



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

# The Burden of Disease in Western Australia 2018

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Epidemiology Directorate  
Public and Aboriginal Health Division  
Department of Health, Western Australia

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Katharine Noonan, Wendy Sun, Ann-Marie Chapman, Suzanne McEvoy of the Department of Health, Western Australia authored this report.

## Contact us

At [epi@health.wa.gov.au](mailto:epi@health.wa.gov.au) for any enquiries or further details.

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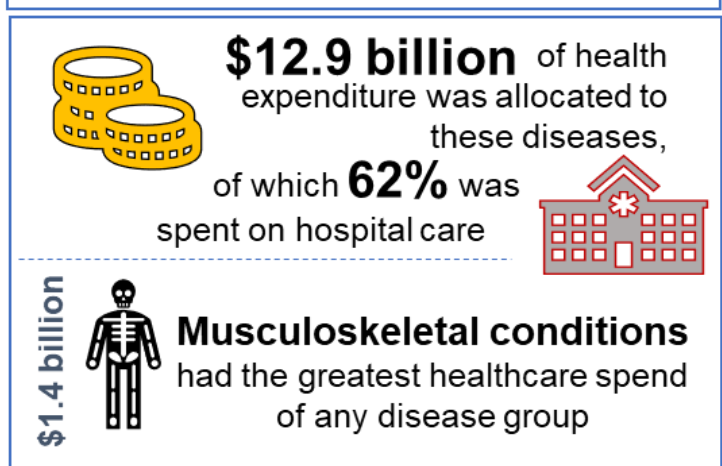
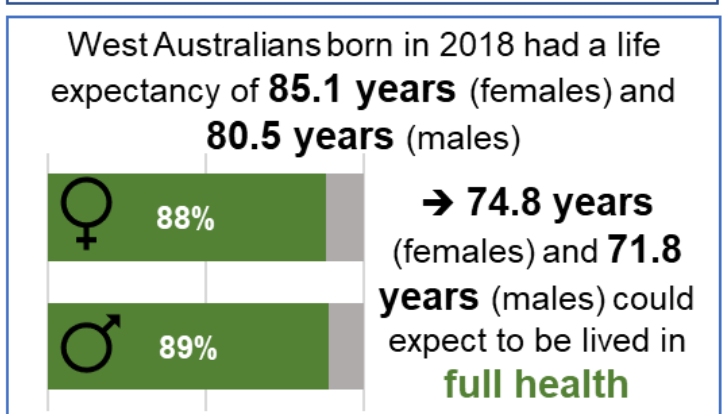
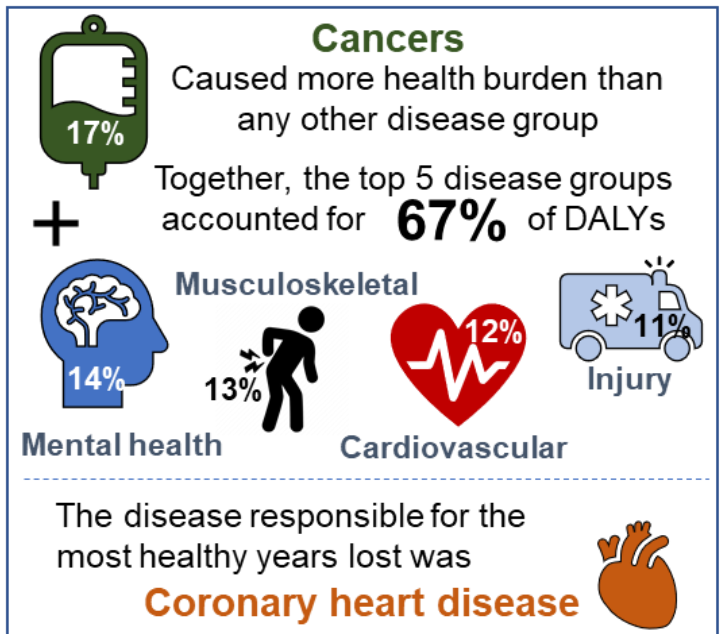
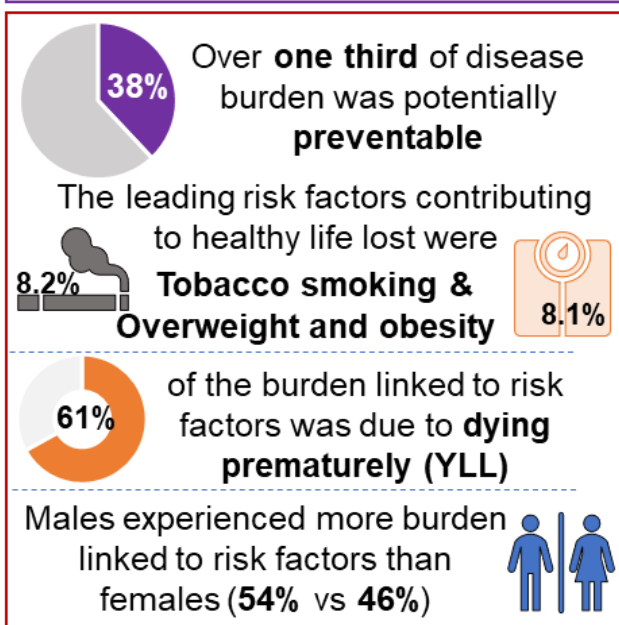
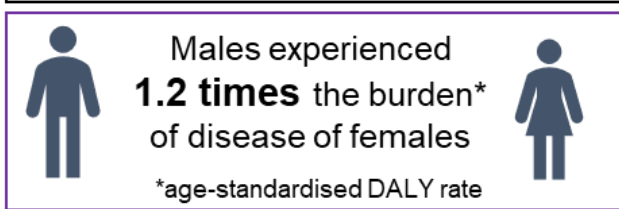
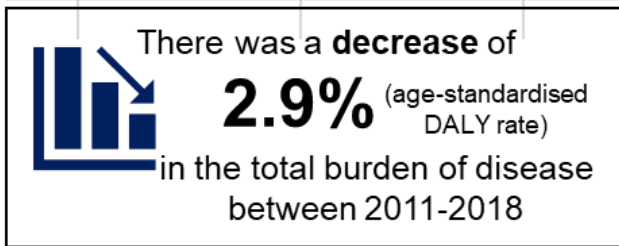
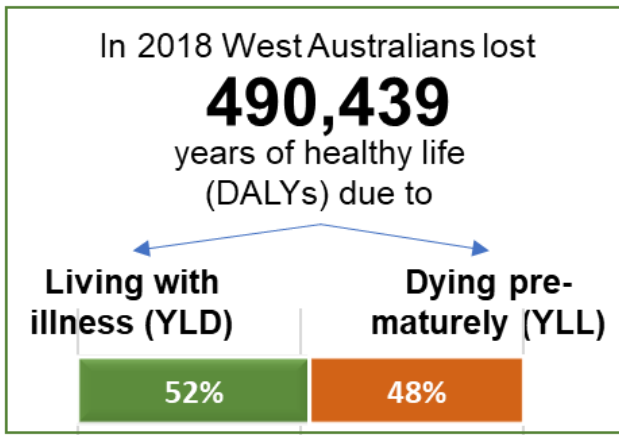
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# Summary



## Box 1: Updates since the WA Burden of Disease Study (WABoDS) 2015

Data in this report has been provided by the Australian Institute of Health and Welfare (AIHW) from the 2018 Australian Burden of Disease Study (ABDS). The study updates include a more comprehensive list of diseases compared with results published for WABoDS 2015<sup>1</sup>. A new measure, the health-adjusted life expectancy (HALE), which indicates the number of years people are expected to live in full health, has been estimated for 2011, 2015 and 2018.

Trends in burden of disease over time have been made by comparing data from the three annual timepoints. This has incorporated recalculated estimates for 2011 and 2015 by AIHW to match the 2018 methods. Note that results from the WABoDS 2015<sup>3</sup> are not comparable to the results in this report due to methodological differences. For comparisons of burden over years, data from this report should be used.

Due to increased evidence, revised risk factor calculations are included and there is an increased number of linked diseases for selected risk factors.

In terms of disease expenditure data, several updates occurred in the 2018 data: spending on cancer and other neoplasms revised upwards; mapping of ICD-10-AM and Medicare Benefits Schedule item numbers to diseases were updated.

### Key findings

- West Australians born in 2018 had a life expectancy of 85.1 years (females) and 80.5 years (males). Females could expect to live 74.8 years (88%) of their life in full health and males could expect to live 71.8 years (89%) of their life in full health.
- Chronic disease and injury continue to cause most of the burden of disease in Western Australia. Cancers caused more health burden than any other disease group. Together, the top five disease groups (cancers, mental health and substance use disorders, musculoskeletal disorders, cardiovascular diseases and injuries) accounted for more than two-thirds of the total health burden.
- Between 2011 and 2018, there was a decrease of 2.9% in the total burden of disease. Cancer and cardiovascular diseases reduced in burden between 2011 and 2018 (by 8.1% and 14.5%, respectively). By contrast, the burden of mental health and substance use disorders and injuries increased by 4.6% and 9.6%, respectively.
- Western Australia experienced similar rates of most chronic diseases to Australia as a whole. However, the burden of injuries in Western Australia was the second highest in the country, behind the Northern Territory, at 20.1 age standardised DALYs per 1,000 compared to the Australian figure of 16.6 per 1,000 population.
- Coronary heart disease was the single condition responsible for the most years of healthy life lost. However, the burden decreased by 22% (age standardized rate 13.6 to 10.6 per 1,000 population) between 2011 and 2018.
- Over one-third of the burden of disease was potentially preventable due to modifiable risk factors, most importantly tobacco smoking, overweight (including obesity), dietary risks and alcohol. Males experienced 1.5 times the burden attributable to risk factors as females.
- The health burden due to tobacco smoking reduced by 15% between 2011 and 2018. The impact of overweight (including obesity) on health increased slightly.
- \$12.9 billion in healthcare spending was attributable to ABDS disease groups in 2018, with the highest financial burden associated with musculoskeletal diseases (\$1.4 billion).
- The majority of healthcare spending was allocated to hospital-based care (\$7.9 billion, 62%), compared with only \$841 million (7%) in primary care (General Practice).

## Introduction

Australians are living longer and in better health, with improvements in living standards, public health measures and medical treatments over the past century. Reductions in mortality have seen Australian life expectancy increase by more than 10 years since the 1960's<sup>4</sup>. However, recent increases in lifestyle-related chronic conditions, mental illness as well as health challenges experienced by an aging population, have slowed and even threaten to reverse this progress.

This report provides estimates of the total, non-fatal and fatal burden for the West Australian population in 2018, using the disability-adjusted life year (DALY) measure. One disability adjusted life year (DALY) represents one year of healthy life lost, either through premature death ('years of life lost'; YLL) or from living with an illness or injury ('years lived with disability'; YLD).

DALY estimates are presented for 219 diseases, as well as estimates of the burden attributable to 26 individual risk factors, such as tobacco use and physical inactivity. Measures of life expectancy, including health-adjusted life expectancy, are presented which capture the overall health status of the population. Where available, trends in the burden of disease between 2011 and 2018 are also presented.

As this study provides estimates of disease burden for the 2018 reference year, estimates of the burden due to COVID-19 are not included.

## Burden of disease studies

Burden of disease studies measure the impact of diseases, injuries and risk factors on a population including the relative impacts of different diseases. This enables decision makers to identify opportunities to reduce the burden attributable to diseases, injuries and risk factors through the investment of resources, and planning and development of health services, policies and programs. Burden of disease is comparable between conditions, as well as across age groups and sexes, providing a powerful tool to assess the 'human costs' of various conditions.

Burden of disease data can be used to:

- Monitor population health
- Guide resource allocation, policy development and health service planning
- Measure the progress and impact of health programs and initiatives
- Estimate potential health gains that could be achieved through investment

The first global burden of disease (GBD) study was the GBD 1990. Global studies have continued every few years, with the most recent published study being the GBD 2019. The Australian Institute of Health and Welfare (AIHW) have undertaken national burden of disease studies to supplement the GBD studies with Australia-specific estimates. These national studies adapt the global methods by using the best available Australian data, resulting in estimates that can better inform Australian health policy.

## Key definitions

**Disability-adjusted life year (DALY):** the summary measure for burden of disease, measuring healthy years of life lost through both premature death and the effects of living with ill-health or disability. DALYs are calculated by summing 'years of life lost prematurely' (YLL) and 'years lived with a disability' (YLD).

**Years of life lost (YLL):** known as the fatal burden of disease. One YLL represents one year of life lost due to premature death. YLL are calculated by multiplying the number of deaths for males and females of different ages by an 'ideal life span' according to a reference life table. Total YLL are influenced by both the total number of deaths, and the ages at which those deaths occur.

**Years lived with disability (YLD):** Known as the non-fatal burden of disease, YLDs are measured as years lived with ill-health or disability. One YLD represents one year of life lost due to the disabling effects of ill health. Total YLD are influenced by the number of people with each disease, the time spent in less than full health, and the disability weights, indicating severity, defined for each disease or condition.

**Health-adjusted life expectancy (HALE):** Extends the concept of life expectancy by considering the time spent living with ill health from disease or injury. It reflects the average length of time a person at a specific age can expect to live in full health.

**Risk factor:** any determinant - attributes, characteristics or exposures - that increase the likelihood of a person developing a disease or health disorder. Twenty-six modifiable risk factors have been included in the ABDS.

**Attributable burden:** The disease burden attributed to a specific risk factor. It is the reduction in burden that would have occurred if exposure to the risk factor had been avoided or had been reduced to its theoretical minimum risk exposure distribution.

**Age-standardised rate:** the weighted average of event rates, with the weights being equal to the proportion of people in each age group in a chosen standard population. At the AIHW, the current standard population is the total estimated resident population in Australia on 30 June 2001. Age-standardised rates allow comparison of rates between populations by accounting for the differences in age distribution.



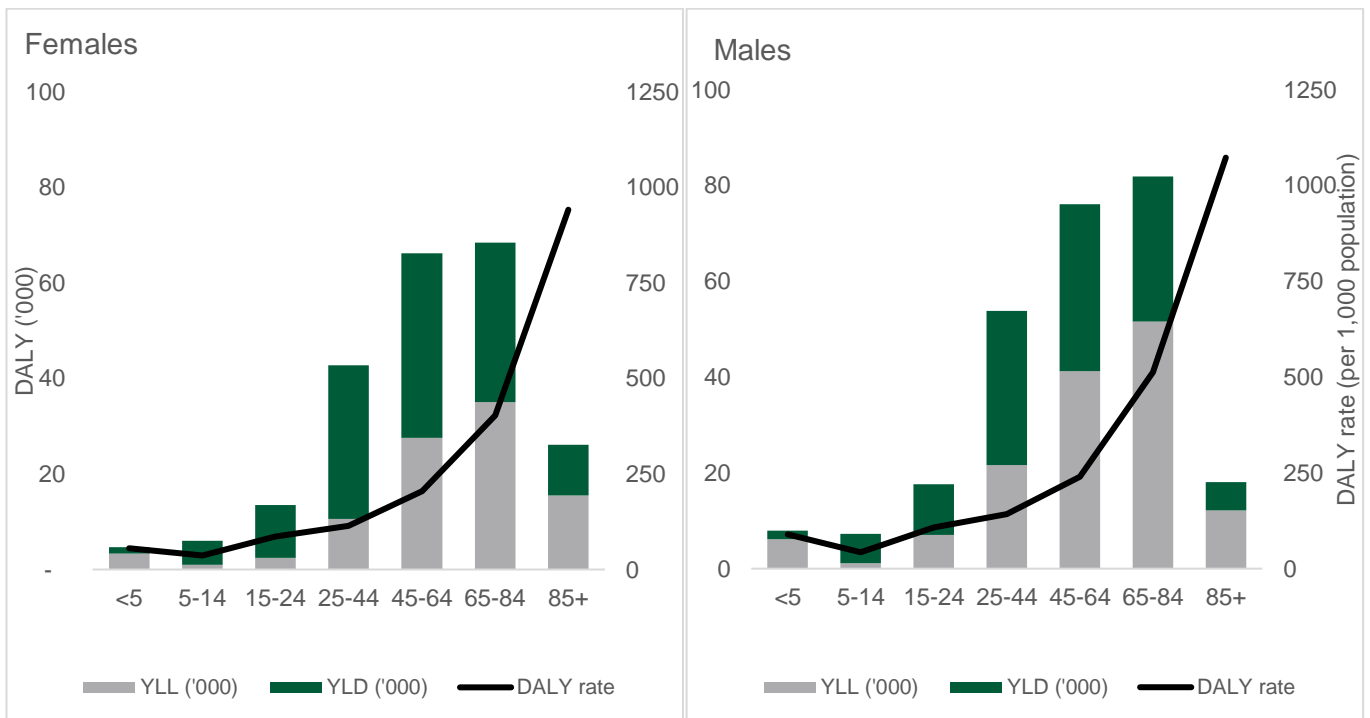
## Chapter 1: Summary of burden of disease

In 2018, there were **179 years** of health life lost **per 1000 people** living in Western Australia (WA) due to living with or dying prematurely from disease, injury or other health-related conditions. This amounts to approximately **490,439 DALYs** for the WA population.

The total burden of disease (measured as DALYs) increased from age 25 years and older, peaking for people aged 65-84 years, then dropping from age 85 years and older (**Figure 1**). The marked drop is primarily due to the smaller population size in this age group. The DALY rate increased with age, with a sharp increase in those aged 85 and over.

Males account for a higher burden of disease than females across all age groups, except for those aged 85 years and over. This is primarily due to the higher fatal burden among males (YLL ASR 105.2 per 1,000 population) compared with females (YLL ASR 64.9 per 1,000 population). In contrast, the non-fatal burden was modestly higher in females (YLD ASR 95.9 per 1,000 population) than males (YLD ASR 92.4 per 1,000 population).

**Figure 1: Fatal (YLL) and non-fatal (YLD) composition of total burden of disease (DALY), and DALY rates<sup>i</sup> (per 1,000 population), by sex and age group, WA, 2018**



i. The number of DALYs can exceed the population resulting from years lost from multiple diseases.

## Life expectancy and Health-adjusted life expectancy

Life expectancy is the average number of years a person in a given population can expect to live. It does not consider a person's state of health during those years.

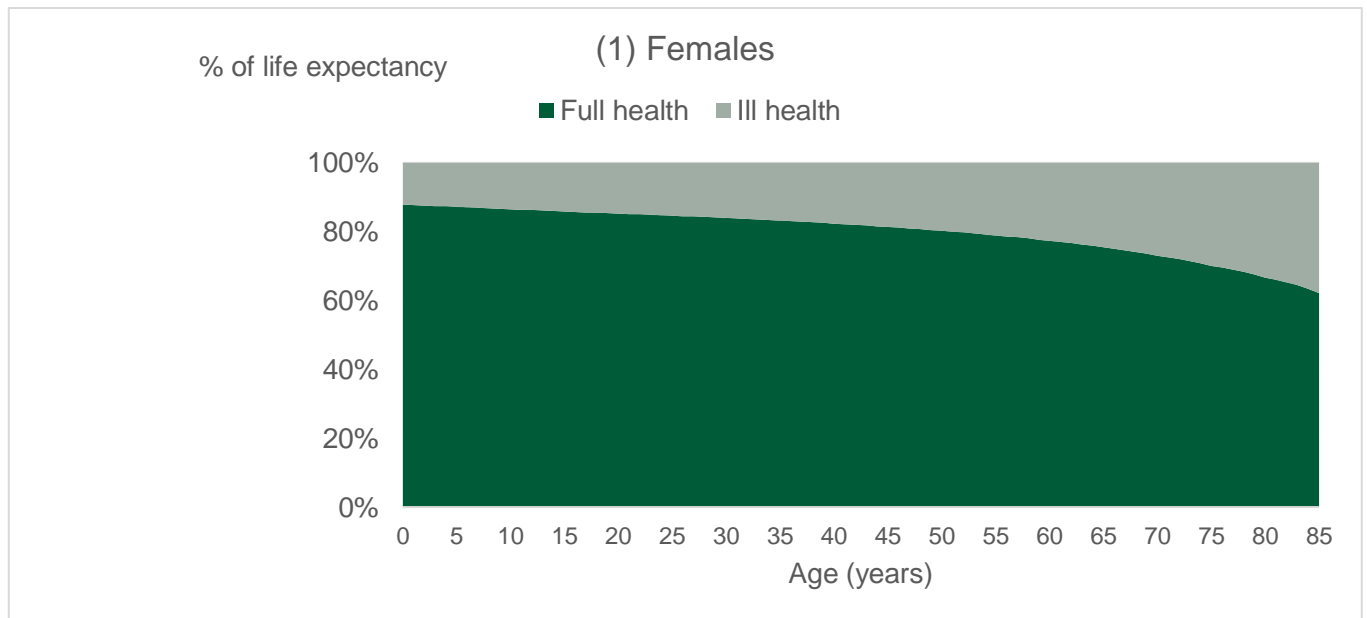
The Health-adjusted life expectancy (HALE) is measured using the morbidity and mortality experienced by the population for a particular year, applied to Australian life expectancy data.

Life expectancy in Western Australia for males born in 2018 was **80.5 years** and for females it was **85.1 years**<sup>1</sup>. In the same year, HALE of West Australians at birth — that is, the estimated number of years a person could expect to live in full health — was **71.8 years** for males and **74.8 years** for females.

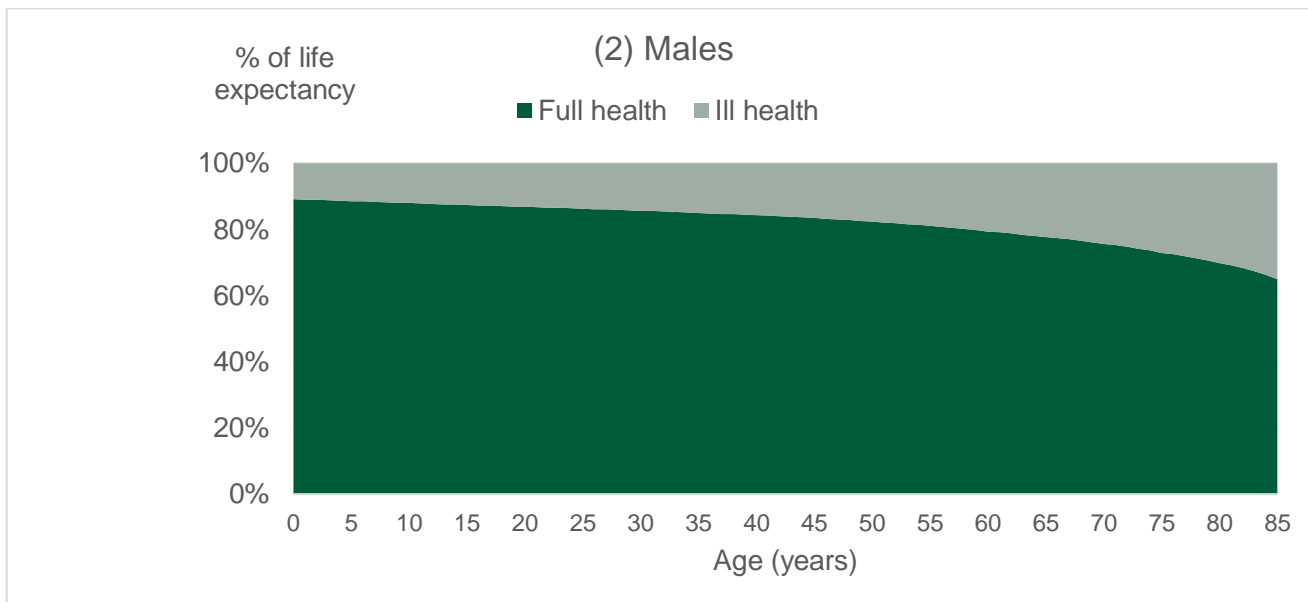
On average, females born in WA in 2018 expected to **live 4.6 years longer** and have **3 more years of healthy life** than males born the same year.

By another measure, a boy born in 2018 could expect to live 89% of his life in full health while a girl could expect to live 88% of her life in full health. People in WA aged 65 in 2018 could expect to live approximately three-quarters of their remaining years in full health. By the age of 85 years, males and females in WA could expect to live 65% and 62% of their remaining years in full health, respectively (**Figure 2**). Overall, females live longer than males but experience a higher burden of chronic conditions (morbidity, reflected by YLDs) especially in later years of life.

**Figure 2: Health-adjusted life expectancy (HALE) for (1) females (2) males, WA, 2018**



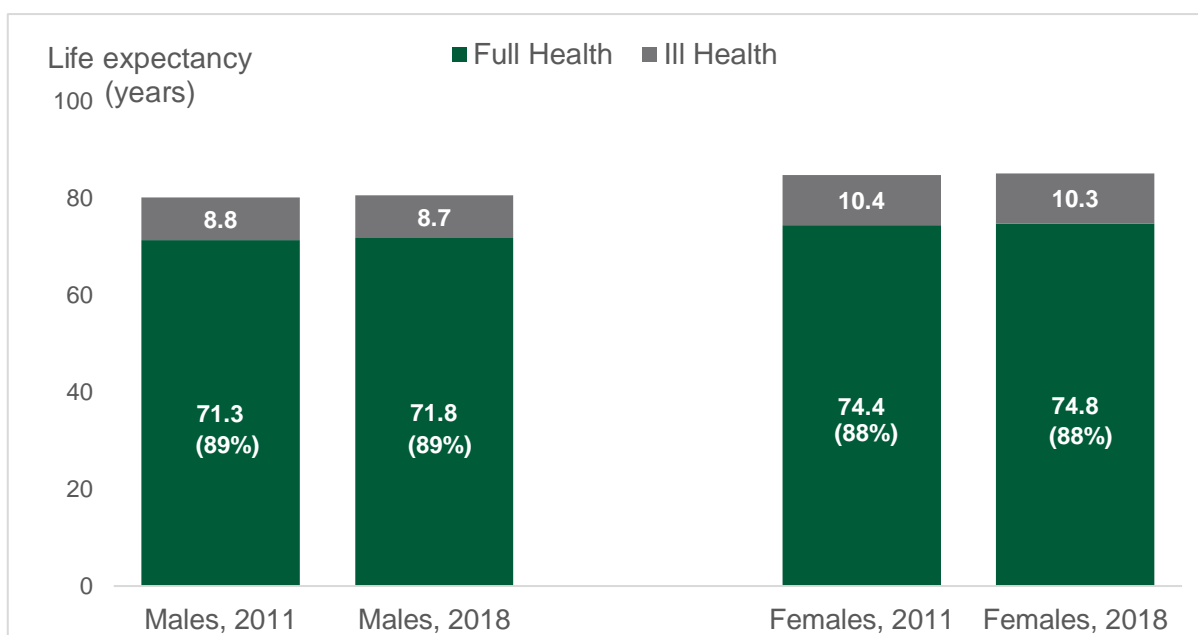
<sup>1</sup> Australian life expectancy is calculated by the ABS using multiple years of mortality data: 2010–2012 for 2011, 2014–2016 for 2015 and 2017–2019 for 2018.



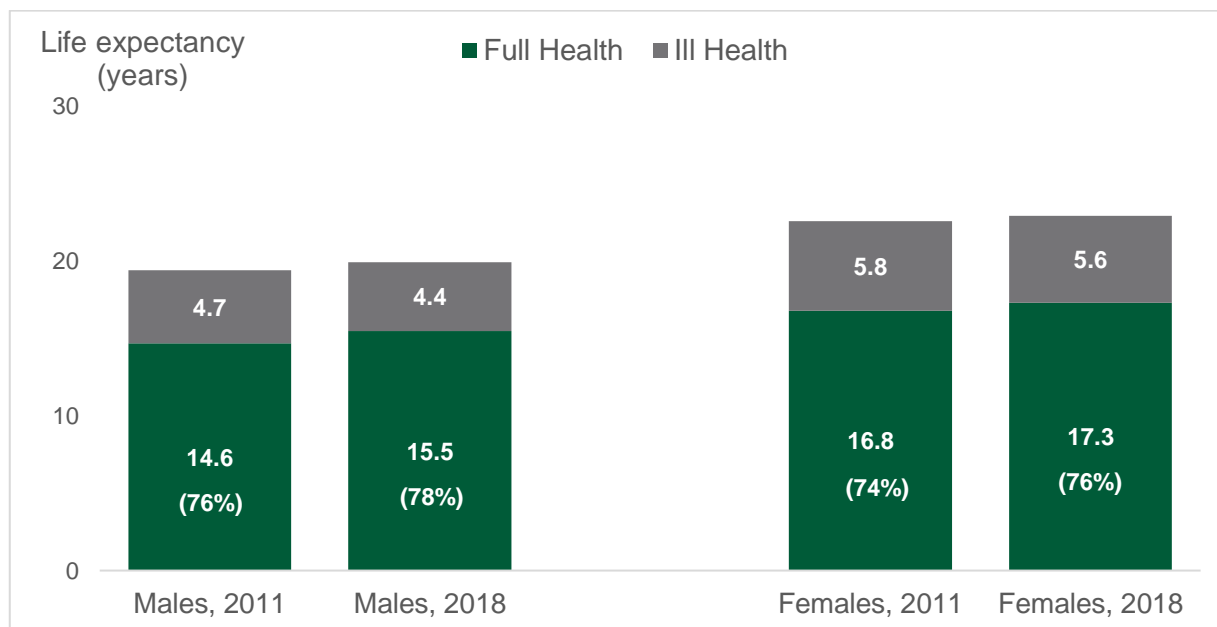
Between 2011 and 2018, there were marginal increases (<1 year) in life expectancy for both males and females in WA, as well as small increases in years of life spent in full health (HALE) (**Figure 3**). However, years lived in ill health (YLD) are also increasing, resulting in little change in the proportion of life spent in full health.

The proportion of life that is expected to be spent in full health remained largely the same for both males (89%) and females (88%) born between 2011 and 2018 (**Figure 3**). However, for West Australians aged 65 years, the proportion of life spent in full health increased slightly between 2011 and 2018 (76% to 78% for males, 74% to 76% for females; **Figure 4**).

**Figure 3: Life expectancy at birth in full health (HALE) and ill health, males and females, 2011 and 2018**



**Figure 4: Life expectancy at age 65 years in full health (HALE) and ill health, males and females, 2011 and 2018**

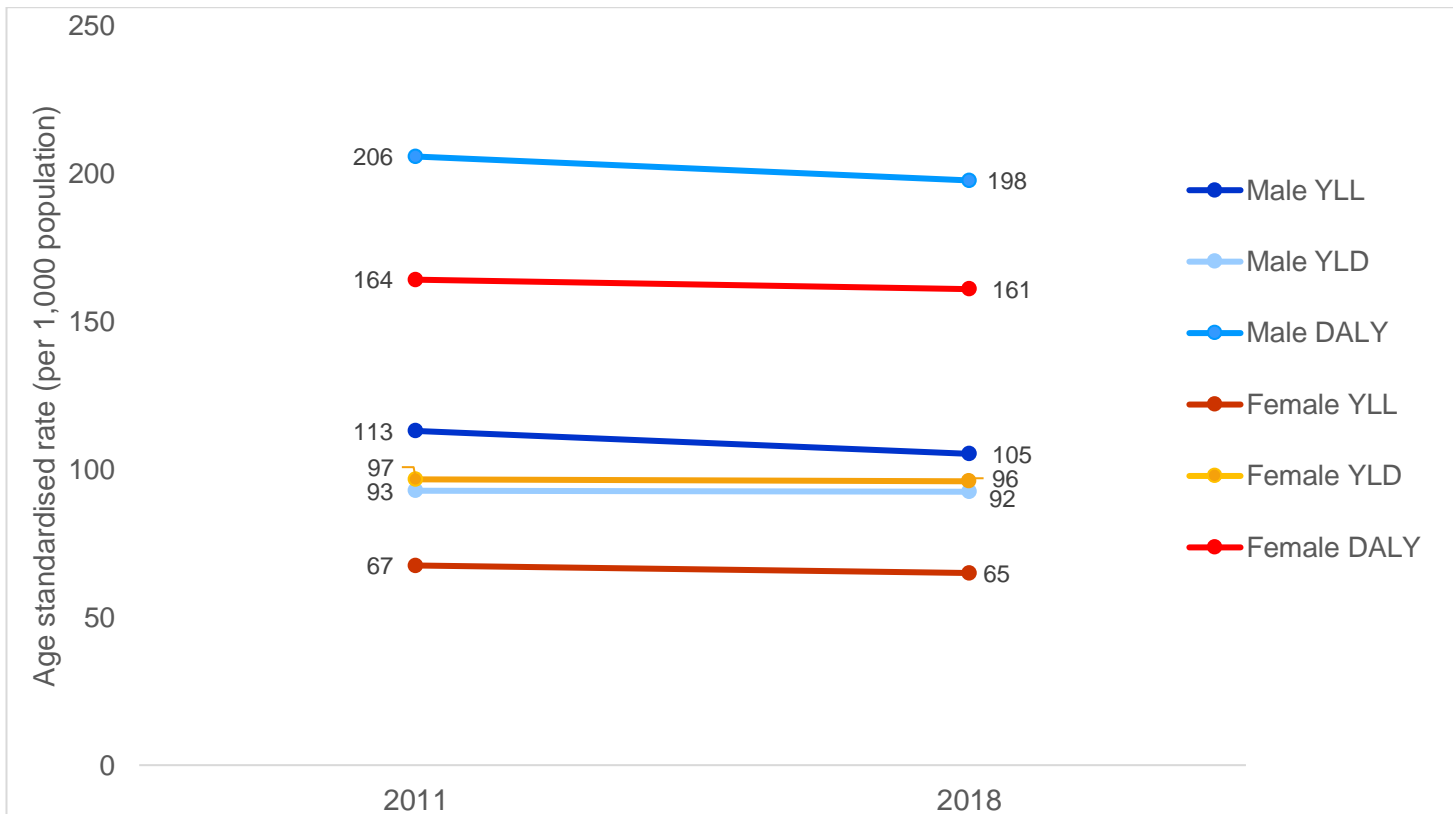


## Differences in burden between males and females

Overall, males experienced 35,185 more years of healthy life lost than females in 2018, accounting for **54%** of the total burden of disease (DALYs) in WA in 2018.

Males in WA had **1.2 times** the **total burden of disease** (age-standardised DALY rate) and **1.6 times** the **fatal burden** of disease of females in 2018. Females experienced slightly more (1.04 times) of the non-fatal burden of disease than males. The gap in total and fatal burden of disease between males and females narrowed slightly between 2011 and 2018 (**Figure 5**) as a result the larger reduction in YLL in males than females.

**Figure 5. Age-standardised rates (per 1,000 population) of DALY, YLL and YLD for males and females, WA, 2011 and 2018**



## Health priorities across life stages

### Children

In young children (aged less than 5 years) the majority (75%) of burden experienced is due to dying prematurely (YLL), with infant and congenital conditions responsible for 56% of the total burden. The leading causes of total burden in the youngest age group were cardiovascular defects, birth trauma and asphyxia, pre-term birth and low birth weight, and neonatal infections (**Figure 6**). The total quantum of burden of disease in this age group was low (3% of all DALYs).

In contrast, for children aged 5 to 14 years, most (84%) of the burden of disease is due to living with illness or disability. Mental and substance use disorders contributed more than one third (38%) of the total burden of disease for this age group. In terms of specific diseases, asthma, anxiety disorders, depressive disorders, conduct disorders and autism spectrum disorders were the leading causes of disease burden.

### Adolescents and Young Adults

Amongst young people aged 15 to 24 years, over two-thirds of the health burden (69%) is due to YLD, with 35% of the burden attributable to mental and substance use disorders. Suicide and self-inflicted injuries, depressive disorders, anxiety disorders, alcohol use disorders and road traffic injuries (RTI) were the leading causes of total burden in this age group (**Figure 6**).

Suicide and self-inflicted injury were the leading contributor of burden of disease for males in this age group, and fourth among females of the same age.

Gender-specific differences are observed amongst adolescents and young adults, for example RTIs were a leading cause of burden in young males but not for females of the same age. Drug and alcohol use disorders were in the top five causes of disease burden for males aged 15-24 years, while females experienced burden due to eating disorders and back pain.

### Adults aged 25 to 64 years

Along with increasing rates of cancer and cardiovascular disease with increasing age, musculoskeletal conditions and mental health disorders represent the greatest causes of ill health in West Australian adults.

### Older persons

The five leading causes of total burden in persons aged 65 to 84 years were coronary heart disease, chronic obstructive pulmonary disease (COPD), lung cancer, dementia and type 2 diabetes mellitus. Among West Australians aged 85 years and over, dementia was the leading cause of total burden of disease. This was followed by coronary heart disease, COPD, stroke and falls.

Figure 6: Leading causes of total burden (DALYs; %) by sex and age group, WA, 2018

		Age group (years)						
		Under 5	5-14	15-24	25-44	45-64	65-84	85+
<b>MALES</b>	<b>1st</b>	Birth trauma and asphyxia (959; 12.1%)	Asthma (905; 12.4%)	Suicide and self-inflicted injuries (2587; 14.6%)	Suicide and self-inflicted injuries (6233; 11.6%)	Coronary heart disease (7742; 10.2%)	Coronary heart disease (8974; 11.0%)	Coronary heart disease (2923; 16.2%)
	<b>2nd</b>	Pre-term birth and LBW complications (912; 11.5%)	Anxiety disorders (729; 10.0%)	Road traffic injuries - motor vehicle occupants (1378; 7.8%)	Poisoning (4546; 8.4%)	Back pain and problems (5302; 7.0%)	Lung cancer (4851; 5.9%)	Dementia (1863; 10.3%)
	<b>3rd</b>	Cardiovascular defects (727; 9.2%)	Autism spectrum disorders (568; 7.8%)	Alcohol use disorders (1317; 7.5%)	Alcohol use disorders (3525; 6.5%)	Suicide and self-inflicted injuries (3300; 4.3%)	COPD (4569; 5.6%)	COPD (995; 5.5%)
	<b>4th</b>	Neonatal infections (441; 5.6%)	Conduct disorder (525; 7.2%)	Depressive disorders (948; 5.4%)	Back pain and problems (3469; 6.4%)	Lung cancer (3181; 4.2%)	Type 2 diabetes mellitus (3121; 3.8%)	Prostate cancer (817; 4.5%)
	<b>5th</b>	Asthma (215; 2.7%)	Depressive disorders (521; 7.1%)	Drug use disorders (excluding alcohol) (771; 4.4%)	Depressive disorders (3225; 6.0%)	Type 2 diabetes mellitus (2358; 3.1%)	Prostate cancer (3019; 3.7%)	Stroke (729; 4.0%)
<b>FEMALES</b>	<b>1st</b>	Cardiovascular defects (557; 11.8%)	Anxiety disorders (636; 10.6%)	Anxiety disorders (1340; 9.9%)	Depressive disorders (3676; 8.6%)	Back pain and problems (4979; 7.5%)	COPD (4671; 6.8%)	Dementia (4652; 17.8%)
	<b>2nd</b>	Pre-term birth and LBW complications (299; 6.4%)	Depressive disorders (598; 10.0%)	Depressive disorders (1283; 9.5%)	Back pain and problems (3666; 8.6%)	Breast cancer (3709; 5.6%)	Coronary heart disease (4018; 5.9%)	Coronary heart disease (3049; 11.7%)
	<b>3rd</b>	Birth trauma and asphyxia (282; 6.0%)	Asthma (499; 8.3%)	Eating disorders (911; 6.7%)	Anxiety disorders (3663; 8.6%)	Depressive disorders (2873; 4.3%)	Dementia (3917; 5.7%)	Stroke (1712; 6.6%)
	<b>4th</b>	Homicide and violence (275; 5.8%)	Conduct disorder (320; 5.3%)	Suicide and self-inflicted injuries (840; 6.2%)	Suicide and self-inflicted injuries (2001; 4.7%)	Osteoarthritis (2815; 4.3%)	Lung cancer (3269; 4.8%)	COPD (1570; 6.0%)
	<b>5th</b>	Neonatal infections (268; 5.7%)	Acne (293; 4.9%)	Back pain and problems (783; 5.8%)	Eating disorders (1910; 4.5%)	Rheumatoid arthritis (2809; 4.2%)	Osteoarthritis (3210; 4.7%)	Falls (1156; 4.4%)

## Leading causes of burden of disease

### Chronic disease and injury continue to cause most of the burden of disease in WA.

The broad disease groups contributing the most to total burden of disease (DALYs) in 2018 were cancer (17%), mental and substance use disorders (14%), musculoskeletal conditions (13%) cardiovascular diseases (12%) and injuries (11%). Together these five groups accounted for around two-thirds (67%) of the total burden of disease (**Table 1**).

While the age-standardised burdens of cancer and cardiovascular diseases decreased between 2011 and 2018, the burdens of mental and substance use disorders, musculoskeletal conditions, and injuries increased. Overall, the age-standardised burden of disease decreased by 2.9% from 2011 to 2018.

**Table 1. Summary of total burden and 5 leading disease groups, 2018**

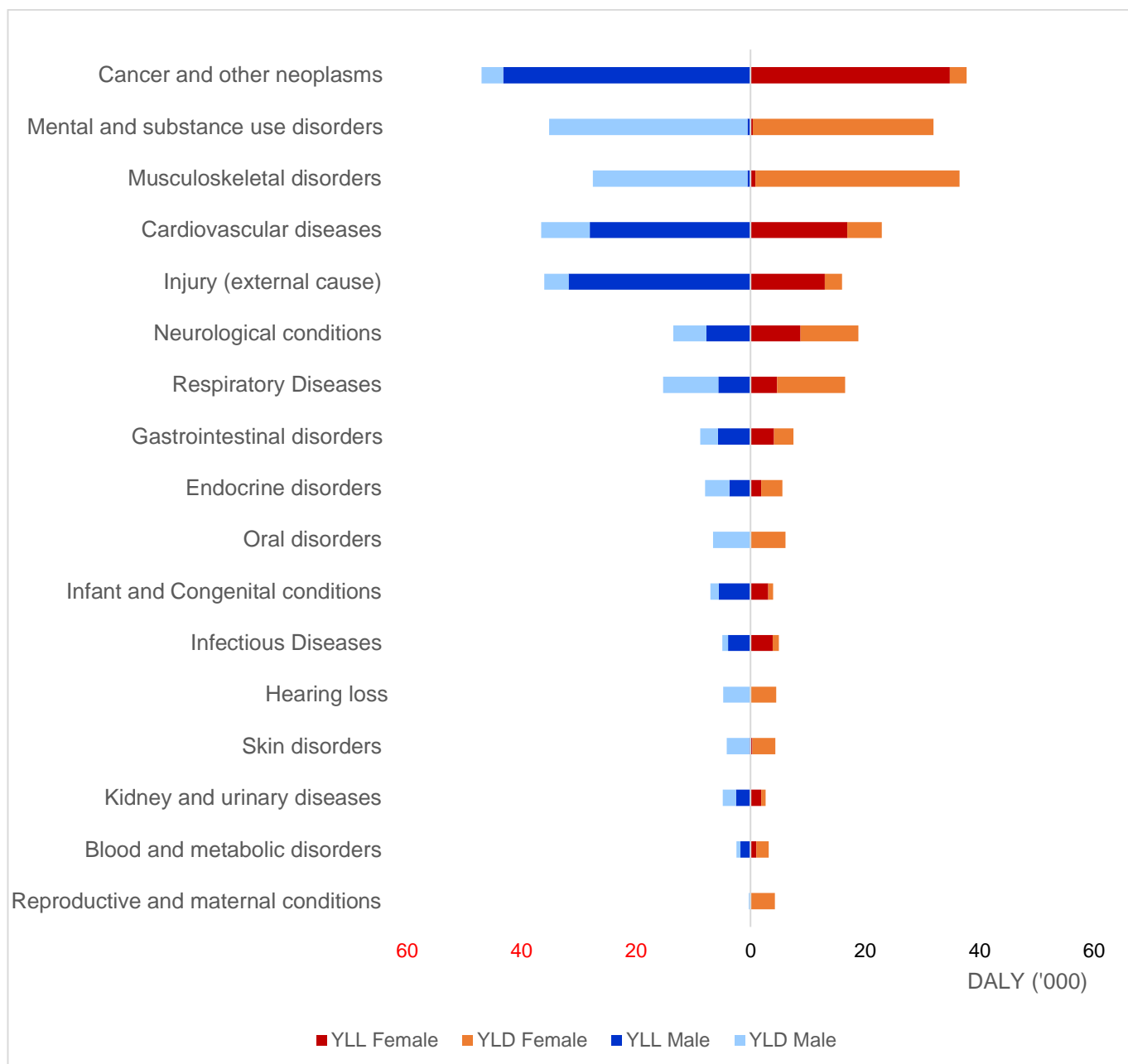
	Cancer	Mental/ substance use	Musculoskeletal	Cardiovascular	Injuries	Total (all diseases)
<b>Number of DALYs (‘000)</b>	85	67	64	60	52	490
<b>% of total DALYs</b>	17%	14%	13%	12%	11%	N/A
<b>% of DALYs that was fatal</b>	92%	1%	2%	76%	86%	48%
<b>Change in DALYs between 2011 – 2018<sup>i</sup></b>	↓ 8.1%	↑ 4.6%	↑ 1.9%	↓ 14.5%	↑ 9.6%	↓ 2.9%

<sup>i</sup> Based on rate difference; i.e. absolute difference between age-standardised rate of burden from 2011-2018

Among the top five disease groups causing the highest proportion of total burden, cancer, cardiovascular diseases and injuries caused mainly fatal burden (YLL) while mental health and substance use disorders and musculoskeletal conditions cause primarily non-fatal burden (**Figure 7**). Some disease groups were over-represented by males and others by females. Males contributed a greater proportion of the total burden for injuries (69%) and cardiovascular diseases (61%), as well as infant and congenital disorders (64%). Females contributed 57% of the total burden due to musculoskeletal disorders and 58% of the burden due to neurological conditions. Unsurprisingly, 94% of the relatively small burden due to reproductive and maternal disorders was experienced by females.



**Figure 7: Non-fatal (YLD) and fatal (YLL) burden, by disease group and sex, WA, 2018**



At the disease level, the five leading causes of total burden (**Table 2**) were coronary heart disease (6.3%), back pain and problems (5.1%), suicide and self-inflicted injuries (3.5%), depressive disorders (3.4%) and COPD (3.1%).

Although many conditions ranked similarly high for both males and females, there were several differences in the leading conditions between the sexes. Notably, suicide and self-inflicted injuries was the second leading cause of total burden in males, with 9.9 age-standardised DALYs per 1,000 population, compared with 3.6 age-standardised DALYs for females. While coronary heart disease ranked highly for both females and males (second and first, respectively), the age-standardised DALY rate was substantially higher for males (15.5 per 1,000 population) than females (6.1 per 1,000 population). By contrast, females had higher age-standardised rates than males of both depression (7.4 vs. 5.6 per 1,000 population) and anxiety (7.1 vs 4.7 per 1,000 population).

While poisoning was a leading cause of burden in males, it did not rank in the top 15 conditions for females. Both osteoarthritis and rheumatoid arthritis ranked highly in females, but not for males. Of course, there are certain conditions that can only be leading causes of burden for either only males or females – such as breast cancer and prostate cancer.

**Table 2: Top 15 conditions<sup>i</sup> by proportion of DALYs and Age Standardised Rates (ASR) by sex, WA, 2018**

Rank	FEMALES			MALES			PERSONS		
	Disease	DALYs (%)	ASR (per 1000)	Disease	DALYs (%)	ASR (per 1000)	Disease	DALYs (%)	ASR (per 1000)
1	Back pain and problems	12,788 (5.6%)	9.4	Coronary heart disease	20,992 (8.0%)	15.5	Coronary heart disease	30,730 (6.3%)	10.6
2	Coronary heart disease	9,738 (4.3%)	6.1	Suicide and self-inflicted injuries	12,746 (4.8%)	9.9	Back pain and problems	24,853 (5.1%)	9.2
3	Depressive disorders	9,473 (4.2%)	7.4	Back pain and problems	12,065 (4.6%)	8.8	Suicide and self-inflicted injuries	17,303 (3.5%)	6.8
4	Anxiety disorders	8,980 (3.9%)	7.1	Lung cancer	8,505 (3.2%)	6.0	Depressive disorders	16,620 (3.4%)	6.5
5	Dementia	8,910 (3.9%)	5.2	Poisoning	7,383 (2.8%)	5.8	COPD <sup>ii</sup>	15,240 (3.1%)	5.2
6	COPD <sup>ii</sup>	8,205 (3.6%)	5.3	Depressive disorders	7,147 (2.7%)	5.6	Anxiety disorders	14,998 (3.1%)	5.9
7	Breast cancer	7,196 (3.2%)	5.0	COPD <sup>ii</sup>	7,035 (2.7%)	5.1	Lung cancer	14,543 (3.0%)	4.9
8	Osteoarthritis	7,030 (3.1%)	4.8	Type 2 diabetes mellitus	6,304 (2.4%)	4.6	Dementia	14,220 (2.9%)	4.7
9	Rheumatoid arthritis	6,825 (3.0%)	4.7	Alcohol use disorders	6,135 (2.3%)	4.9	Asthma	11,146 (2.3%)	4.3
10	Lung cancer	6,037 (2.7%)	4.0	Anxiety disorders	6,018 (2.3%)	4.7	Type 2 diabetes mellitus	10,866 (2.2%)	3.8
11	Asthma	5,881 (2.6%)	4.4	Dementia	5,311 (2.0%)	4.1	Rheumatoid arthritis	10,615 (2.2%)	3.8
12	Stroke	5,475 (2.4%)	3.5	Asthma	5,265 (2.0%)	4.1	Stroke	10,601 (2.2%)	3.7
13	Type 2 diabetes mellitus	4,562 (2.0%)	3.0	Stroke	5,126 (2.0%)	3.8	Osteoarthritis	10,453 (2.1%)	3.6
14	Suicide and self-inflicted injuries	4,557 (2.0%)	3.6	Bowel cancer	5,092 (1.9%)	3.7	Poisoning	10,146 (2.1%)	4.0
15	Falls	3,612 (1.6%)	2.3	Prostate cancer	4,615 (1.8%)	3.4	Bowel cancer	8,418 (1.7%)	2.9

- i. 'Other' conditions, for example, other musculoskeletal conditions, have been excluded from the ranking  
 ii. COPD: Chronic Obstructive Pulmonary Disease

## Cancer

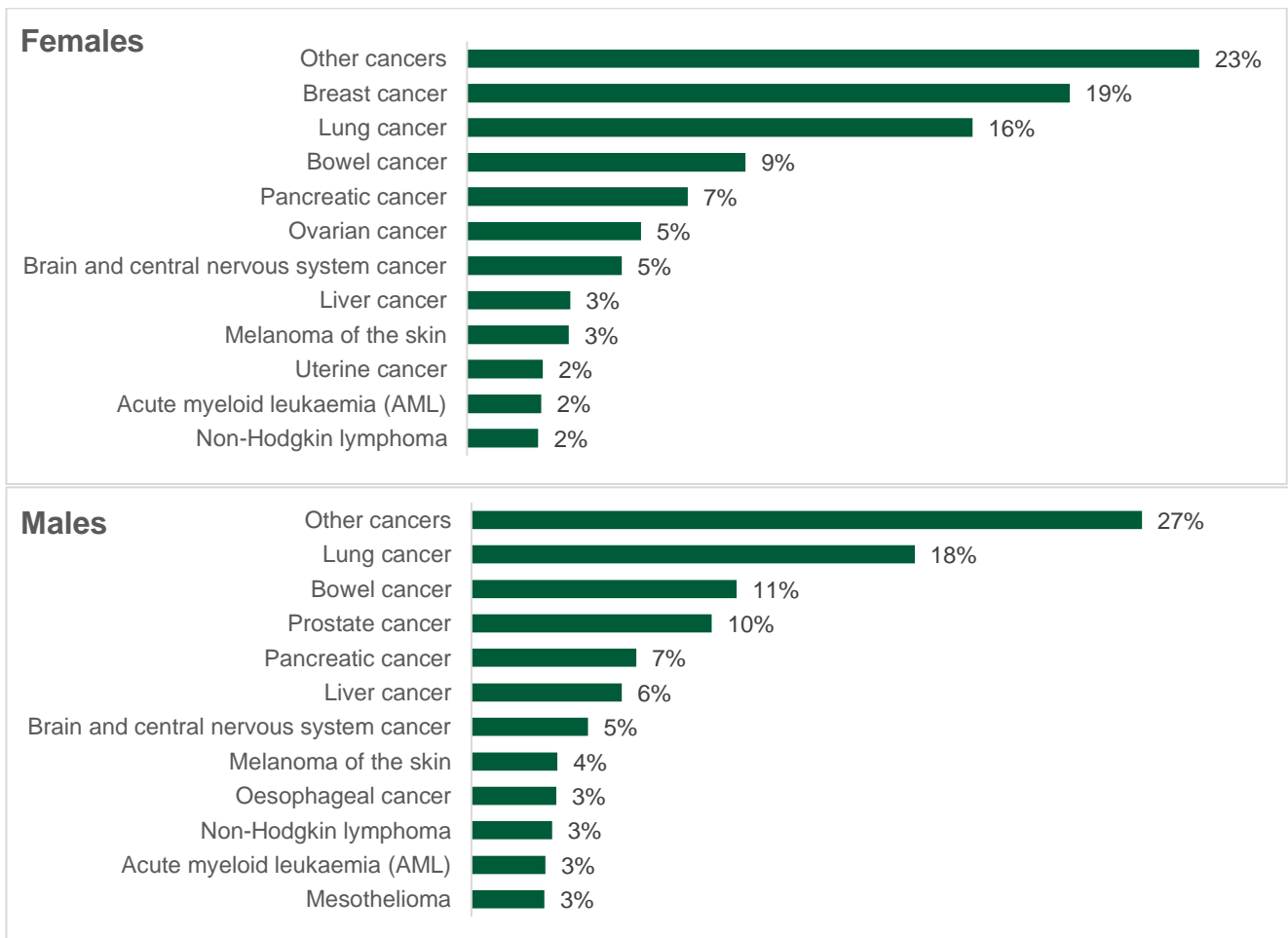
Cancer was the disease group which contributed the most to the total burden of disease and injury (17% of DALYs). It was also responsible for the greatest proportion of fatal burden, contributing to one-third of all life lost in WA in 2018. Most of the burden due to cancer was a result of the years of life lost (92%).

A substantial proportion of cancer burden occurred in people aged 45 to 64 years (41% of the total burden for females and 33% for males). The largest proportion of the total cancer burden was experienced in older West Australians aged 65 years and over (49% in females and 60% in males).

In both males and females, the youngest age groups (less than 5 years, 5 to 14 years and 15 to 24 years) each contributed 1% or less to the total burden of cancer.

The three cancers that contributed the most to the burden of disease due to cancer in females were breast cancer (19% of cancer burden in females), lung cancer (16%) and bowel cancer (9%) - see **Figure 8**. In males, the top three cancers were lung cancer (18% of cancer burden in males), bowel cancer (11%) and prostate cancer (10%).

**Figure 8: Proportion of total cancer burden (DALYs) by disease and sex, in Western Australia in 2018**



## Mental and substance use disorders

Mental and substance use disorders are the leading cause of total burden of disease in West Australians aged 15-44 years. They are significant from childhood through the life course with the second largest contribution to the total burden of disease and injury (14%) and the greatest proportion of non-fatal burden (26%).

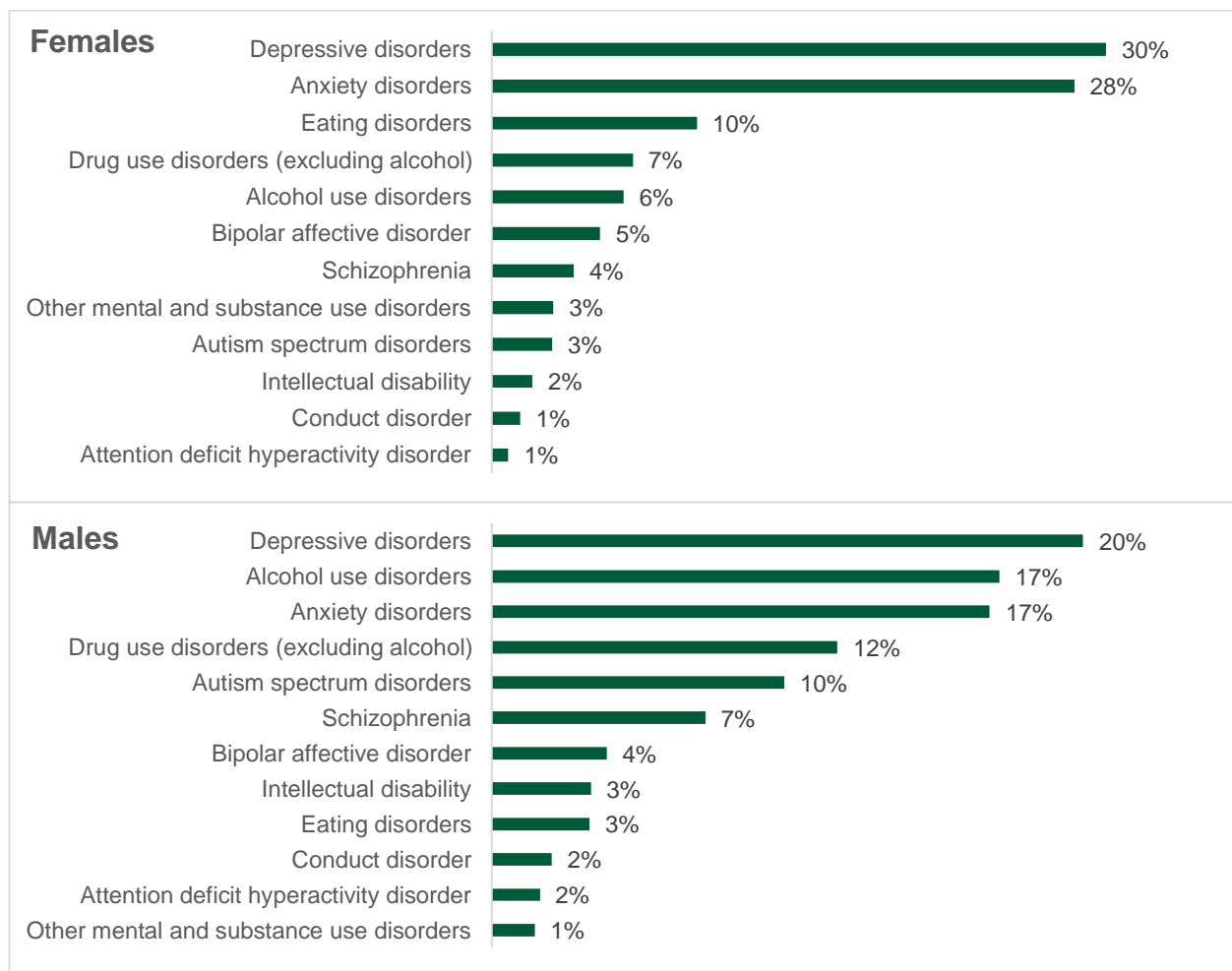
Overall, years of healthy life lost to disability (YLD) made up 99% of the total burden due to mental and substance use disorders. However, it is important to note that suicide and self-inflicted injuries, manifestations of mental health issues, are considered part of the injury disease group. Suicide and self-injuries represent the third leading cause of healthy life lost, with the vast majority (99%) being due to premature deaths (YLL). The fatal burden of suicide and self-inflicted injuries is particularly high given the young age at which death occurs compared with life expectancy, therefore resulting in more years of life lost. As such, the full toll of mental health disorders is substantially higher than the burden captured in this disease group alone.

The largest proportion of the total burden due to mental and substance use disorders occurred in persons aged 25 to 44 years (45% overall, 46% for males and 43% for females). Those aged 15 to 24, and 45 to 64 years contributed 16% and 24% of the burden of mental and substance use disorders respectively.

In both males and females, the youngest age group (under 5 years) accounted for 1% of the mental health and substance use burden. However, children aged 5 to 14 years contributed 7% to the burden due to mental illness and substance use, more than those aged 65 to 84 years.

The highest ranked mental and substance use disorders in females were depressive disorders (30%) and anxiety disorders (28%) – see **Figure 9**. In males, depressive disorders were also the largest contributors to total burden due to mental and substance use disorders (20%), followed by alcohol use disorders (17%), anxiety disorders (17%), and drug use disorders (12%).

**Figure 9: Proportion of the total mental and substance use disorders burden (DALYs) by disease and gender, in Western Australia in 2018**



### Musculoskeletal conditions

Musculoskeletal conditions, including various forms of arthritis and back pain and problems, are common long-term conditions affecting the bones, muscles and connective tissues.

Musculoskeletal conditions were the third highest contributor of total disease burden overall, due to significant non-fatal burden of disease across a range of age groups, ranking second overall (25%) and for males (22%), and as the leading disease group for non-fatal burden among West Australian females (27%).

These conditions have a significant burden in females as the second highest contributor to DALYs (16% of burden). Females accounted for 57% of the total burden due to musculoskeletal conditions.

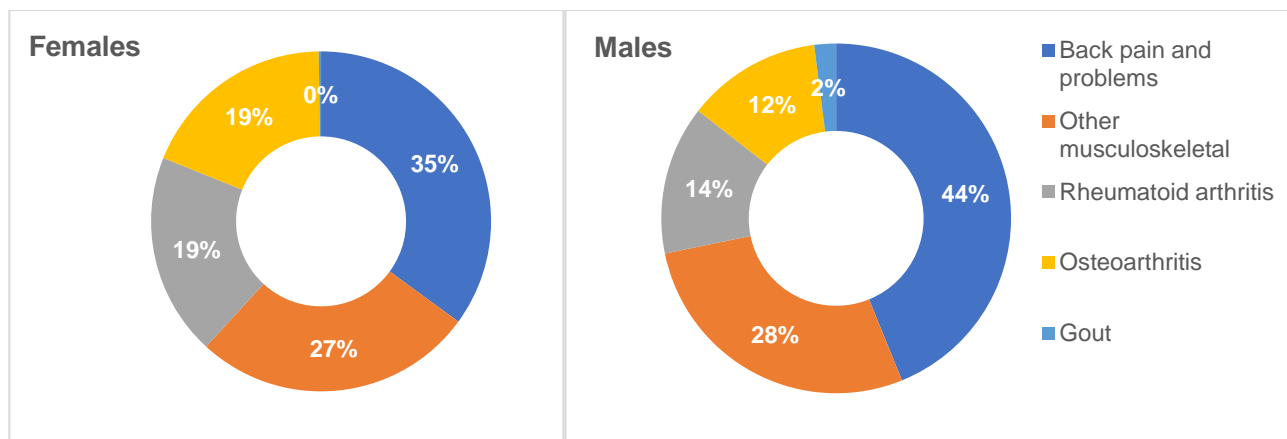
The impact of musculoskeletal conditions is significant even in young age groups. Those aged 25-44 years were responsible for 19% of the total musculoskeletal conditions burden. However, most of the burden of musculoskeletal conditions occurred in males and females aged 45 to 84 years (71% and 73%, respectively). The age group that accounted for the highest proportion of burden due to musculoskeletal conditions was those aged 45-64 years (41%).

Back pain and related problems were the leading cause of years of healthy life lost due to disease and injury, for both men and women. Back pain was responsible for 44% of male and 35% of female burden due to musculoskeletal conditions.

Osteoarthritis and rheumatoid arthritis also caused substantial burden, particularly in females (19% vs. 12% in males and 19% vs. 14% in males, respectively).

A total of 28% of male burden and 27% of female burden was due to other musculoskeletal conditions (**Figure 10**).

**Figure 10: Proportion of total musculoskeletal condition burden (DALYs) by condition and sex, WA, 2018**



### Cardiovascular disease

Cardiovascular diseases were the fourth highest contributing disease group to total burden, responsible for the second highest fatal burden overall (**Figure 7**). Fatal burden of cardiovascular disease contributed 76% of the total disease group burden, 74% in females and 77% in males (**Figure 7**).

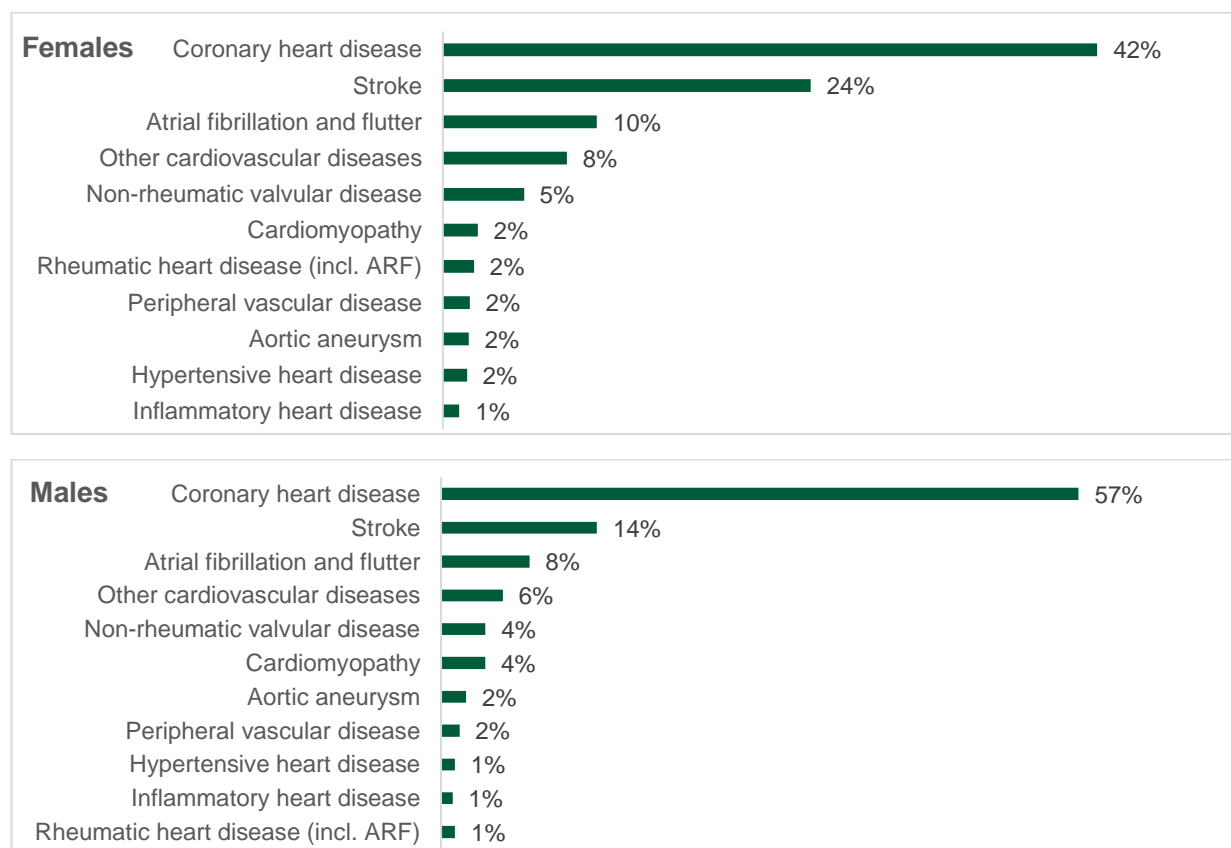
The leading causes of cardiovascular disease burden in both males and females were coronary heart disease and stroke (**Figure 11**).

Almost all the burden of cardiovascular diseases occurred in people over the age of 45 years (92%). The age group that accounted for the largest proportion of the cardiovascular burden was 65-84 years, making up 42% of DALYs in females and 44% of DALYs in males. The cardiovascular burden in females was skewed towards older age groups than in males: 14% of the cardiovascular burden amongst males was experienced by those aged 85 years and over, compared to 30% of the burden in females – likely reflecting the longer life expectancy of women compared to men.

While there has been decline in the burden due to coronary heart disease and stroke between 2011 and 2018 (see Chapter 5, **Figure 29**), some modifiable risk factors, such as overweight (including obesity) are highly prevalent in the community. Over time this could affect the downward trend in the burden of cardiovascular conditions.

In 2018, 88.6% of the total burden due to coronary heart disease and 73.3% of the total burden of stroke were attributable to modifiable risk factors in the study, including high blood pressure, high cholesterol, dietary risks, overweight (including obesity), and physical inactivity.

**Figure 11: Proportion of the total cardiovascular burden (DALYs) by disease and sex, WA, 2018**



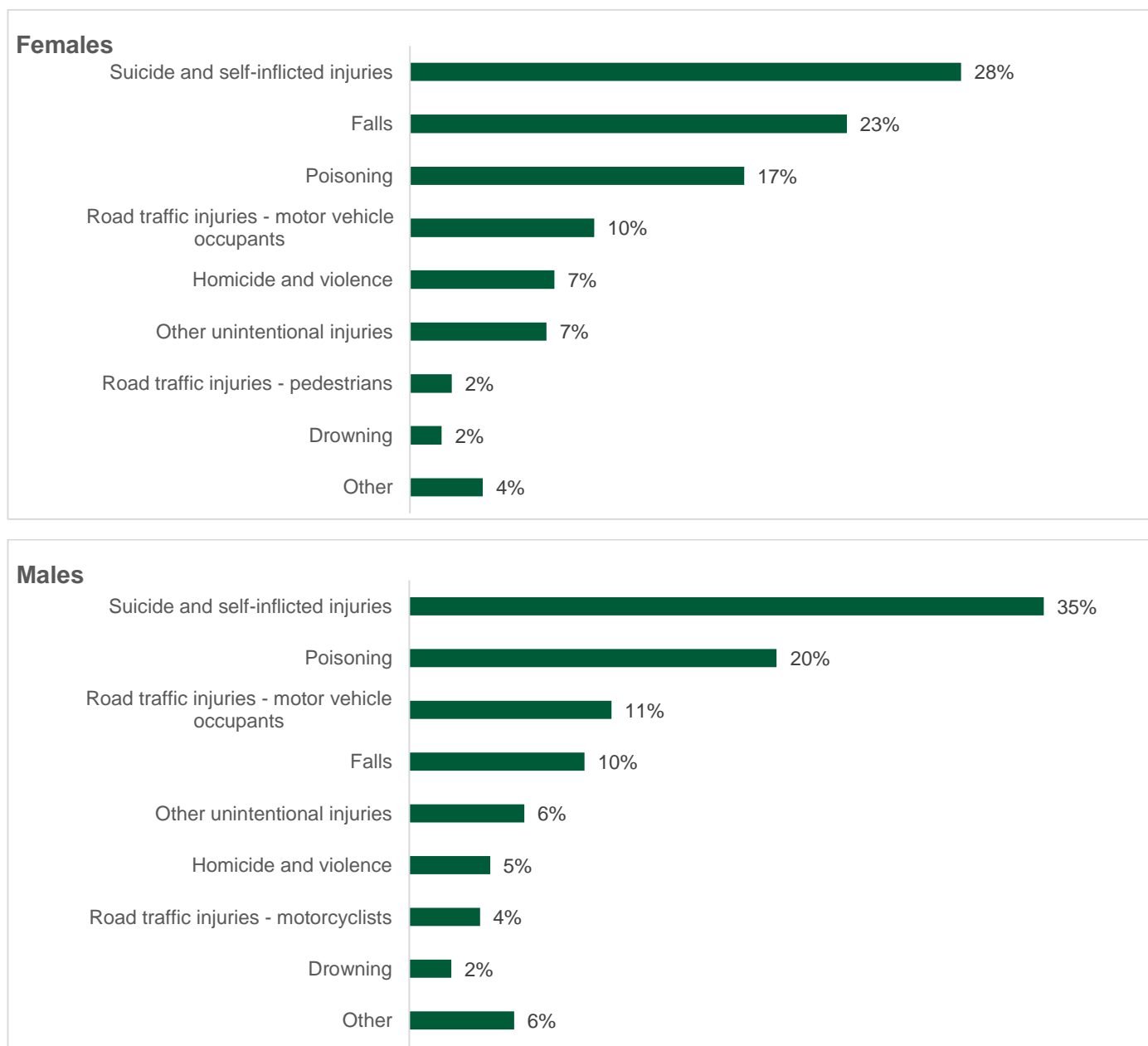
## Injuries

In 2018, injuries were the fifth highest cause of burden of disease (52,018 DALYs). Most of this burden was due to fatal burden (44,778 YLL, 86%).

Suicide and self-inflicted injuries were the leading cause of injury related burden for both males and females, with poisoning, falls and road traffic injuries also contributing substantially (**Figure 12**). Males experienced more than double the injury burden of females (DALY ASR 28 per 1,000 population vs. 12 per 1,000 population).

Injuries ranked higher as a cause of healthy life lost among people aged under 45 years, with 40% of the injury burden experienced by people aged 25-44 years<sup>5</sup>. However, the age specific DALY rate was highest for older people (85 years and over) at 3.5 per 1,000 population. This is driven by the high rate of falls in this age group (DALY age specific rate 41.2 per 1,000 population), whereas those aged 25-44 years experienced highest age-specific DALY rates of suicide and self-inflicted injuries (10.9 per 1,000 population) and poisoning (7.7 per 1,000 population)<sup>5</sup>.

**Figure 12. Proportion of the total injury burden (DALYs) by disease and sex, WA, 2018**





## Comparison of WA burden of disease to other Australian states and territories

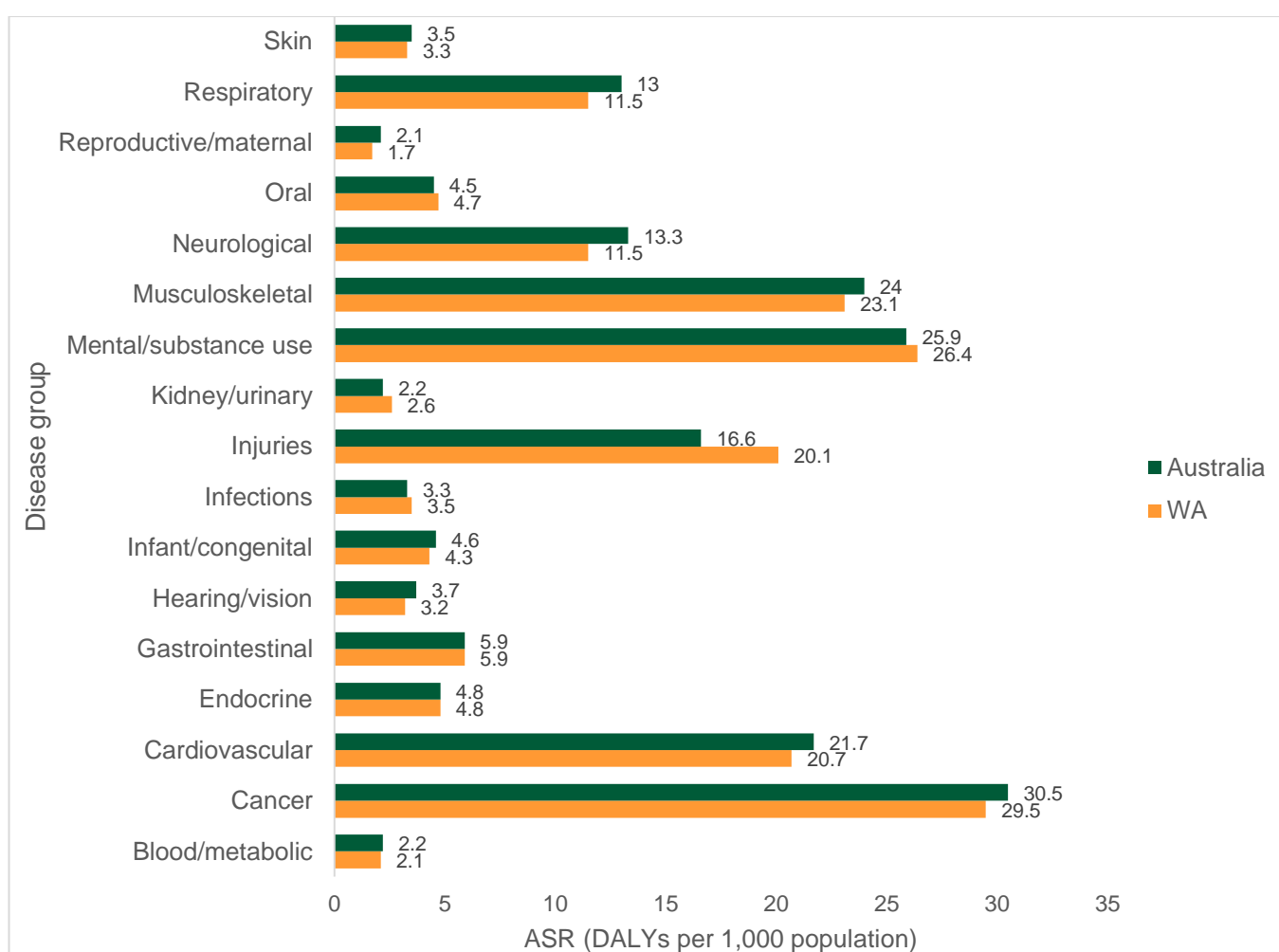
There was small variation in rates of YLD between jurisdictions. However, the overall YLD rate for WA was the lowest of any jurisdiction (94.3 per 1,000 population compared to Australian rate of 98.1 per 1,000 population). The rate of YLL in WA was slightly higher than the Australian figure at 84.7 compared to 83.7 per 1,000 population. Overall, WA had a slightly lower rate of burden of disease than Australia as a whole (179.0 vs. 181.8 DALYs per 1,000 population).

### Disease group comparison

WA experienced similar rates of most chronic diseases to Australia as a whole (**Figure 13**). However, WA experienced a higher rate of injury burden than the overall Australian figure in 2018 (16.6 per 1,000 population), at 20.1 per 1,000 population, making it the second highest in Australia after the Northern Territory<sup>6</sup>.

**Figure 13. Total burden (DALY) rates, by disease group, WA and Australia, 2018**

Source: AIHW<sup>6</sup>



## Chapter 2: Fatal burden of disease

In WA in 2018, there were 236,486 YLL due to disease. Sixty percent of the fatal burden was experienced by males.

### Years of life lost by cause

Of the disease groups, in 2018, cancer was the leading cause of YLL for both males and females in Western Australia, accounting for 33% of the fatal burden of disease. It was responsible for 1.7 times the YLL as the second leading cause of fatal burden: cardiovascular diseases. Injuries, including suicide and self-inflicted injury, followed closely behind.

In relation to specific conditions, coronary heart disease was the leading contributor to YLL for both females and males in WA in 2018.

Considering cancer types separately, two of the 10 leading causes of death in males and four of the 10 leading causes in females were cancers (**Table 3**).

**Table 3. Leading causes of fatal burden (YLL) by sex, WA, 2018**

Rank	Females			Males		
	Condition	%YLL	ASR	Condition	%YLL	ASR
1	Coronary heart disease	7.5%	4.5	Coronary heart disease	12.0%	12.6
2	Breast cancer	6.5%	4.4	Suicide and self-inflicted injuries	9.0%	9.9
3	Lung cancer	6.2%	3.9	Lung cancer	5.9%	5.9
4	Dementia	5.8%	3.4	Poisoning	5.2%	5.8
5	Stroke	5.2%	3.1	Bowel Cancer	3.4%	3.5
6	Suicide and self-inflicted injuries	4.7%	3.6	Stroke	3.2%	3.3
7	COPD	3.5%	2.2	Road traffic injuries (motor vehicle occupants)	2.7%	3.0
8	Bowel cancer	3.2%	2.1	COPD	2.7%	2.8
9	Poisoning	2.9%	2.1	Dementia	2.7%	2.9
10	Pancreatic cancer	2.7%	1.7	Chronic liver disease	2.6%	2.7

For males and females, the causes of fatal burden varied depending on the age at which death occurred. As more people die at older ages, the leading causes at older ages are increasingly reflective of the leading causes of death for the entire population.

In 2018, amongst those West Australians aged 45 years and over, heart disease and cancers were the greatest contributors to YLL. For those under 45 years, external causes of death such as suicide and self-inflicted injury and road traffic injuries were responsible for the greatest loss of life. At the youngest ages, conditions present from birth were leading causes of fatal burden of disease. Amongst both males and females aged 85 years and older, dementia was a leading cause of fatal burden (**Table 4** and **Table 5**).

While not broken down further into types of drug or substance, poisoning was a leading cause of fatal burden amongst West Australians aged 15-44 years, for both sexes but markedly so in males. Poisoning includes drug overdose, which may be accidental, intentional or unclear.

Table 4: Leading causes of fatal burden (YLL) in males by age group, WA, 2018

	Under 5	5-14	15-24	25-44	45-64	65-84	85+
1st	Birth trauma and asphyxia (953; 15.5%)	Homicide and violence (311; 26.8%)	Suicide and self-inflicted injuries (2574; 36.4%)	Suicide and self-inflicted injuries (6201; 28.6%)	Coronary heart disease (6620; 16.1%)	Coronary heart disease (6889; 13.4%)	Coronary heart disease (2218; 18.3%)
2nd	Pre-term birth and low birth weight complications (876; 14.2%)	Cardiovascular defects (151; 13.1%)	Road traffic injuries - motor vehicle occupants (1324; 18.7%)	Poisoning (4531; 20.9%)	Suicide and self-inflicted injuries (3285; 8.0%)	Lung cancer (4728; 9.2%)	Dementia (1279; 10.5%)
3rd	Cardiovascular defects (700; 11.4%)	Road traffic injuries - motor vehicle occupants (81; 7.0%)	Poisoning (632; 8.9%)	Road traffic injuries - motor vehicle occupants (1542; 7.1%)	Lung cancer (3149; 7.6%)	COPD (2450; 4.7%)	Stroke (616; 5.1%)
4th	Neonatal infections (432; 7.0%)	Brain malformations (81; 7.0%)	Drowning (279; 4.0%)	Coronary heart disease (1229; 5.7%)	Chronic liver disease (2184; 5.3%)	Bowel cancer (2403; 4.7%)	Prostate cancer (614; 5.1%)
5th	Brain malformations (173; 2.8%)	Birth trauma and asphyxia (80; 6.9%)	Road traffic injuries - pedestrians (269; 3.8%)	Road traffic injuries - motorcyclists (722; 3.3%)	Bowel cancer (1681; 4.1%)	Prostate cancer (2184; 4.2%)	Lower respiratory infections (610; 5.0%)

Table 5: Leading causes of fatal burden (YLL) in females by age group, WA, 2018

	Under 5	5-14	15-24	25-44	45-64	65-84	85+
1st	Cardiovascular defects (532; 15.9%)	Brain malformations (236; 23.3%)	Suicide and self-inflicted injuries (819; 33.1%)	Suicide and self-inflicted injuries (1971; 18.7%)	Breast cancer (3305; 12.0%)	Lung cancer (3175; 9.1%)	Dementia (2922; 18.8%)
2nd	Birth trauma and asphyxia (279; 8.4%)	Stroke (82; 8.1%)	Road traffic injuries - motor vehicle occupants (480; 19.4%)	Poisoning (1201; 11.4%)	Lung cancer (2154; 7.8%)	Coronary heart disease (2858; 8.2%)	Coronary heart disease (2237; 14.4%)
3rd	Homicide and violence (274; 8.2%)	Suicide and self-inflicted injuries (81; 8.0%)	Poisoning (93; 3.8%)	Breast cancer (887; 8.4%)	Coronary heart disease (1907; 6.9%)	Dementia (2591; 7.4%)	Stroke (1556; 10.0%)
4th	Pre-term birth and low birth weight complications (274; 8.2%)	Lung cancer (80; 7.9%)	Homicide and violence (81; 3.3%)	Road traffic injuries - motor vehicle occupants (477; 4.5%)	Suicide and self-inflicted injuries (1337; 4.9%)	Stroke (2091; 6.0%)	Lower respiratory infections (832; 5.3%)
5th	Neonatal infections (261; 7.8%)	Brain and central nervous system cancer (74; 7.3%)	Road traffic injuries - pedestrians (70; 2.8%)	Bowel cancer (336; 3.2%)	Bowel cancer (1157; 4.2%)	COPD (1939; 5.5%)	Falls (773; 5.0%)

Note:

- In the youngest age group (under five years), actual numbers of deaths are very low. Given the weighting of young people in the life table (compared to life expectancy), fatal burden, while still small compared to other age groups, is relatively high.
- "Other" causes of disease such as other malignant neoplasms (cancers), other unintentional injuries and other neurological conditions are excluded from the tables, although they rank highly among the youngest age groups (under five years and 5-14 years).

## Chapter 3: Non-fatal burden of disease

In WA in 2018, there were 253,946 years lived with disability, accounting to 94.3 per 1,000 population.

The non-fatal burden of disease was higher in females than males (YLD = 132,130, 102 per 1000 population in females, YLD = 121,816, 94 per 1000 population in males).

### Leading causes of non-fatal burden

Overall, the leading disease group causing years of healthy life lost due to disease and injury (YLD) was mental and substance use disorders (26%). Musculoskeletal conditions ranked second overall (25%) and for males (22%), but it was the leading disease group for non-fatal burden among West Australian females (27%). Respiratory conditions, neurological conditions and cardiovascular diseases also contributed substantially to the burden of non-fatal disease.

The leading individual causes of morbidity in WA in 2018 were back pain, depressive disorders and anxiety disorders for both males and females (**Table 6**).

**Table 6. Leading causes of YLD for females and males, WA, 2018**

Females			Males			
Rank	Condition	%YLD	ASR	Condition	% YLD	ASR
1	Back pain and problems	9.3%	9.4	Back pain and problems	9.6%	8.9
2	Depressive disorders	6.9%	7.3	Depressive disorders	5.7%	5.6
3	Anxiety disorders	6.5%	7.0	Anxiety disorders	4.8%	4.7
4	Osteoarthritis	5.1%	4.7	Alcohol use disorders	4.6%	4.7
5	Rheumatoid arthritis	4.9%	4.6	Asthma	4.1%	4.0
6	Asthma	4.2%	4.3	Drug use disorders	3.3%	3.2
7	COPD	3.5%	3.1	Coronary heart disease	3.2%	3.0
8	Migraine	2.6%	2.7	Rheumatoid arthritis	3.0%	2.7
9	Dementia	2.3%	1.9	Hearing loss	2.9%	2.7
10	Eating disorders	2.3%	2.6	Autism spectrum disorder	2.8%	2.7

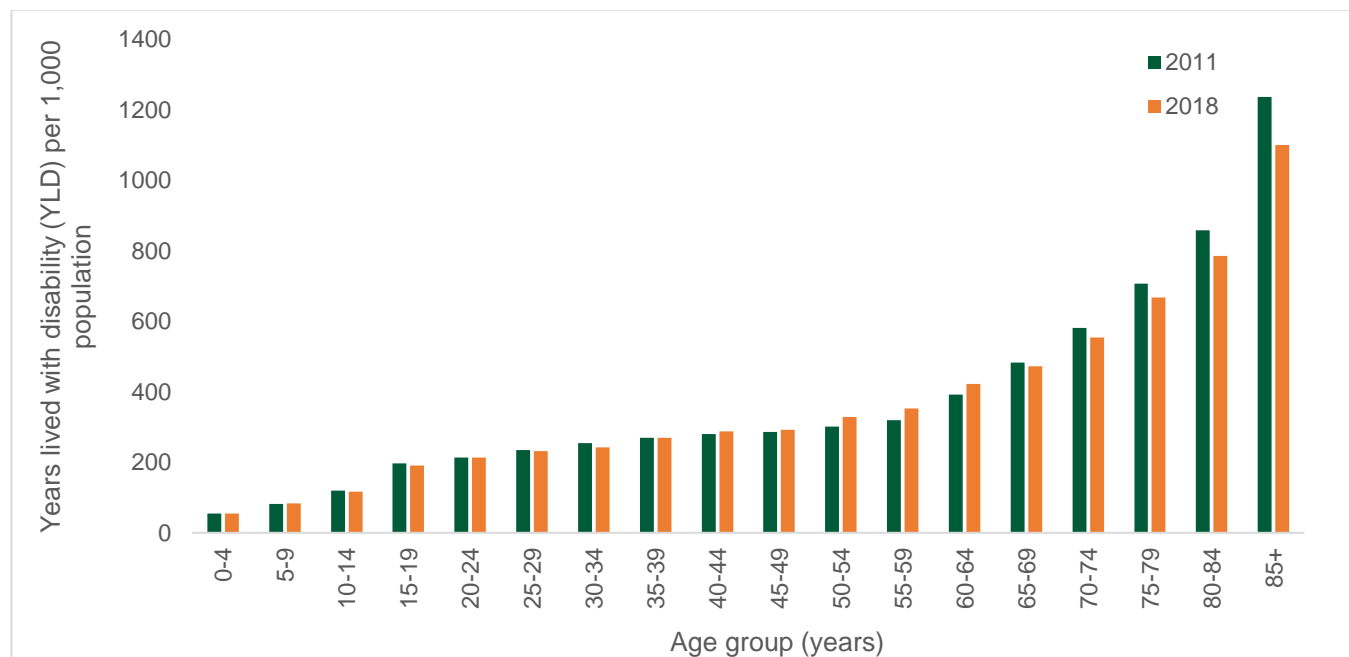
Almost half of the total non-fatal burden in males and females (43.9% and 47.6%, respectively) was accounted for by the top 10 conditions in 2018.

### Morbidity by age

The age-specific morbidity rate (YLDs per 1,000 population) increases steadily from birth through to middle age and then more rapidly into old age. The over 85 age group experiences twice the morbidity rate of those aged 60 to 75 years, which is in turn twice that of people aged between 15 and 24 years (**Figure 14**). This reflects the fact that morbidity from many diseases increases with age; in particular, musculoskeletal conditions, neurological diseases (including dementia), cardiovascular diseases (stroke and coronary heart disease), as well as hearing and

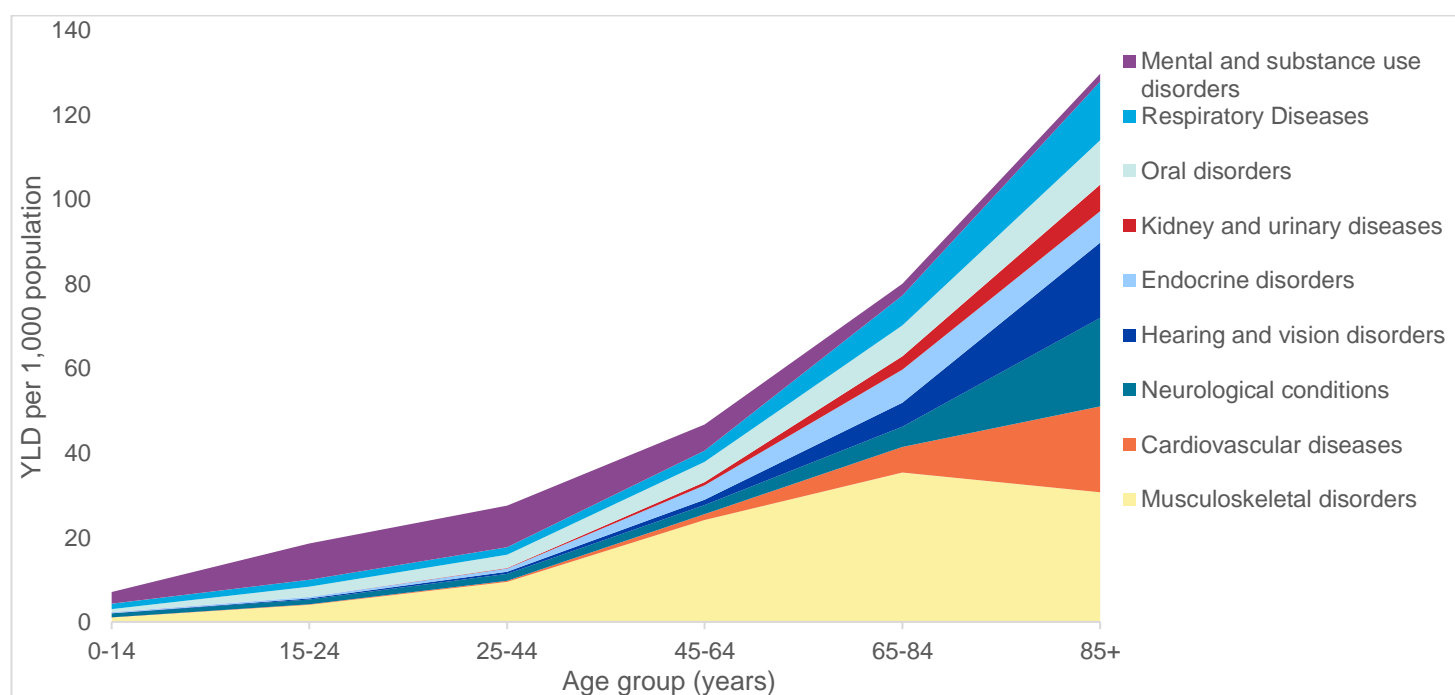
vision disorders (**Figure 15**). While the overall age-standardised YLD rate reduced by only 0.4% between 2011 and 2018, the age-specific morbidity decreased by 11% in people aged 85 years and older and by 8% in those aged 80-84 years.

**Figure 14: Rate of morbidity (age specific YLDs<sup>i</sup> per 1,000 population), WA, 2011 and 2018**



i. The number of YLDs can exceed the population resulting from healthy years lost from multiple diseases.

**Figure 15: Morbidity by age group and top 9 broad causes, (YLDs per 1,000 population), persons, WA, 2018**



While the total morbidity experienced by young children (under five years) is low in WA, the largest burden was due to asthma for both males and females, followed by dermatitis and eczema (**Table 7** and

	Under 5	5-14	15-24	25-44	45-64	65-84	85+
1st	<b>Asthma (214; 12.1%)</b>	<b>Asthma (905; 14.7%)</b>	<b>Alcohol use disorders (1317; 12.4%)</b>	<b>Back pain and problems (3469; 10.8%)</b>	<b>Back pain and problems (5273; 15.1%)</b>	<b>Back pain and problems (2304; 7.6%)</b>	<b>Coronary heart disease (705; 11.9%)</b>
2nd	<b>Dermatitis and eczema (111; 6.3%)</b>	<b>Anxiety disorders (729; 11.8%)</b>	<b>Depressive disorders (948; 8.9%)</b>	<b>Alcohol use disorders (3467; 10.8%)</b>	<b>Anxiety disorders (1857; 5.3%)</b>	<b>COPD (2119; 7.0%)</b>	<b>Dementia (584; 9.8%)</b>
3rd	<b>Intellectual disability (107; 6.1%)</b>	<b>Autism spectrum disorders (568; 9.2%)</b>	<b>Drug use disorders (excl. alcohol) (766; 7.2%)</b>	<b>Depressive disorders (3225; 10.0%)</b>	<b>Depressive disorders (1834; 5.3%)</b>	<b>Coronary heart disease (2085; 6.9%)</b>	<b>COPD (463; 7.8%)</b>
4th	<b>Autism spectrum disorders (84; 4.7%)</b>	<b>Conduct disorder (525; 8.5%)</b>	<b>Asthma (731; 6.9%)</b>	<b>Drug use disorders (excl. alcohol) (2500; 7.8%)</b>	<b>Rheumatoid arthritis (1655; 4.7%)</b>	<b>Hearing loss (1756; 5.8%)</b>	<b>Hearing loss (360; 6.1%)</b>
5th	<b>Epilepsy (83; 4.7%)</b>	<b>Depressive disorders (521; 8.5%)</b>	<b>Back pain and problems (665; 6.3%)</b>	<b>Anxiety disorders (2337; 7.3%)</b>	<b>Osteoarthritis (1413; 4.1%)</b>	<b>Type 2 diabetes mellitus (1709; 5.6%)</b>	<b>Atrial fibrillation and flutter (330; 5.6%)</b>

**Table 8).**

In children aged 5-14 years, asthma remained a major cause of morbidity for both males (first) and females (third), but in females, anxiety and depressive disorders were the two leading causes of years lost due to disability. Conduct disorders were significant for both males and females in this age group, while autism spectrum disorders were the third leading cause of morbidity for males aged 5-14 years.

In adolescents and young adults, mental health and substance use disorders dominate the leading causes of morbidity for both males and females, with slight variations in the types of disorders – for example, alcohol and drug use disorders are more prominent in males, while females experience higher burden due to anxiety and eating disorders.

Back pain and problems were among the leading causes of non-fatal burden for both males and females across the ages 25 to 84 years. Depressive and anxiety disorders were also significant contributors to morbidity for both sexes between ages 25 and 64 years.

In the older age groups, conditions such as dementia become leading causes of morbidity, along with hearing loss and COPD.

**Table 7: Leading causes of non-fatal burden (YLD) in males by age group, WA, 2018**

	Under 5	5-14	15-24	25-44	45-64	65-84	85+
1st	<b>Asthma</b> (214; 12.1%)	<b>Asthma</b> (905; 14.7%)	<b>Alcohol use disorders</b> (1317; 12.4%)	<b>Back pain and problems</b> (3469; 10.8%)	<b>Back pain and problems</b> (5273; 15.1%)	<b>Back pain and problems</b> (2304; 7.6%)	<b>Coronary heart disease</b> (705; 11.9%)
2nd	<b>Dermatitis and eczema</b> (111; 6.3%)	<b>Anxiety disorders</b> (729; 11.8%)	<b>Depressive disorders</b> (948; 8.9%)	<b>Alcohol use disorders</b> (3467; 10.8%)	<b>Anxiety disorders</b> (1857; 5.3%)	<b>COPD</b> (2119; 7.0%)	<b>Dementia</b> (584; 9.8%)
3rd	<b>Intellectual disability</b> (107; 6.1%)	<b>Autism spectrum disorders</b> (568; 9.2%)	<b>Drug use disorders (excl. alcohol)</b> (766; 7.2%)	<b>Depressive disorders</b> (3225; 10.0%)	<b>Depressive disorders</b> (1834; 5.3%)	<b>Coronary heart disease</b> (2085; 6.9%)	<b>COPD</b> (463; 7.8%)
4th	<b>Autism spectrum disorders</b> (84; 4.7%)	<b>Conduct disorder</b> (525; 8.5%)	<b>Asthma</b> (731; 6.9%)	<b>Drug use disorders (excl. alcohol)</b> (2500; 7.8%)	<b>Rheumatoid arthritis</b> (1655; 4.7%)	<b>Hearing loss</b> (1756; 5.8%)	<b>Hearing loss</b> (360; 6.1%)
5th	<b>Epilepsy</b> (83; 4.7%)	<b>Depressive disorders</b> (521; 8.5%)	<b>Back pain and problems</b> (665; 6.3%)	<b>Anxiety disorders</b> (2337; 7.3%)	<b>Osteoarthritis</b> (1413; 4.1%)	<b>Type 2 diabetes mellitus</b> (1709; 5.6%)	<b>Atrial fibrillation and flutter</b> (330; 5.6%)



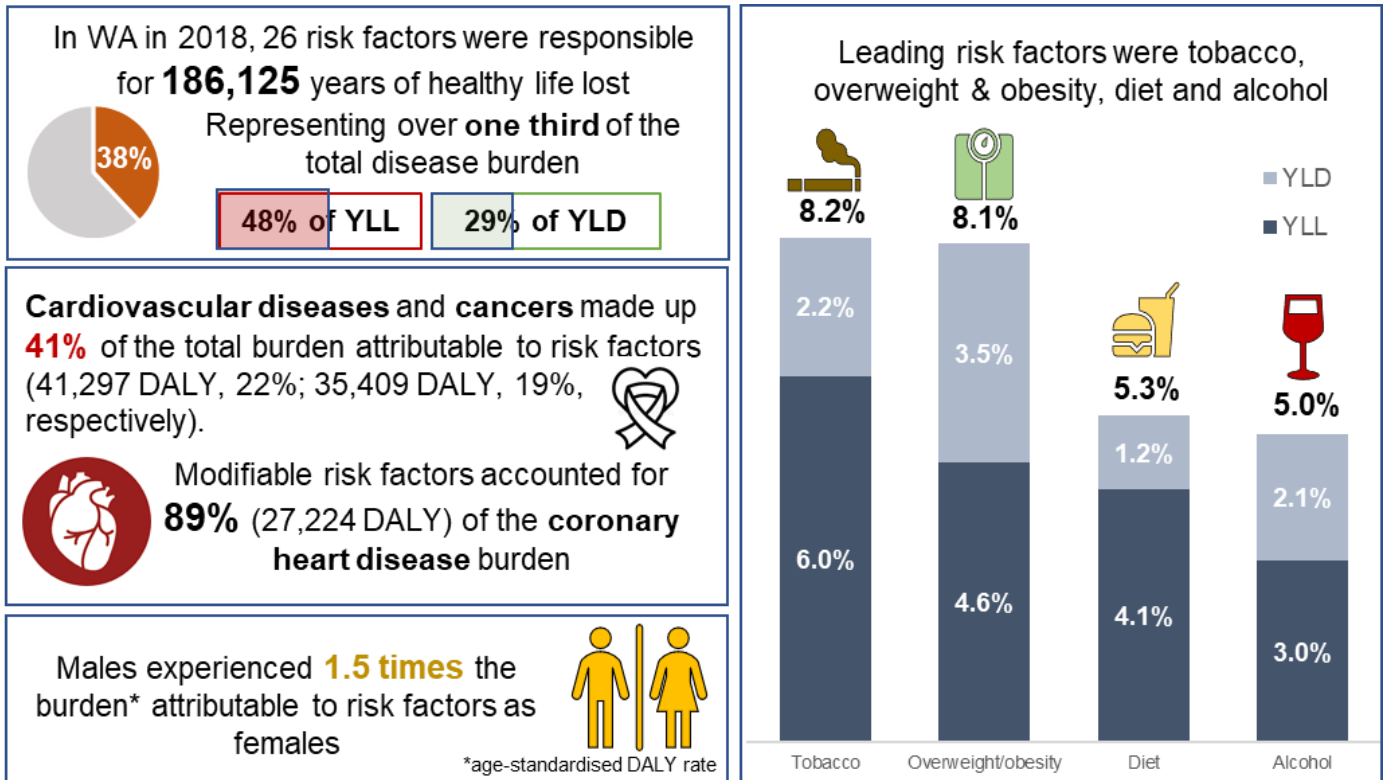
**Table 8: Leading causes of non-fatal burden (YLD) in females by age group, WA, 2018**

	<b>Under 5</b>	<b>5-14</b>	<b>15-24</b>	<b>25-44</b>	<b>45-64</b>	<b>65-84</b>	<b>85+</b>
1st	<b>Asthma (121; 8.8%)</b>	<b>Anxiety disorders (636; 12.8%)</b>	<b>Anxiety disorders (1340; 12.1%)</b>	<b>Depressive disorders (3676; 11.4%)</b>	<b>Back pain and problems (4978; 12.9%)</b>	<b>Osteoarthritis (3209; 9.6%)</b>	<b>Dementia (1730; 16.5%)</b>
2nd	<b>Dermatitis and eczema (105; 7.7%)</b>	<b>Depressive disorders (598; 12.1%)</b>	<b>Depressive disorders (1283; 11.6%)</b>	<b>Back pain and problems (3666; 11.4%)</b>	<b>Depressive disorders (2872; 7.4%)</b>	<b>Back pain and problems (2775; 8.3%)</b>	<b>COPD (1100; 10.5%)</b>
3rd	<b>Epilepsy (78; 5.6%)</b>	<b>Asthma (498; 10.0%)</b>	<b>Eating disorders (911; 8.3%)</b>	<b>Anxiety disorders (3663; 11.4%)</b>	<b>Osteoarthritis (2815; 7.3%)</b>	<b>COPD (2733; 8.2%)</b>	<b>Coronary heart disease (812; 7.7%)</b>
4th	<b>Anxiety disorders (61; 4.5%)</b>	<b>Conduct disorder (320; 6.4%)</b>	<b>Back pain and problems (783; 7.1%)</b>	<b>Eating disorders (1910; 5.9%)</b>	<b>Rheumatoid arthritis (2804; 7.3%)</b>	<b>Rheumatoid arthritis (2506; 7.5%)</b>	<b>Hearing loss (741; 7.0%)</b>
5th	<b>Rheumatoid arthritis (59; 4.3%)</b>	<b>Acne (293; 5.9%)</b>	<b>Asthma (629; 5.7%)</b>	<b>Asthma (1719; 5.3%)</b>	<b>Anxiety disorders (2790; 7.2%)</b>	<b>Hearing loss (1647; 4.9%)</b>	<b>Osteoarthritis (455; 4.3%)</b>



## Chapter 4: Risk factors contributing to disease

Using AIHW Burden of Disease estimates it is possible to identify the behavioural, metabolic and environmental risk factors that contribute to burden of disease in each age group and by cause, and to estimate the proportion of disease burden that can be accounted for by the risk factors. The estimated contribution of a risk factor to disease burden depends upon the prevalence of the observed risk factor and the relative risk of morbidity or mortality attributable to the risk factor for the linked disease.



### Box 2: Combined risk factor analysis<sup>1</sup>

The burden from different risk factors for a specific disease cannot simply be added together, because:

- There are complex pathways and interactions between many risk factors included in this study, with some lying on the same causal pathway (for example, dietary risks increase the likelihood of overweight/obesity).
- Population attributable fractions (PAFs) are estimated independently and risk factors were analysed and reported individually. The burden due to each risk factor for a given disease might exceed the total burden of that disease.

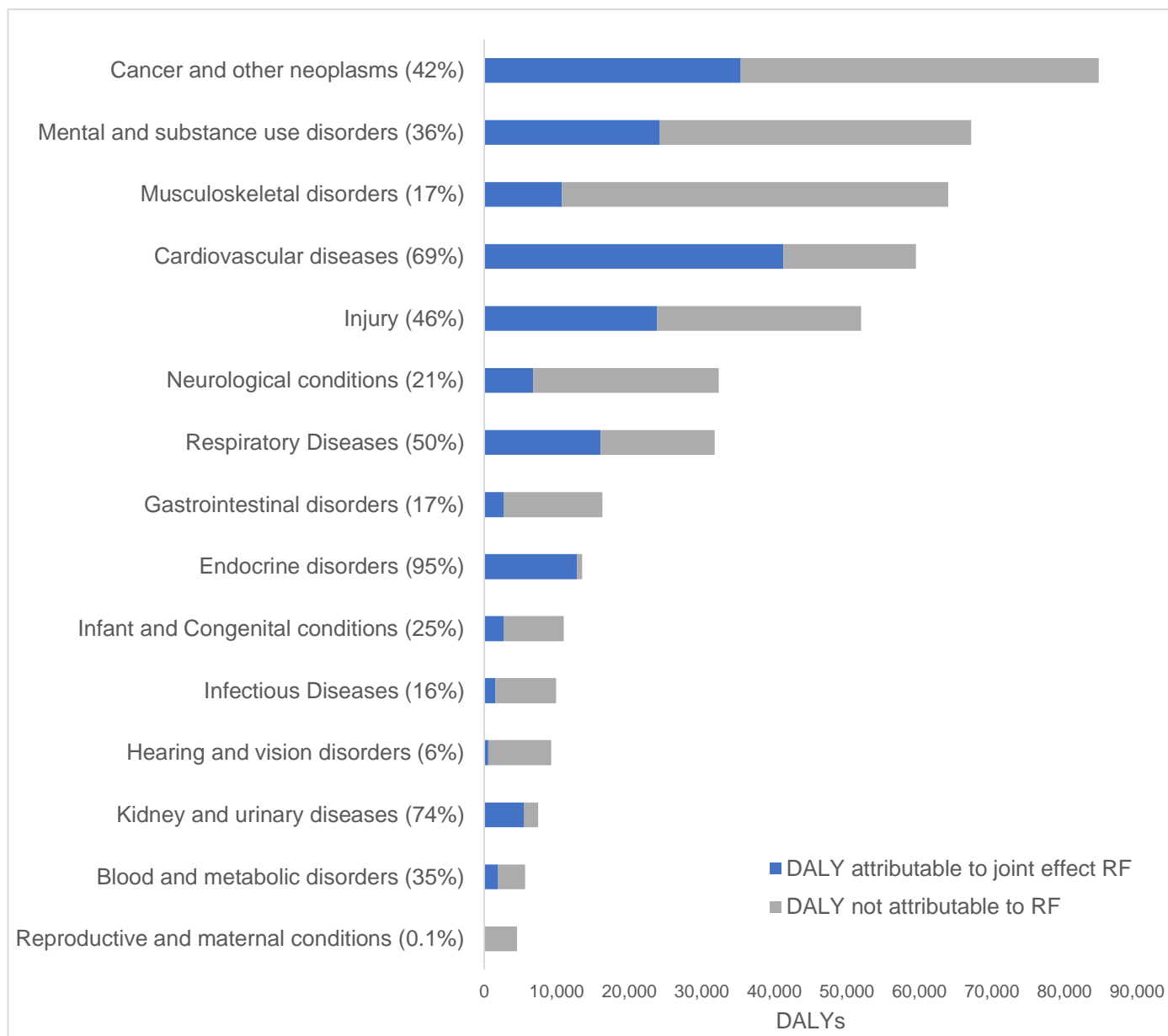
A combined “joint effect” estimate is reported for all risk factors using a multiplicative method that adjusts for the co-occurrence of multiple risk factors.

Of the total burden of disease and injury in WA in 2018, 186,125 DALYs, or 38.0% of the total burden, was attributable to the joint effect of all 26 risk factors included in this study. Disease groups that had the largest attributable burden were cardiovascular diseases and cancers ( **Figure 16**).

While nearly all DALYs due to endocrine disorders and kidney and urinary disease were attributable to risk factors in this study, they accounted for only 12,845 (6.9%) and 5,481 (2.9%) respectively of all DALYs attributable to risk factors across all the disease groups (joint effects).

Almost half (46%) of the total burden due to injury was attributable to risk factors, making up 23,871 DALYs or 12.8% of all DALYs across disease groups attributable to risk factors. Similarly, mental and substance use disorders contributed 13% of the total burden due to risk factors, and 36% of DALYs due to mental and substance use disorders were attributable to risk factors in the study.

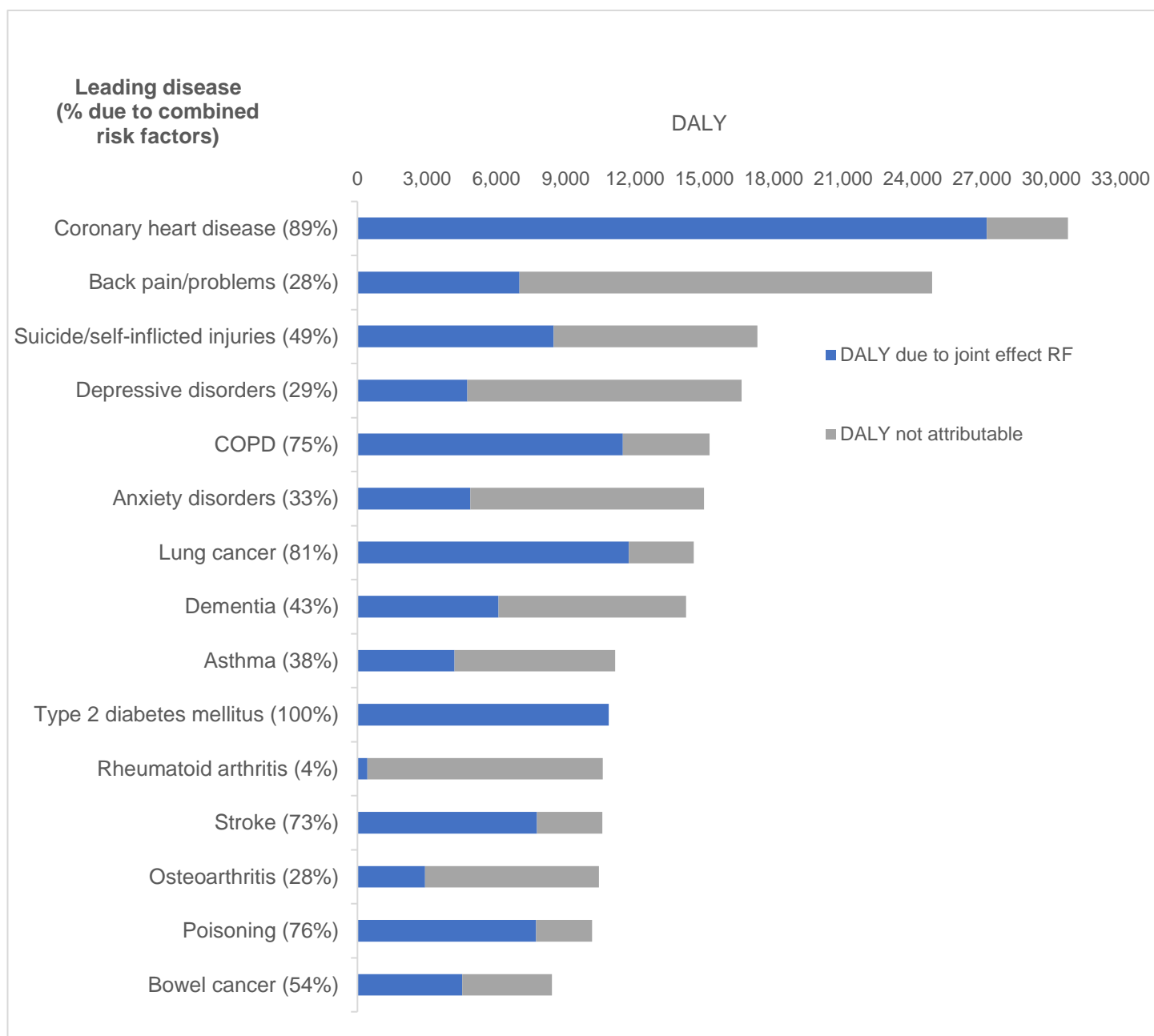
**Figure 16. Disease group burden due to all risk factors (joint effect), WA, 2018**



Note: RF = risk factor

Of the 20 leading causes of disease and injury in WA in 2018 (**Figure 17**), over three-quarters of the total burden for coronary heart disease, COPD, lung cancer, stroke and poisoning were attributed to the joint effect of all risk factors.

**Figure 17. Joint effect of included risk factors on top 20 leading diseases, WA, 2018**



**Notes:**

1. 'Other' conditions, for example other musculoskeletal conditions, have been omitted from the DALY top 20 leading causes
2. See Box 3 regarding combined effect of risk factors on type 2 diabetes mellitus

### Box 3: Type 2 diabetes mellitus

Type 2 diabetes mellitus (T2DM) accounts for **10,866** (80%) of all endocrine disorder DALYs. Risk factors linked to T2DM in the study included high blood plasma glucose, overweight (including obesity), dietary risk factors, physical inactivity and tobacco use. Genetic factors for T2DM were outside the scope of this study. By definition, a diagnosis of T2DM requires the presence of a high blood plasma glucose<sup>2</sup>, therefore 100% of cases appear to be linked to the combined effect of risk factors in the study.

While it is not possible to exclude the effect of high plasma glucose from the joint effects burden (i.e. sum the effects of risk factors other than high blood plasma glucose – see ‘Box 2 - Combined risk factor analysis’ above), the individual effects of the other linked modifiable risk factors for T2DM are:

- Overweight (including obesity): 5,996 DALYs (55%)
- Dietary risks: 2,805 DALYs (26%)
- Physical inactivity: 2,209 DALYs (20%)
- Air pollution: 725 DALYs (7%)
- Tobacco use: 431 (4%)

Diabetes can act as risk factor for other diseases such as coronary heart disease, chronic kidney disease and dementia. The inclusion of high blood plasma glucose as a risk factor allows the burden of T2DM to be captured in terms of both ‘direct’ (DALYs due to T2DM itself) and ‘indirect’ (DALYs due to high blood plasma glucose linked diseases) burdens. The ‘direct’ burden from T2DM was 10,866 in 2018; the ‘indirect’ burden attributed to high blood plasma glucose was 20,294 DALYs due to its contribution to 15 conditions, including coronary heart disease, chronic kidney disease, dementia, stroke, peripheral vascular disease and several cancers.

### Leading risk factors

Overall, the leading risk factors contributing to burden of disease were tobacco use, overweight (including obesity), dietary risks, and alcohol use. While tobacco remains the leading risk factor causing burden of disease, the impact of overweight (including obesity) is approaching that of tobacco (39,749 DALYs vs 40,069 DALYs, **Table 9**)

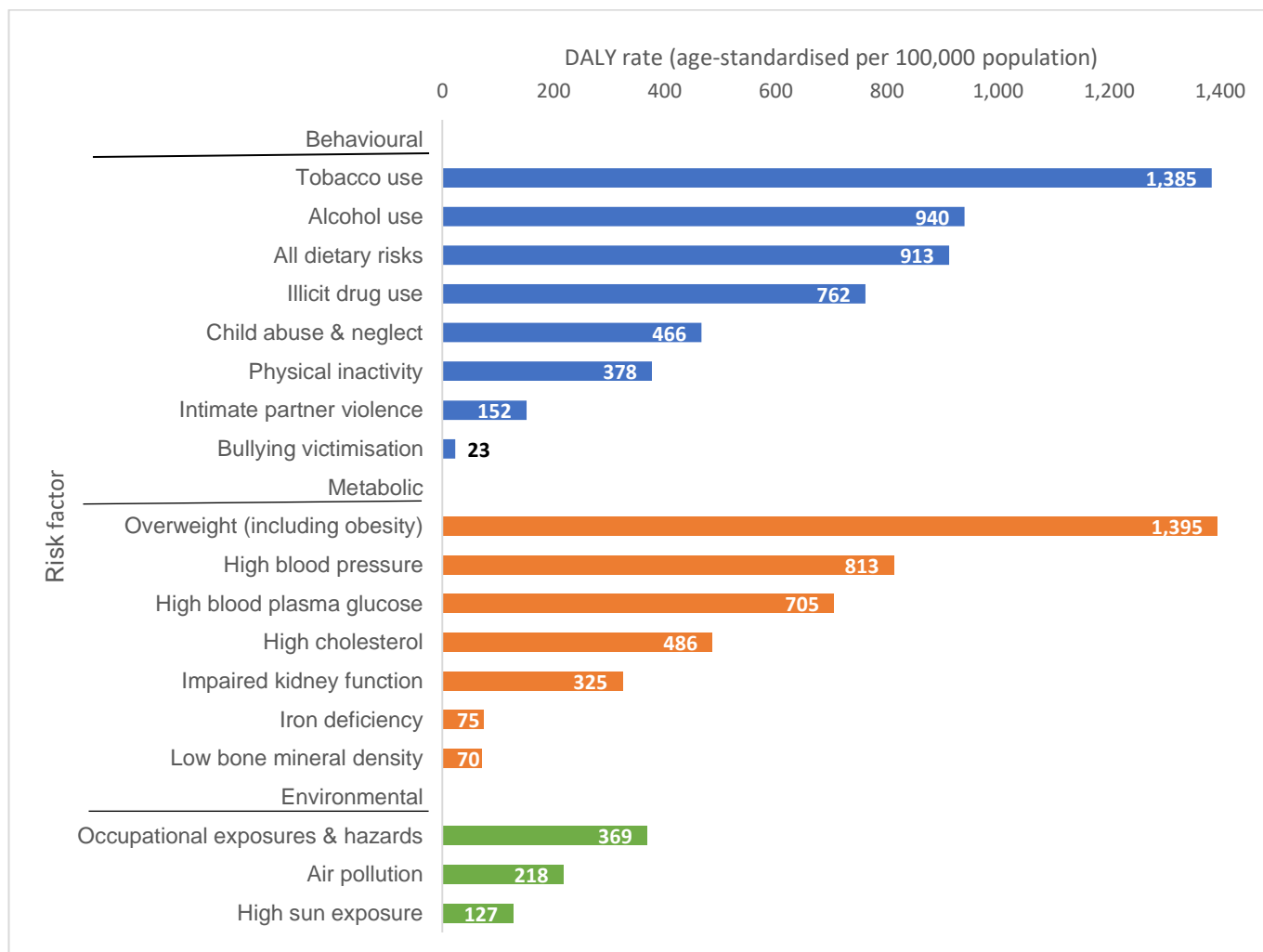
**Table 9. Number and proportion of fatal, non-fatal and total burden attributable to each risk factor in WA, 2018.**

Risk factor	Attributable DALYs	% DALYs	Attributable YLL	% YLL	Attributable YLD	% YLD
<b>Behavioural</b>						
Tobacco use	40,069	8.2%	29,082	12.3%	10,987	4.3%
All dietary risks	26,142	5.3%	20,307	8.6%	5,835	2.3%
Alcohol use	24,711	5.0%	14,510	6.1%	10,200	4.0%
Illicit drug use	19,612	4.0%	13,037	5.5%	6,576	2.6%
Child abuse & neglect	11,882	2.4%	4,490	1.9%	7,392	2.9%
Physical inactivity	10,950	2.2%	7,815	3.3%	3,134	1.2%
Intimate partner violence	3,909	0.8%	1,346	0.6%	2,563	1.0%
Low birth weight & short gestation	2,713	0.6%	2,037	0.9%	676	0.3%

Risk factor	Attributable DALYs	% DALYs	Attributable YLL	% YLL	Attributable YLD	% YLD
Unsafe sex	762	0.2%	614	0.3%	148	0.1%
Bullying victimisation	540	0.1%	-	0.0%	540	0.2%
<b>Environmental</b>						
Occupational exposures & hazards	9,910	2.0%	3,972	1.7%	5,937	2.3%
Air pollution	6,191	1.3%	4,560	1.9%	1,630	0.6%
High sun exposure	3,605	0.7%	3,124	1.3%	481	0.2%
<b>Metabolic</b>						
Overweight (including obesity)	39,749	8.1%	22,354	9.5%	17,395	6.9%
High blood pressure	23,553	4.8%	17,974	7.6%	5,578	2.2%
High blood plasma glucose	20,294	4.1%	11,393	4.8%	8,901	3.5%
High cholesterol	13,778	2.8%	11,275	4.8%	2,503	1.0%
Impaired kidney function	9,341	1.9%	6,872	2.9%	2,469	1.0%
Low bone mineral density	2,069	0.4%	1,092	0.5%	978	0.4%
Iron deficiency	1,939	0.4%	34	0.0%	1,905	0.8%
<b>All risk factors combined</b> (joint effect)	<b>186,125</b>	<b>38.0%</b>	<b>112,978</b>	<b>47.8%</b>	<b>73,147</b>	<b>28.8%</b>

However, once standardised for age, overweight (including obesity) has a marginally greater impact on burden of disease than tobacco and is the leading risk factor for burden of disease (**Figure 18**). This is because the burden of tobacco-attributable disease is proportionately higher amongst older age groups, reflecting patterns of smoking in the population. By contrast, overweight (including obesity) affects people across the life course and is responsible for both YLL and YLD from an earlier age. This has changed since 2011, where tobacco was responsible for both the largest attributable DALYs and higher ASR (See **Figure 18**).

**Figure 18: Age-standardised burden (DALYs) per 100,000 population attributable to leading risk factors, WA, 2018**



The proportion of burden attributable to each risk factor within a selected number of disease groups is presented in **Table 10**. When interpreting this table, it should be noted that the total number of DALYs for each disease group differs, so percentages need to be considered in the context of the size of the disease group.

Table 10. Proportion (%) of total burden attributable to risk factors for each disease group in WA, 2018

	Cancer & other neoplasms	Mental & substance use disorders	Cardio-vascular diseases	Musculo-skeletal disorders	Injury	Respiratory diseases	Neuro-logical conditions	Gastro-intestinal disorders	Endocrine disorders	Hearing & vision disorders	Infectious diseases	Blood & metabolic disorders	Kidney & urinary diseases	Reproductive & maternal conditions	Infant & congenital conditions
<b>DALY total (number)</b>	<b>84,777</b>	<b>67,151</b>	<b>59,533</b>	<b>64,010</b>	<b>52,018</b>	<b>31,802</b>	<b>32,344</b>	<b>16,322</b>	<b>13,516</b>	<b>9,256</b>	<b>9,949</b>	<b>5,620</b>	<b>7,435</b>	<b>4,509</b>	<b>10,987</b>
Tobacco use	20.6%		12.1%	2.2%		38.5%	1.2%	0.5%	3.2%	0.4%	8.4%				
Overweight (including obesity)	7.0%		23.1%	9.0%		9.2%	8.7%	0.9%	44.4%	0.3%			32.0%		
All dietary risks	4.1%		32.7%						20.7%				5.0%		
Alcohol use	5.0%	12.2%	3.9%		14.9%		1.9%	7.3%			4.3%				
High blood pressure			35.5%				1.4%						26.4%		
High blood plasma glucose	3.1%		4.6%				3.1%		95.0%	0.4%			14.4%		
Illicit drug use	1.3%	9.9%			19.8%			9.6%			0.3%				
High cholesterol			23.1%												
Child abuse & neglect		11.0%			8.7%										
Physical inactivity	1.6%		9.6%				5.1%		16.3%						
Occupational exposures & hazards	2.7%			6.6%	2.8%	4.7%				4.8%					
Impaired kidney function			4.4%	0.1%			3.7%						73.7%		
Air pollution	0.6%		6.1%			3.2%			5.4%		2.9%				
Intimate partner violence		3.7%			2.7%									0.1%	
High sun exposure	4.3%														
Low bone mineral density					4.0%										
Iron deficiency												34.5%			
Unsafe sex	0.7%							0.3%			1.2%				
Low birth weight & short gestation								0.0%			0.2%				24.5%
Bullying victimisation		0.8%													
<b>Joint Effect</b>	<b>41.8%</b>	<b>36.1%</b>	<b>69.4%</b>	<b>16.7%</b>	<b>45.9%</b>	<b>50.4%</b>	<b>21.0%</b>	<b>16.5%</b>	<b>95.0%</b>	<b>5.8%</b>	<b>15.9%</b>	<b>34.5%</b>	<b>73.7%</b>	<b>0.1%</b>	<b>24.5%</b>

- Notes:
1. Attributable burden is expressed as a percentage of total burden (DALYs) for that disease group. Disease groups are ordered by number of total DALYs
  2. The percentages cannot be added together by row or column and do not add up to the joint effect row as the risk factors were analysed independently
  3. Blank cells indicate that the risk factor has no associated diseases or injuries in the disease group

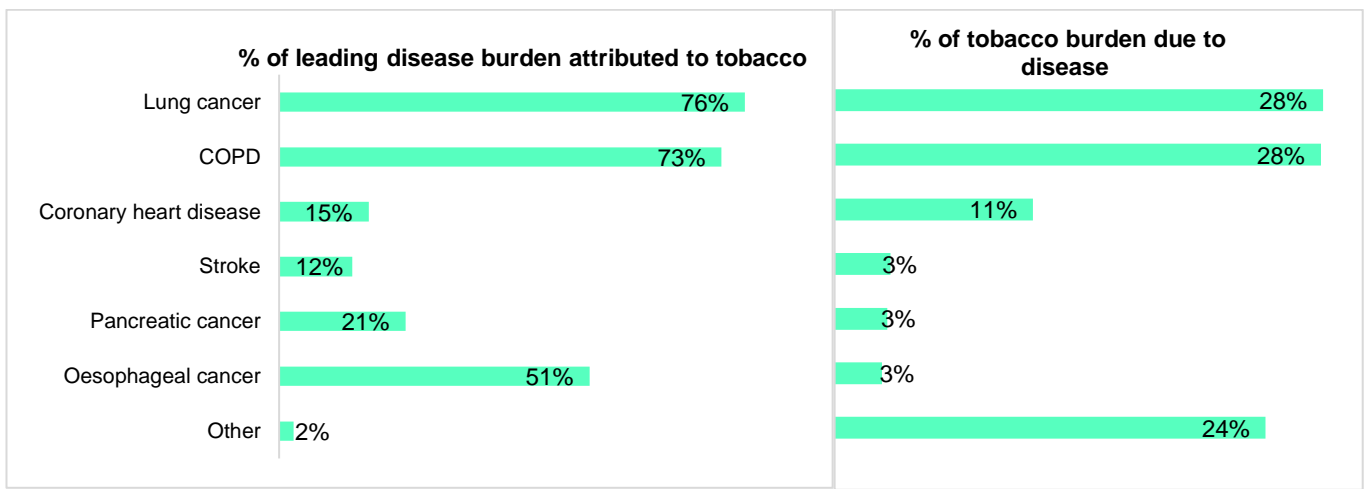
## Selected risk factors

### Tobacco

Tobacco use was attributable for 8.2% of the total health burden (DALYs) in WA in 2018. The majority of this (72.6%) attributable burden was due to its contribution to fatal burden.

Tobacco use contributed to the burden of disease among nine different disease groups (**Table 10**) and was responsible for 38.5% (12,255 DALYs) of the respiratory disease burden and 20.6% (17,441 DALYs) of the cancer burden. The leading diseases associated with tobacco use were lung cancer and COPD, for which tobacco contributed 76% and 73% of the total burden, respectively (**Figure 19**).

**Figure 19. Contribution of tobacco use to leading diseases**



Tobacco as a risk factor contributed most to the burden of disease in people aged 45 years and over, reflecting lower rates of smoking in young people but also the time lag in health outcomes due to smoking.

### Overweight (including obesity)

Overweight (including obesity) contribute to a wide range of illnesses and were attributable for 8.1% of the total health loss in 2018. Of this, 56.2% was due to fatal burden (YLL). Overweight (including obesity) is now a major risk factor in both children and adults, with health effects being seen throughout the life course (**Figure 22**). As a result, when the attributable DALYs due to overweight (including obesity) were standardised for age, it was the most significant contributor to overall burden of disease (**Figure 18**).

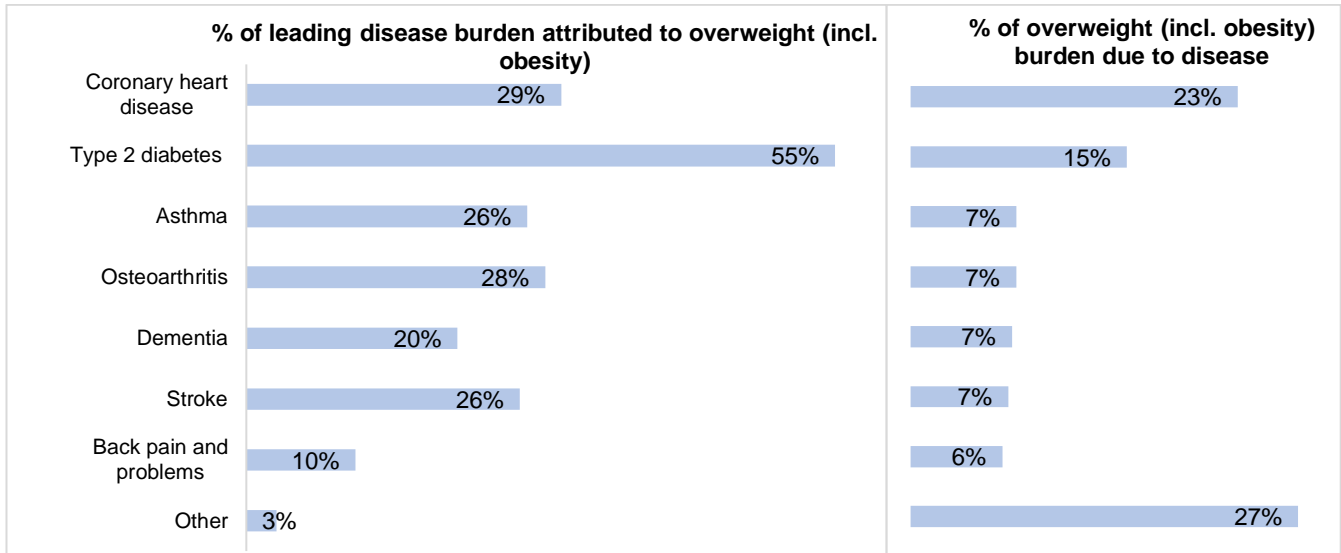
In terms of disease groups, overweight (including obesity) contributed to 44.4% (5,996 DALYs) of the burden from endocrine disorders, 23.1% (13,733 DALYs) of cardiovascular disease burden and 32.0% (2,382 DALYs) of burden due to kidney and urinary diseases (**Table 10**).

Overweight (including obesity) was also the second largest contributor to cancers (5,964 DALYs, 7.0% **Table 10**) although substantially behind the attributable burden of tobacco.

The largest impacts of overweight (including obesity) were through its effects on coronary heart disease and type 2 diabetes (**Figure 20**). These conditions together caused 38% of the total burden associated with overweight (including obesity).



**Figure 20. Contribution of overweight (including obesity) to leading diseases**

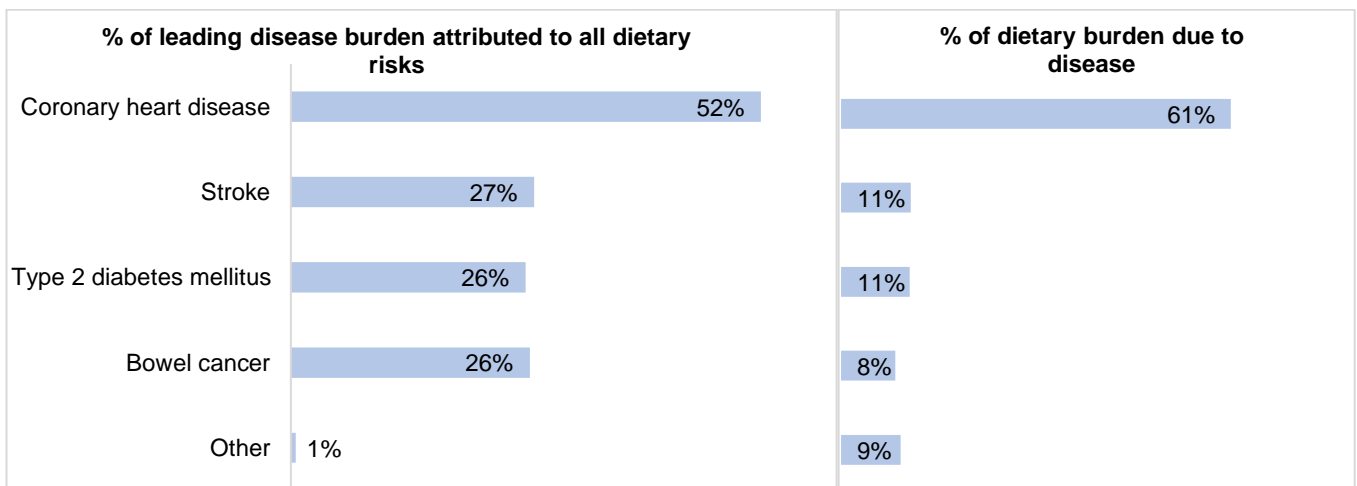


### Dietary risks

The combined impact of all dietary risks was the third largest modifiable cause of healthy life lost in WA in 2018 (**Table 9**) and linked to several disease groups (**Table 10**). Dietary risks caused 8.6% (20,307 YLL) of the fatal burden and 2.3% (5,835 YLD) of the non-fatal burden. Over three-quarters of the total burden due to dietary risks was due to YLL (**Table 9**).

Most of the burden due to dietary risks was associated with cardiovascular diseases, contributing 32.7% (19,494 DALYs). Dietary risks were also attributable for 20.7% (2,805 DALYs) of endocrine disorders burden (**Table 10**). The largest contribution of dietary risks in terms of specific diseases was to coronary heart disease (52% of the total health burden, 15,876 DALYs, **Figure 21**).

**Figure 21. Contribution of all dietary risks to leading diseases**



### Alcohol and illicit drug use

Alcohol use contributed to 5.0% of the total burden of disease, of which 59% was due to fatal burden. Four percent of the total health burden in 2018 was attributable to illicit drug use, 66% of this being fatal burden.

The most significant effect of alcohol and illicit drug use was their contributions to the burden of injury (**Table 10**). Alcohol use was responsible for 14.9% (7,762 DALYs) of injuries, while illicit drug use contributed to 19.8% (10,310 DALYs) of injuries in WA in 2018.

In terms of specific drugs, opioid use was attributable for 9.3% of injuries (4,856 DALYs), while amphetamine use was responsible for 5.6% of injuries (2,894 DALYs). Almost half of the burden due to poisoning was attributable to opioid use (42.7%, **Table 11**).

Alcohol use attributed 14.3% of the burden due to suicide and self-inflicted injury, 12.5% of poisoning, 25.3% of road traffic injuries (motor vehicle occupants), 31% of the burden of motorcycle road traffic injuries and 28.5% of cycling injuries (**Table 11**).

The other major impact of alcohol and drug use was through the contribution to mental and substance use disorders. Alcohol and illicit drug use were attributable for 12.2% (8,168 DALYs) and 9.9% (6,616 DALYs) of the burden of mental and substance use disorders, respectively.

Alcohol-related deaths typically occur at younger ages than deaths from all causes. As a result, in 2018, there were an estimated 14,510 years of life lost due to alcohol, 6% of all YLL lost in WA. As well as injury, alcohol use is associated with the development of cancers, liver disease and cardiovascular disease.

**Table 11: Proportion of total burden (DALYs) for injuries attributable to alcohol and drug use, WA, 2018**

Injury	Alcohol use	Illicit drug use	Amphetamine use	Cannabis use	Cocaine use	Opioid use	Total DALYs
Suicide and self-inflicted injuries	14.3%	15.1%	5.6%		6.5%	3.0%	17,303
Poisoning	12.5%	72.8%	17.0%	10.4%	2.7%	42.7%	10,146
Falls	8.6%						7,132
Road traffic injuries - motor vehicle occupants	25.3%	4.3%	2.7%	0.7%	0.8%	0.0%	5,585
Other unintentional injuries	12.8%						3,445
Homicide and violence	12.7%						2,820
Road traffic injuries - motorcyclists	31.0%	4.7%	3.1%	0.7%	0.8%	0.0%	1,504
Other land transport injuries	29.7%						870
Road traffic injuries - pedestrians	20.7%						938
Drowning	12.3%						1,110
Fire, burns and scalds	9.4%						516
Road traffic injuries - pedal cyclists	28.5%						321
<b>Total DALYs</b>							<b>52,018</b>

Note: amphetamine use, cannabis use, cocaine use and opioid use are independent subsets of 'illicit drug use'

## Child abuse and neglect

Child abuse and neglect is a leading risk factor for overall burden of disease in children under 15 years, adolescents and young people, as well as adults aged 24-44 years. Notably, 11.0% of mental and substance use disorders were attributable to child abuse and neglect (7,362 DALYs).

Child abuse and neglect was also responsible for 4,520 healthy years lost due to injury (8.7% of total injury burden), including 26.1% of suicide and self-inflicted injuries. As suicide and self-inflicted injuries are being experienced by younger age groups, the impact of child abuse and neglect is likely to be a significant contributor to this burden, particularly in young people. While the rates of child abuse and neglect are low overall in WA, the health and mental health impacts are proportionately high.

### **Intimate partner violence**

Intimate partner violence (IPV) is an important risk factor particularly for women in WA, responsible for 3,909 years of healthy life lost due to death or disability in 2018. It is a leading risk factor for females aged 15-24 years and 25-44 years, with the impacts seen markedly in the burden due to injury (2.7% attributable to IPV), and the burden of mental and substance use disorders (3.7% of DALYs attributable to IPV).

Within the injuries group, IPV was attributable for 17.5% of the burden of homicide and violence, and 5.3% of suicide and self-inflicted injury.

### **Occupational exposures and hazards**

Occupational safety continues to be important in the prevention of acute injuries as well as long term health issues. The impact of occupational exposures and hazards is seen more so in younger age groups and in males. In 2018, 21.7% of 'other' unintentional injuries; 12.1% of fires, burns, scalds; 8.8% road traffic injuries (motor vehicle occupants); and 16.8% of back pain and problems were attributed to occupational exposures and hazards.

## Contribution of risk factors across the life stages

As demonstrated in **Figure 22** risk factors contributing to burden of disease vary across the lifespan. Alcohol and drug use are important in young adults through to middle age; after which dietary risks become more significant. Overweight (including obesity) is a risk factor across the lifespan.

Note that both the absolute burden of disease and the relative contribution of modifiable risk factors in young children are very low.

**Figure 22. Leading risk factor contribution to total burden (DALYs, % proportion of DALYs) for females and males, by age group, WA, 2018**

Female age group (years)					
	0-14	15-24	25-44	45-64	65+
1 <sup>st</sup>	Low birth weight & short gestation (593, 5.5%)	Child abuse & neglect (1053, 7.8%)	Child abuse & neglect (2887, 6.7%)	Overweight (including obesity) (5817, 8.8%)	Tobacco use (10922, 11.6%)
2 <sup>nd</sup>	Child abuse & neglect (224, 2.1%)	Alcohol use (854, 6.3%)	Illicit drug use (2611, 6.1%)	Tobacco use (5576, 8.4%)	Overweight (including obesity) (9469, 10.0%)
3 <sup>rd</sup>	Iron deficiency (101, 0.9%)	Illicit drug use (569, 4.2%)	Intimate partner violence (1829, 4.3%)	All dietary risks (2863, 4.3%)	High blood pressure (6688, 7.1%)
4 <sup>th</sup>	Bullying victimisation (75, 0.7%)	Intimate partner violence (290, 2.1%)	Alcohol use (1672, 3.9%)	High blood plasma glucose (2397, 3.6%)	All dietary risks (5633, 6.0%)
5 <sup>th</sup>	Overweight (including obesity) (56, 0.5%)	Bullying victimisation (244, 1.8%)	Overweight (including obesity) (1439, 3.4%)	Alcohol use (2280, 3.4%)	High blood plasma glucose (5421, 5.7%)
	<b>All risks (10.1%)</b> Rate <sup>2</sup> : 4.4	<b>All risks (25.7%)</b> Rate: 22.2	<b>All risks (30.2%)</b> Rate: 34.5	<b>All risks (34.8%)</b> Rate: 71.4	<b>All risks (39.2%)</b> Rate: 187.7
Male age group (years)					
	0-14	15-24	25-44	45-64	65+
1 <sup>st</sup>	Low birth weight & short gestation (1593, 10.5%)	Alcohol use (2756, 15.6%)	Illicit drug use (7652, 14.2%)	Overweight (including obesity) (9122, 12.0%)	Tobacco use (12883, 12.9%)
2 <sup>nd</sup>	Child abuse & neglect (133, 0.9%)	Illicit drug use (1844, 10.4%)	Alcohol use (7104, 13.2%)	Tobacco use (8671, 11.4%)	Overweight (including obesity) (11011, 11.0%)
3 <sup>rd</sup>	Overweight (including obesity) (100, 0.7%)	Child abuse & neglect (953, 5.4%)	Child abuse & neglect (2652, 4.9%)	All dietary risks (6810, 9.0%)	High blood pressure (8924, 8.9%)
4 <sup>th</sup>	Bullying victimisation (67, 0.4%)	Occupational exposures & hazards (520, 2.9%)	Overweight (including obesity) (2308, 4.3%)	High blood pressure (5092, 6.7%)	All dietary risks (8878, 8.9%)
5 <sup>th</sup>	High blood plasma glucose (30, 0.2%)	Overweight (including obesity) (293, 1.7%)	Occupational exposures & hazards (2091, 3.9%)	Alcohol use (4903, 6.4%)	High blood plasma glucose (6873, 6.9%)
	<b>All risks (12.9%)</b> Rate: 7.6	<b>All risks (35.0%)</b> Rate: 37.5	<b>All risks (41.9%)</b> Rate: 59.7	<b>All risks (44.7%)</b> Rate: 106.9	<b>All risks (43.9%)</b> Rate: 248.2

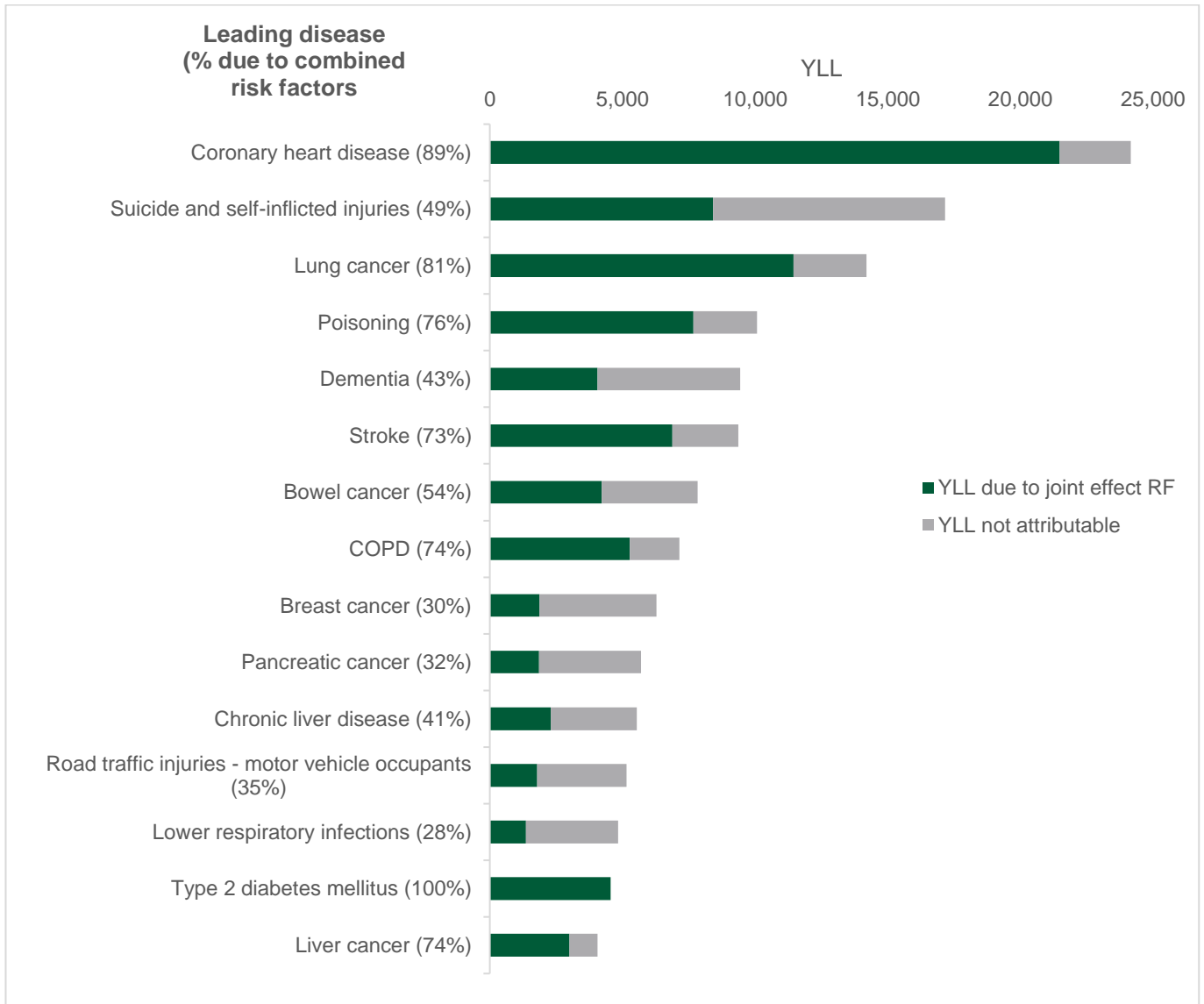
Notes:

1. All risks: combined (joint) effect of all risk factors as a proportion across the specific age group and sex
2. Rates: age specific rates per 1,000 population

## Contribution of risk factors to fatal burden

Forty-eight percent of the fatal burden could be attributed to the risk factors included in this study. A substantial proportion of the leading causes of fatal burden, such as cancers and coronary heart disease, were attributable to risk factors in the study (**Figure 23**)

**Figure 23: Attributable fatal burden (YLL) for leading causes of fatal burden due to joint effects of risk factors, WA, 2018**

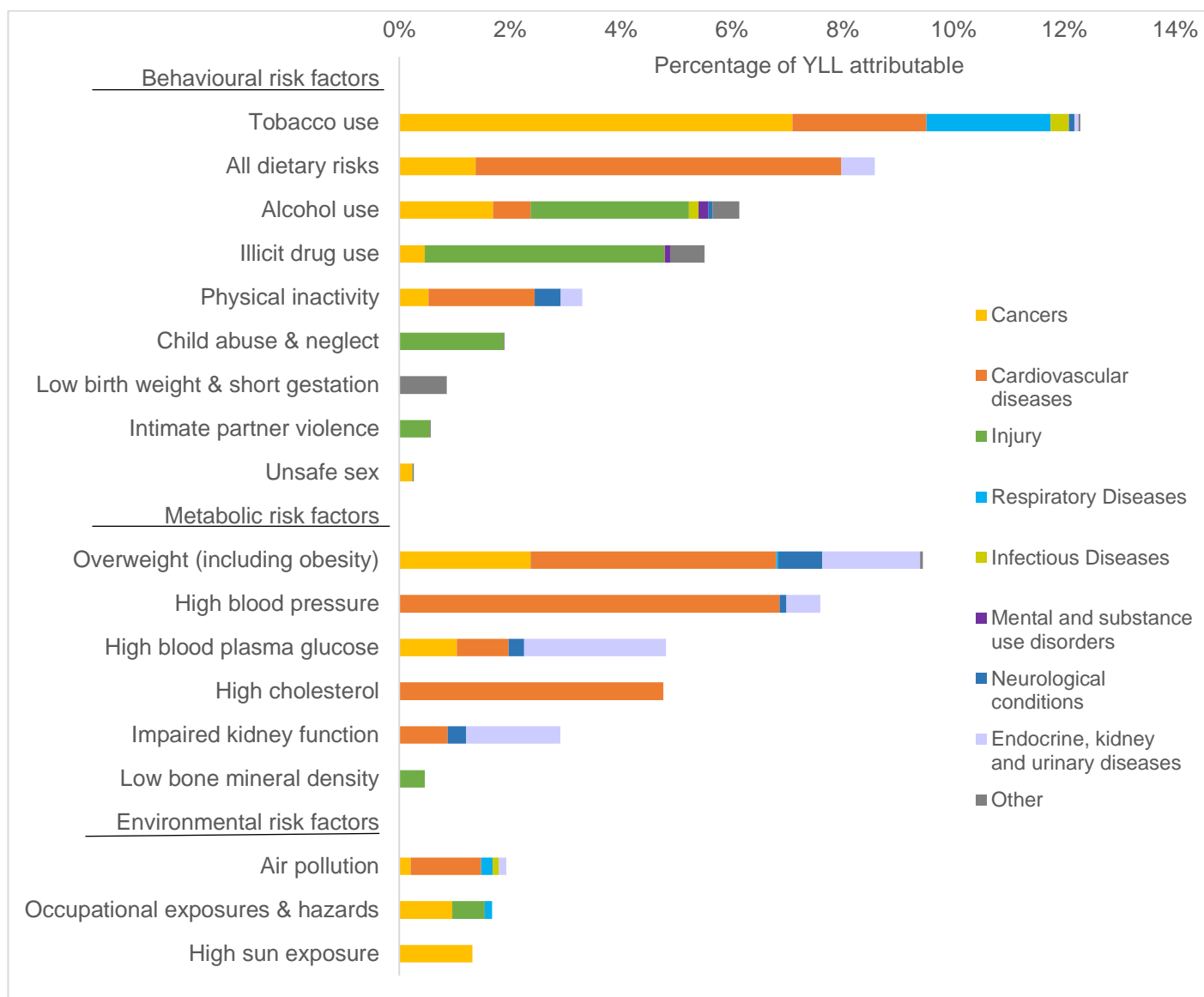


Note: See Box 3 regarding combined effect of risk factors on type 2 diabetes mellitus

In WA in 2018, the behavioural risk factors contributing to the highest proportion of YLL were tobacco use (12.3%), dietary risks (8.6%) and alcohol use (6.1%) (**Figure 24**).

Tobacco smoking is associated with deaths from cancer, chronic respiratory diseases, cardiovascular diseases, and other common infections, especially lower respiratory conditions. Dietary risk factors are associated with deaths from cardiovascular disease (coronary heart disease and stroke), cancers and endocrine disorders (namely, Type 2 Diabetes). Alcohol use is associated with deaths from injury (such as motor vehicle crashes), cancers and cardiovascular disease.

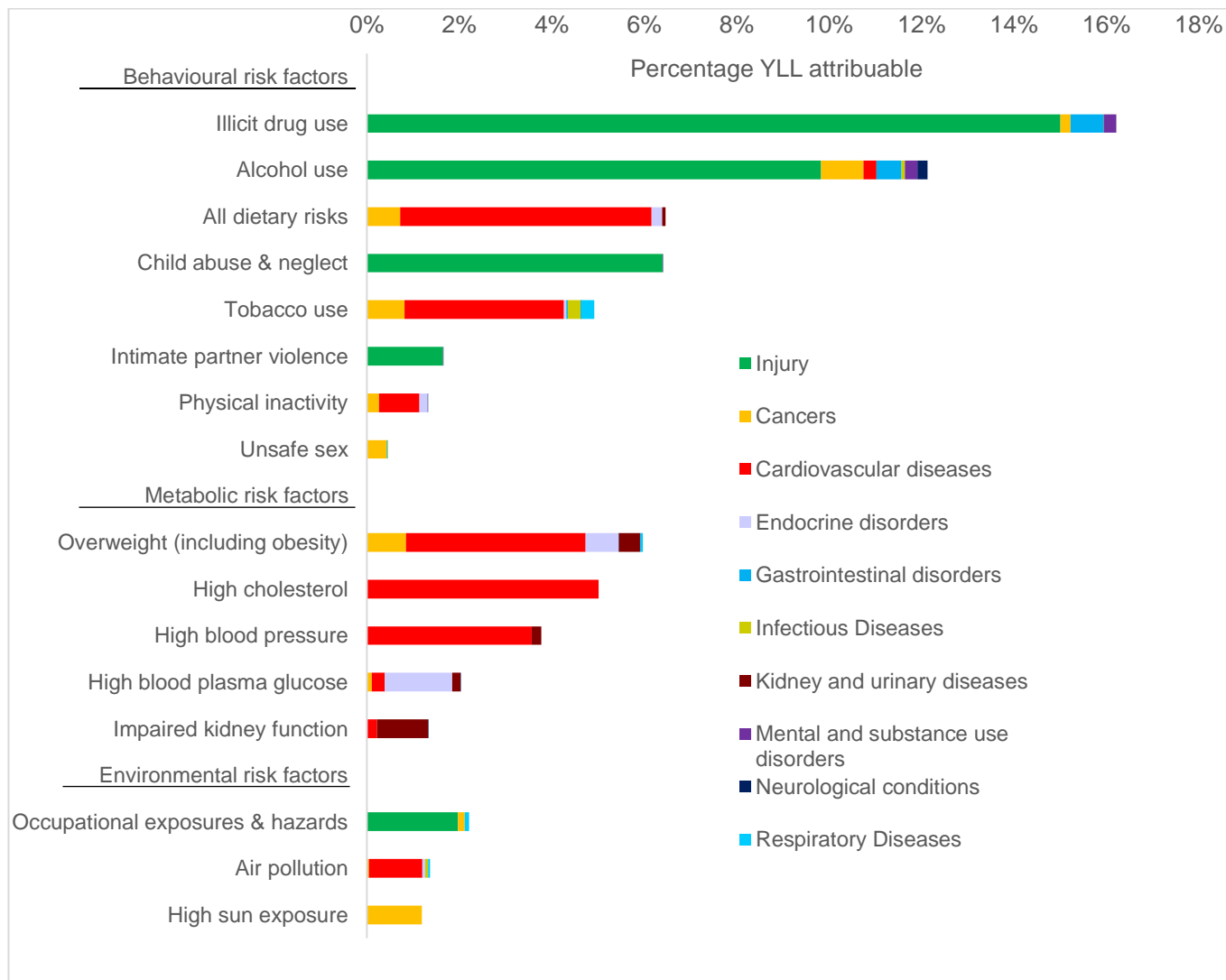
**Figure 24: Attribution of years of life lost (YLL) to selected risk factors, broken down by broad causes of fatal burden in WA, 2018**



\*'Other' causes of fatal burden include infant and congenital conditions, gastrointestinal disorders, reproductive and maternal conditions, musculoskeletal disorders, hearing and vision disorders, blood and metabolic disorders

For deaths among those aged 15 to 49 years, unlike deaths at all ages, alcohol and illicit drug use were the behavioural risk factors associated with the highest proportion of years of life lost (**Figure 25**). Alcohol and illicit drug use were associated with several causes of death, the most common being injuries, which includes suicide and road traffic accidents.

**Figure 25: Attribution of years of life lost in ages 15 to 49 to risk factors and broken down by disease groups, WA, 2018**



## Contribution of risk factors to non-fatal burden

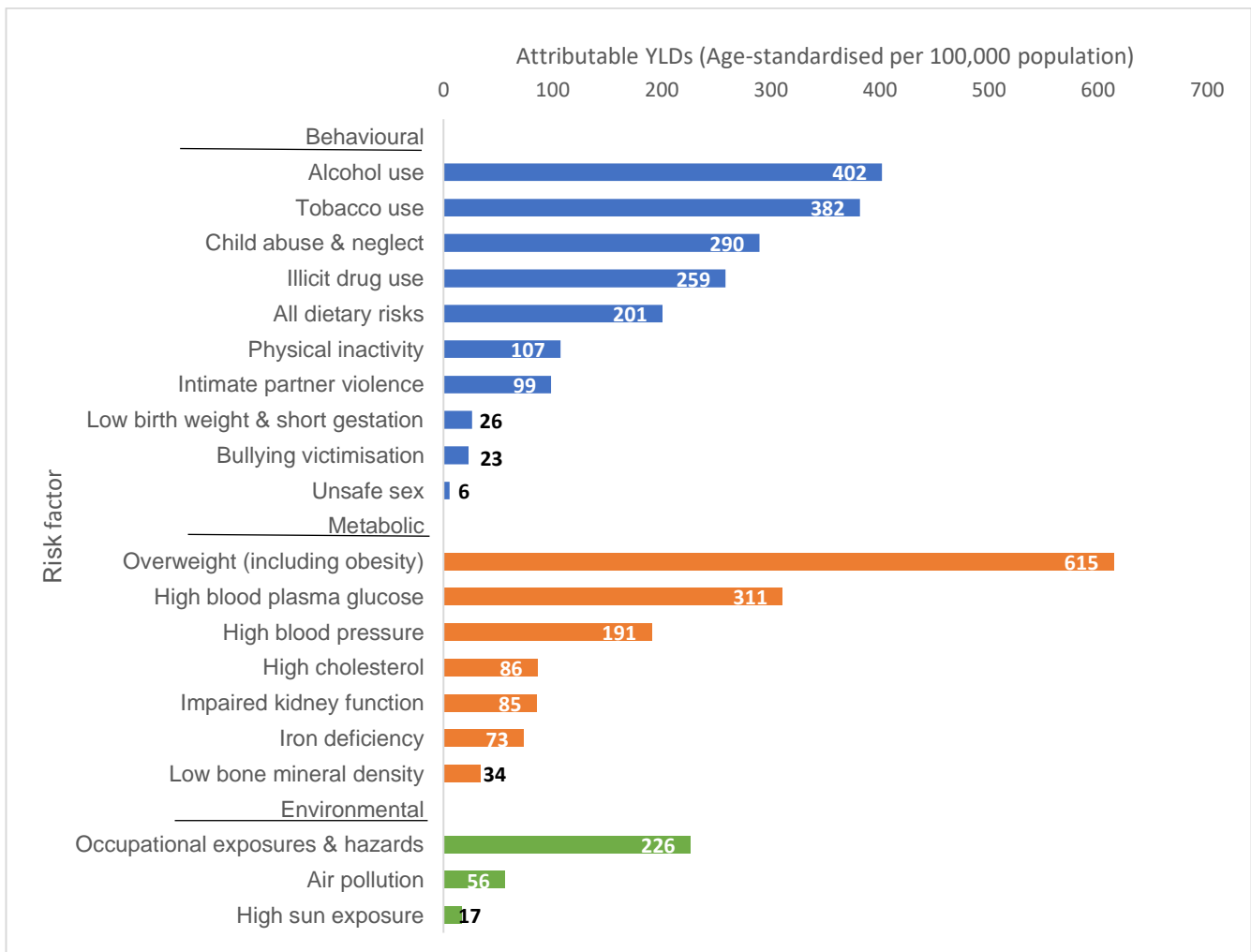
In 2018, all 26 identified risk factors jointly explained 29% of age standardised YLDs.

The single risk factor accounting for the most morbidity was overweight (including obesity) (6.9%), followed by tobacco (4.3%) and alcohol use (4.0%). When accounting for age structure of the population, alcohol became a marginally greater contributor to morbidity, due to its disproportionate effects on younger age groups – while tobacco use is more common in older groups.

High body mass index (BMI; overweight (including obesity)) is a risk factor for a range of conditions including diabetes, heart disease, stroke, osteoarthritis, back pain, chronic kidney disease, and some cancers. When attributable YLDs were age-standardised (**Figure 26**) the magnitude of overweight (including obesity) on morbidity was even more marked. This is in part due to overweight (including obesity) now being prevalent from a younger age, including children, and at higher rates. The health impacts of overweight (including obesity) are therefore seen across the lifespan, although the largest burden is still observed in the chronic diseases of older adulthood.

Smoking is associated with non-fatal burden of respiratory diseases such as COPD, cardiovascular diseases and cancers. Alcohol use is associated with injuries, mental and substance use disorders, as well as cardiovascular disease and cancers.

**Figure 26: Age-standardised morbidity for persons attributed to risk factors (YLDs per 100,000 population), WA 2018**

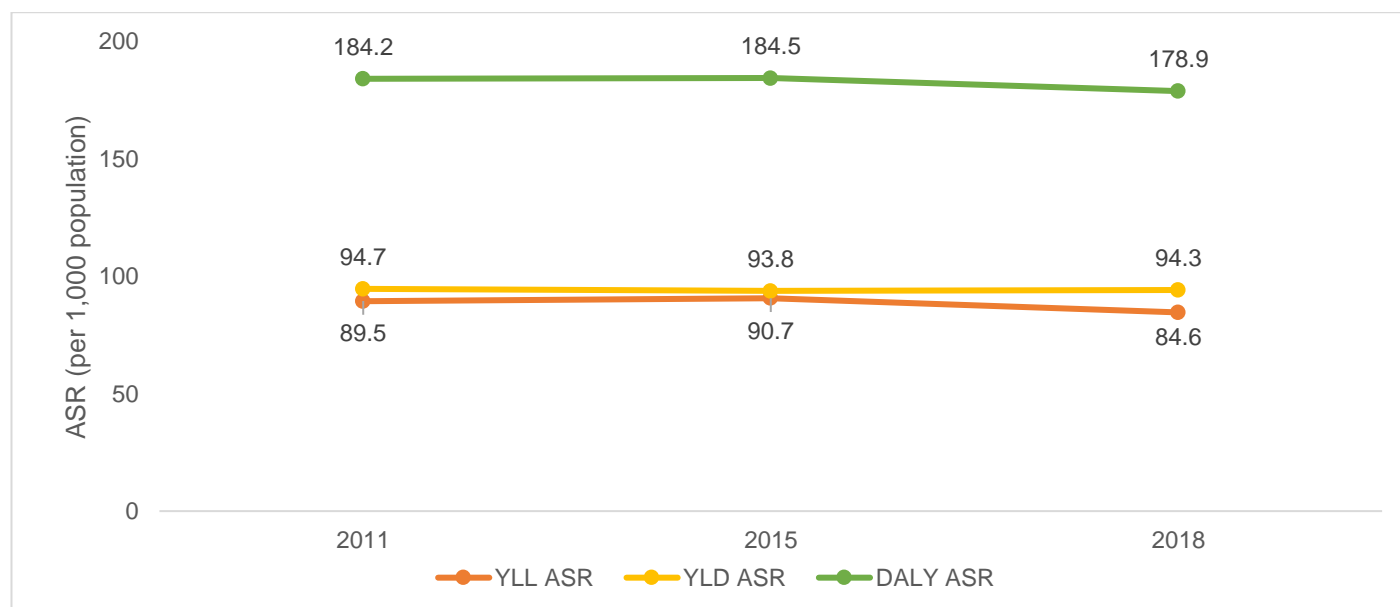




## Chapter 5: Trends in burden of disease and risk factors over time (2011 to 2018)

Burden of disease rates in WA remained relatively similar over the years 2011, 2015 and 2018. The absolute number of years of healthy life lost either due to premature death or living with disability increased from 436,857 DALYs in 2011 to 490,432 DALYs in 2018. However, the age-standardised total burden decreased slightly from 184.2 per 1,000 population in 2011 to 178.9 DALYs per 1,000 population in 2018, a reduction of 2.9%. This was driven by a reduction in fatal burden; the non-fatal burden of disease has remained essentially the same (**Figure 27**).

**Figure 27: Change between 2011 and 2018 in the age-standardised total burden (DALYs), fatal burden (YLL) and non-fatal burden (YLD) rate (per 1,000 population)**

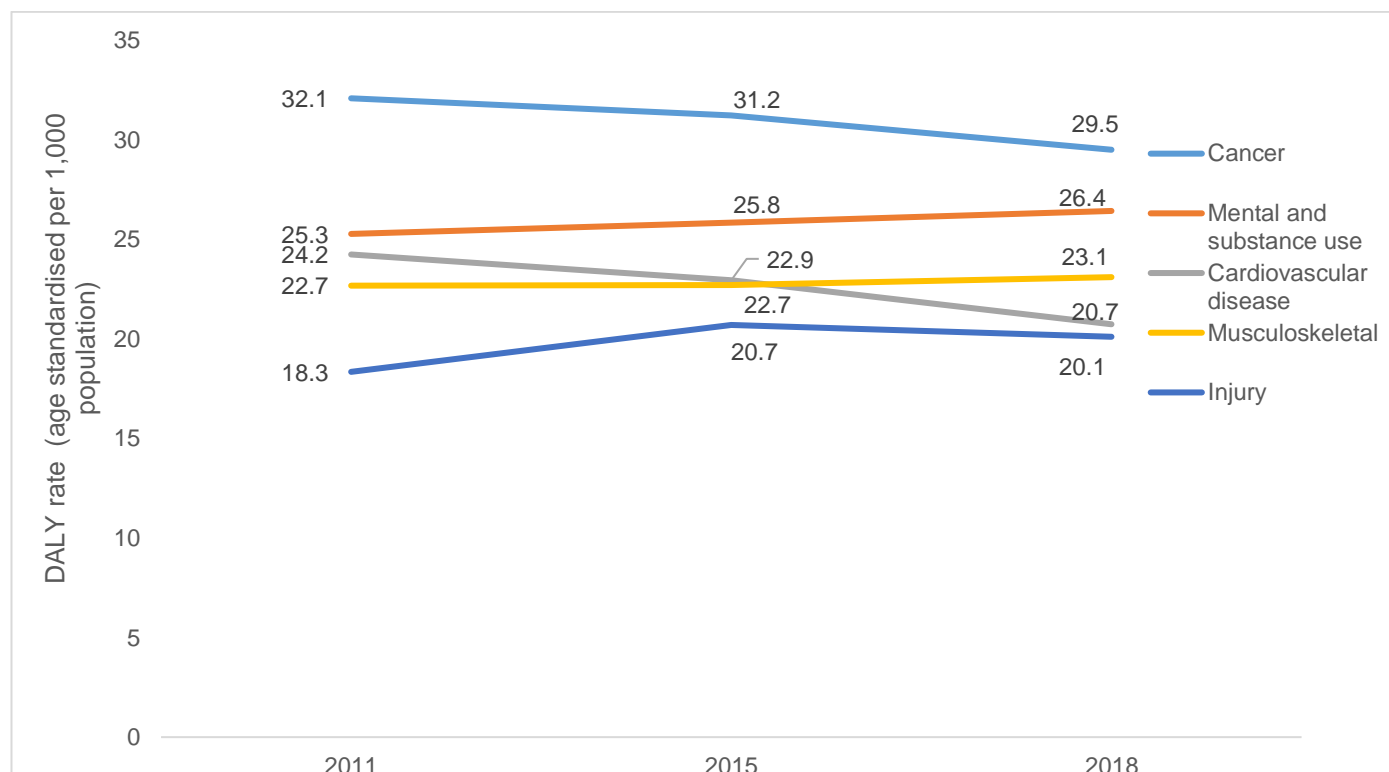


### Trends in total burden by disease group

Of the 17 disease groups, cancers and other neoplasms had the highest age-standardised rate of DALYs from 2011 to 2018 despite a reduction in the total burden over this time (**Figure 28**). Cancers that had a reduction in age-standardised DALY rate between 2011 and 2018 include lung cancer (5.9 to 4.9 per 1,000 population), bowel cancer (3.2 to 2.9 per 1,000 population), prostate cancer (1.9 to 1.6 per 1,000 population) and melanoma (1.7 to 1.0 per 1,000 population).

The age-standardised DALY rate of cardiovascular diseases decreased from 24.2 per 1000 in 2011 to 20.7 in 2018, overtaken by musculoskeletal conditions as the third leading cause of total health burden. The age-standardised burdens of mental and substance use disorders, musculoskeletal conditions and injuries all increased over this period.

**Figure 28. DALY rate (ASR per 1000 population) by disease group, 2011-2018**



### Trends in total burden by specific disease or injury

The change in disease ranking and DALY rates (age standardised per 1,000 population) are shown in **Figure 29**.

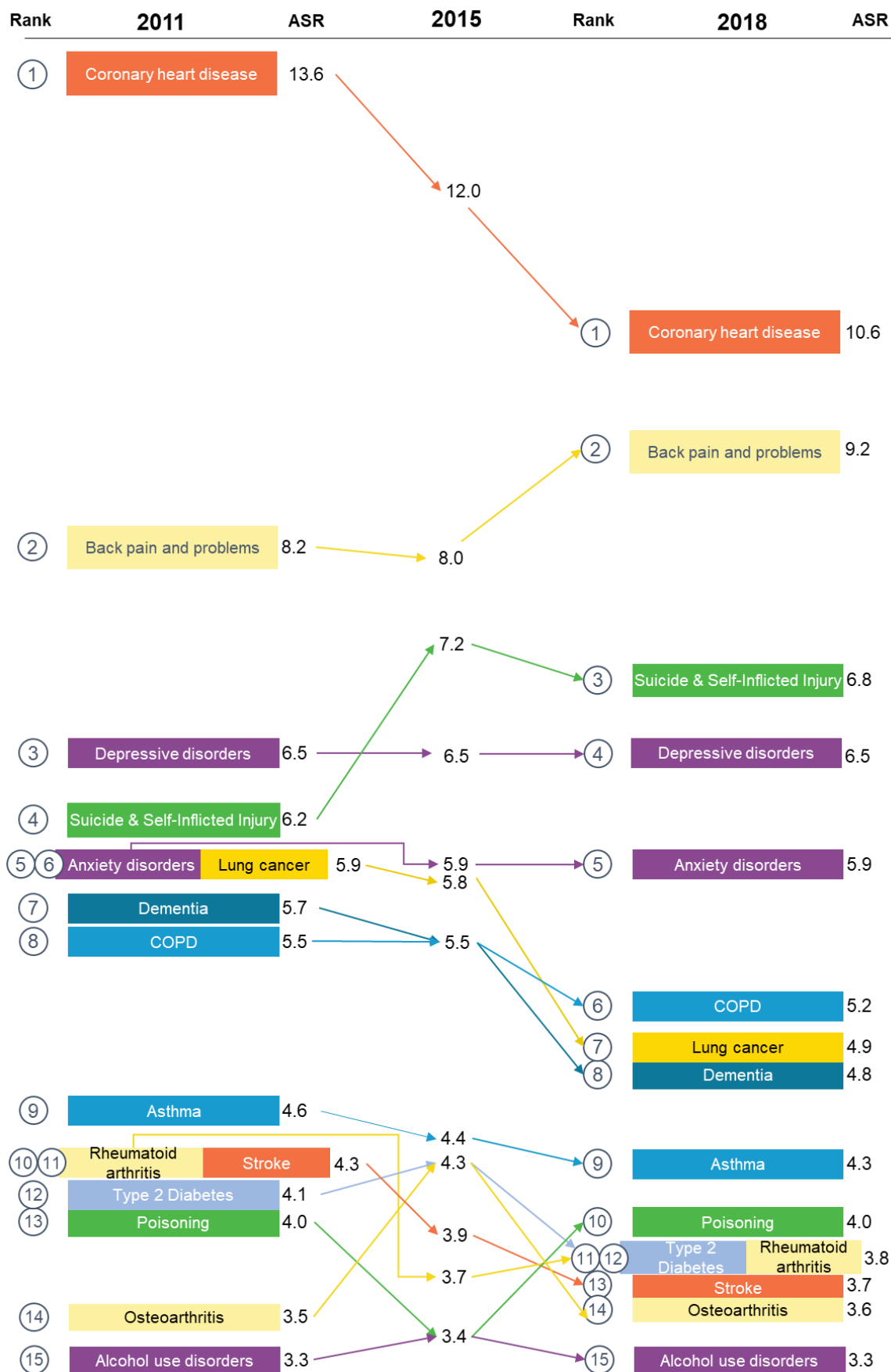
Between 2011 and 2018, both coronary heart disease and stroke decreased in burden between 2011-2018 contributing to the reduction in burden of cardiovascular disease. Coronary heart disease showed the largest reduction in burden (from 13.6 to 10.6 DALYs per 1000 population) but remained the leading cause of healthy years of life lost.

While there was a reduction in the age-standardised burden for rheumatoid arthritis, back pain remained the second leading cause of total burden and increased from 8.2 to 9.2 DALYs per 1000 population.

There was an increase in total burden of disease for suicide and self-inflicted injuries, which increased in rank from 4<sup>th</sup> to 3<sup>rd</sup>, contributing to the increase in total injury burden over this time.

A decline in age-standardised DALY rate was observed for respiratory diseases chronic obstructive pulmonary disease (COPD) and asthma. The age-standardised DALY rate of dementia declined from 5.7 to 4.8 per 1,000 population, driven entirely by a reduction in non-fatal burden (2.5 to 1.6 YLD per 1,000 population).

Figure 29. Change in disease ranking and age-standardised DALY rate (per 1,000 population), 2011 and 2018



ASR = age-standardised rate; COPD = chronic obstructive pulmonary disease

Notes:

1. Diseases are presented in descending order, from highest to lowest ASR,
2. 'Other musculoskeletal conditions' are excluded from the top disease rankings

### WA comparison with Australia-wide trend (2011-2018)

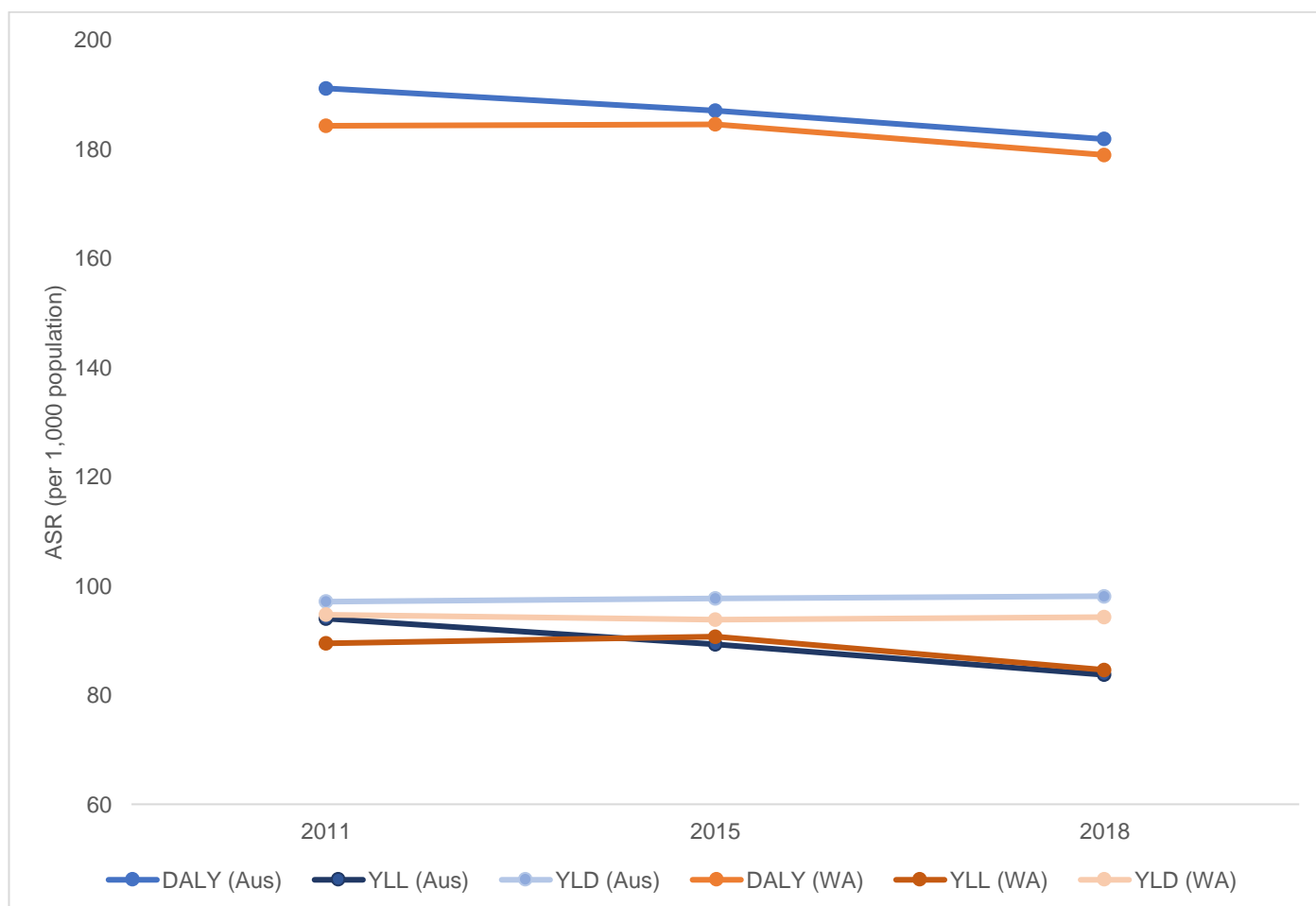
Australia wide, there was a 4.9% decrease in the overall age-standardised DALY rate between 2011 and 2018<sup>7</sup>, compared with a 2.9% decrease for WA. However, the 2011 DALY rate for Australia was 191.1 DALYs per 1,000 population, compared with 184.2 per 1,000 population in WA (**Figure 30**). The 2018 DALY rate for WA (178.9 per 1,000 population) compared to the rest of Australia (181.8 per 1,000 population) remained slightly lower, but largely comparable.

In terms of fatal burden, Australia experienced an 11% decrease in age standardised YLL rate between 2011 and 2018 (94.0 to 83.7 YLL per 1,000 population), whereas WA had a 5% reduction (89.5 to 84.6 YLL per 1,000 population). Again, the 2011 fatal burden for WA was lower than for Australia as a whole, while the YLL rates were comparable in 2015 and 2018.

For non-fatal burden, there was a 1% increase in YLD rate Australia-wide (97.1 to 98.1 YLD per 1,000 population), compared with a 0.4% reduction in WA (94.7 to 94.3 YLD per 1,000 population).

**Figure 30. Comparison of trend in age-standardised DALY, YLL and YLD rates between 2011 and 2018 for Australia and WA**

Source: AIHW<sup>7</sup>



Notably, the Australian DALY rate for injury reduced by 0.5% between 2011 and 2018<sup>7</sup>, while in WA the injury rate increased by 10% (18.3 to 20.1 DALYs per 1,000 population).

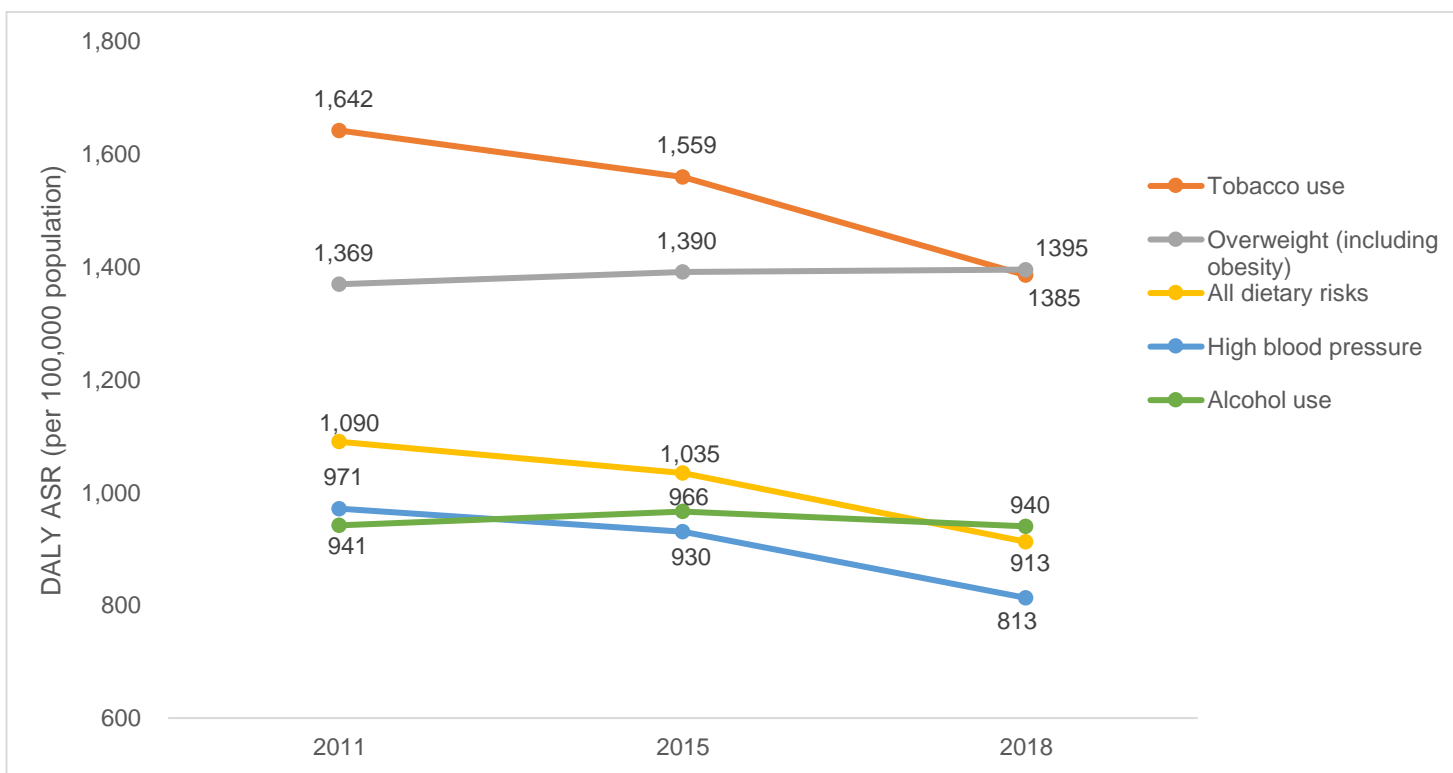
## Trends in modifiable risk factors

The joint effect of all modifiable risk factors included in the study varied across the years 2011 (34%), 2015 (42%) and 2018 (38%). However, there are some differences in the risk factors included in the three studies. For example, air pollution was included as a risk factor from 2015 onwards, and low birth weight is a risk factor in the 2018 study only. It is not possible to remove the individual attributable DALY estimates of low birth weight and air pollution from the joint effect estimates, given the complex interaction accounted for in this calculation. However, the attributable burden of these two risk factors was low: air pollution accounted for 6,191 DALYs (1.3% of total burden) in 2018 and 6,432 DALYs (1.5% of total burden) in 2015; low birth weight contributed 2,713 DALYs (0.6% of total burden) in 2018.

The leading individual risk factors over the three study years demonstrated change over time (**Figure 31**). In particular, the age-standardised attributable burden due to tobacco reduced substantially from 1,642 DALYs per 100,000 population in 2011 to 1,385 per 100,000 population in 2018 – a decrease of 15%. In contrast, the age-standardised attributable burden due to overweight (including obesity) increased slightly from 1,369 to 1,395 per 100,000 population and overtook tobacco as the leading cause of attributable burden.

The attributable burden due to alcohol demonstrated a small degree of fluctuation, but essentially remained stable. The attributable burdens of both high blood pressure and dietary risks decreased between 2011 and 2018.

**Figure 31. Change in DALY ASR (per 100,000 population) of leading risk factors, WA 2011-2018**



A number of other modifiable risk factors had an increase in their attributable burden between 2011 and 2018, including illicit drug use, child abuse and neglect, and intimate partner violence (**Table 12**) although their respective proportions of attributable DALYs are relatively small. An increase in attributable burden may be due to an increase in the prevalence of the risk factors themselves, or an increase in the burden of linked diseases. This is possibly the case for illicit drug use, which is linked to injuries, and intimate partner violence and child abuse and neglect,

which are both linked to mental health and substance use disorders as well as injuries. Study methodology also can influence the attributable burden, through inclusion of additional linked diseases (for example, to intimate partner violence), or changes to the calculation of population attributable fraction.

Additionally, exposure to risk factors such as child abuse, intimate partner violence and illicit drug use in the past can contribute to the burden attributable in the current year of the study. This is because for these risk factors, the onset of linked diseases may not occur until years after initial exposure.

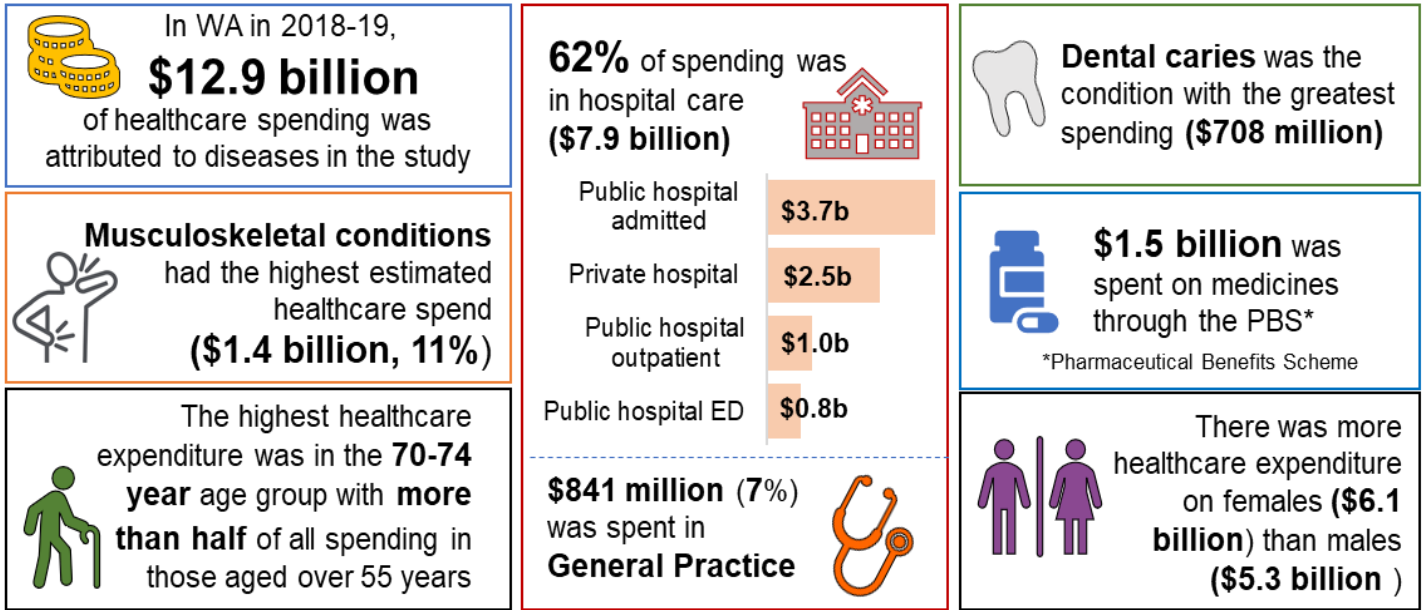
**Table 12. Modifiable risk factors attributable burden, WA 2011, 2015 and 2018**

Risk factor	Attributable DALYs			% DALYs			Attributable DALY rate (per 100,000 population)		
	2011	2015	2018	2011	2015	2018	2011	2015	2018
<b>All risk factors combined</b>	<b>164,592</b>	<b>183,423</b>	<b>186,125</b>	<b>37.7%</b>	<b>38.1%</b>	<b>38.0%</b>	<b>6,917</b>	<b>6,980</b>	<b>6,721</b>
Tobacco use	39,149	41,643	40,069	9.0%	8.7%	8.2%	1,642	1,559	1,385
Overweight (including obesity)	32,729	37,053	39,749	7.5%	7.7%	8.1%	1,369	1,390	1,395
All dietary risks	26,057	27,562	26,142	6.0%	5.7%	5.3%	1,090	1,035	913
High blood pressure	23,015	24,820	23,553	5.3%	5.2%	4.8%	971	930	813
Alcohol use	22,447	24,938	24,711	5.1%	5.2%	5.0%	941	966	940
High blood plasma glucose	18,498	20,938	20,294	4.2%	4.4%	4.1%	778	785	705
High cholesterol	15,174	14,581	13,778	3.5%	3.0%	2.8%	630	547	486
Illicit drug use	13,078	17,496	19,612	3.0%	3.6%	4.0%	551	687	762
Physical inactivity	11,021	11,331	10,950	2.5%	2.4%	2.2%	465	426	378
Child abuse & neglect	10,723	12,095	11,882	2.5%	2.5%	2.4%	450	476	466
Occupational exposures & hazards	9,948	10,189	9,910	2.3%	2.1%	2.0%	417	392	369
Impaired kidney function	7,495	9,835	9,341	1.7%	2.0%	1.9%	320	372	325
High sun exposure	4,196	3,956	3,605	1.0%	0.8%	0.7%	177	148	127
Intimate partner violence	3,328	3,710	3,909	0.8%	0.8%	0.8%	139	145	152
Low bone mineral density	1,416	1,880	2,069	0.3%	0.4%	0.4%	60	70	70
Iron deficiency	1,401	1,882	1,939	0.3%	0.4%	0.4%	59	74	75
Unsafe sex	877	777	762	0.2%	0.2%	0.2%	37	31	28
Bullying victimisation	543	545	540	0.1%	0.1%	0.1%	23	23	23
Air pollution	-	6,432	6,191		1.3%	1.3%	-	243	218
Low birth weight & short gestation	-	-	2,713			0.6%	-	-	104

Note: colour gradient based on percentage difference of age-standardised DALY rate between 2011 rate and 2015 and 2018 rates. (1) Yellow = no change increase/decrease of <2% (2) Pink = increase of 2-5% (3) Light green = decrease of 2-5% (4) Red = increase of >5% (5) Dark green = decrease of >5%

## Chapter 6: Healthcare expenditure

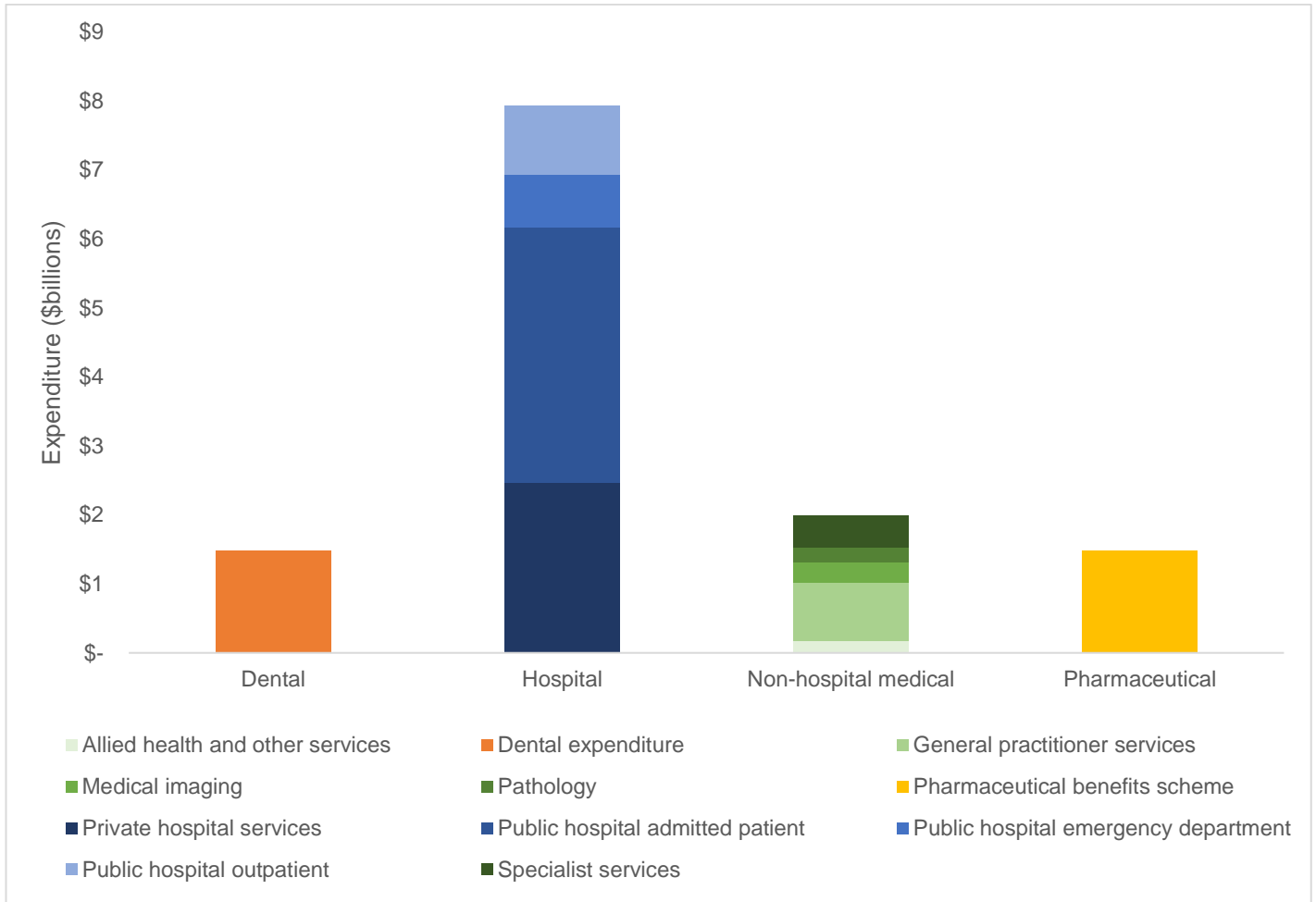
The ‘financial costs’ encountered by a population provide a different perspective to the burden of disease, namely, the healthcare spending on diseases within the health system. The financial costs of conditions and disease groups can be used by government and health service providers, in combination with burden of disease data, to identify priorities and design policies, programs and services that best meet the needs of the WA population. **Figure 32** shows the significant healthcare expenditures.



**Figure 32. Summary of WA healthcare expenditure in 2018/19**

The \$12.9 billion accounts for approximately 61% of total spending on healthcare goods and services in WA for 2018-19<sup>8</sup> and includes estimates of out-of-pocket expenses. Of that, \$7.9 billion (62%) was spent on hospital care, \$2.0 billion (15%) on non-hospital medical care, \$1.5 billion on dental care and \$1.5 billion on pharmaceuticals (both 11.5%). Spending on general practice was less than spending on hospital-based services (even when considered in specific categories), at \$841 million for 2018-19 (**Figure 32** and **Figure 33**).

**Figure 33. WA healthcare expenditure by area of expenditure, 2018-19**



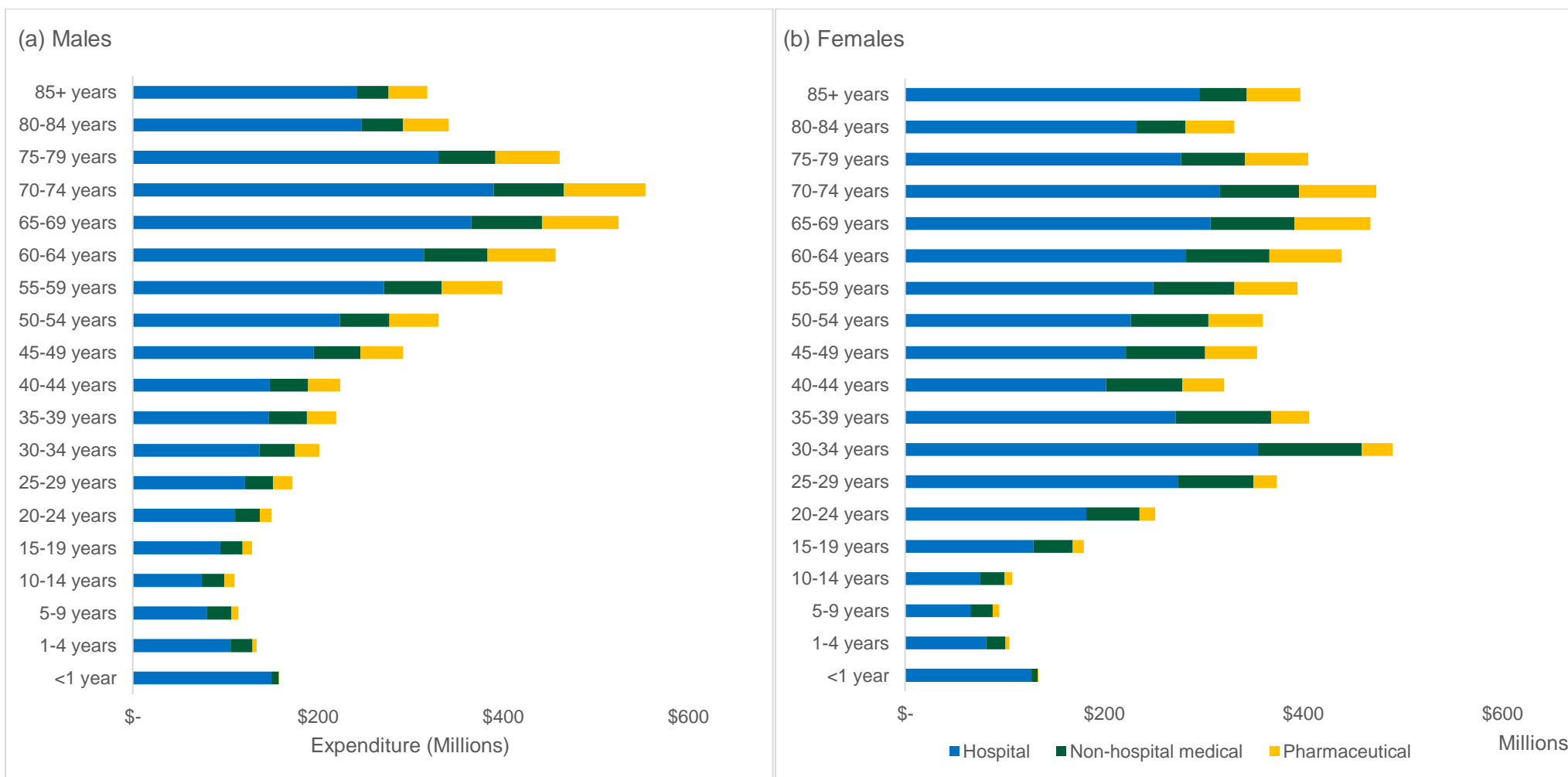
**Healthcare expenditure by age and sex**

Allocated spending in each area varied according to age, with the total spending generally increasing with age for hospital admitted patient services, pathology and medical imaging. Spending on both the Pharmaceutical Benefits Scheme and medical specialist services generally increased substantially with age. Emergency department and allied health spending were relatively steady across age groups.

However, these patterns of disease spending by age varied according to sex (**Figure 34**). For males, most spending occurred later in life. Spending for females between the ages of 20 to 45 is substantially higher than for males of the same age, largely due to spending on maternal conditions.



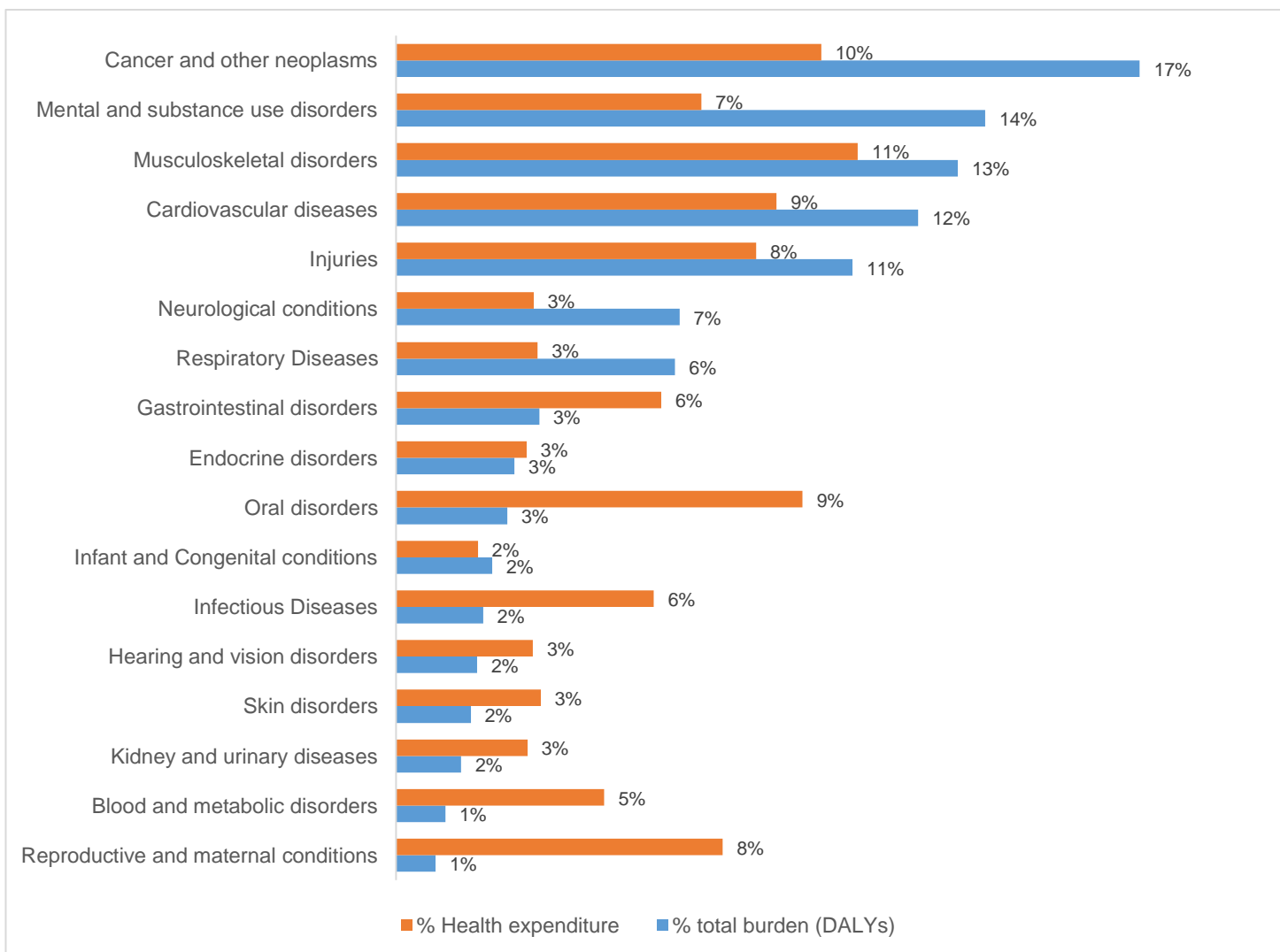
Figure 34: Health expenditure by age for (a) males (b) females by broad area of expenditure, WA, 2018-19



## Healthcare expenditure on leading causes of disease burden

The conditions groups with the highest spending were musculoskeletal disorders, followed by cancers, oral disorders and cardiovascular diseases (**Figure 35**). Healthcare expenditure is not necessarily proportionate with burden of disease as the relationship between the two is complex. For some conditions, preventative healthcare is important and spending (for example, in reproductive and maternal health, and immunisation for infectious diseases) likely leads to better health outcomes and lower burden of disease. For some disease groups, spending outside the healthcare system may be important – such as road and vehicle safety to reduce RTIs, or health promotion to reduce smoking and dietary risk factors. Large emergency department costs may reflect a lack of community health services. Finally, burden of disease includes the fatal burden of disease and injury, which is not captured in healthcare expenditure, as further costs are no longer incurred.

**Figure 35. Healthcare expenditure and burden attributable to disease groups in WA, 2018-19**



## Healthcare spending on musculoskeletal conditions

Musculoskeletal conditions accounted for \$1.38 billion in healthcare expenditure, representing the largest proportion of healthcare spending overall. The largest proportion of musculoskeletal spend was in private hospital services (**Figure 36**). The costs of medical imaging of musculoskeletal conditions were particularly high, double the next highest disease groups

(cardiovascular diseases). Notably, over \$42 million of imaging costs was spent on investigating back pain.

In general practice, approximately \$84 million was allocated to the diagnosis and management of musculoskeletal disorders, \$25 million of which was allocated to back pain, \$15 million to osteoarthritis, and \$38 million for other musculoskeletal conditions. Only \$5.7 million in allied health services such as physiotherapy were spent on back pain and problems.

Musculoskeletal conditions also accounted for the second highest expenditure on PBS medications after cancer, at \$181 million. The largest portion of this was due to rheumatoid arthritis medication (\$87 million), with \$52 million on 'other' musculoskeletal conditions and \$23 million spent on medication for back pain.

### Healthcare costs due to cancer

The investigation, diagnosis and treatment of cancer accounted for \$1.27 billion of healthcare spending in WA in 2018-19. The largest expenditure for cancer was on PBS medications, with significant spend in both private and public hospitals including admissions and outpatient services (**Figure 36**).

### Healthcare costs due to cardiovascular diseases

More than \$1.1 billion was spent in the health system on cardiovascular diseases in WA in 2018-19. Hospital admissions, both public and private, accounted for the greatest expenditure for cardiovascular conditions (**Figure 36**).

### Healthcare costs of injury

In 2018, \$1.1 billion of healthcare expenditure was spent on injuries in WA. Most of the healthcare spend on injuries was in the public hospital system - over \$373 million spent on public hospital admitted patients, and \$217 million spent in emergency departments (**Figure 36**). Falls were responsible for the greatest healthcare spend of any injury, at \$408 million.

### Healthcare costs due to mental and substance use disorders

Mental and substance use disorders accounted for \$913 million in healthcare spending; the 7<sup>th</sup> highest disease group in terms of health expenditure whilst representing the second highest disease burden. The largest spends on mental and substance use disorders were in public hospital admissions, private hospital admissions and emergency departments (**Table 13**).

Anxiety and depressive disorders had the two highest levels of allied health and other services expenditure, \$34 million and \$30 million respectively, mostly due to psychologist treatment and other therapy. Over \$44 million was spent on mental health and substance use disorders for specialist services.

An additional \$29 million was spent on suicide and self-inflicted injuries, including \$11 million on public hospital admissions and \$10.9 million through public hospital emergency departments. This spend is accounted for in the injury disease group. Notably, as a proportion of the burden due to mental illness manifests in suicide, this loss of life will not be reflected in high healthcare costs.

### Area of healthcare expenditure by disease groups

For two of the five disease groups with the highest healthcare expenditure (cardiovascular diseases and injuries), public hospital admissions were the leading source of expenditure (**Figure 36**).

Figure 36. Top five areas of healthcare expenditure for disease groups with the highest healthcare expenditure in WA, 2018–19

Rank	Musculoskeletal disorders	Cancer	Oral disorders	Cardiovascular diseases	Injury
1 <sup>st</sup>	Private hospital services (\$544M, 39.5%)	PBS (\$331M, 26.1%)	Dental expenditure (\$1,119M, 92.1%)	Public hospital admitted patient (\$382M, 33.6%)	Public hospital admitted patient (\$373M, 34.7%)
2 <sup>nd</sup>	Public hospital admitted patient (\$223M, 16.2%)	Private hospital services (\$314M, 24.7%)	Private hospital services (\$41M, 3.4%)	Private hospital services (\$285M, 25.0%)	Public hospital emergency department (\$217M, 20.2%)
3 <sup>rd</sup>	PBS (\$181M, 13.1%)	Public hospital admitted patient (\$276M, 21.7%)	Public hospital admitted patient (\$33M, 2.8%)	PBS (\$166M, 14.6%)	Private hospital services (\$174M, 16.1%)
4 <sup>th</sup>	Public hospital outpatient (\$109M, 7.9%)	Public hospital outpatient (\$159M, 12.5%)	General practitioner services (\$6M, 0.5%)	General practitioner services (\$80M, 7.0%)	Dental expenditure (\$91M, 8.5%)
5 <sup>th</sup>	Medical imaging (\$105M, 7.6%)	Specialist services (\$98M, 7.7%)	Public hospital emergency department (\$5M, 0.4%)	Public hospital outpatient (\$71M, 6.2%)	Public hospital outpatient (\$89M, 8.3%)

M = Million; % = percentage of overall healthcare expenditure spent on an area for each disease group.  
 PBS: Pharmaceutical Benefits Scheme

More than half of spending for allied health and other health practitioners related to mental and substance use disorders (\$93 million out of \$173 million total), with just over a quarter (\$47 million) relating to hearing and vision disorders (**Table 13**).

Table 13. Areas of health expenditure by disease group (\$M), WA 2018-19

Disease group	Hospital					Hospital Total	Non-hospital					Non-hospital Total	Other		Total
	Private hospital services	Public hospital admitted patient	Public hospital emergency department	Public hospital outpatient	Allied health & other services		General practitioner services	Medical imaging	Pathology	Specialist services	PBS		Dental		
<b>Musculoskeletal</b>	544.4	222.9	34.3	109.2	910.8	13.8	84.0	104.6	14.5	28.6	245.5	181.4	41.8	<b>1,379.5</b>	
<b>Cancer</b>	314.2	276.0	3.7	158.5	752.5	0.4	36.9	13.9	16.2	97.7	165.1	331.1	21.8	<b>1,270.5</b>	
<b>Oral disorders</b>	41.2	33.5	5.4	5.0	85.1	0.8	5.8	1.0	0.6	0.7	8.8	2.4	1118.6	<b>1,214.9</b>	
<b>Cardiovascular</b>	284.7	382.0	61.8	70.6	799.1	1.6	79.6	17.0	18.1	39.9	156.2	166.2	15.4	<b>1,136.9</b>	
<b>Injury</b>	173.7	373.5	216.8	89.1	853.1	4.1	50.8	45.3	3.8	11.8	115.8	15.6	91.1	<b>1,075.6</b>	
<b>Reproductive &amp; maternal</b>	212.8	368.7	25.8	131.9	739.2	3.1	55.7	37.3	29.6	75.8	201.5	35.4	0.0	<b>976.2</b>	
<b>Mental &amp; substance use</b>	89.8	313.9	63.8	50.0	517.6	92.6	106.4	8.4	10.3	44.5	262.2	103.3	29.8	<b>912.8</b>	
<b>Gastrointestinal</b>	161.6	358.7	63.9	30.1	614.3	0.3	39.9	16.4	10.1	25.0	91.6	82.4	4.0	<b>792.3</b>	
<b>Infectious diseases</b>	54.9	245.9	130.8	23.6	455.2	0.6	127.3	8.9	28.5	7.0	172.1	132.2	10.9	<b>770.5</b>	
<b>Blood &amp; metabolic</b>	106.4	284.1	13.2	47.6	451.3	1.3	42.5	1.9	22.6	4.7	73.0	96.6	1.3	<b>622.2</b>	
<b>Skin disorders</b>	40.6	121.4	40.2	33.7	236.0	1.2	84.5	4.7	14.0	26.2	130.5	48.2	17.6	<b>432.3</b>	
<b>Respiratory</b>	62.1	129.9	41.5	40.3	273.8	0.7	42.6	11.6	4.0	17.2	76.1	62.3	11.1	<b>423.3</b>	
<b>Neurological</b>	60.8	114.6	16.5	67.4	259.2	1.4	19.5	11.7	3.6	16.1	52.3	77.7	21.9	<b>411.0</b>	
<b>Hearing and vision</b>	145.0	78.1	8.9	24.3	256.3	46.8	17.7	3.3	0.9	40.8	109.6	39.1	4.3	<b>409.3</b>	
<b>Kidney &amp; urinary</b>	110.6	148.5	22.1	54.7	335.9	0.2	11.5	12.0	6.8	7.9	38.4	17.3	1.0	<b>392.7</b>	
<b>Endocrine</b>	19.7	71.4	5.2	52.0	148.3	4.3	35.1	6.1	22.3	8.5	76.4	88.1	77.7	<b>390.4</b>	
<b>Infant &amp; congenital</b>	46.1	173.8	1.6	12.9	234.3	0.1	1.5	0.7	0.2	1.7	4.2	0.3	6.1	<b>244.9</b>	
<b>Total</b>	2,468.6	3,696.9	755.6	1,000.8	7,921.9	173.4	841.1	304.8	206.1	454.2	1,979.6	1,479.4	1,474.3	<b>12,855.3</b>	

*PBS = Pharmaceutical Benefits Scheme*

## Differences in healthcare expenditure for males and females by disease group

Healthcare expenditure on the WABODS disease groups differed between males and females. Cancer and other neoplasms contributed the most to healthcare expenditure for males (\$659 million), followed by cardiovascular diseases (\$649 million), musculoskeletal disorders (\$611 million) and injuries (\$534 million). For females, reproductive and maternal conditions was the disease group with the highest healthcare expenditure (\$930 million), followed by musculoskeletal disorders (\$726 million), cancers (\$590 million) and mental and substance use disorders (\$489 million).

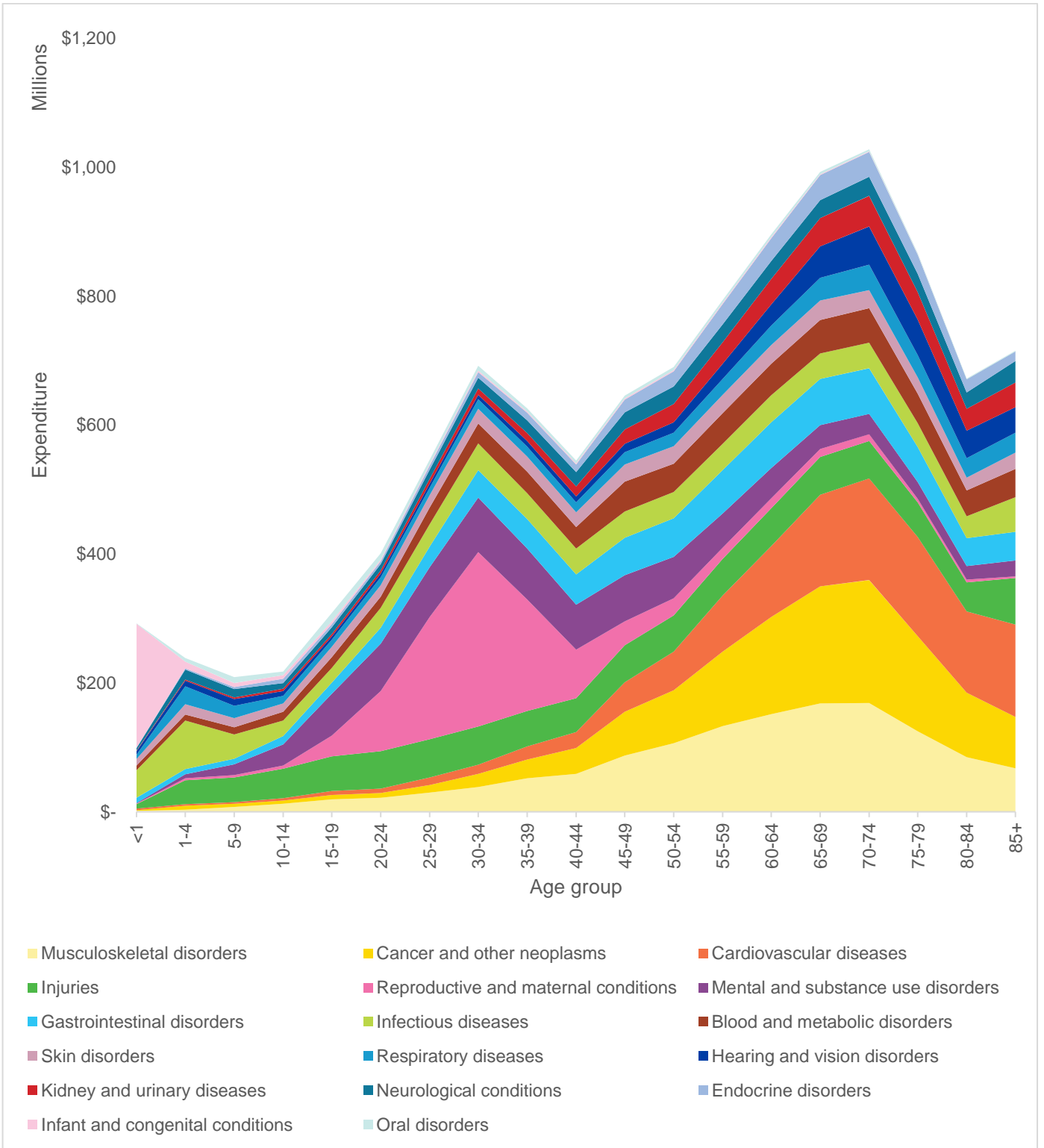
Overall, there was more healthcare expenditure on females (\$6.1 billion) than males (\$5.3 billion), which could be attributed to greater spending on reproductive and maternal conditions in females (\$886 million more in females than males). Notably, costs are not provided by sex for certain costs, for example, dental expenditure.

## Differences in healthcare expenditure by age group and disease group

In WA in 2018–19, the age group associated with the highest proportion of healthcare expenditure was 70–74 year-olds (9.0%), followed by 65–69 year-olds (8.7%) and 60–64 year-olds (7.9%) (**Figure 37**). More than 50% of healthcare expenditure in 2018–19 was for people aged over 55 years and the largest proportion of this spending was for cancers (\$965 million), followed by cardiovascular diseases (\$920 million) and musculoskeletal disorders (\$899 million).

For infants (less than 12 months of age) and those aged one to four years, most healthcare spending was for infant and congenital conditions and infectious diseases respectively. This trend shifts for older children and adolescents, with most healthcare expenditure attributed to injuries, and mental and substance use disorders. For those aged 20–39 years, the largest proportion of healthcare expenditure was for reproductive and maternal conditions, followed by mental health and substance use disorders, and injuries. Healthcare spending trends then change into middle age and older age groups, with increasing expenditure on musculoskeletal conditions, cancers, and cardiovascular diseases.

Figure 37. WA healthcare expenditure by age group and disease group in WA, 2018–19.



## Chapter 7: Discussion

### Implications for health policy and planning

This report provides a detailed examination of the burden of disease in WA for 2018, as well as the changes in burden over recent years (2011-2018). It also identifies the leading modifiable risk factors contributing to ill health among the WA population.

Population health data plays an important role in policy and program development and evaluation, with reports such as the burden of disease enhancing our understanding of the leading diseases and risk factors affecting the WA community. Knowledge of priority conditions and contributing risk factors is an important element for policy makers and service providers to inform health service planning and delivery, and target priority issues for prevention and control.

### Health priorities

Overall, when adjusted for population size and structure, there was a 2.9% reduction in health burden from 2011 to 2018, driven almost entirely by a reduction in fatal burden.

The disease groups and individual conditions contributing the most to the burden of disease are those that have been known to cause substantial mortality and morbidity for some time. Chronic diseases continue to be responsible for most of the health burden and health spending in WA.

Collectively, cancers continue to be the leading cause of healthy life lost in WA, but the age-standardised burden decreased between 2011 and 2018 – driven by reductions in the burden of several individual cancers such as lung and bowel cancer. Similarly, the overall burden of cardiovascular diseases has decreased.

There are several encouraging trends in the burden of disease. For example, a steady reduction has been seen in the burden due to coronary heart disease, the leading individual cause of healthy life lost. This trend signals the importance of prevention (such as reducing smoking, encouraging physical activity and a healthy diet) as well as early detection, management and access to quality care. However, continued efforts are needed to address modifiable risk factors such as overweight (including obesity) that could compromise the progress made to date.

By contrast, the health burden due to musculoskeletal disorders has increased, now third in terms of total burden. Back pain remains the second highest individual cause of healthy years lost and has increased from 8.2 to 9.2 age standardised DALYs per 1000 population between 2011 and 2018. Furthermore, musculoskeletal conditions were responsible for the greatest healthcare expenditure in 2018-19.

Another major cause of health loss for West Australians is mental health and substance use disorders. The overall age standardised DALY rate for this condition group increased from 25.3 to 26.4 per 1000 population between 2011 and 2018, with depression, anxiety and alcohol use disorders among the leading 15 conditions in terms of burden. The impact of mental health conditions is seen from a young age, with 38% and 35% of the total burden in people aged 5-14 years and 15-24 years due to mental ill health, respectively.

The burden of injury in WA has increased from 18.3 to 20.1 age standardised DALYs per 1000 population between 2011 and 2018 and WA has the second highest rate of injury burden in the country. Suicide and self-inflicted injuries were the leading cause of injury-related burden for both males and females, with poisoning, falls and road traffic injuries (motor vehicle occupants) also contributing substantially.



## Priority risk factors

This study demonstrates that a substantial proportion of the burden of disease in WA in 2018 was due to modifiable risk factors such as tobacco, overweight (including obesity), dietary risks and alcohol. However, it also identifies that the impact of several modifiable risk factors has reduced in recent years. The ongoing decline in the burden of disease due to tobacco is evidence of the success of incremental and sustained public health measures. Reduction in the burden due to high sun exposure is also likely testament to the success of health promotion campaigns. The burden due to dietary risks also declined between 2011 and 2018 – although in this study dietary risks are not disaggregated into diets high in sodium, low in fibre, high in sugar-sweetened beverages, etc.

Notably, the health burden attributable to overweight (including obesity) has increased slightly (1,369 to 1,395 DALYs per 100,000 population) between 2011 and 2018 and is becoming increasingly significant as tobacco use declines. In addition, the health impacts of illicit drug use increased between 2011 and 2018, particularly with regards to injuries such as poisoning. Alcohol use remains a significant cause of preventable health burden for West Australians, influencing a range of both chronic conditions and injuries. Other modifiable risk factors such as intimate partner violence increased.

## Relevant strategies and plans

The importance of investment in prevention is highlighted in the Sustainable Health Review Final Report to the Western Australian Government<sup>9</sup>, which includes recommendations to 'increase and sustain focus and investment in public health, with prevention rising to at least five per cent of total health expenditure by July 2029'.

Recognising the importance of public health challenges such as obesity and alcohol use, the **Sustainable Health Review (2019)** has prioritised addressing these modifiable risk factors in Recommendation 2a "Halt the rise in obesity in WA by July 2024 and have the highest percentage of population with a healthy weight of all states in Australia by July 2029" and Recommendation 2b "Reduce harmful alcohol use by 10 per cent by July 2024". The data presented in this report relates to 2018 and can provide a baseline from which to measure change as the recommendations of the Sustainable Health Review are adopted. Moreover, this report emphasises the need to improve care and outcomes for people with mental health, alcohol and drug disorders.

The Sustainable Health Review also highlights the need for a cultural shift away from a hospital-based system to one with a strong focus on prevention. As evidenced in this report, the majority (62%) of health spending is on hospital-based care, compared with only 7% of spending in general practice. This considerable spending on hospital care (\$7.9 billion), particularly for disease groups such as cardiovascular disease (\$799 million), cancers (\$752 million) and injuries (\$853 million) which have significant attributable burdens to modifiable risk factors (69%, 42% and 46%, respectively), provides further impetus to reduce population exposure to these risk factors.

WA state-specific plans also highlight the key issues affecting public health identified in this report, namely the major causes of burden of disease and modifiable risk factors. These include the **WA State Public Health Plan**<sup>10</sup> (2020), the **Western Australian Health Promotion Framework 2022-2026** (HPSF)<sup>11</sup>, and the **Western Australian Mental Health, Alcohol and Other Drug Prevention Plan 2018-2025**<sup>12</sup>. The findings of this study are consistent with previously identified health issues which are widely acknowledged priorities in public health. Results from burden of disease studies may be useful in monitoring and evaluating performance of these plans and the programs identified therein, particularly when comparing health burdens and impacts of risk factors over time.

## Limitations

While this report describes the impact of several modifiable risk factors for the WA population, it does not address the importance of the social determinants of health. Social and economic disadvantage is associated with both higher rates of risky health behaviours and poorer health outcomes and has an impact throughout the life course. The ABDS 2018<sup>6</sup> presents information on burden of disease across socioeconomic groups for Australia by disaggregating the burden estimates by socioeconomic group, which would be worthwhile to undertake for a subsequent study of the WA data.

The WABoDS 2015 reports have documented the disparity in health outcomes between Aboriginal and non-Aboriginal people, as well as poorer health outcomes experienced by those living in rural and remote WA. This report describes health outcomes for WA and is not disaggregated by location or Aboriginal status. As such, further analysis will be required to assess these differences for 2018 and to monitor trends over recent years.

This report used nationally derived population attributable fractions (PAFs) for modifiable risk factors, rather than WA-specific PAFs which were calculated for the 2015 WABoDS. It is likely that the distribution of certain risk factors in WA is different to other Australian jurisdictions and as such, there may be discrepancies in the burden attributable to these risk factors.

While the ABDS data provides insight into the health impacts of a small number of environmental risk factors (for example, air pollution), the emerging impact of climate change is not captured in this study. As highlighted in both the Climate Change WA Inquiry<sup>13</sup> and the Sustainable Health Review<sup>9</sup>, the already present dangers of heatwave, bushfires, and other extreme weather events are likely to increase in the coming years.

Given that this report analyses burden of disease, risk factor and healthcare expenditure data from 2018, the impacts of the COVID-19 pandemic are not captured here. The recently published *Australian Burden of Diseases Study 2022* report<sup>16</sup> found COVID-19 ranked the 8<sup>th</sup> among the specific diseases nationally in 2022. It was the 5<sup>th</sup> leading cause of fatal burden and 21<sup>st</sup> leading cause of non-fatal burden in Australia.

## Appendix 1: Methods

### Burden of disease measures

Detailed burden of disease estimates were last reported for the State and health regions in the Western Australian Burden of Disease Study (WABoDS) 2015<sup>3</sup>. The WABoDS 2018 utilises updated estimates for WA provided by the AIHW, including revised 2011 and 2015 data using Australian Burden of Disease Study (ABDS) 2018 methodology<sup>1</sup>, allowing comparison of health status over recent years.

DALY, YLL and YLD estimates for WA for 2011, 2015 and 2018 in this report were provided by the AIHW. These were calculated as described by the AIHW in the ABDS 2018<sup>1</sup>. The Epidemiology Directorate used these estimates to calculate age-standardised rates per population, utilising the 2001 standardised population.

### Risk factors

The estimated contribution of a risk factor to disease burden is calculated by comparing the prevalence of the observed risk factor distribution with an alternative hypothetical distribution, together with the relative risk of morbidity or mortality for the linked disease due to the risk factor.

Forty risk factor components or exposures were identified and combined into 26 risk factors for inclusion in the 2018 ABDS. These risk factors were grouped into three broad categories; behavioural, metabolic and environmental. Metabolic risk factors include high BMI and high cholesterol; behavioural risk factors include smoking, alcohol use, and drug use, while environmental and occupational risk factors include air pollution, high sun exposure and other risks due to the working or living environment.

Population Attributable Fractions (PAFs), defined as the fraction of all cases of a particular disease or other adverse condition in a population that is attributable to a specific risk factor exposure<sup>14</sup> are calculated by applying the relative risk and the prevalence of exposure to risk factors. PAFs are then applied for each risk factor's linked disease to the relevant YLL and YLD, to calculate the burden of the linked disease that is attributable to the risk factor. National PAFs were provided by AIHW for this study.

### Healthcare spending

Healthcare expenditure data for WA for 2018-19 were estimated and provided by the AIHW<sup>15</sup>. The healthcare costs for burden of disease conditions and disease groups were estimated by ABDS condition, age group, and sex for admitted patient, emergency department, and outpatient hospital services, out-of-hospital medical services (e.g. primary health care, dental, allied health), prescription pharmaceuticals and referred medical services (e.g. pathology and diagnostic imaging). All sources of funding, including patient co-payments, are included in estimates of healthcare spending. Types of expenditure that were not included were capital expenditure (spending on new buildings and equipment), spending on community and public health programs, and indirect healthcare costs (e.g. lost productivity, travel costs for patients).

It should be noted that the relationship between healthcare expenditure and burden of disease is complex and health expenditure relative to burden should not be used to draw conclusions about the level of funding needs.

There are many possible reasons for high expenditure on disease groups that have a low burden on the population, or vice versa. For example, high expenditure on healthcare for reproductive and maternal conditions may translate to better outcomes for mothers, resulting in a lower burden from these conditions. Additionally, for some disease groups, spending outside

of the healthcare system can play an important role in reducing the human cost of diseases – such as in education, public campaigns and transport to reduce road transport injuries, or investment in health promotion campaigns to reduce the impacts of smoking and dietary risk factors. Finally, healthcare costs do not account for fatal burden, as premature death inevitably results in no further healthcare utilisation.

## Glossary

**attributable burden:** The disease burden attributed to a particular risk factor.

**burden of disease (and injury):** The quantified impact of a disease or injury on a population using the **disability-adjusted life year (DALY)** measure.

**disability:** In burden of disease analysis, any departure from an ideal health state.

**disability-adjusted life year (DALY):** A measure of healthy life lost, either through premature death or living with disability due to illness or injury. Often used synonymously with **health loss**.

**fatal burden:** The burden from dying prematurely as measured by years of life lost. Often used synonymously with **years of life lost**.

**health-adjusted life expectancy (HALE):** The number of healthy years a person of a particular age can expect to live.

**morbidity:** Ill health in an individual, and levels of ill health in a population or group.

**mortality:** Death.

**non-fatal burden:** The burden from living with ill-health as measured by years lived with disability. Often used synonymously with **years lived with disability**.

**risk factor:** Any factor that represents a greater risk of a health condition or health event.

**years lived with disability (YLD):** The number of years of what could have been a healthy life that were instead spent in states of less than full health. YLD represent non-fatal burden.

**years of life lost (YLL):** The number of years of life lost due to premature death, defined as dying before the ideal life span. YLL represent fatal burden.

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