



Government of **Western Australia**
Department of **Health**

Trends in fatal burden of disease in Western Australia 2014 – 2018

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Epidemiology Branch

Public Health and Aboriginal Health Division

Department of Health, Western Australia

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Using the term Aboriginal

Within Western Australia, the term Aboriginal is used in preference to Aboriginal and Torres Strait Islander, in recognition that Aboriginal people are the original inhabitants of Western Australia. Aboriginal and Torres Strait Islander may be referred to in the national context and Indigenous may be referred to in the international context. No disrespect is intended to our Torres Strait Islander colleagues and community.

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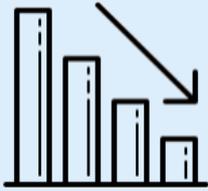
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Executive Summary



236 000 years of life
lost in 2018
Rate ↓ by 3.6% from 2015



Up to 2x greater
fatal burden in
non-Metropolitan areas



More than 3x greater
burden among
Aboriginal people

Fatal burden as a population health indicator

Fatal burden is a metric that describes premature mortality, and can provide valuable insight about the distribution of disease burden within a community. Trends in fatal burden are useful for monitoring population health over time. This report builds on global and national frameworks to estimate detailed trends in fatal burden in Western Australia for the first time, establishing a foundation for routine monitoring of this metric in the future.

Fatal burden in Western Australia is declining

Western Australians lost between 225 000 and 241 000 years of life due to premature mortality each year between 2014 and 2018. Taking into account changes in population size and structure over this period, the rate of fatal burden fell by 3.6% over this five year period, from 87.7 to 84.5 YLL per 1000 population. This success was largely due to reductions in fatal burden due to cancers and cardiovascular diseases. The decline was consistent among men and women, though men still experience 1.6 times greater fatal burden than women each year, with injuries and cardiovascular diseases the major contributors to this difference.

Progress is not equally shared

Fatal burden in Western Australia reflects known health inequities within our state. Rates of fatal burden are markedly higher among Aboriginal people, with upward trends observed in this population for fatal burden due to cancers, and to a lesser extent infections and infant and congenital conditions, during the period of 2014-2018. Similarly, many regional areas of WA experience rates of fatal burden which are nearly double the rates observed in metropolitan Perth. Ongoing work is needed to address health inequities in Western Australia.

Introduction

Burden of disease

Burden of disease is defined as the impact of a health problem on a population. Impacts can be measured in numerous ways, most commonly in terms of morbidity (the years of healthy life lost due to illness), mortality (years of life lost due to premature death), financial costs, or a combination of these. Burden of disease analyses are important for i) monitoring population health, ii) guiding resource allocation and prioritising services; iii) measuring the progress of health programs; and iv) estimating potential health gains from investment.

Years of Life Lost: the fatal burden of disease

Years of life lost (YLL) is a metric of the number of years of life lost due to dying before the ideal lifespan. As a direct reflection of premature mortality and 'fatal burden of disease', YLL progress is a key indicator of population health. Fatal burden offers additional information to crude mortality numbers and rates, as it incorporates age at the time of death. YLL can be summed with years lived with disability (YLD) to calculate disability-adjusted life years (DALY), where one DALY reflects the loss of one year of healthy life. In contrast to YLD, estimates of YLL are considered more precise and are simpler to calculate because the input mortality data are comparatively complete and reliable.

Fatal burden of disease in Western Australia

Six burden of disease estimates for Western Australia have been completed since 1996 (Table 1). Four of these were completed as part of national analyses (1-4). Since 1996, the Australian Institute of Health and Welfare (AIHW) has led or collaborated on the Australian Burden of Disease Study (ABDS) reports, adapting the global framework implemented in the Global Burden of Disease Study (GBDS) for the Australian context. A further two estimates were completed specifically for WA in 2000 and 2015 (5, 6). Most recently, the WA Department of Health completed the Western Australian Burden of Disease Study (WABODS) in 2015, in collaboration with AIHW.

Table 1: Prior analyses of fatal burden of disease in Western Australia

Year	Organisation	YLL in WA	Population	Age-standardised YLL/1000 population
1996	AIHW	117,990	1,726,000	NA
2000	WA Department of Health	112,950	1,884,000	87.3
2003	AIHW and University of QLD	110,348	1,952,000	NA
2011	AIHW	212,000	2,350,000	89.4
2015	AIHW	237,000	2,590,000	90.2
2015	WA Department of Health	237,469	2,590,259	88.6

NA = not available

Each of these analyses considered single year mortality data in a cross-sectional manner. Trends can be evident when comparing the reports, particularly when rates are calculated against the same standard reference population, however small differences in methodology mean that no two reports are directly comparable.

Generally, males experience higher rates of fatal burden for most disease groups than females in Western Australia. Fatal burden is high in infancy, reflecting the large number of life years lost with each death. Burden decreases after one year of age, then increases again from age 15, peaking at ages 60-69 for men, and 80-89 for women. Previous reports have demonstrated that cancer is the leading cause of fatal burden in Western Australia for both sexes, followed by cardiovascular disease and injuries. The AIHW's report of burden of disease among Aboriginal and Torres Strait Islander people described substantially higher rates of fatal burden among Aboriginal people in WA, for most disease groups (7). Detailed trends in fatal burden have not previously been estimated for the Aboriginal population of Western Australia, nor for the health regions.

Scope of this report

This report examines mortality data from Western Australia between 2014 and 2018 inclusive. Objectives of the study are:

1. To estimate total fatal burden of disease in WA, 2014-2018; and
2. To identify trends in fatal burden of disease in WA by sex, age, disease group, Aboriginality, and health region.

Methodology

Mortality data

Mortality data was extracted on 21 July 2020 from the Western Australian Registry of Births, Deaths and Marriages. Records with a 'date of death' recorded between 01 January 2014 and 31 December 2018 were included. Australian mortality data are considered complete (i.e. all deaths are registered), with no adjustments required to address missing records (8). Records related to stillbirths were not included in this analysis.

Death records with missing data

For those records missing information on age at death, dates of birth and death were used to calculate age. For those missing information on both date of birth and age, the median age for their sex, race and year of death was assigned (n=7). For those records missing information on sex, or where sex was listed as other/unknown, sex was assigned (n=18). When other information in the record indicated a sex or gender (for example, cause of death listed as prostate cancer, or occupation listed as 'businesswoman'), this information was used to inform the assigned sex; otherwise sex was assigned equally at random. Analyses in this report, as with mortality analyses by AIHW, treat sex as a binary variable; this remains an area for improvement but is limited by data collection practices informing the mortality dataset.

Mortality records can have missing causes of death in two patterns. Firstly, a small number of records (n=61 over the four year period 2014-2017) truly have an absent final cause of death, presumably where no information on cause of death was available for coding. These records were included in analyses, and had cause of death proportionally assigned based on all causes of death by sex, age and race in the respective year of death. Secondly, the most recent year of mortality data (in this case, 2018) is available in a 'preliminary format', and some records have a missing cause of death that will be completed as the dataset moves into revised and then final versions (9). To assign causes of death in the preliminary year (n=726 in 2018), patterns of changes between previous preliminary and final mortality datasets (2014-2016) were analysed and proportionally applied to the 2018 dataset.

Alignment of causes of death

Records from the Western Australian Registry of Births, Deaths and Marriages have the cause of death coded to the International Classification of Disease 10th revision (ICD-10) by the Australian Bureau of Statistics (ABS). These ABS causes of death codes (more than 12,000 unique codes) were then mapped to 216 diseases and injuries, falling within 17 disease groups, as per ABDS 2015 methods. Of the 17 disease groups, hearing and vision disorders were not included in the findings of this report, as these did not cause any fatal burden. One adjustment was made in line with new AIHW methodology since 2015, whereby ICD codes C26.0 to C26.1 are allocated to specific ABDS diseases rather than being redistributed.

Redistribution of causes of death

Some causes of death are considered not appropriate or valid for analysis of fatal burden; these include causes of death which are i) considered implausible as the underlying cause of death

(e.g. hypertension and paraplegia); ii) intermediate causes which have a precipitating cause (e.g. septicaemia and pneumonitis); iii) immediate causes that occur in the final stages of dying (e.g. cardiac arrest and respiratory failure); or iv) causes that are ill-defined or unspecified (e.g. ill-defined digestive diseases and unspecified diabetes) (8). These codes occur in approximately 10% of deaths, and contribute approximately 8% of YLL each year (Table 2).

Deaths coded to these causes are reassigned to one or more target diseases according to codes reflecting a more probable underlying cause. AIHW has developed algorithms that guide this 'redistribution', based on direct evidence, indirect multiple causes of death (MCOB), or proportional redistribution (8). In this analysis, ABDS 2015 algorithms were applied, with the exception of: i) Non-specific Cancers (C76-C80) and Non-Specific Digestive Cancers (C26.9), for which new algorithms were developed using recent data from the Western Australian Cancer Registry 2013-2017; and ii) Undetermined Intent codes (Y10-Y34), which have been split into two algorithms (Y10-Y19 and Y20-Y34) by AIHW since ABDS 2015 was published.

The impact of redistribution of deaths on total number of and proportion of deaths and YLL in 2018 is shown in Appendix 1. The largest numbers of deaths gained by redistribution were for cardiovascular disease (538 deaths, an increase of 14.6%); cancers (348 deaths, an increase of 7.7%); and injury (173 deaths, an increase of 12.0%). Endocrine disorders also had a notable increase by proportion (150 more deaths, an increase of 40.0%), largely due to deaths coded as 'unspecified diabetes' being reassigned to Type 1, Type 2 or Other Diabetes.

Table 2: Number and per cent of deaths and YLL, total and redistributed, by year

Year	Total deaths	Deaths for redistribution	Per cent of total deaths	Total YLL	YLL for redistribution	Per cent of total YLL
2014	13,732	1191	8.7	225,950	17,160	7.6
2015	14,504	1464	10.1	239,310	20,378	8.5
2016	14,941	1553	10.4	240,718	19,584	8.1
2017	14,556	1602	11.0	235,710	21,692	9.2
2018	14,642	1578	10.8	236,092	20,212	8.6

Reference life table

The reference life table used in this study is the standard reference life table used in the GBDS 2010 and 2013, and ABDS 2011 and 2015 (10). The most recent global estimates of YLL are based on the Theoretical Minimum Risk Life Table (TMRLT) (11). To date, the TMRLT has only been published in an abridged format; that is, in five year age groups. AIHW examined the impact of using an abridged life table without single year of age detail available, and found that YLL estimations were less accurate (4). As such, the standard reference life table was used in this analysis. The maximum age at death featured in the standard reference life table is 105 years, for which YLL is estimated at 1.63 years. All deaths at ages greater than 105 years were assigned this same YLL estimate.

Reference populations

All population-based rates for 2014-2018 were calculated using Estimated Resident Population from the Australian Bureau of Statistics, published in 2020 (12), which is rebased to the 2016 Census, and considered final up to 2016, and revised for 2017 and 2018. To enable comparisons across different populations and different years, the Australian 2001 standard population (13) was used for all age-standardisation.

Aboriginal population estimates for 2014-2018 previously completed by the Epidemiology Branch were used in this analysis. These are based on the 2016 Census population for Western Australia from ABS (14). Estimates for 2014 and 2015 were back cast, and estimates for 2017 and 2018 were forecast.

Estimates by region and Aboriginal status

Categorical data for region and race were obtained directly from the mortality database, which routinely collects information on Aboriginal status and usual residence of the deceased. The mortality database includes the 'Derived Aboriginal and Torres Strait Islander Flag', established by the Western Australian Data Linkage Branch, which improves identification of Aboriginal people based on all available data collections, and which was used for this analysis.

Statistical analysis

This analysis was completed in R Studio (version 1.2.5033) using R (version 3.6.0). Graphs were made using the ggplot2 package in R. Confidence intervals show a 95% confidence range around the rates of fatal burden; the interval reflects the precision of the rates, not of the methodology used to derive YLL counts. They are calculated based on the standard error of the rate.

Results

Fatal burden of disease in WA 2014-2018

The number of deaths per year in Western Australia has remained steady over the five years between 2014 and 2018, with a mean of 14,475 deaths per year (Figure 1). Western Australians experienced between 225,950 and 240,718 YLL per year in this period.

The age-standardised rate peaked at 91.1 YLL per 1000 population in 2015, and has demonstrated a statistically significant decline each year since, most recently estimated at 84.5 in 2018 (Table 3, Figure 1). Males had a greater number of deaths (52.7% in 2018), amount of YLL (59.6% in 2018), and higher age-standardised rate (105 vs 65 YLL per 1000 population in 2018) than females each year; however the pattern of declining ASR since 2015 is consistent between sexes.

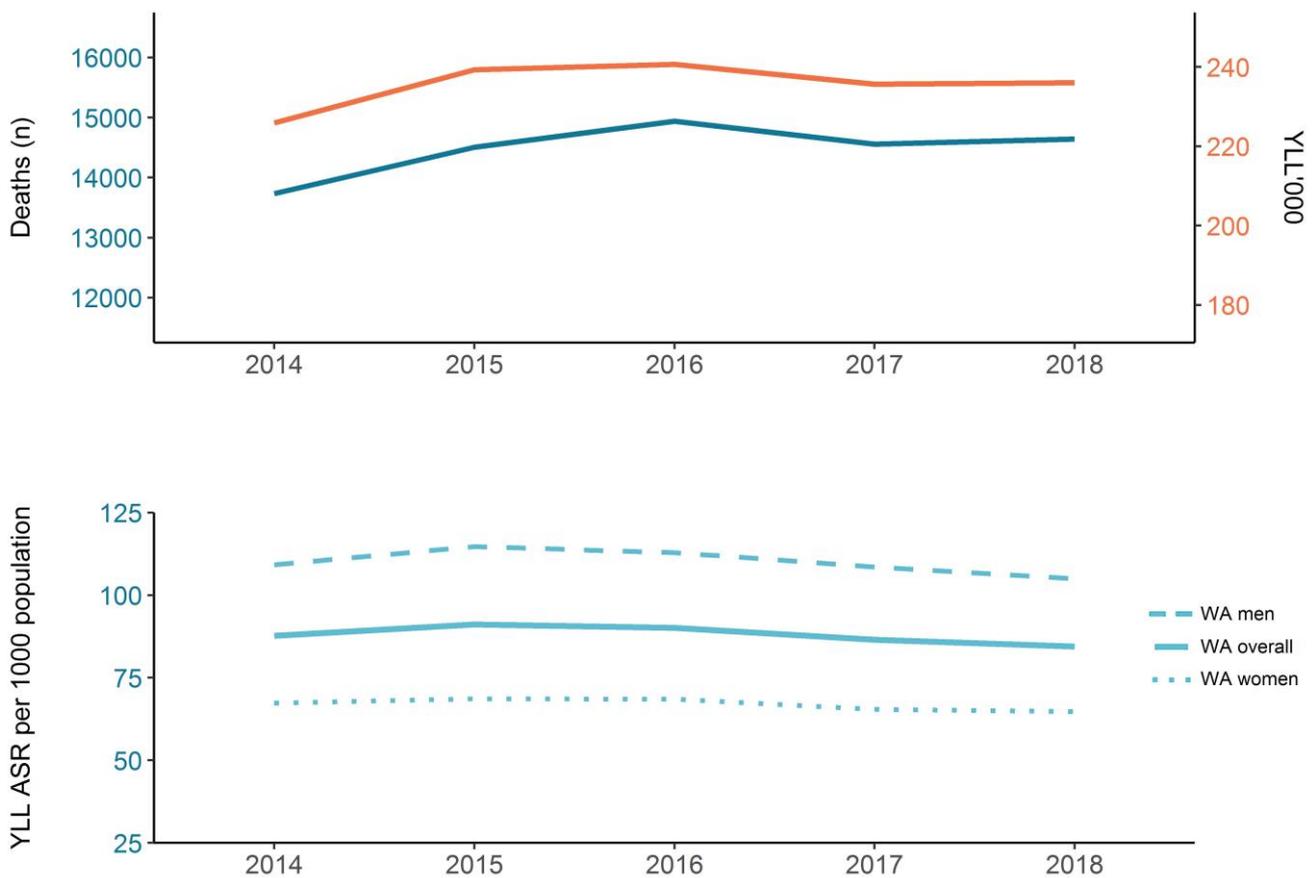


Figure 1: the upper graph shows the number of deaths (blue, left y axis) and the amount of YLL (orange, right y axis) across time; the lower graph shows YLL ASR per 1000 population among all people (blue line) across time, as well as for males (dashed line) and females (dotted line).

Trends in fatal burden by disease group

Of the 17 disease groups, cancers and other neoplasms had the highest age-standardised rate of YLL across all years (Figure 2). Since 2015, injuries have overtaken cardiovascular disease as the disease group causing the second highest rate of fatal burden per population. Rates for other disease groups remained stable.

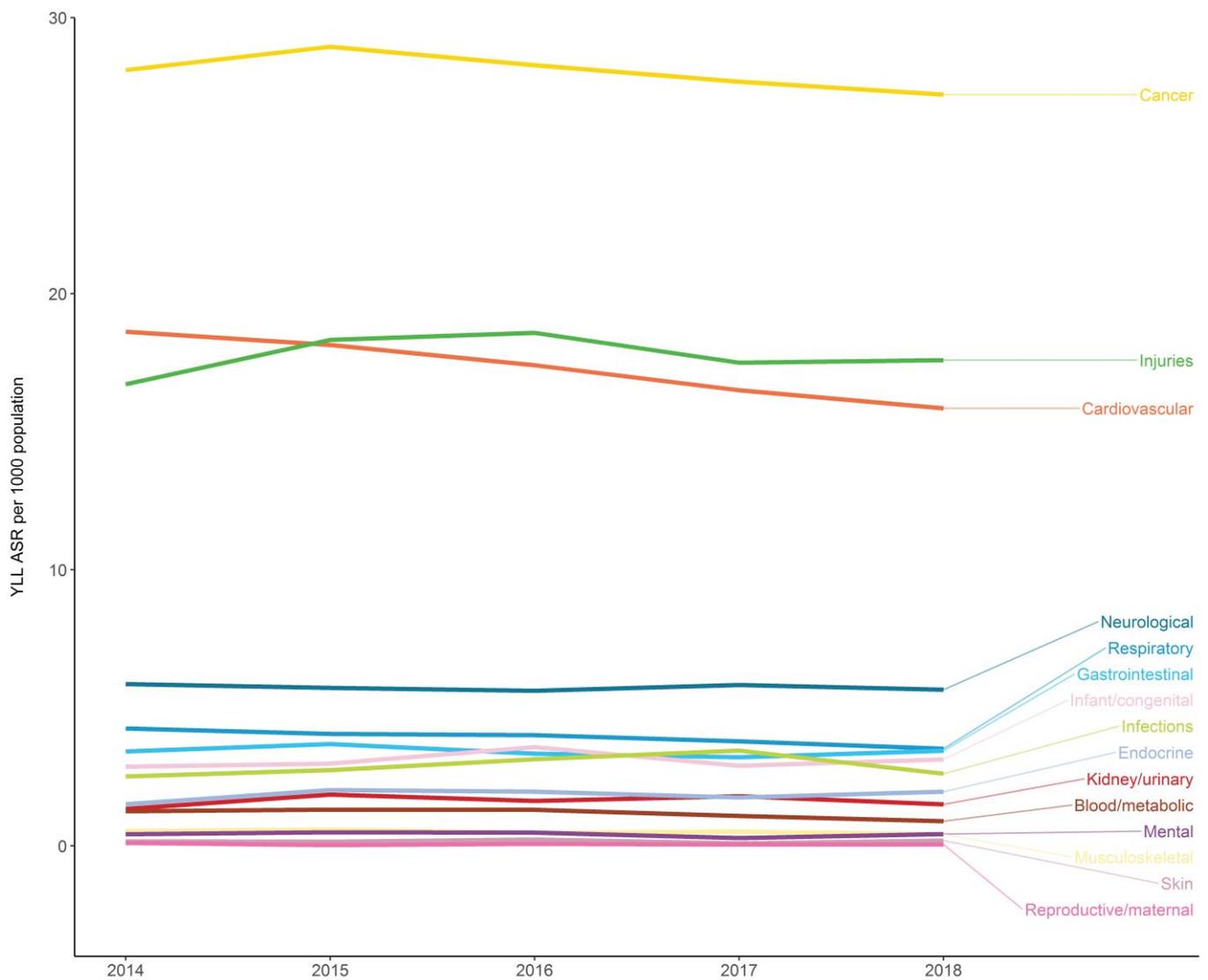


Figure 2: YLL (ASR per 1000 population) by disease group, 2014-2018.

Trends in fatal burden by sex

Males experienced 1.6 times greater rates of fatal burden than women in Western Australia between 2014 and 2018. Higher rates among men were observed for all disease groups except musculoskeletal conditions, which caused more fatal burden in women. Appendix 2 shows a comparison of deaths and fatal burden by disease group and sex for 2018.

Of the 216 unique diseases and injuries, coronary heart disease was the biggest individual contributor to fatal burden among both males and females, across all years (Figure 3). The age-standardised rates of coronary heart disease exhibited a slight downward trend over the five year period among both sexes.

Cancers were important contributors of fatal burden among women, with four cancer types (lung, breast, bowel and ovarian) among the top ten causes of fatal burden. In contrast, males experienced more fatal burden from injuries, with suicide and self-inflicted injuries and poisoning ranking second and fourth respectively. Rates of fatal burden from injury were stable among women, but trending upward among men.

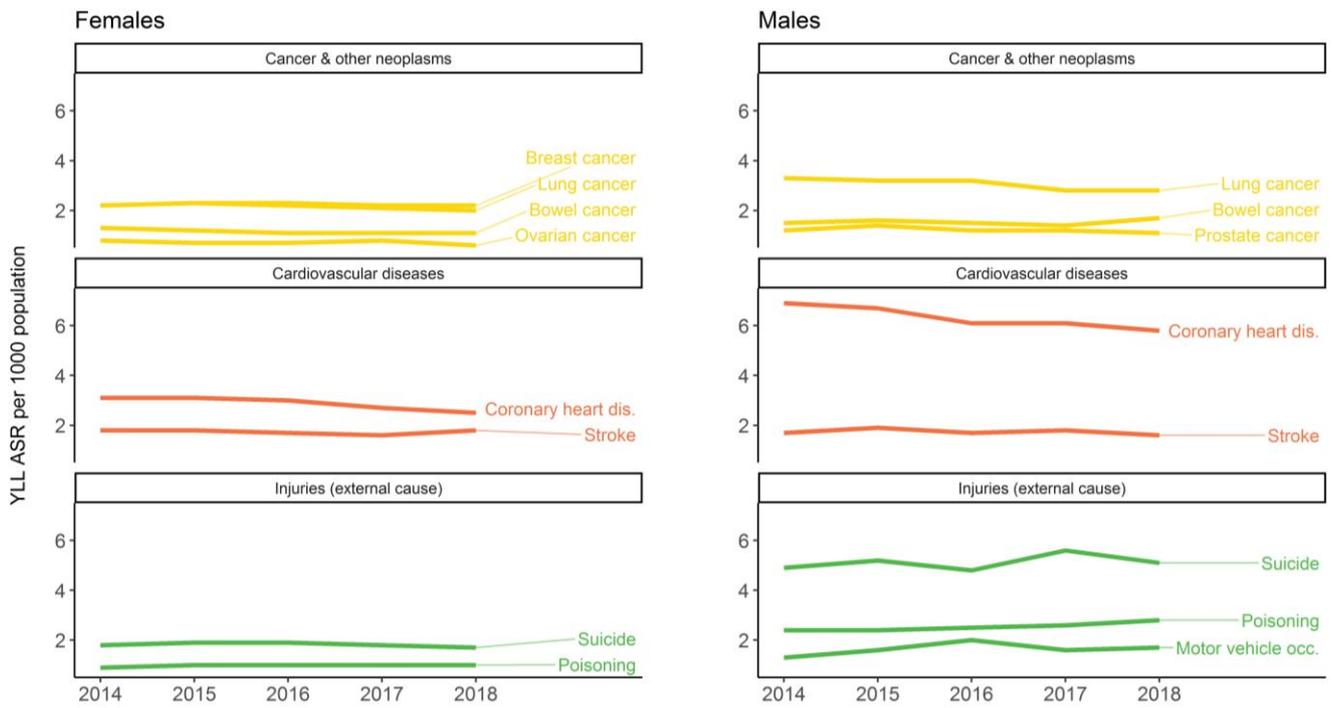


Figure 3: Leading causes of fatal burden (YLL ASR per 1000 population) by unique disease or injury, by sex, 2014-2018.

Table 3: Trends in fatal burden in WA, 2014-2018.

	2014	2015	2016	2017	2018
Crude counts					
Deaths	13,732	14,504	14,941	14,556	14,642
YLL	225,950	239,310	240,718	235,701	236,092
Rates of deaths (ASR per 1000 population)					
All people	5.3	5.4	5.4	5.1	5.0
All people (95% CI)	5.2 – 5.3	5.3 – 5.5	5.3 – 5.5	5.0 – 5.2	4.9 – 5.1
Rates of YLL (ASR per 1000 population)					
All people	87.7	91.1	90.1	86.5	84.5
All people (95% CI)	87.4 – 88.1	90.7 – 91.4	89.8 – 90.5	86.1 – 86.8	84.1 – 84.8
Males	109.2	114.7	112.9	108.6	105.1
Females	67.3	68.6	68.5	65.5	64.8
Trend by disease group (ASR per 1000 population)					
Cancer	28.1	28.9	28.4	27.6	27.0
Injuries	16.7	18.5	18.5	17.6	17.7
Cardiovascular	18.6	18.0	17.5	16.3	15.8
Neurological	5.9	5.7	5.7	5.7	5.7
Respiratory	4.2	4.1	4.1	3.8	3.5
Gastrointestinal	3.4	3.7	3.3	3.3	3.5
Infant/congenital	3.0	3.0	3.3	3.0	3.2
Infections	2.4	2.7	3.2	3.5	2.6
Endocrine	1.5	2.0	1.9	1.7	2.0
Kidney/urinary	1.3	1.8	1.6	1.9	1.5
Blood/metabolic	1.3	1.3	1.3	1.1	1.0
Musculoskeletal	0.5	0.6	0.4	0.5	0.5
Mental	0.4	0.6	0.5	0.3	0.4
Skin	0.2	0.1	0.2	0.1	0.2
Reproductive/maternal	0.1	0.0	0.1	0.0	0.1
Oral	0.0	0.0	0.0	0.0	0.0
Leading causes* of fatal burden in women (ASR per 1000 population)					
Coronary heart disease	3.1	3.1	3.0	2.7	2.5
Lung cancer	2.2	2.4	2.2	2.1	2.0
Breast cancer	2.2	2.2	2.3	2.2	2.2
Dementia	1.9	1.8	1.8	1.7	1.7
Stroke	1.8	1.7	1.7	1.6	1.8
Suicide	1.8	1.9	1.9	1.8	1.7
Bowel cancer	1.3	1.3	1.1	1.1	1.1
COPD	1.1	1.2	1.2	1.2	1.1

Poisoning	0.9	1.1	1.0	1.0	1.0
Ovarian cancer	0.8	0.6	0.7	0.8	0.6
Chronic liver disease	0.7	1.7	0.7	0.6	0.7
RTI – motor vehicle occupants	0.7	0.8	0.9	0.3	0.5
Leading causes* of fatal burden in men (ASR per 1000 population)					
Coronary heart disease	6.9	6.7	6.1	6.1	5.8
Suicide	4.9	5.2	4.8	5.6	5.1
Lung cancer	3.3	3.2	3.2	2.8	2.8
Poisoning	2.4	2.4	2.5	2.6	2.8
Stroke	1.7	1.9	1.7	1.8	1.6
COPD	1.6	1.5	1.6	1.4	1.3
Bowel cancer	1.5	1.6	1.5	1.4	1.7
RTI – motor vehicle occupants	1.3	1.6	2.0	1.6	1.7
Prostate cancer	1.2	1.4	1.2	1.2	1.1
Dementia	1.2	1.1	1.3	1.3	1.2
Chronic liver disease	1.1	1.3	1.2	1.2	1.3

Note: *the ten greatest causes of fatal burden each year for men and women respectively are included in the table; the causes are listed in order of ASR in 2014; the ten greatest causes change over time and as a result, more than ten conditions are listed for each sex.

Fatal burden by age, 2018

Western Australians experienced varying numbers of deaths and amounts of fatal burden throughout the life course (data for 2018 shown in Figure 4). These trends are relatively consistent across years, and are in keeping with trends demonstrated at the national level.

Deaths among infants aged less than one year of age comprised only 0.7% of deaths but contributed 3.8% of fatal burden in 2018. This is because each death among infants is associated with a large number of years of life lost. Young people aged 1-14 years had very few deaths and, despite the high life expectancy for their age, contributed the lowest amount of fatal burden compared to all other age groups under 100.

The number of deaths increased with age between 10-14 and 85-89 years, after which they decreased in line with the smaller population in this age group. Fatal burden also increased with age, but peaked at 65-69 years of age, after which it decreased, reflecting fewer years of life lost per death in the older age groups.

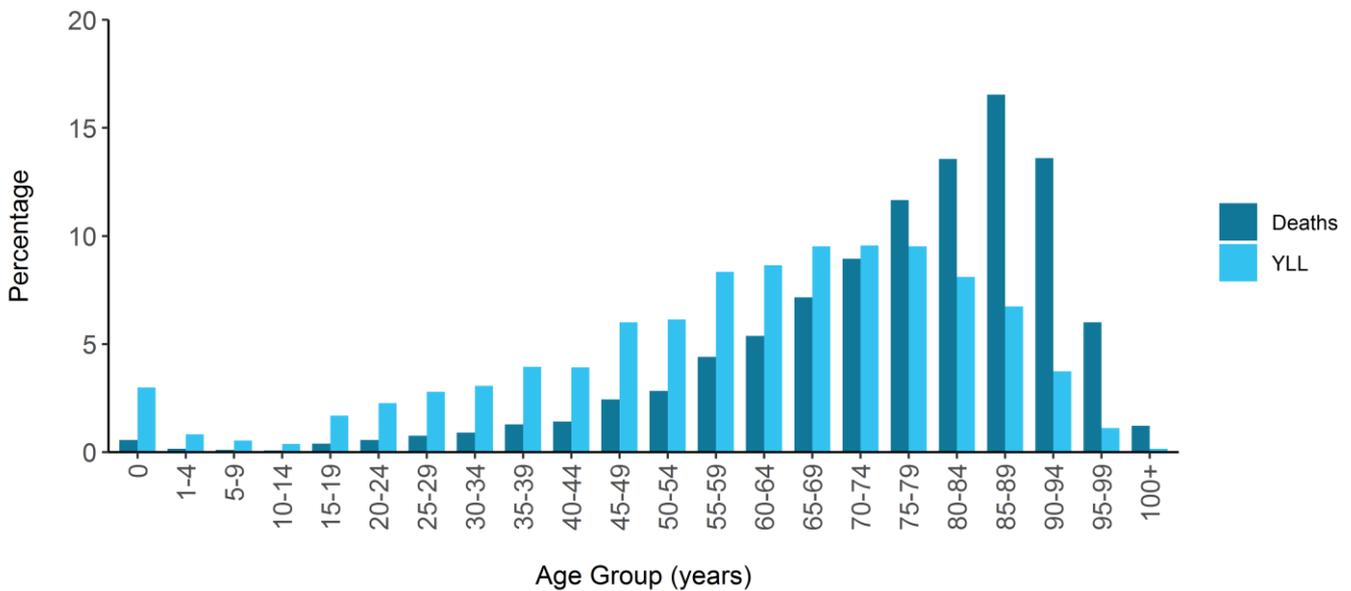


Figure 4: Proportion (%) of fatal burden (YLL) and deaths, by age group, 2018

Fatal burden by disease group and age, 2018

Figure 5 shows the amount and relative proportion of fatal burden contributed by each disease group across the life course in 2018. The top 10 diseases per age group and sex in 2018 are presented in Appendices 3 and 4. Infant and congenital conditions were the predominant cause of fatal burden in those aged under five. Injury was the predominant cause of fatal burden in Western Australians aged less than 45, causing 54% of fatal burden in this age group, and up to 82% among certain age groups (15-19 year olds and 25-29 year olds).

Among adults aged over 45, cancers and cardiovascular diseases were the major causes. Cancers caused more fatal burden than cardiovascular diseases at all ages under 80 years, with cardiovascular diseases taking over as the major cause of fatal burden among older adults. Neurological diseases were a substantial cause of fatal burden among Western Australians aged 75 and over, accounting for 13% of the burden in this group.

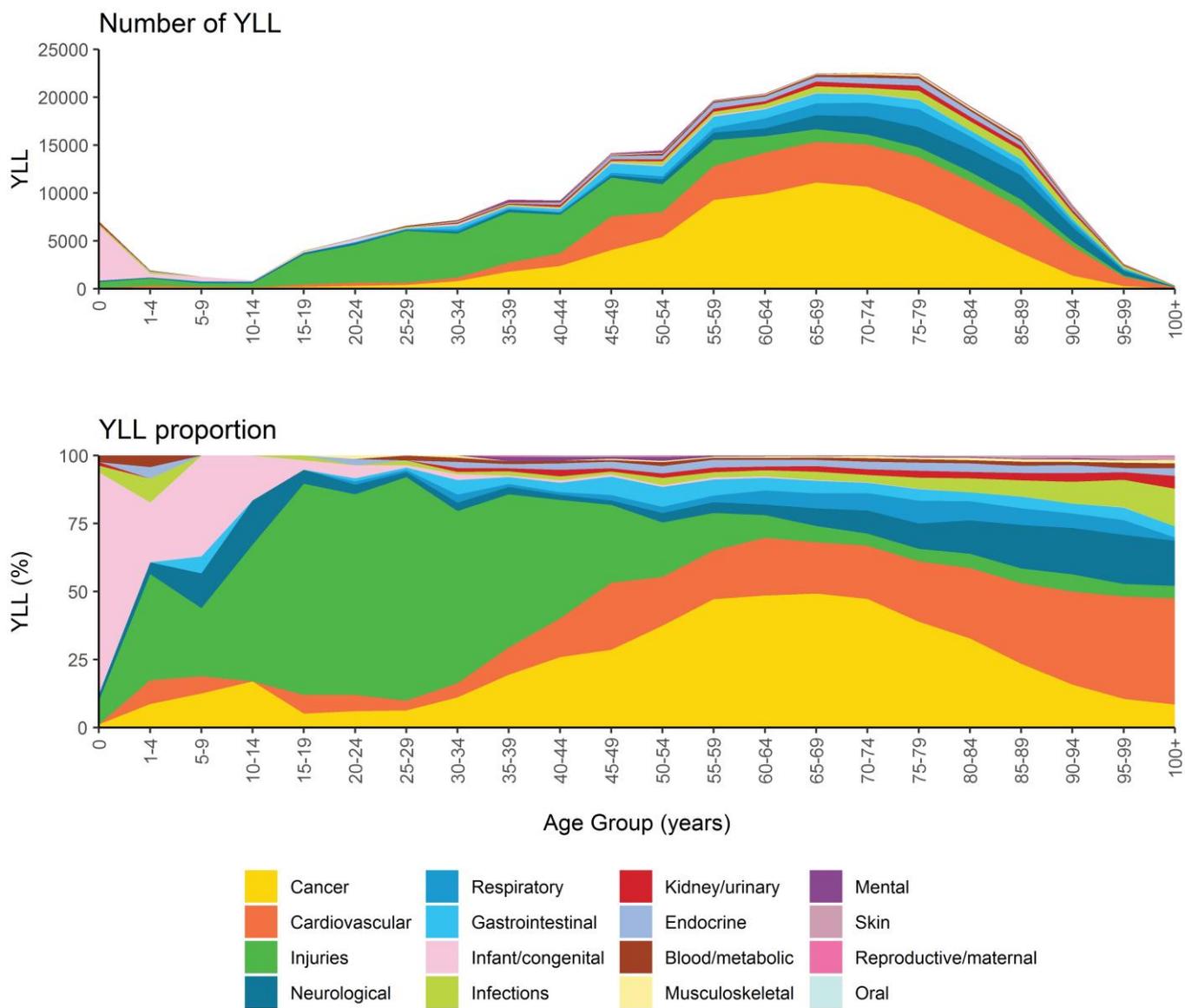


Figure 5: Number and relative proportion of fatal burden (YLL), by disease group and age group, 2018

Trends in fatal burden among Aboriginal people

The rate of fatal burden among Aboriginal people in WA was 3.1 – 3.2 fold higher than for the WA population overall, each year between 2014 and 2018 (Figure 6). Consistent with rates in the general population, rates among Aboriginal people had a downward trend since 2015, achieving statistical significance in some years (Table 4). Rates among Aboriginal women declined more consistently than rates among Aboriginal men, which increased again between 2017 and 2018.

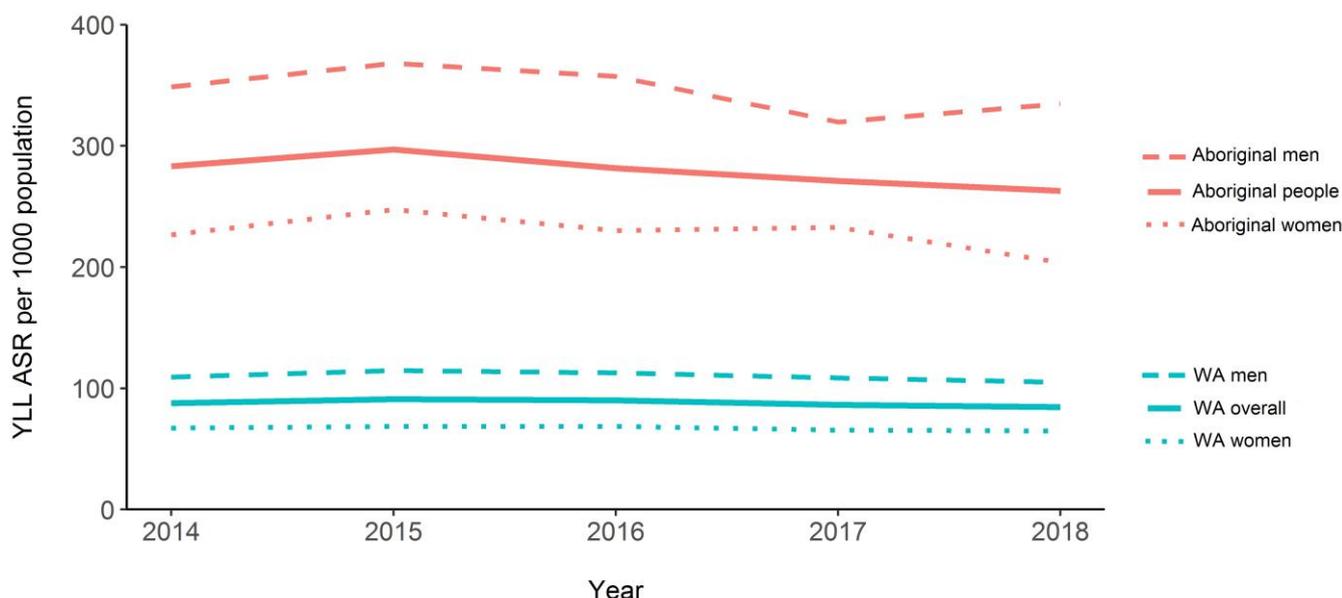


Figure 6: the rate of fatal burden (YLL ASR per 1000 population) among Aboriginal people (orange line) and the WA population overall (blue line). Rates among men and women are also shown in the dashed and dotted lines respectively.

Trends in fatal burden among Aboriginal people, by disease group

Rates of 15 of the 17 disease groups (excepting Skin disorders and Oral disorders) were substantially higher in Aboriginal people compared with rates in the population overall (Table 4). Cardiovascular diseases caused the greatest amount of fatal burden among Aboriginal people between 2014 and 2017 (Figure 7; note different scale from Figure 2 which shows the same information for WA overall). In 2018, the rising rate of fatal burden from cancers surpassed the declining rate of burden from cardiovascular disease.

In addition to cancer, rates of fatal burden were also observed to be increasing for infections, and infant and congenital conditions between 2014 and 2018. Rates of fatal burden from injuries and gastrointestinal diseases declined during this five year period. Burden from other disease groups remained steady or fluctuated too much to be able to determine a trend.

Coronary heart disease, suicide and self-inflicted injuries, chronic kidney disease and type 2 diabetes were the greatest individual contributors to fatal burden among Aboriginal people between 2014 and 2018 (Table 4).

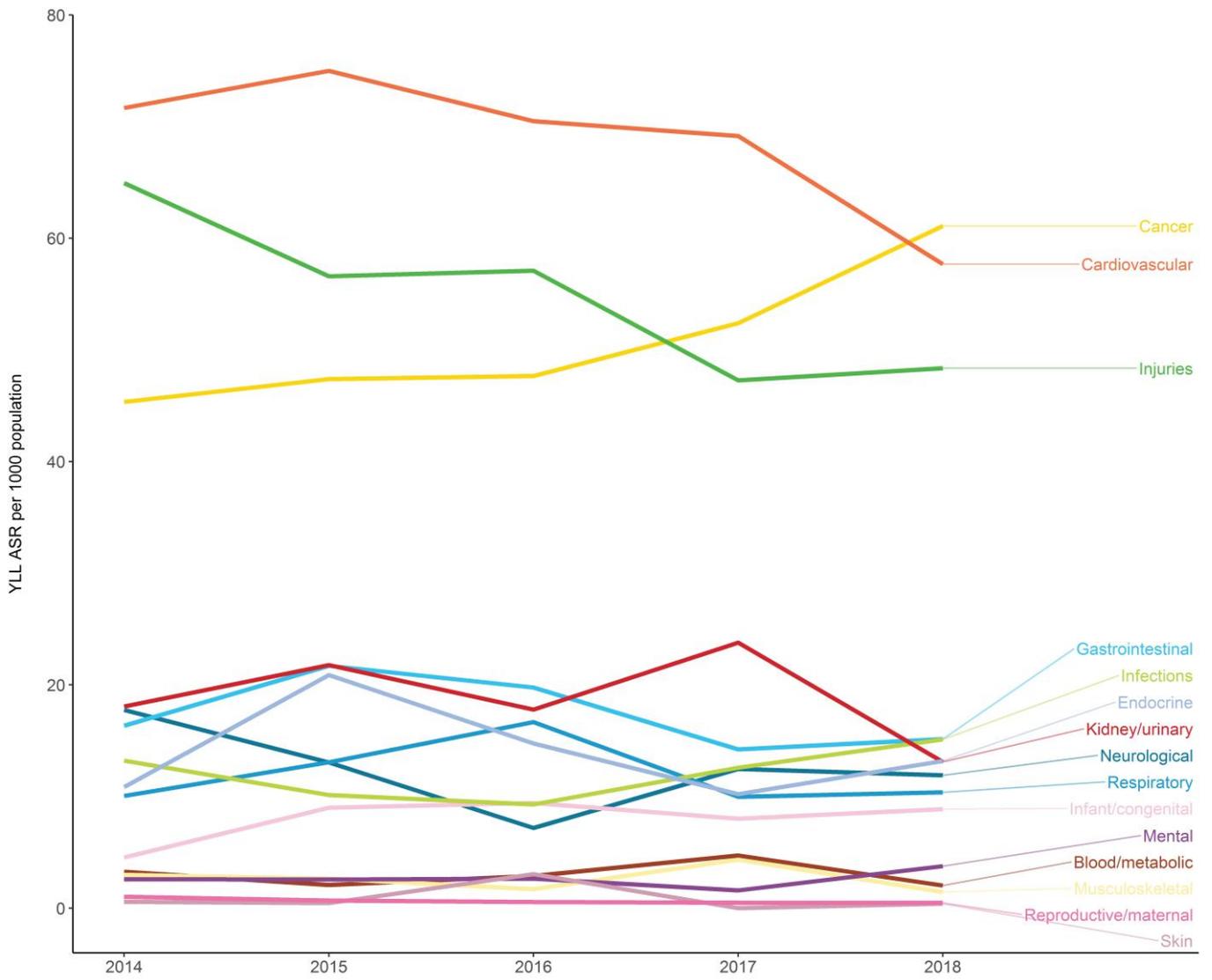


Figure 7: YLL (ASR per 1000 population) by disease group, 2014-2018.

Table 4: Trends in fatal burden among Aboriginal people in WA, 2014-2018.

	2014	2015	2016	2017	2018
Crude counts					
Deaths	495	543	534	538	555
YLL	17,834	19,484	19,041	18,081	18,710
Rates of deaths (ASR per 1000 population)					
All people	12.4	13.8	13.7	12.0	11.8
All people (95% CI)	10.9 – 14.0	12.1 – 15.4	11.9 – 15.4	10.7 – 13.3	10.5 – 13.0
Rates of YLL (ASR per 1000 population)					
All people	283.2	297.0	281.5	271.2	262.9
All people (95% CI)	277.6-288.8	291.3-302.7	275.9-287.1	266.3-276.1	258.3-267.5
Males	348.8	368.2	357.3	319.6	334.7
Females	226.6	247.4	230.1	232.8	203.7
Trend by disease group (ASR per 1000 population)					
Cancer	45.3	47.4	47.7	52.4	61.1
Injuries	64.9	56.6	57.1	47.3	48.4
Cardiovascular	71.7	75.0	70.5	69.2	57.7
Neurological	17.8	13.0	7.2	12.5	11.9
Respiratory	10.0	13.1	16.7	10.0	10.4
Gastrointestinal	16.3	21.7	19.8	14.2	15.1
Infant/congenital	4.5	9.0	9.4	8.0	8.9
Infections	13.2	10.1	9.3	12.6	15.1
Endocrine	10.8	20.9	14.8	10.2	13.2
Kidney/urinary	18.1	21.8	17.8	23.8	13.1
Blood/metabolic	3.3	2.1	2.9	4.7	2.0
Musculoskeletal	3.0	2.6	1.7	4.4	1.4
Mental	2.6	2.6	2.6	1.6	3.8
Skin	0.6	0.5	3.0	0.0	0.4
Reproductive/maternal	1.0	0.7	0.5	0.5	0.5
Oral	0.0	0.0	0.0	0.0	0.0
Leading causes* of fatal burden in women (ASR per 1000 population)					
Coronary heart disease	14.7	18.1	17.8	21.8	11.7
Chronic kidney disease	11.4	9.5	9.7	13.5	6.3
Suicide	10.1	5.7	8.0	5.7	3.7
Stroke	6.8	5.5	9.4	5.1	4.4
Breast cancer	4.8	3.8	2.2	2.1	3.7
Chronic liver disease	4.7	5.4	4.1	2.8	4.8
COPD	4.4	5.8	5.1	3.5	2.9
Dementia	3.8	5.8	2.6	4.2	2.3
Type 2 diabetes	3.5	14.0	7.5	4.9	3.9
Non-rheumatic valvular heart dis.	3.0	0.5	0.8	0.0	0.5
RTI – motor vehicle occupants	2.6	6.4	3.1	1.1	1.2

Lung cancer	2.4	5.0	4.0	3.4	4.2
Poisoning	2.1	2.4	4.2	2.1	2.2
Lower respiratory infections	2.1	2.8	0.6	4.8	7.2
Other cardiovascular diseases	1.4	1.7	0.6	4.2	1.0
Leading causes* of fatal burden in men (ASR per 1000 population)					
Coronary heart disease	33.1	31.7	25.2	20.9	22.6
Suicide	23.9	16.8	11.4	14.6	13.7
Lung cancer	8.5	5.7	7.5	6.9	5.4
Type 2 diabetes	5.9	5.6	6.6	5.0	7.6
Poisoning	5.9	5.2	6.9	5.3	7.4
Lower respiratory infections	5.7	2.8	3.9	4.1	3.1
Chronic kidney disease	5.5	12.3	8.0	10.1	6.8
RTI – motor vehicle occupants	5.3	4.7	4.9	5.1	5.0
Chronic liver disease	4.5	6.1	8.8	8.1	6.5
Epilepsy	3.9	1.5	1.4	2.4	0.0
Stroke	3.8	6.0	3.5	4.9	7.0
COPD	3.1	5.9	6.3	5.0	3.5
Bowel cancer	0.6	0.8	2.6	2.5	4.3

Note: *the ten greatest causes of fatal burden each year for men and women respectively are included in the table; the causes are listed in order of ASR in 2014; the ten greatest causes change over time and as a result, more than ten conditions are listed for each sex.

Trends in fatal burden by region

Western Australia is comprised of ten health regions; three in the metropolitan area (East, North and South Metropolitan), and seven non-metropolitan regions. Concordant with population distribution, most deaths (77% in 2018) and most YLL (73% in 2018) in Western Australia occur in the metropolitan regions.

Some of the non-metropolitan regions have small numbers of deaths per year, resulting in some instability in YLL counts and rates across years. Results must be interpreted with this caveat acknowledged.

After adjustment for different age distributions between regions, the rate of fatal burden per population was markedly higher in most non-metropolitan regions, compared to the metropolitan regions (Figure 8). The Kimberley region, in particular, had fatal burden rates that were more than double those observed in metropolitan Perth, across all years. The Goldfields and Midwest regions had the second and third highest rates of fatal burden per population. A slight downward trend in ASR was observed in all three metropolitan regions (reflecting the overall trend in Western Australia), but was less apparent in the non-metropolitan regions.

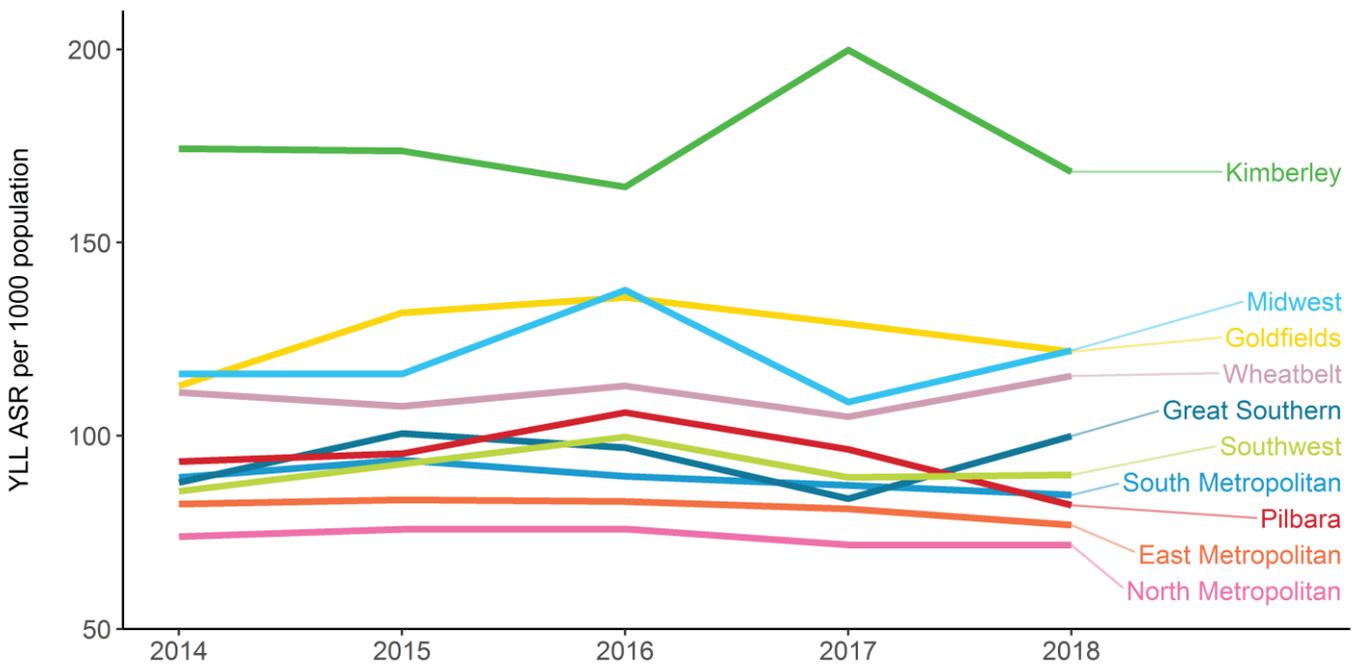


Figure 8: Age-standardised rate of fatal burden (YLL per 1000 population), by health region, 2014-2018.

Trends in fatal burden by disease group, metropolitan regions

The rates of fatal burden by disease group were reasonably consistent between health regions in metropolitan Perth (Table 5). Cancer was the leading cause of disease burden in all three health regions in Perth (Figure 9). The South Metropolitan region had comparatively higher rates of fatal burden from cancers, injuries, and neurological diseases; and the North Metropolitan region had comparatively lower rates of fatal burden from cancers and respiratory diseases.

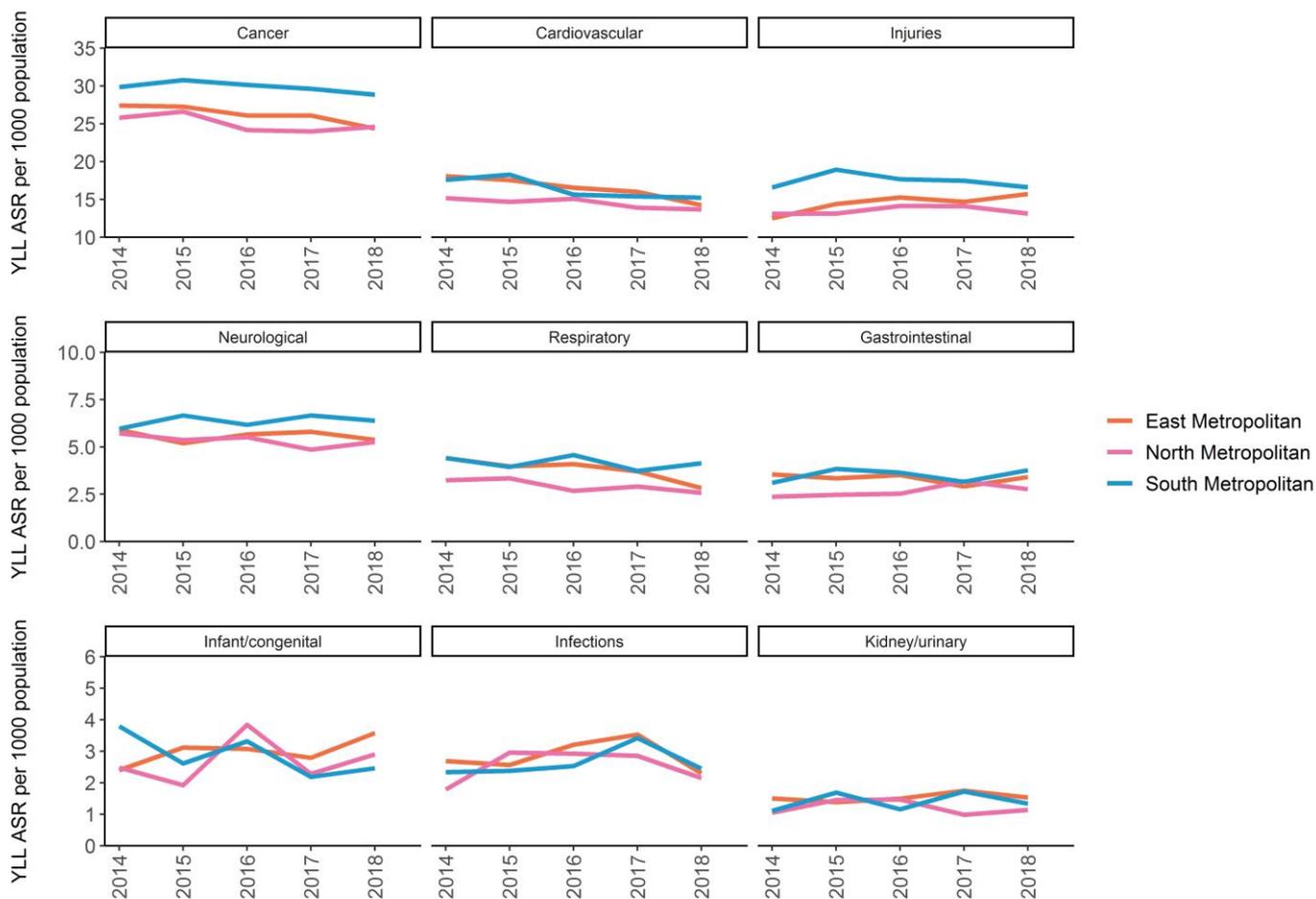


Figure 9: Age-standardised rate of fatal burden (YLL per 1000 population), by disease group, by metropolitan health region, 2014-2018.

Trends in fatal burden by disease group, in non-metropolitan regions

Figure 10 shows the age-standardised rates of YLL per 1000 population in each non-metropolitan region, by disease group. Most recently in 2018, cancer was the greatest contributor of fatal burden in the Goldfields, Southwest, Midwest and Kimberley; cardiovascular disease caused the highest rate of fatal burden in the Pilbara; and injuries were the greatest cause of fatal burden in the Great Southern and Wheatbelt.

Compared to the other regions, the Kimberley had substantially higher rates of fatal burden from cardiovascular disease, injuries, respiratory disease, and kidney and urinary disease. The rate of kidney and urinary disease in the Kimberley was more than double the rate observed in the next most affected regions (Pilbara and Goldfields); in 2017, the rate was five-fold higher than any other region.

Despite the fluctuations in rates due to small numbers of deaths in some regions, some trends were observed. Rates of cancers demonstrated an upward trend across most regions, and rates of injuries were declining in regions in the north of Western Australia.

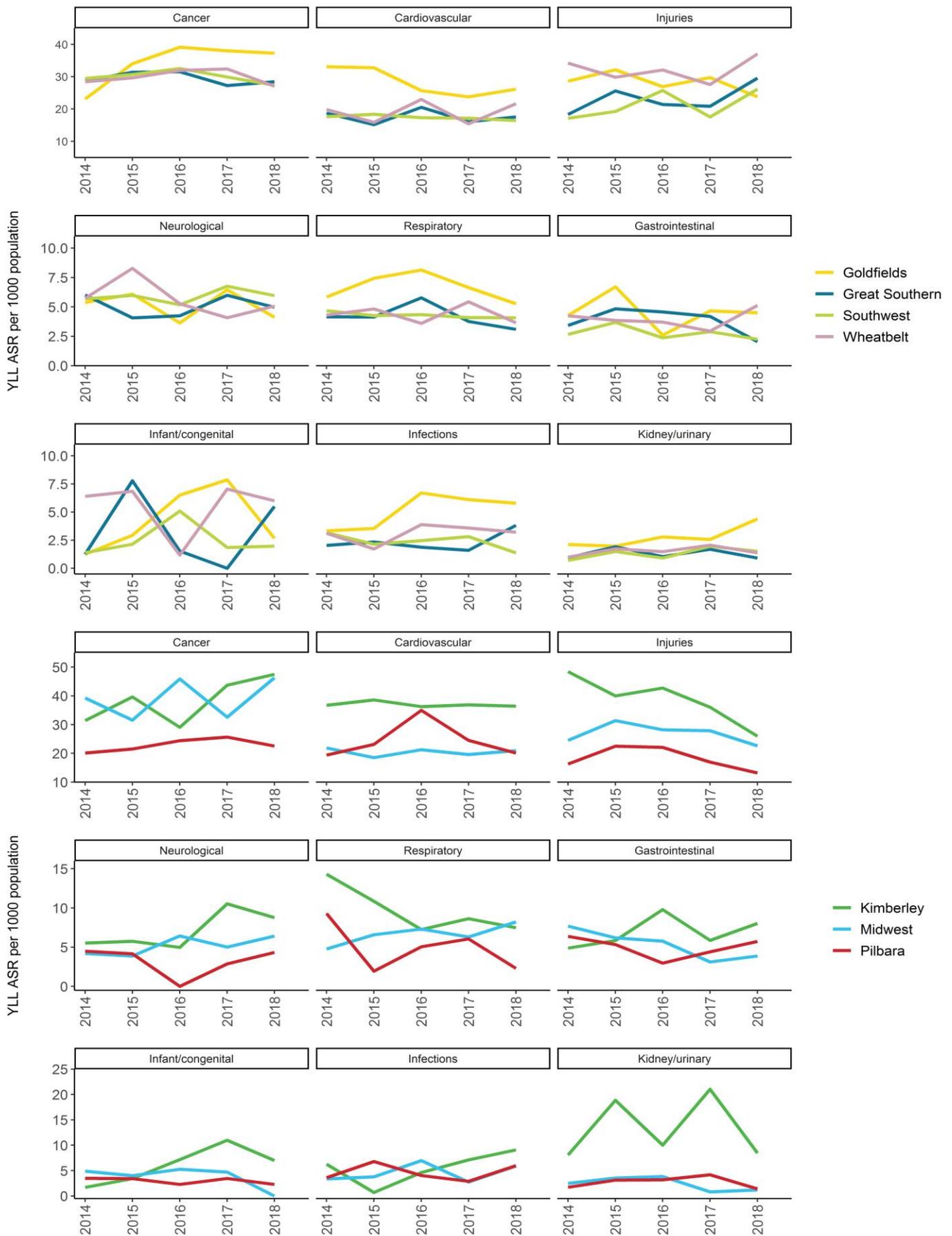


Figure 10: Age-standardised rate of fatal burden (YLL per 1000 population), by disease group, by non-metropolitan health region, 2014-18.

Table 5: Trends in deaths and fatal burden by health region, 2014-2018.

	2014	2015	2016	2017	2018
Crude counts of deaths and (YLL)					
East Metropolitan	3479 (58,223)	3646 (60,746)	3793 (61,694)	3735 (61,774)	3604 (59,885)
North Metropolitan	3581 (52,879)	3775 (55,332)	3838 (56,362)	3643 (54,506)	3786 (56,022)
South Metropolitan	3488 (53,681)	3713 (57,584)	3806 (56,319)	3789 (56,078)	3837 (56,149)
Goldfields	272 (5748)	302 (6530)	294 (6671)	283 (6275)	270 (6243)
Great Southern	450 (7726)	484 (7446)	512 (7579)	466 (6704)	479 (7518)
Kimberley	174 (5,460)	168 (5089)	159 (4827)	197 (5732)	169 (4764)
Midwest	404 (8146)	430 (8124)	461 (9483)	420 (7675)	498 (8813)
Pilbara	118 (3924)	121 (4335)	101 (3242)	114 (3703)	112 (3369)
Southwest	1059 (16,307)	1095 (18,099)	1197 (19,357)	1188 (18,448)	1154 (18,323)
Wheatbelt	538 (9653)	563 (9709)	620 (10,314)	547 (9504)	560 (10,213)
Rates of YLL (ASR per 1000 population)					
East Metropolitan	82.3	83.4	83.0	81.1	76.9
North Metropolitan	73.9	75.8	75.9	71.8	71.7
South Metropolitan	89.2	93.7	89.5	87.2	84.7
Goldfields	112.9	131.8	135.8	129.0	121.8
Great Southern	87.9	100.6	96.9	83.7	99.9
Kimberley	174.3	173.7	164.4	199.8	168.3
Midwest	116.0	116.0	137.7	108.7	122.1
Pilbara	93.3	95.4	106.0	96.5	82.0
Southwest	85.6	92.7	99.7	89.2	89.9
Wheatbelt	111.2	107.6	112.9	104.9	115.5

Discussion

This report estimated the fatal burden of disease in Western Australia over the five year period 2014 to 2018, inclusive. Western Australians lost between 225,000 and 241,000 years of life due to premature death each year in this period. Although the number of deaths and amount of YLL each year remained steady, the age-standardised rate of YLL gradually declined over the five years, from 87.7 YLL per 1000 population in 2014, to 84.5 in 2018.

The declining rate of fatal burden in Western Australia is largely a result of declining burden attributed to cancers and cardiovascular diseases. Cancers remain the greatest contributor to fatal burden, among men and women, among Aboriginal people, and in most health regions. In 2015, injuries succeeded cardiovascular diseases as the disease group with the second greatest contribution to fatal burden.

Despite the overall decline in fatal burden, progress is inequitable. Rates remain 1.6 times higher among men, three times higher among Aboriginal people, and up to two times higher in some health regions compared to the metropolitan area. There are some concerning upward trends in rates of fatal burden, including increasing burden from cancers among Aboriginal people, increasing burden from injuries (particularly suicide) among men, and markedly higher rates of burden from kidney and urinary diseases in some regional areas.

The results of this report are generally consistent with results of previous burden of disease studies in both Western Australia and nationally. The estimated fatal burden in 2015 in this report is slightly higher (1841 more YLL) than the estimate provided by WABODS 2015; this variation may be the result of inclusion of death records with a missing cause of death in the current analysis, and possibly the use of a more finalised mortality dataset for this year (i.e. more death registrations complete at the time of analysis). Different population estimates for Western Australia were also used in WABODS 2015, which may have caused slight differences in reported rates.

This study has some limitations, mostly arising from its methodology, data sources and estimations. Firstly, causes of death were mapped based on underlying cause of death only, without consideration of additional information contained in the associated causes of death of each record. This is consistent with AIHW methodology, and is used with the known caveat that the complexities of multiple causes of death are not accounted for. Secondly, approximately 10% of deaths are 'redistributed' to more appropriate causes. Despite being a best-practice technique, this represents a major manipulation of mortality data, and relies on complex algorithms, most of which are sourced from AIHW and have not been reviewed for relevance specifically to the Western Australian context. A key strength of this study was therefore the development and utilisation of two new WA-specific cancer redistribution algorithms, based on updated input data from the Western Australian Cancer Registry. Finally, the standard reference life developed for the GBDS 2010 (10) lacks differentiation by sex and is now a decade old, and may not accurately reflect life expectancies in WA. The table has been applied consistently, and therefore does not affect comparisons made within this report. Future studies may explore the appropriateness of using the Australian life table.

In this report, detailed trends in fatal burden by Aboriginality and health region have been estimated for the first time, applying consistent methodology across multiple years. The use of the Derived Aboriginal and Torres Strait Islander Flag indicator via the WA Data Linkage Branch is an asset to the study, increasing the reliability of Aboriginal identification variables. Greater fluctuations are observed over time for these smaller population groups, and results must be interpreted with caution. Statistically significant changes could be detected at the state level at

yearly intervals; smaller population subsets may require longer periods to reliably detect trends. Longer time periods, and statistical methods of stabilising data (e.g. three year moving averages) will improve analysis of trends. With these considerations, fatal burden analyses have the potential to be completed for even smaller jurisdictions; for example, fatal burden indicators could be integrated into Public Health Planning requirements for local governments under the Public Health Act (2016).

Fatal burden is a useful metric which should be routinely monitored in WA as a population health indicator. It can be used as a system level measure to track the progress of change, with aims to monitor population health and reduce health inequity and inequality, outlined as key priorities in the Sustainable Health Review 2019 (15).

Recommendations

1. Address inequities in fatal burden in Western Australia

This report affirms known inequities in health outcomes in Western Australia, with a disproportionate fatal burden affecting Aboriginal people and people in regional and remote areas. Findings of this report provide some detail regarding the specific disease groups and populations requiring attention.

2. Routinely monitor fatal burden as a population health indicator

Fatal burden is suitable for adaptation as a population health indicator, able to be measured up to annually as updated mortality datasets become available. In conjunction with other indicators, fatal burden may contribute to identification of problematic health trends, prioritisation of health policy and program needs, and evaluation of health interventions.

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Appendices

Appendix 1: Number and proportion of deaths before and after redistribution and associated change by disease group, 2018

Disease group	Before redistribution				After redistribution				Increase (before to after)			
	Deaths		YLL		Deaths		YLL		Deaths		YLL	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Cancer	4144	28.3	72,771	30.8	4492	30.7	78,063	33.1	348	7.7	5292	6.8
Injuries	1272	8.7	41,950	17.8	1445	9.9	45,422	19.2	173	12.0	3472	7.6
Cardiovascular	3156	21.6	40,688	17.2	3694	25.2	45,328	19.2	538	14.6	4640	10.2
Neurological	1516	10.4	15,253	6.5	1621	11.1	16,351	6.9	105	6.5	1098	6.7
Respiratory	767	5.2	9895	4.2	794	5.4	10,137	4.3	27	3.4	242	2.4
Gastrointestinal	502	3.4	8692	3.7	598	4.1	9738	4.1	96	16.1	1046	10.7
Infant/congenital	108	0.7	7471	3.2	122	0.8	8193	3.5	14	11.5	722	8.8
Infections	697	4.8	6970	2.9	748	5.1	7498	3.2	51	6.8	528	7.0
Endocrine	225	1.5	3254	1.4	375	2.6	5546	2.3	150	40.0	2292	41.3
Kidney/urinary	315	2.2	3926	1.7	348	2.4	4258	1.8	33	9.5	332	7.8
Blood/metabolic	155	1.1	2352	1.0	168	1.1	2515	1.1	13	7.7	163	6.5
Mental	51	0.3	922	0.4	63	0.4	1127	0.5	12	19.0	205	18.2
Musculoskeletal	88	0.6	1083	0.5	98	0.7	1199	0.5	10	10.2	116	9.7
Skin	55	0.4	474	0.2	63	0.4	539	0.2	8	12.7	65	12.1
Reproductive/maternal	10	0.1	142	0.1	10	0.1	142	0.1	0	0.0	0	0.0
Oral	<5	0.0	35	0.0	<5	0.0	35	0.0	0	0.0	0	0.0
Redistribution	1578	10.8	20,212	8.6	0	0.0	0	0.0
Total	14,642	100.0	236,092	100	7738	100.0	236,092	100	7738	100.0	144,520	100

Notes

1. Numbers and percentages shown for disease groups may not add up to the total due to rounding
2. Hearing & vision disorders are excluded as they did not cause any fatal burden
3. Reproductive/maternal, oral and vision/hearing are excluded from the scope of target diseases, due to small numbers of deaths in these disease groups.

Appendix 2: Comparison of deaths and fatal burden (YLL, YLL%, YLL ASR), by disease group and sex, 2018

Disease group	Males						Females					
	Rank (YLL)	Deaths (number)	Deaths (%)	YLL (number)	YLL (%)	YLL ASR	Rank (YLL)	Deaths (number)	Deaths (%)	YLL (number)	YLL (%)	YLL ASR
Cancer	1	2547	33.0	43,264	30.7	31.2	1	1944	28.1	34,799	36.5	23.7
Injuries	2	938	12.2	35,521	23.1	25.3	3	507	7.3	12,901	13.5	9.9
Cardiovascular	3	1906	24.7	28,178	20.0	21.0	2	1788	25.8	17,150	18.0	11.0
Neurological	4	646	8.4	7773	5.5	5.9	4	975	14.1	8578	9.0	5.4
Respiratory	5	424	5.5	5550	3.9	4.1	5	370	5.3	4587	4.8	3.0
Gastrointestinal	6	295	3.8	5531	3.9	4.1	6	303	4.4	4207	4.4	2.8
Infant/congenital	7	77	1.0	5354	3.8	4.0	8	45	0.6	2840	3.0	2.2
Infections	8	307	4.0	3682	2.6	2.8	7	441	6.5	3816	4.0	2.4
Endocrine	9	208	2.7	3593	2.6	2.6	9	167	2.4	1953	2.0	1.3
Kidney/urinary	10	188	2.4	2468	1.8	1.9	10	160	2.3	1790	1.9	1.2
Blood/metabolic	11	83	1.1	1549	1.1	1.1	11	85	1.2	965	1.0	0.6
Mental	12	34	0.4	626	0.4	0.5	13	29	0.4	501	0.5	0.4
Musculoskeletal	13	37	0.5	419	0.3	0.3	12	61	0.9	780	0.8	0.5
Skin	14	23	0.3	227	0.2	0.2	14	40	0.6	312	0.3	0.2
Reproductive/maternal	15	<5	0.1	54	0.0	0.0	15	6	0.1	87	0.1	0.1
Oral	16	<5	0.0	7	0.0	0.0	16	<5	0.0	28	0.0	0.0
Total		7718	100.0	140,795	100.0	105.1		6766	100.0	94,792	100.0	64.8

Notes

1. Rates were age-standardised to the 2001 Australian Standard Population and are expressed as YLL per 1,000 population (YLL ASR)
2. Numbers and percentages shown for disease groups may not add up to the total due to rounding
3. As a result of rounding, very small percentages and rates are expressed as 0.0
4. Hearing & vision disorders are excluded as they did not cause any fatal burden

Appendix 3: Leading causes of fatal burden (YLL; proportion %), for males, by age group, 2018

Age groups (years)

Rank	0-14	15-24	25-44	45-54	55-64	65-74	75-84	85+
1 st	Pre-term/LBW complications (860; 12.2)	Suicide/self-inflicted injuries (2841; 40.2)	Suicide/self-inflicted injuries (5960; 27.5)	Coronary heart disease (2973; 17.2)	Coronary heart disease (3295; 13.7)	Coronary heart disease (3763; 13.3)	Coronary heart disease (2967; 12.8)	Coronary heart disease (2232; 18.4)
2 nd	Birth trauma/asphyxia (852; 12.1)	RTI/motor vehicle occupant (1462; 20.7)	Poisoning (4390; 20.2)	Suicide/self-inflicted injuries (2007; 11.6)	Lung cancer (2311; 9.6)	Lung cancer (2965; 10.5)	Lung cancer (1799; 7.7)	Dementia (1239; 10.2)
3 rd	Cardiovascular defects (839; 11.9)	Poisoning (526; 7.4)	RTI/motor vehicle occupant (1679; 7.7)	Poisoning (1290; 7.5)	Suicide/self-inflicted injuries (1275; 5.3)	Bowel cancer (1587; 5.6)	COPD (1230; 5.3)	Stroke (664; 5.5)
4 th	Other disorders of infancy (688; 9.7)	Drowning (268; 3.8)	Coronary heart disease (1353; 6.2)	Chronic liver disease (1147; 6.6)	Bowel cancer (1124; 4.7)	COPD (1145; 4.0)	Dementia (1228; 5.3)	Lower respiratory infections (595; 4.9)
5 th	Homicide / violence (476; 6.7)	Other malignant neoplasms (202; 2.9)	RTI/motorcyclists (868; 4.0)	Lung cancer (769; 4.5)	Chronic liver disease (1057; 4.4)	Prostate cancer (1126; 4.0)	Stroke (1124; 4.8)	Prostate cancer (587; 4.8)
6 th	Other congenital conditions (430; 6.1)	RTI/pedestrian (200; 2.8)	Homicide / violence (451; 2.1)	Bowel cancer (703; 4.1)	Liver cancer (882; 3.7)	Stroke (1098; 3.9)	Prostate cancer (1001; 4.3)	COPD (523; 4.3)
7 th	Other neurological conditions (339; 4.8)	Other land transport injuries (140; 2.0)	Stroke (449; 2.1)	Brain/CNS Cancer (537; 3.1)	Pancreatic cancer (795; 3.3)	Pancreatic cancer (1092; 3.9)	Bowel cancer (873; 3.8)	Falls (468; 3.9)
8 th	Brain malformations (334; 4.7)	Cardiomyopathy (132; 1.9)	Other unintentional injuries (444; 2.0)	RTI/motor vehicle occupant (482; 2.8)	Stroke (766; 3.2)	Liver cancer (911; 3.2)	Type 2 diabetes (666; 2.9)	Chronic kidney disease (399; 3.3)
9 th	Neonatal infections (258; 3.7)	Homicide / violence (131; 1.8)	Bowel cancer (391; 1.8)	Stroke (415; 2.4)	Poisoning (685; 2.9)	Chronic liver disease (743; 2.6)	Lower respiratory infections (616; 2.7)	Lung cancer (378; 3.1)
10 th	SIDS (258; 3.7)	Other unintentional injuries (128; 1.8)	Drowning (379; 1.7)	Type 2 diabetes (403; 2.3)	Type 2 diabetes (663; 2.8)	Dementia (707; 2.5)	Chronic kidney disease (600; 2.6)	Bowel cancer (323; 2.7)

LBW = low birth weight; SIDS = sudden infant death syndrome; RTI = road traffic injuries; CNS = central nervous system; COPD = chronic obstructive pulmonary disease

Appendix 4: Leading causes of fatal burden (YLL; proportion %), for females, by age group, 2018

Age groups (years)

Rank	0-14	15-24	25-44	45-54	55-64	65-74	75-84	85+
1 st	Other unintentional injuries (424; 10.4)	Suicide/self-inflicted injuries (735; 32.3)	Suicide/self-inflicted injuries (1867; 17.4)	Breast cancer (1198; 10.5)	Breast cancer (1962; 12.2)	Lung cancer (1903; 11.4)	Coronary heart disease (1781; 9.7)	Dementia (2784; 17.9)
2 nd	Homicide / violence 410 (10.0)	RTI/motor vehicle occupant (404; 17.8)	Poisoning (1225; 11.4)	Suicide/self-inflicted injuries (962; 8.4)	Lung cancer (1833; 11.4)	Breast cancer (1080; 6.5)	Dementia (1714; 9.3)	Coronary heart disease (2314; 14.8)
3 rd	Pre-term/LBW complications (344; 8.4)	Other cardiovascular diseases (136; 6.0)	Breast cancer (921; 8.6)	Poisoning (840; 7.4)	Coronary heart disease (1229; 7.6)	Coronary heart disease (1079; 6.5)	Stroke (1361; 7.4)	Stroke (1625; 10.4)
4 th	Other disorders of infancy (343; 8.4)	Other malignant neoplasms (133; 5.8)	RTI/motor vehicle occupant (516; 4.8)	Stroke (555; 4.9)	Bowel cancer (882; 5.5)	COPD (1012; 6.1)	Lung cancer (1183; 6.4)	Lower respiratory infections (826; 5.3)
5 th	Brain malformations (319; 7.8)	Homicide / violence 71 (3.1)	Other cardiovascular diseases (326; 3.0)	Chronic liver disease (554; 4.9)	Pancreatic cancer (673; 4.2)	Stroke (863; 5.2)	COPD (964; 5.2)	Falls (742; 4.8)
6 th	Neonatal infections 258 (6.3)	RTI/pedestrian (70; 3.1)	Bowel cancer (316; 2.9)	Coronary heart disease (534; 4.7)	COPD (585; 3.6)	Pancreatic cancer (738; 4.4)	Lower respiratory infections (811; 4.4)	COPD (463; 3.0)
7 th	Birth trauma/asphyxia (257; 6.3)	Poisoning (69; 3.1)	Chronic liver disease (307; 2.9)	Brain/CNS Cancer (459; 4.0)	Chronic liver disease (566; 3.5)	Bowel cancer (722; 4.3)	Bowel cancer (665; 3.6)	Atrial fibrillation and flutter (431; 2.8)
8 th	Cardiovascular defects (257; 6.3)	Influenza (69; 3.1)	Homicide / violence (305; 2.8)	Lung cancer (431; 3.8)	Brain/CNS Cancer (508; 3.1)	Dementia (578; 3.5)	Breast cancer (640; 3.5)	Chronic kidney disease (376; 2.4)
9 th	Other congenital conditions (256; 6.3)	RTI/motorcyclists (69; 3.1)	Skin melanoma (293; 2.7)	Ovarian cancer (416; 3.6)	Other malignant neoplasms (450; 2.8)	Ovarian cancer (452; 2.7)	Falls (589; 3.2)	Type 2 diabetes (348; 2.2)
10 th	Other neurological conditions (238; 4.8)	Gastrointestinal malformations (69; 3.1)	Brain/CNS Cancer (257; 2.4)	Bowel cancer (322; 2.8)	Stroke (383; 2.4)	Other malignant neoplasms (442; 2.6)	Pancreatic cancer (575; 3.1)	Urinary tract infections (339; 2.2)

LBW = low birth weight; RTI = road traffic injuries; CNS = central nervous system; COPD = chronic obstructive pulmonary disease

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