reference)
1≤1050	0.84	(0.58, 1.22)
1050≤2520	0.64	(0.39, 1.04)
2520≤5880	0.93	(0.62, 1.39)
≥5880	0.60	(0.38, 0.96)

The relationship between physical activity and lung cancer incidence in a cohort of 104,485 men and women aged 20–49 was assessed by Thune and Lund (1997).[87] Physical activity was categorized into occupational and recreational. Each of these categories was further broken down into four grades based on the level of activity. The relative risk estimates were adjusted for age, geographical region, smoking habits, and BMI (**Table A75**).

Table A75[87]
Risk of lung cancer incidence associated with physical activity levels

Physical Activity	RR	95%C.I.
Males		
Occupational		
Sedentary	1.00	(reference)
Walking	1.15	(0.90, 1.47)
Lifting	1.13	(0.87, 1.47)
Heavy Manual	0.99	(0.70, 1.41)
Recreational		
Sedentary	1.00	(reference)
Moderate	0.75	(0.60, 0.94)
Regular	0.71	(0.52, 0.97)
Total (recreational + occupational)		
Sedentary	1.00	(reference)
Active	0.73	(0.54, 0.98)
Females		
Occupational		
Sedentary	1.00	(reference)
Walking	0.81	(0.37, 1.76)
Lifting	0.79	(0.30, 2.12)
Heavy Manual	no cases	
Recreational		
Sedentary	1.00	(reference)
Moderate	0.91	(0.48, 1.71)
Regular	0.99	(0.35, 2.78)
Total (recreational + occupational)		
Sedentary	1.00	(reference)
Active	0.87	(0.21, 3.62)

Prostate cancer incidence

Liu et al. (2000) studied the relationship between physical activity and prostate cancer incidence in a prospective cohort study of 22,071 men from the Physicians' Health Study in the US.[88] Physical activity was recorded by the frequency of vigorous exercise per week. The risk estimates were adjusted for cigarette smoking, alcohol intake, height, history of diabetes mellitus, history of high cholesterol, history of hypertension, use of multivitamins, and BMI (**Table A76**).

Table A76[88]
Risk of prostate cancer incidence associated with physical activity levels

Physical Exercise	RR	95%C.I.
<1 (times/week)	1.00	(reference)
1	1.02	(0.82, 1.26)
2-4	1.08	(0.91, 1.28)
5+	1.12	(0.91, 1.37)

The association between physical activity and prostate cancer was studied in a cohort of men from Iowa.[89] Both leisure and occupational activities were examined. Leisure activity was classified as very active (≥1 strenuous activity/day); moderately active (2–6 strenuous activities/week); and inactive (≤ 4 strenuous activities/month). Occupational activities were classified as very active, moderately active, and inactive, according to occupational codes defined in the literature. The relative risk estimates were adjusted for age (**Table A77**). In this study occupational and leisure physical activities were not associated with the risk of prostate cancer.

Table A77[89]
Risk of prostate cancer incidence associated with physical activity levels.

Physical Activity	RR	95%C.I.
Leisure		
Inactive	1.00	(reference)
Moderately active	1.00	(0.60, 1.60)
Very active	0.90	(0.50, 1.50)
Occupational		
Inactive	1.00	(reference)
Moderately active	1.00	(0.60, 1.80)
Very active	1.00	(0.60, 1.80)

Cerhan et al. (1996) also investigated the associations between smoking, obesity, alcohol, and physical activity a cohort of men enrolled in the Iowa 65+ Rural Health Stud.[54] The level of physical activity was classified into inactive, moderately active, and highly active following a questionnaire to assess the frequency of various physical activities. The relative risk estimates were adjusted for age (**Table A78**).

Table A78[54]
Risk of prostate cancer incidence associated with physical activity levels

Physical Activity	All Prostate	Localized	Regional/ Distant
Inactive	1.00 (reference)	1.00 (reference)	1.00 (reference)
Moderately Active	1.5 (0.8, 2.8)	1.5 (0.7, 3.2)	1.9 (0.5, 6.5)
Very Active	1.9 (1.0, 3.5)	1.8 (0.8, 4.1)	2.7 (0.7, 9.9)

Various Cancers Mortality

Kampert et al. (1996) studied the association between physical activity and cancer mortality in a cohort of 7080 men and 25,341 women at the Cooper Clinic in Dallas Texas. Cancers include ICD-9 codes 140 to 208.[90] Men and women who reported no activity were classified as sedentary; moderate activity consisted of running up to 10 miles/week or participating in moderately active leisure or recreational activities; higher activity levels were calculated by the total miles walked or ran per week. Physical activity levels were indexed from I (low) to V (high). The relative risks for various cancer mortalities associated with activity levels were estimated (**Table A79**).

Table A79[90]
Risk of cancer mortality associated with physical activity levels

Men	RR	95% C.I.
I (low)	1.00	(reference)
II	0.54	(0.35, 0.84)
III	0.56	(0.36, 0.87)
IV	0.59	(0.38, 0.90)
V	0.36	(0.21, 0.61)
Women	**RR**	**95% C.I.**
I (low)	1.00	(reference)
II	0.63	(0.26, 1.54)
III	0.76	(0.32, 1.80)
IV	0.38	(0.14, 1.03)
V	0.47	(0.18, 1.22)

Rosengren and Wilhelmsen (1997) studied the effects of physical activity on mortality from CHD and other causes.[91] Included in their analysis was the effects of physical activity on the risk of all cause cancer mortality. The study included men from the Multifactor Primary Prevention Study in Goteborg, 7,395 men had available information on their leisure time physical activity. Physical activity was divided into four categories: sedentary, moderately active, regular exercise, and athletic sports. For all cancer mortality, only a relative risk estimate comparing the most active to the least active was reported. The relative risk for all cancer mortality for those most active (compared to those least active) was 0.89, with 95% C.I. (0.34, 1.12).

20.4 Risk factor: sun exposure

Melanoma incidence

Armstrong and Kricker's (2001) reviewed the association between sun exposure and melanoma incidence.[92] This study aimed to show the relationship between average daily hours of bright sunlight averaged or accumulated over all places of residence in people born in Australia with risks of BCC (basal cell carcinoma), SCC (squamous cell carcinoma) and melanoma (**Table A80**). The relative risk for migrants to Australia other than those of Southern European origin was estimated (**Table A81**) as well as the relative risks associated with the type of exposure (**Table A82**). Total exposure and occupational exposure are considered a continuous pattern of exposure. Non-occupational exposure is considered recreational exposure.

Table A80[92]
Risk of skin cancer incidence associated with hours of sunlight exposure

Hours of Sunlight	BCC	SCC	Melanoma
1st quarter	1.00	1.00	1.00
2nd quarter	0.90(0.50, 1.65)	1.8(0.7, 4.5)	1.34(0.96, 1.86)
3rd quarter	1.45(0.65, 3.24)	5.2(1.6, 16)	1.92(1.16, 3.18)
4th quarter	1.47(0.58, 3.71)	3.5(0.97, 12)	N/A

Table A81[92]
Risk of skin cancer incidence associated with the age of immigration to Australia

Age at Arrival in Australia	BCC	SCC	Melanoma
Birth	1.00	1.00	1.00
0-9	1.05(0.38, 2.54)	0.66(0.07, 2.8)	0.89(0.44, 1.80)
10-19	0.14(0.02, 0.53)	0.40(0.05, 1.6)	N/A
20+	0.22(0.11, 0.42)	0.36(0.16, 0.72)	N/A
10-29	N/A	N/A	0.34(0.16, 0.72)
30+	N/A	N/A	0.30(0.08, 1.13)

Table A82[92]
Risk of skin cancer incidence associated with the type of sun exposure

Type of Exposure	BCC	SCC	Melanoma
Total	0.98(0.68, 1.41)	1.53(1.02, 2.27)	1.20(1.00, 1.44)
Occupational	1.19(1.07, 1.32)	1.64(1.26, 2.13)	0.86(0.77, 0.96)
Non-Occupational	1.38(1.24, 1.54)	0.91(0.68, 1.22)	1.71(1.54, 1.90)
Sunburn at any age	1.40(1.29, 1.51)	1.23(0.90, 1.69)	1.91(1.69, 2.17)

A review by Elwood and Jopson's summarised case-control studies on sun exposure and cutaneous melanoma from.[93] Due to the nature of case-control studies only odds ratios were calculable (**Table A83**).

Table A83[93]
Risk of melanoma incidence associated with sun exposure

Author	Study Location	Intermittent Exposure	Occupational Exposure	Total Exposure
Klepp and Magnus (1979)	Norway	2.4(1.0, 5.8)	1.4(0.6.3.5)	
Adam et al. (1981)	UK	1.5(0.9, 2.5)		
Mackie and Aitchison (1982)	Scotland	0.6(0.2, 1.2)	0.4(0.1, 0.7)	
Lew et al. (1983)	USA	2.5(1.1, 5.8)		
Rigel et al. (1983)	USA	2.4(1.2, 5.0)		1.6(1.0, 2.6)
Elwood et al. (1985)	Canada	1.7(1.1, 2.7)	0.9(0.6, 1.5)	1.2(0.7, 2.0)
Graham et al. (1985)	USA (males)	0.7(0.3, 1.3)		0.5(0.2, 1.0)
Graham et al. (1985)	USA (females)		0.6(0.3, 1.1)	
Sorahan and Grimley (1985)	UK	6.5(1.0, 42.0)		
Dubin et al. (1986)	USA	1.7(1.2, 2.3)	2.5(1.4, 4.4)	1.1(0.8, 1.6)
Elwood et al. (1986)	UK		1.7(0.3, 8.6)	
Green et al. (1986)	Australia	1.9(0.5, 7.4)		2.3(0.9, 6.1)
Holman et al. (1986)	Australia	1.1(0.7, 1.8)		0.7(0.4, 1.1)
Cristofolini et al. (1987)	Italy		0.9(0.5, 1.7)	0.6(0.4, 1.0)
Osterlind et al. (1988)	Denmark	1.8(1.2, 2.5)	0.7(0.5, 0.9)	
Zanetti et al. (1988)	Italy		2.1(0.6, 6.8)	
Garbe et al. (1989)	Germany		5.5(1.2, 25.3)	
Beiter et al. (1990)	Sweden	1.8(1.2, 2.6)	0.6(0.4, 1.0)	
Dubin et al. (1990)	USA	1.5(1.0, 2.4)	1.8(0.9, 4.0)	1.7(1.1, 2.8)
Grob et al. (1990)	France	8.4(3.6, 19.7)	2.5(1.2, 5.1)	3.8(2.2, 6.5)
Zanetti et al. (1992)	Italy	2.3(1.3, 3.8)		
Zaridze et al. (1992)	USSR	3.4(0.6, 17.4)		
Herzfeld et al. (1993)	USA	2.0(1.3, 3.3)	0.7(0.5, 1.0)	
Autier et al. (1994)	Belgium, France and Germany	6.1(1.8, 20.3)	0.3(0.1, 0.9)	
Nelemans et al. (1994)	Netherlands	2.4(1.3, 4.2)		
Westerdahl et al. (1994)	Sweden	1.2(0.8, 1.8)	0.8(0.6, 1.0)	
White et al. (1994)	USA		0.6(0.3, 1.2)	0.9(0.5, 1.6)
Holly et al. (1995)	USA (females)	0.8(0.6, 1.1)	0.8(0.5, 1.5)	
Rodenas et al. (1996)	Spain	4.9(2.2, 10.9)	3.7(1.7, 7.5)	5.4(2.4, 12.0)

Kennedy et al. (2003) assessed the effects of lifetime sun exposure and the development of malignant melanoma in a case-control study of 966 men and women in the Dutch population.[94] Due to the nature of the study only odds ratios were calculable (**Table A84**). Sun exposure was measured in hours over the period of a lifetime.

Table A84[94]
Risk of melanoma incidence associated with lifetime hours of sun exposure

Lifetime Sun Exposure (h)	#controls	# cases	OR	Malignant Melanoma
8932-19999	50	49		1.00 (reference)
20000-29999	158	48	0.50	95% C.I. (0.28, 0.90)
30000-39999	103	13	0.47	95% C.I. (0.17, 1.3)
40000	75	15	1.4	95% C.I. (0.40, 4.8)

21. Appendix D Survival-Dependant Prevalence

This will indicate the proportions of those with the various survival characteristics within the prevalence at any time. The quantity is denoted by $q(a,g,t,T,s)$ for a specific gender g, age group a, severity s, T years after the initial diagnosis (given at time t).

Given the cancer treatment costs (total or per case) which have been endured within a specific year as well as the consumption curves, the proper concentrations of the consumption curves within the prevalent groups must be determined. In general, this is an accounting system based upon the historical (or simulated) incidence $I(a,g,t,s)$, mortality $M(a, g,t,s)$, prevalence $q(a,g,t,s)$ as well as survival statistics $S(a,g,T,s)$. The aim of this exercise is to determine the concentrations of the various survival characteristics among those who are alive with cancer at a specific time t.

In general, the cancer prevalence (in any year) can be written as:

$$q(a,g,t,s)=\sum_{T}^{T=15} q(a,g,T,t,s)$$

The above formula indicates the grouping of the prevalence at time t into specific classes in which all patients have survived T years after the last diagnosis (i.e., they were not diagnosed with cancer for this period of time) are assumed to be part of the healthy population (and therefore are no longer part of the prevalence).

22. References

1. Australian Institute of Health and Welfare (AIHW) & Australasian Association of Cancer Registries (AACR) 2004. Cancer in Australia 2001. AIHW cat. no. CAN 23. Canberra: AIHW (Cancer Series no. 28).

2. Australian Institute of Health and Welfare 2006. Australia's health 2006. AIHW cat. no. AUS 73. Canberra: AIHW.

3. Tracey E, Baker D, Chen W, et al. Cancer in New South Wales: Incidence, Mortality and Prevalence, 2005. Sydney: Cancer Institute NSW, November 2007.

4. Doll R, Hill B. The mortality of soctors in relation to their smoking habits. BMJ :1451-5; 1954.

5. Renehan AG, Tyson M, Egger M, et al. Body-mass index and incidence of cancer: a systemic review and meta-analysis of prospective observational studies. Lancet 371: 569-78; 2008.

6. Danaei G, Vander Hoorn S, Lopez AD, et al. Causes of cancer in the world: comparative risk assessment of nine behavioural and environmental risk factors. Lancet 366;1784-93; 2005.

7. The Canadian Stretegy for Cancer Control: A Cancer Plan for Canada. July 2006 http://www.cancer.ca/vgn/images/portal/cit_86751114/10/2/1404842209cw_CSCC_Discussion_Paper_July_2006_v2.pdf (last accessed March 2008).

8. Baan C, et al. Public Health models, Tools for Health Policy making at national and European Level. Biomed project BMH4-CT95-1000; 1999.

9. 9. Wolfson MC. POHEM – a framework for understanding and modeling the health of human populations. World Health Stat Q 47:157-76; 1994.

10. Gunning-Schepers LJ. The health benefits of prevention: a simulation approach. Health Policy 12:1–256; 1989.

11. Golditz GA, Atwood KA, Emmons K, et al., Harvard Report on Cancer Prevention Volume 4: Harvard Risk Index., Cancer Causes Control 11: 477-488, 2000.

12. Berg BA. Markov chain Monte Carlo simulations and their statistical analysis (With Web-Based Fortran Code), World Scientific; 2004.

13. MacKeown PK. Stochastic Simulation Physics. Springer Verlag; 1997.

14. Noether GE. A brief survey of nonparametric statistics. In R.V. Hogg (ed.). Studies in statistics 1978; Math. Assoc. Amer: 39-65.

15. Danaei G, Vander Hoorn S, Lopez AD, et al. Causes of cancer in the world: comparative risk assessment of nine behavioural and environmental risk factors. Lancet 366;1784-93; 2005.

16. AIHW, AACR & NCSG: Ian McDermid 2005. Cancer incidence projections, Australia 2002 to 2011. Canberra: Australian Institute of Health and Welfare (AIHW), Australasian Association of Cancer Registries (AACR) and the National Cancer Strategies Group (NCSG).

17. Aitken R, Morrell S, Barraclough H, et al. Cancer incidence and mortality projections in New South Wales, 2007 to 2011. Cancer Institute NSW 2007.

18. WHO, IARC (2002). Tobacco Smoke and Involuntary Smoking. Summary of Data Reported and Evaluation. Lyon: IARC Monographs, 2002.http://monographs.iarc.fr/htdocs/indexes/vol83index.html.

19. Stein CJ, Colditz GA. Modifiable risk factors for cancer. Br J Cancer 90: 299-303; 2004.

20. Renehan AG, Tyson M, Egger M, et al. Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. Lancet 371:569-578; 2008.

21. Bergstrom A, Pisani P, Tenet V, et al. Overweigh as an avoidable cause of cancer in Europe. Int J Cancer 91: 421-430; 2001.

22. Australian Institute of Health and Welfare (AIHW) 2006. BreastScreen Australia monitoring report 2002–2003. AIHW cat. no. CAN 27. Canberra: Australian Institute of Health and Welfare (Cancer Series no. 32).

23. Hardcastle JD, Chamberlain JO, Robinson MHE, et al. Randomised controlled trial of faecal occult blood screening for colorectal cancer. Lancet 348:1472-77; 1996.

24. Krogberg O, Fenger C, Olsen J, et al. Randomised study of screening for colorectal cancer with faecal-occult-blood test. Lancet 348:1467-1471; 1996.

25. Mandel JS, Bond JH, Church TR, et al. Reducing mortality from colorectal cancer by screening for faecal occult blood. Minnesota Cancer Control Study. N Eng J Med 328:1365-1371; 1993.

26. Glass P, Pezzullo ML, Cutler HG, et al. Health Return on Investment in Cancer Research. Cancer Institute NSW 2008.

27. Shaper AG, Wannamethee SG, Walker M. Pipe and cigar smoking and major cardiovascular events, cancer incidence and all-cause mortality in middle-aged British men. International Journal of Epidemiology 32: 802-808; 2003.

28. Cigarette Smoking and Male Lung Cancer in an Area of Very High Incidence II Report of a General Population Cohort Study in the West of Scotland. Authors/ Organizations: Journal of Epidemiology, Community Heal Ruchill Hospital. Univ. of Mi. and West of Scotland Cancer Surveillance. http://tobaccodocuments.org/pm/2063628467-8471.html (last accessed March 2008).

29. Memorandum by British American Tobacco The Tobacco Industry and the Health Risks of Smoking (TB 28) (Wu-Williams A and Samet JM, "Epidemiology of Lung Cancer", Marcel Dekker Inc, p 71; 1994.

30. Dosemeci M, Gokmen I, Unsal M, et al. Tobacco, alcohol use, and risks of laryngeal and lung cancer by subsite and histologic type in Turkey. Cancer Causes and Control 8:729-737; 1997.

31. Kabat GC. Aspects of the epidemiology of lung cancer in smokers in the United States. Lung Cancer 15:1-20; 1996.

32. MaoY, HuJ, Ugnat AM, et al. Socioeconomic status and lung cancer risk in Canada. Int Epidemiol Assoc 30:809-817; 2001.

33. Rachtan J, Sokolowski A. Risk factors for lung cancer among woman in Poland. Lung Cancer 18:137-145; 1997.

34. Rachtan J. Smoking, passive smoking and lung cancer cell types among woman in Poland. Lung Cancer 35:129-136; 2002.

35. Speizer FE, Colditz GA, Hunter DJ, et al. Prospective study of smoking, antioxidant intake, and lung cancer in middle-aged women (USA). Cancer Causes and Control 10:475-482; 1999.

36. Godtfredsen NS, Prescott E, Osler M. Effect of smoking reduction on lung cancer risk. JAMA 294: 1505 -1510; 2005.

37. Marang-van de Mheen P, Smith GD, Hart CL, et al. Are women more sensitive to smoking than men? Finding from the Renfrew and Paisley study. Int J Epidemiol 30:787-792; 2001.

38. Wen C-P, Tsai SP, Chen C-J, et al. The mortality risks of smokers in Taiwan Part 1: cause-specific mortality. Prev Med 39:528-535; 2004.

39. Lam TH, He Y, Shi QL, et al. Smoking, Quitting, and Mortality in a Chinese Cohort of Retired Men. Ann Epidemiol12:316-320; 2002.

40. Prescott E, Osler M, Anderson PK, et al. Mortality in women and men in relation to smoking. Int J Epidemiol 27:27-32; 1998.

41. 41. Zhang B, Ferrence R, Cohen J, et al. Smoking cessation and lung cancer mortality in a cohort of middle-aged Canadian women. Ann Epidemiol 15:302 -309; 2005

42. Ebbert JO, Willams BA, Sun Z, et al. Duration of smoking abstinence as a predictor for non-small cell lung cancer survival in women. Lung Cancer 47:165-172; 2005.

43. Lange JH, Mastrangelo G, Fadda E, et al. Elevated lung cancer risk shortly after smoking cessation: is it due to a reduction of endotoxin exposure. Med Hypotheses 65:534-541; 2005.

44. Nia PS, Weyler J, Colpaert C, et al. Prognostic value of smoking status in operated non-small cell lung cancer. Lung Cancer 47:351-359; 2005.

45. Terry PD, Miller AB, Rohan TE, et al. Cigarette smoking and breast cancer risk: a long latency period? Int J Cancer 100:723-728; 2002.

46. Manjer J, Anderson I, Berglund G, et al. Survival of women with breast cancer in relation to smoking. Eur J Surg166, 852-858; 2000.

47. Lash TL, Aschengrau A. A null association between active or passive cigarette smoking and breast cancer risk. Breast Cancer Res Treat 75:181-184; 2002.

48. ManjerJ, Johansson R, Lenner P. Smoking is associated with postmenopausal breast cancer in women with high levels of estrogens. Int J Cancer 112:324-328; 2004.

49. Johnson KC. Accumulating evidence on passive and active smoking and breast cancer risk. Int J Cancer 117:619-628; 2005.

50. Fentiman IS, Allen DS, Hamed H. Smoking and prognosis in women with breast cancer. Int J Clin Pract 59:1051-10; 2005.

51. Tominaga K, Andow J, Koyama Y, et al. Family environment, hobbies and habits as psychological predictors of survival for surgically treated patients with breast cancer. Jpn J Clin Oncol 66:36-41; 1998.

52. Miller GH. Can active smoking cause breast cancer? Chem Health Saf 9:20-23; 2002.

53. Villeneuve PJ, Johnson KC, Kreiger N, et al. Risk factors for prostate cancer: results from the Canadian National Enhanced Cancer Surveillance System. Cancer Causes Controls 10:355-367; 1999.

54. Cerhan JR, Torner JC, Lynch CF, et al. Association of smoking, body mass, and physical activity with risk of prostate cancer in the Iowa 65+ Rural Health Study (United States). Cancer Causes Control 8:229-238; 1997.

55. Hsing AW, McLaughlin JK, Hrubec Z, et al. Tobacco use and prostate cancer: 26-year follow-up of US veterans. Am J Epidemiol 133:437-441; 1991.

56. Hayes RB, Pottern LM, Swanson GM, et al. Tobacco use and prostate cancer in Blacks and Whites in the United States. Cancer Causes Control 5:221-226; 1994.

57. Lotufo PA, Lee I-M, Ajani UA, et al. Cigarette smoking and risk of prostate cancer in the Physicians' Health Study (United States). Int J Cancer 87:141-144; 2000.

58. Meyer F, Bairati I, Shadmani R, et al. Dietary fat and prostate cancer survival. Cancer Causes Control 10:245 -251; 1999.

59. Limburg PJ, Vierkant RA, Cerhan JR, et al. Cigarette smoking and colorectal cancer: long-term, subsite specific risks in a cohort study of postmenopausal women. Clinical Gastroenterology and Hepatology 1:202-210; 2003.

60. D'Avanzo B, La Vecchia C, Franceshi S, et al. Cigarette smoking and colorectal cancer; A study of 1584 cases and 2879 controls. Prev Med 24:571-574; 1995.

61. Terry P, Ekbom A, Lichtenstein P, et al. Long-term tobacco smoking and colorectal cancer in a prospective cohort study. Int J Cancer 91:585-587; 2001.

62. Hsing AW, McLaughlin JK, Chow, W-H, et al. Risk factors for colorectal cancer in a prospective study among US white men. IntJ Cancer 77:549-553; 1998.

63. Rohan TE, Jain M, Rehm JT, et al. Cigarette smoking and the risk of death from colorectal cancer in women. Colorectal Dis 2:298-303; 2000.

64. Limburg PJ, Vierkant RA, Cerhan JR, et al. Cigarette smoking and colorectal cancer: long-term, subsite specific risks in a cohort study of postmenopausal women. Clin Gastroenterol Hepatol 1:202-210; 2003.

65. Harnack LJ, Anderson KE, Zheng W, et al. Smoking, Alcohol, Coffee, and Tea Intake and Incidence of Cancer of the Exocrine Pancreas: The Iowa Women's Health Study. Cancer Epidemiol Biomarkers Prev 6: 1081-1086; 1997.

66. Gallicchio L, Kouzis A, Genkinger JM, et al. Active cigarette smoking, household passive smoke exposure, and the risk of developing pancreatic cancer. Prev Med 42:200-205; 2006.

67. Nordland LA, Carstensen JM, Pershagen G. Cancer Incidence in Female Smokers: A 26 year follow up. Int J Cancer 73:625-627; 1997.

68. Iribarren C, Tekawa IS, Sidney S, et al. Effect of cigar smoking on the risk of cardiovascular disease, chronic obstructive pulmonary disease, and cancer in men. N Eng J Med 340:1773-1780; 1999.

69. Jee SH, Samet JM, Ohrr H, et al. Smoking and cancer risk in Korean men and women. Cancer Causes Control. 15:341-348; 2004.

70. Chen CW, Gibb H. Procedures for calculating cessation lag. RegulToxicol Pharmacol 38:157-165; 2003.

71. Sonnenschein E, Tonlolo P, Terry MB, et al. Body fat distribution and obesity in pre- and postmenopausal breast cancer. Int J Epidemiol 28:1026-1031; 1999.

72. Carmichael AR, and Bates T. Obesity and breast cancer: a review of the literature. Breast 13: 85-92; 2004.

73. Vatten LJ. Body size and breast cancer risk. Breast 5:5-9; 1996.

74. McCullough ML, Feigelson HS, Diver WR, et al. Risk factors for breast cancer in African-American women and White women in a large US prospective cohort. Am J Epidemiol 162:734- 742; 2005.

75. Holmbergm L, Ekbom A, Calle E, et al. Breast cancer mortality in relation to self-reported use of breast self-examination. A cohort study of 450,000 women. Breast Cancer Res Treat 43:137 -140; 1997.

76. Patrelli JM, Calle EE, Rodriguez C, et al. Body mass index, height, and postmenopausal breast cancer mortality in a prospective cohort of US women. Cancer Causes Control 13:325-332; 2002.

77. Nilsen TL, Vatten LJ. Prospective study of colorectal cancer risk and physical activity, diabetes, blood glucose and BMIL exploring the hyperinsulinaemia hypothesis. Br J Cancer 84:417-422; 2001.

78. Bergstrom A, Pisani P, Tenet V, et al. Overweight as an avoidable cause of cancer in Europe. Int J Cancer 91:421-430; 2001.

79. Lin J, Zhang SM, Cook NR, et al. Body mass index and risk of colorectal cancer in women (United States). Cancer Causes and Control 15:581-589; 2004.

80. Calle EE, Rodriguez C, Walker-Thurmond K, et al. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of US adults. N Eng J Med 348:1625 – 1638; 2003.

81. Inoue M, Sobue T, Tsugane S. Impact of body mass index on the risk of total cancer incidence and mortality among middle-aged Japanese: data from a large-scale population-based cohort study – The JPHC Study. Cancer Causes Control 15:671-680; 2004.

82. Wannamethee SG, Shaper AG, Walker M. Physical activity and risk of cancer in middle-aged men. Br J Cancer 85:1311-1316; 2001.

83. Tang R, Wang J-Y, Lo S-K, et al. Physical activity, water intake and risk of colorectal cancer in Taiwan: A hospital-bases case-control study. Int J Cancer 82:484-489; 1999.

84. Sesso HD, Paffenbarger RS Jr., et al. Physical activity and breast cancer risk in the College Alumni Health Study (United States). Cancer Causes Control 9:433-449; 1998.

85. Patel AV, Calle EE, Bernstein L, et al. Recreational physical activity and risk of postmenopausal breast cancer in a large cohort of US women. Cancer Causes Control 14:519-529; 2003.

86. Lee I-M, Sesso HD, Paffenbarger RS Jr. Physical activity and risk of lung cancer. Int J Epidemiol 28:620-625; 1999.

87. Thune I, Lund E. The influence of physical activity on lung-cancer risk: a prospective study of 81, 516 men and women. Int J Cancer 70:57-62; 1997.

88. Liu S, Lee I-M, Linson P, et al. A prospective study of physical activity and risk of prostate cancer in US physicians. Int J Epidemiol 29, 29-35; 2000.

89. Putnam SD, Cerhan JR, Parker AS, et al. Lifestyle and anthropometric risk factors for prostate cancer in a cohort of Iowa men. Ann Epidemiol 10:361-369; 2000.

90. Kampert JB, Blair SN, Barlow CE, et al. Physical activity, physical fitness, and all-cause and cancer mortality: a prospective study of men and women. Ann Epidemiol 6:452-457; 1996.

91. Rosengren A, Wilhelmsen L. Physical activity protects against coronary death and deaths from all causes in middle-aged men: evidence from a 20-year follow-up of the Primary Prevention Study in Goteborg. Ann Epidemiol 83:2003 -2007; 1997.

92. Armstrong BK, Kricker A. The epidemiology of UV induced skin cancer. J Photochem Photobiol B 63:8-18; 2001.

93. Elwood JM, Jopson J. Melanoma and sun exposure: an overview of published studies. Int J Cancer. 73:198-203; 1997.

94. Kennedy C, Bajdik CD, Willemze R, et al. The influence of painful sunburns and lifetime sun exposure on the risk of actinic keratoses, seborrheic warts, melanocytic nevi, atypical nevi, and skin cancer. J Invest Dermatol 120:1087-1093; 2003.

DATA

AIHW Cat. No. HWE 4 (Health and Welfare Expenditure Series no. 4, 1998), AIHW Cat. No. HWE 29 (Health and Welfare Expenditure Series no. 22, 2005).

AIHW, AACR & NCSG: Ian McDermid 2005. Cancer incidence projections, Australia 2002 to 2011. Canberra: Australian Institute of Health and Welfare (AIHW), Australasian Association of Cancer Registries (AACR) and the National Cancer Strategies Group (NCSG).

Australian Bureau of Statistics 3201.0 TABLE 1. Estimated Resident Population By Single Year Of Age, New South Wales.

Australian Bureau of Statistics 3222.0 Projected Population, Components of Change and Summary Statistics - Australia.

Australian Bureau of Statistics 3222.0 TABLE A1. Population projections, By age and sex, New South Wales - Series A.

Australian Bureau of Statistics 3222.0 TABLE B1. Population projections, By age and sex, New South Wales - Series B.

Australian Bureau of Statistics 3222.0 TABLE C1. Population projections, By age and sex, New South Wales - Series C.

Australian Bureau of Statistics 3301.0 Births, Australia.

Australian Bureau of Statistics 3302.0 Deaths, Australia.

Australian Bureau of Statistics 3302.0.55.001 Table 1. Life Tables, Australia - 2002-2004.

Australian Bureau of Statistics 3302.1.55.001 Table 1. Life Tables, New South Wales - 2002-2004.

Australian Bureau of Statistics 3303.0.55.001 Causes of Death, Australia Preliminary Summary Tables - 2004.

Australian Bureau of Statistics 3311.1 Demography, New South Wales.

Australian Bureau of Statistics 3311.1.55.001 Demography, NSW.

Australian Bureau of Statistics 3412.0 Migration, Australia.

Australian Bureau of Statistics 4102.0 Australian Social Trends - Health - 2005.

Australian Bureau of Statistics 4102.0 Australian Social Trends - Population - 2005.

Australian Bureau of Statistics 4102.0 Australian Social Trends - Work - 2005.

Australian Bureau of Statistics 4108.1 Older People, New South Wales.

Australian Bureau of Statistics 43620 New South Wales state tables, smoking.

Australian Bureau of Statistics 4812.0 Health Risk Factors, Australia.

Australian Bureau of Statistics 5204.0 Table 12. Income from GDP, Current prices.

Australian Bureau of Statistics 5204.0 Table 22. Productivity in the Market Sector.

Australian Bureau of Statistics 5204.0 Table 40. General Government Income Account, Current prices ($m).

Australian Bureau of Statistics 5204.0 Table 5. Expenditure on GDP, Current prices ($m).

Australian Bureau of Statistics 5206.0.40.001 Australian National Accounts Quarterly State Details.

Australian Bureau of Statistics 5216.0 Australian System of National Accounts Concepts, Sources and Methods.

Australian Bureau of Statistics 5220.0 Australian National Accounts State Accounts.

Australian Bureau of Statistics 5220.0 Table 22. Expenditure Components of Gross Domestic Product, Australia - Current prices ($m).

Australian Bureau of Statistics 5220.0 Table 24. Total Factor income by Industry and Principal Components, New South Wales - Current prices ($m).

Australian Bureau of Statistics 5220.0 Table 34. Household Income Account, New South Wales - Current prices ($m).

Australian Bureau of Statistics 5220.0 Table 5. Expenditure Components of Gross Domestic Product, New South Wales - Chain volume measures ($m)(a).

Australian Bureau of Statistics 5220.0 Table 6. Expenditure Components of Gross State Product, New South Wales - Current prices ($m).

Australian Bureau of Statistics 5246.0 Information Paper Australian National Accounts Introduction to Input-Output Multipliers.

Australian Bureau of Statistics 5506.0 Taxation Revenue, Australia.

Australian Bureau of Statistics 6105.0 Australian Labour Market Statistics.

Australian Bureau of Statistics 6201.1 Labour Force, New South Wales and Australian Capital Territory.

Australian Bureau of Statistics 6202.0.55.001 Table 01. Labour force status by Sex - Trend.

Australian Bureau of Statistics 6216.0 Multiple Jobholding, Australia.

Australian Bureau of Statistics 6220.0 Persons Not in the Labour Force, Australia.

Australian Bureau of Statistics 6260.0 Labour Force Projections, Australia.

Australian Bureau of Statistics 6261.0.55.001 - Characteristics of Wage and Salary Earners in Regions of Australia, 2002-03.

Australian Bureau of Statistics 6291.0.55.001 EM1 - Employed Persons by Sex, Age, Hours Worked, State.

Australian Bureau of Statistics 6291.0.55.001 NM1_FEB78 - Not in the Labour Force Status by Sex, State, Age.

Australian Bureau of Statistics 6291.0.55.001 Table 02 Labour force status by State, Capital city - Balance of state and Sex.

Australian Bureau of Statistics 6291.0.55.001 Table 08 Employed persons by status in employment and Sex.

Australian Bureau of Statistics 6291.0.55.001 UM2 - Unemployed Persons by Sex, State, Duration of Unemployment.

Australian Bureau of Statistics 6302.0 TABLE 10A. Average Weekly Earnings, Industry, Australia (Dollars) - Original - Males, Full Time Adult Ordinary Time Earnings.

Australian Bureau of Statistics 6302.0 TABLE 11A. Average Weekly Earnings, New South Wales (Dollars) - Trend.

Australian Bureau of Statistics 6302.0 TABLE 13A. Average Weekly Earnings, New South Wales (Dollars) - Original.

Australian Bureau of Statistics 6345.0 Labour Price Index, Australia.

Australian Bureau of Statistics 6348.0.55.001 Labour costs by State territory, Labour costs by Sector, Labour Costs by Industry.

Australian Bureau of Statistics 6401.0 TABLE 1. CPI All Groups, Index Numbers (Quarterly)(a).

Australian Bureau of Statistics 6401.0 TABLE 6F. CPI Health, Contribution to Change in All Groups Indexes (Quarterly)(a).

Australian Bureau of Statistics 6425.0 Information Paper Price Indexes and The New Tax System.

Australian Bureau of Statistics 6455.0.40.001 Consumer Price Index Standard Data Report Capital Cities Index Numbers by Expenditure Class.

Australian Bureau of Statistics Labour Price Index, ABS Catalogue No. 6351.0.55.001.

Australian Bureau of Statistics Series 5220.0 Table 24.

Australian Bureau of Statistics Series 5220.0 Table 24.

Australian Bureau of Statistics Series 5506.0 Taxation Revenue, 2004-2005, Commonwealth and State Governments.

Australian Bureau of Statistics Migration data NSW and Australia 1985-2005, Australian Bureau of Statistics (Provided by NSW Cancer Institute).

Australian Institute of Health and Welfare (AIHW 2005). Health system expenditures on cancer and other neoplasms in Australia, 2000–01. AIHW cat. no. HWE 29.

Australian Institute of Health and Welfare (AIHW) & Australasian Association of Cancer.

Australian Institute of Health and Welfare (AIHW) 2005. Australian hospital statistics 2003–04. AIHW cat. no. HSE 37. Canberra: AIHW (Health Services Series no. 23).

Other Data Sets

NSW Report of the Chief Health Officer 2004 on 'smoking status by sex, persons aged 16 and over, NSW 1977 to 2002-03'.

Cancer Registry Data Sets

Australian Institute of Health and Welfare (AIHW) 2005. State & Territories GRIM (General Record of Incidence of Mortality) Books. AIHW: Canberra:

All cancers (ICD10 C00-C97)

Breast cancer (ICD10 C50)

Colon cancer (ICD10 C18)

Colo-rectal cancer (ICD10 C18-C21)

Lung cancer (ICD10 C33,C34)

Prostate cancer (ICD10 C61)

Other malignant neoplasms of the skin (ICD10 C44)

Prostate cancer (ICD10 C61).

Contact Directory

Cancer Institute NSW
Level 1, Biomedical Building
Australian Technology Park
1 Central Avenue
Eveleigh NSW 2015
Australia

PO Box 41
Alexandria NSW 1435

Tel: + 61 2 8374 5600
Fax: + 61 2 8374 5700
Email: information@cancerinstitute.org.au
Web: www.cancerinstitute.org.au

Service and business hours: 8.30am – 5.00pm