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Economics of sports injury and participation – Preliminary results

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Summary

In June 2020, the Australian Sports Commission (ASC) commissioned the AIHW to investigate the benefits and costs to the health system associated with participation in physical activity. This analysis is part of a broader project to gather evidence around injuries arising by sport participation and the potential population benefits to be achieved through improved injury prevention and management and increased physical activity.

The purpose of this project is to quantify the health spending related to physical activity within the Australian population. This is done by assessing:

- costs due to immediate and long term risk of injuries; and
- the avoided health spending due to better health status.

Hospital costs of injury associated with physical activity

This initial report presents estimates of hospital spending related to emergency departments and hospital admissions (where diagnosis and external cause data is available). It is estimated that the immediate cost of treating injuries caused by physical activity through the hospital system was $764 million in 2018-19, with:

- $164 million spent in emergency departments and $600 million spend on admitted patient care treating injuries related to physical activity
- Injury spending in emergency departments due to physical activity was highest for *other injuries* ($51 million), *other fractures* ($45 million), and *soft tissue injuries* ($32 million).
- Injury spending due to physical activity for admitted patients was highest for *other fractures* ($205 million), *soft tissue injury* ($98 million), and *tibia and ankle fractures* ($86 million).

The costs associated with injuries estimated in this report are assumed to reflect a preventable burden, in that the costs captured here reflect post-injury care rather than injury prevention activities and, the assumption that all injuries related to physical activity are potentially preventable (through improved prevention activities rather than avoiding activity).

Preliminary estimates of non-hospital burden and benefits of physical activity

Estimates presented in this report are conservative, and do not represent the full cost of injuries and benefits from physical activity participation, due to current data limitations. Injury costs do not currently include ongoing rehabilitation costs, or costs of other conditions such as osteoarthritis occurring after the injury. Preliminary (conservative) estimates show that:

- Managing health conditions due to physical inactivity (such as coronary heart disease and type 2 diabetes) was estimated to cost the health system $968 million in 2018-19; and
- Participation in physical activity is estimated to save the health system $484 million per year on avoided disease costs (equating to health costs on related conditions being reduced by 6% due to participation in physical activity).

The benefits of physical activity through reduced chronic disease ($484 million) are conservative due to the limited number of conditions currently included in the physical inactivity model, and underestimate the benefits due to physical activity. While the cost of injuries ($764 million) and the savings on treatment of chronic diseases ($484 million) due to physical activity can be calculated from currently available data, it is not appropriate to subtract these from each other to calculate the net impact of physical activity due to the current limitations of data availability, which may provide misleading conclusions. Further work will be undertaken to more fully describe the benefits due to physical activity as well as the potential additional costs that might be incurred through increased physical activity.

1 Introduction

Insufficient physical activity is one of the leading causes of ill health and death globally, with high income countries comprising the bulk of attributable disease burden. The link between ill health and insufficient physical activity is well described and is the 9^{th} leading risk factor in 2018, accounting for 2.5% of total disease burden (AIHW 2021a).

Physical activity is associated with a range of health benefits, which have flow-on effects in terms of avoided health spending. On the other hand, physical activity can also be associated with injuries that have both acute and long-term health impacts that are associated with health spending.

Several studies have previously looked at the social and economic benefits of participation in physical activity (KPMG 2018, Boston Consulting Group 2017, Frontier Economics 2010). Health system costs of physical (in)activity have only been estimated and published to a limited degree in Australia. The methods used in these studies are not always well described, and the health costs in these studies were undertaken using a cost-of-illness approach generally focused on individual conditions in isolation. This approach can overestimate the actual cost of conditions, particularly where co-morbidities are experienced, and health spending might be aimed at addressing multiple conditions. This approach is also often not well suited to estimating the potential for cost avoidance through increased physical activity, or improved injury prevention and management practices.

Participation in physical activity contributes to the disease burden experienced due to injuries ('sports injuries'). This includes injuries occurring during (or resulting from) physical activity. Such injuries are also known to contribute to the development of several chronic musculoskeletal disorders (e.g. osteoarthritis) and chronic traumatic brain injury (e.g. chronic traumatic encephalitis). In many cases this burden might be prevented through improved injury prevention activities such as improved physical training exercises and routines and/or changes to the way physical activity is conducted.

Until now, however, no attempt has been made to look at both health system spending related to physical activity as well as spending that was avoided because of participation in physical activity on a population level. This project uses data available from the AIHW on disease expenditure and disease burden to advance the data available and fill the data gap for health system expenditure related to physical activity.

The AIHW disease expenditure database contains estimates of expenditure by Australian Burden of Disease Study (ABDS) condition, age group, and sex, for public and private admitted patient, emergency department, and outpatient hospital services, out-of-hospital medical services, and prescription pharmaceuticals (AIHW 2021b). In this database, spending on a given condition is viewed as a component of total health spending and as relative to spending on all other conditions. This approach helps mitigate some of the issues raised above. Current estimates are available for the cost of physical activity related injuries in admitted patient care and emergency departments, and future analyses will expand the estimates to include the cost of injuries not treated in hospitals.

The ABDS has estimated the proportion of disease burden on certain conditions that is due to physical inactivity as a risk factor. Physical activity is the inverse of physical inactivity and can be treated as such in a model. This project will use the fraction of chronic disease burden that is due to physical inactivity to calculate the health cost of inactivity, and to estimate the health costs avoided due to participation in activity.

This project will develop a more complete characterisation of the epidemiology of physical activity, and how it has been modelled for varying purposes. The overall benefit to the Australian health system attributable to participation in physical activity will then be estimated using a comparative risk assessment framework, and a measure of the avoidable level of physical inactivity related burden calculated as a baseline. This will then be extended into a proportional multistate life table to estimate the total avoidable disease burden and healthcare costs over the population lifetime if all Australians participated in the highest level of physical activity, with lowest injury risk. This will estimate the maximum possible health gain available over time, and to estimate the impact of Australia meeting physical activity guidelines, including the interactions between health benefits and injury risk.

This report provides an overview of initial findings relating to:

- Cost of physical activity related injuries treated as a hospital inpatient
- Cost of physical activity related injuries treated in emergency departments
- Summary of literature relating to non-hospital treated injuries from physical activity
- The health costs due to current levels of physical inactivity in Australia
- Cost offsets for diseases that are avoided due to the current level of physical activity undertaken

Estimates presented in this report are conservative, and do not represent the full cost of injuries and benefits from physical activity participation, due to current methodological and data limitations.

Additional stages of this project will expand the epidemiological model of physical (in)activity to better capture the risk of other associated conditions, providing updated health costs and cost offsets associated with physical (in)activity. The cost of physical activity related injuries treated outside of hospitals will be estimated, as will the long term outcomes of injuries. This data will then be used to model projections of various changes to population rates of physical activity. This work will conclude in late-2022.

2 Health system costs due to injury

Participation in physical activity can increase the chance of experiencing injuries. These can range from mild sprains causing discomfort, to fractures and dislocations limiting mobility and function. Many of these injuries are potentially preventable either through improved physical training regimes or changes in the way physical activity occurs.

Previous work within the AIHW has estimated the spending on injuries across the health system by cause, such as traffic accidents, and nature of the injury, such as fractures, within the context of a whole-of-system perspective (AIHW 2020b). The analysis in this report aims to estimate the contribution of physical activity to the health system expenditure on injuries. Due to data limitations on activities undertaken at the time of injury for injuries treated outside of hospitals, the analysis initially focuses on injuries treated in emergency departments and during hospital admissions. This places a focus on the spending that is associated with post-injury care, rather than preventive activities.

The estimates presented in this section represent a conservative estimate of costs from physical activity related injuries. Further work will be undertaken to estimate the contribution of physical activity to injuries treated outside of hospitals, and is discussed further in Chapter 3.1: *Non-hospital treated injury: literature review*.

Measuring the health service costs of physical activity related injury

Injuries within hospitals are classified using the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian modification (ICD-10-AM) Principal Diagnosis codes S00–T75 or T79. These codes are supplemented with an ICD-10-AM 'Activity at the time of injury' code in the range U50–U71, which allows the grouping of hospitalisations into physical activity and non-physical activity related.

The cost of injuries presented in Chapter 3 reflect injuries from all types of physical activity, not only 'sport related' injuries. The classification of ICD codes into 'physical activity related' is broad, so as to capture the spectrum of activities that are considered physical activity in the specifications for the physical inactivity risk factor, and includes codes such as 'leisure activity not elsewhere classified'. For further information, see Chapter 3.2: *Health cost of physical inactivity*.

Unlike admitted patient data, emergency department diagnosis data does not contain an 'Activity at the time of injury' code. The proportion of injuries due to physical activity has been estimated using the attribution of each ICD-10-AM diagnosis code to activities in the admitted patient data, applied to ICD-10-AM diagnoses in emergency departments.

In 2018-19, it is estimated that $764 million was spent treating injuries caused by physical activity in emergency departments and hospital admissions (Table 2.1). This was an average of 11% of all injury spending in these settings (Figure 2). The injuries with the highest total physical activity related expenditure in hospital settings were *other fractures* ($250 million), *soft tissue injuries* ($130 million), and *other injuries* ($118 million) (Table 2.1).

Figure 2: Total injury spending and percent of spending related to physical activity, by area of expenditure, 2018-19

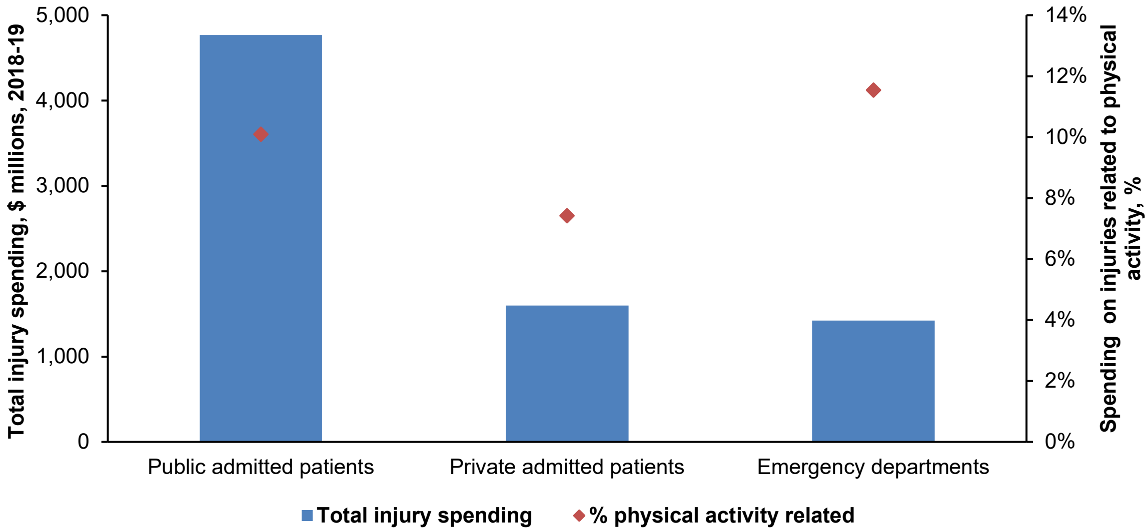


Table 2.1: Cost of physical activity related emergency department presentations and hospital admissions, by type of injury

Condition	Emergency department ($)	Admitted patient ($)	Total ($)
Other fractures	44,714,628	204,836,795	249,551,423
Soft tissue injuries	32,028,949	98,112,036	130,140,985
Other injuries	51,033,922	66,589,460	117,623,382
Tibia and ankle fracture	7,474,320	86,136,361	93,610,681
Humerus fracture	3,346,882	37,641,960	40,988,842
Traumatic brain injury	5,934,901	25,962,671	31,897,573
Dislocations	10,982,253	16,044,314	27,026,567
Hip fracture	902,730	22,277,281	23,180,011
Internal and crush injury	3,106,875	19,678,971	22,785,846
Spinal cord injury	100,035	8,528,278	8,628,313
Poisoning	2,110,349	6,483,232	8,593,580
Burn injuries	1,424,418	5,794,094	7,218,512
Drowning and submersion injuries	849,920	1,606,129	2,456,049
Total	**164,010,182**	**599,691,582**	**763,701,764**

2.1 Emergency department costs

Emergency departments are often the first location of treatment for serious injuries, accounting for $1.4 billion in total spending (Figure 2). It was estimated that $164 million (12%) of injuries treated in emergency departments were related to physical activity (Table 2.2).

Spending was highest for *other injuries* ($51 million), *other fractures* ($45 million), and *soft tissue injuries* ($32 million). The proportion of total injury spending attributed to physical activity was highest for *drowning and submersion injuries* (52%), *dislocations* (27%) and *tibia and ankle fractures* (23%).

Table 2.2: Cost of physical activity related emergency department presentations, by type of injury and percent of total

Condition	Physical activity cost ($)	Total cost($)	Cost due to physical activity (%)
Drowning and submersion injuries	849,920	1,638,696	52
Dislocations	10,982,253	40,462,533	27
Tibia and ankle fracture	7,474,320	32,490,879	23
Other fractures	44,714,628	208,311,217	21
Humerus fracture	3,346,882	16,986,794	20
Soft tissue injuries	32,028,949	162,690,870	20
Spinal cord injury	100,035	562,083	18
Traumatic brain injury	5,934,901	34,562,258	17
Internal and crush injury	3,106,875	26,145,845	12
Other injuries	51,033,922	761,539,242	7
Burn injuries	1,424,418	30,944,368	5
Hip fracture	902,730	22,164,411	4
Poisoning	2,110,349	81,601,517	3
Total	**164,010,182**	**1,420,100,714**	**12**

Spending on physical activity injuries presenting to the emergency department was higher for males ($109 million) than females ($55 million, Table 2.3). The percentage of total injuries that were attributed to physical activity was higher for males (14%) than females (9%).

The conditions that were treated varied substantially by sex. While 34% of *dislocations* were related to physical activity for males, this was only 17% for females. Similar differences are observed for *tibia and ankle fractures*, *humerus fractures,* and *other fractures*.

Table 2.3: Cost of physical activity related emergency department presentations, by sex and type of injury, 2018-19

Condition	Male physical activity cost ($)	Male physical activity %	Female physical activity cost ($)	Female physical activity %
Drowning and submersion injuries	526,884	55	321,042	47
Dislocations	8,252,791	34	2,728,571	17
Tibia and ankle fracture	5,213,985	31	2,259,592	14
Humerus fracture	1,937,432	28	1,409,364	14
Other fractures	31,012,709	26	13,698,203	15
Soft tissue injuries	19,246,211	24	12,779,798	16
Spinal cord injury	82,341	22	17,694	10
Traumatic brain injury	4,195,994	20	1,737,241	13
Internal and crush injury	2,414,664	14	691,774	8
Other injuries	33,733,229	8	17,295,505	6
Burn injuries	972,519	5	451,873	3
Hip fracture	411,712	5	491,010	3
Poisoning	1,150,608	3	959,077	2
Total	**109,151,079**	**14**	**54,840,744**	**9**

The percentage of injury spending attributed to physical activity was higher in younger age groups (Table 2.4). The percentage of spending on physical activity was highest at 10-14 years (12% and 19% for females and males), decreasing to 7-9% for those aged 85 years and over.

The total cost of physical activity related injuries is influenced by the size of the population and rate of injuries occurring within age and sex groups, as well as the relative cost of different types of injuries. The per person cost of injuries is calculated as the total cost divided by the total population with an age and sex group. The per person cost of physical activity injuries in 2018-19 was $8.74 per male in Australia, and $4.32 per female (Table 2.4). The average cost in the population was highest for at age 10-14 years for both males and females, and generally decreases over time.

Table 2.4: Total cost of physical activity (PA) related emergency department presentations, by age group and sex, 2018-19

Age group	Males PA cost ($)	Per person ($)	Males PA %	Females PA cost ($)	Per person ($)	Females PA %
<1 year	1,038,722	6.66	11	600,110	4.08	7
1-4 years	8,124,509	12.48	14	4,133,877	6.71	9
5-9 years	9,394,163	11.36	17	4,472,667	5.70	11
10-14 years	13,026,866	16.51	19	5,272,250	7.06	12
15-19 years	11,205,259	14.59	16	3,937,472	5.41	8
20-24 years	9,947,804	11.13	14	3,545,949	4.17	8
25-29 years	8,796,662	9.28	14	3,253,922	3.45	8
30-34 years	7,001,122	7.55	13	2,800,477	2.95	8
35-39 years	6,079,347	6.98	13	2,566,022	2.91	8
40-44 years	5,456,217	6.87	13	2,450,808	3.06	8
45-49 years	5,275,633	6.41	12	2,589,014	3.03	8
50-54 years	4,465,789	5.95	12	2,518,722	3.22	9
55-59 years	4,034,026	5.35	12	2,666,048	3.40	9
60-64 years	3,329,138	4.98	11	2,496,212	3.54	10
65-69 years	2,933,984	4.95	11	2,309,180	3.70	9
70-74 years	2,651,713	5.21	11	2,245,684	4.25	9
75-79 years	2,151,581	6.28	10	1,964,713	5.24	9
80-84 years	1,832,056	8.21	10	1,903,708	7.00	8
85 years and over	2,391,985	12.34	9	3,111,507	9.88	7
Total	**109,136,576**	**8.74**	**14**	**54,838,340**	**4.32**	**9**

2.2 Hospital admitted patients

Separations with an injury as a principal diagnosis accounted for an estimated $4.8 billion of expenditure for public hospital admitted patients, and $1.6 billion of private hospital admissions (Figure 2). This relates to 11.5% and 6.9% of total spending on public and private hospital admissions respectively (AIHW 2021b).

Physical activity was estimated to be responsible for $600 million of total admitted patient expenditure, around 9% of injury spending (Table 2.5). This varied widely by type of injury.

Injury spending due to physical activity was highest for *other fractures* ($205 million), *soft tissue injury* ($98 million), and *tibia and ankle fractures* ($86 million). On average, most sport related injuries are less costly than non-sport related (with the exception of soft tissue injuries).

Drowning and submersion injuries had the highest percentage of physical activity related spending (47%), followed by *soft tissue injuries* (26%), and *tibia and ankle fractures* and *dislocations* (both 20%). Physical activity contributed the least to *poisoning* (2%), *hip fractures* (4%) and *burn injuries* (5%).

Table 2.5: Total cost and number of separations related to physical activity, by type of injury, dollars and %, 2018-19

Condition	Physical activity cost ($)	Physical activity % of cost	Physical activity separations	Physical activity % of separations
Drowning and submersion injuries	1,606,129	47	303	52
Soft tissue injuries	98,112,036	26	12,809	22
Tibia and ankle fracture	86,136,361	20	7,891	22
Dislocations	16,044,314	20	3,148	24
Humerus fracture	37,641,960	19	3,719	19
Spinal cord injury	8,528,278	17	311	19
Other fractures	204,836,795	16	31,435	19
Internal and crush injury	19,678,971	12	1,852	15
Traumatic brain injury	25,962,671	8	5,712	17
Burn injuries	5,794,094	5	451	5
Hip fracture	22,277,281	4	1,887	4
Other injuries	66,589,460	3	19,461	5
Poisoning	6,483,232	2	1,156	2
Total	**599,691,582**	**9**	**90,136**	**11**

Total spending on physical activity related injuries was higher in public hospitals ($481 million) than private hospitals ($118 million, Table 2.6). The proportion of injuries that are related to physical activity was also higher in public compared to private hospitals (10% and 7% respectively). The greatest differences in physical activity related injury costs between hospital types were for *tibia and ankle fracture*, *humerus fracture*, and *other fractures* (between 10 to 15 percentage points higher in public hospitals). Total injury spending, and spending due to physical activity, was higher in private hospitals than public hospitals for *soft tissue injuries* ($54 million and 27%, compared to $44 million and 25%). Differences in the types of injuries treated in public and private hospital admissions is in part related to relatively higher rates of acute injury admissions in public hospitals following presentations to emergency departments, and more elective surgeries occurring in private hospitals.

Table 2.6: Total cost and proportion of injuries related to physical activity in public and private hospital admissions, by type of injury, dollars and %, 2018-19

Condition	Public hospital physical activity cost ($)	Public hospital (%)	Private hospital physical activity cost ($)	Private hospital (%)
Drowning and submersion injuries	1,600,803	47	5,325	72
Soft tissue injuries	44,427,064	25	53,684,972	27
Humerus fracture	33,968,171	22	3,673,789	7
Tibia and ankle fracture	74,869,706	22	11,266,655	13
Dislocations	12,093,118	22	3,951,196	15
Other fractures	173,984,363	18	30,852,432	10
Spinal cord injury	8,433,575	17	94,703	5
Internal and crush injury	19,036,906	13	642,065	5
Traumatic brain injury	25,007,256	9	955,415	3
Burn injuries	5,742,800	5	51,295	2
Other injuries	59,556,990	4	7,032,470	1
Hip fracture	16,484,322	3	5,792,959	4
Poisoning	6,036,526	2	446,706	3
Total	**481,241,600**	**10**	**118,449,981**	**7**

Health spending on injuries related to physical activity were higher for males ($402 million) than females ($197 million, Table 2.7). The proportion of total injuries spending that were caused by physical activity was almost double among males compares to females (12% and 7%).

Physical activity contributed the most to *drowning and submersion injuries* for both sexes (47%). For males, the next greatest proportion of injury spending was for *humerus fractures* and *tibia and ankle fractures* (both 27%), followed by *soft tissue injuries* and *dislocations* (both 26%). For females, the next greatest proportion of injury spending was *soft tissue injuries* (25%), followed by *tibia and ankle fractures* and *humerus fractures* (both 14%).

Table 2.7: Cost for physical activity related injuries for all admitted patients by sex, 2018-19

Condition	Males ($)	Males (%)	Females ($)	Females %
Drowning and submersion injuries	1,090,886	47	515,243	47
Humerus fracture	19,576,111	27	18,065,849	14
Tibia and ankle fracture	56,248,053	27	29,888,308	14
Soft tissue injuries	66,269,246	26	31,842,790	25
Dislocations	12,015,779	26	4,028,536	11
Other fractures	140,900,499	21	63,926,517	10
Spinal cord injury	6,864,220	18	1,664,058	13
Internal and crush injury	15,579,627	14	4,099,344	8
Traumatic brain injury	19,714,172	9	6,248,499	6
Burn injuries	4,327,951	5	1,466,144	3
Hip fracture	10,447,873	5	11,829,409	3
Other injuries	44,897,006	4	21,687,520	2
Poisoning	4,566,958	3	1,916,274	1
Total	**402,498,380**	**12**	**197,178,488**	**7**

The causes of injuries treated in public and private hospitals varied (Table 2.8). In public hospitals, injuries from *Leisure activity, not elsewhere classified* contributed the most to total injury spending ($129 million), followed by *team ball sports* ($117 million), and *wheeled non-motored sports* ($64 million). In private hospitals, injuries from *team ball sports* cost the most ($42 million), followed by *unspecified sport and exercise activity* ($18 million) and *leisure activity, not elsewhere classified* ($15 million). Note that leisure activity is included in specifications for the physical inactivity risk factor, so is included in estimates of physical activity related injuries. For further information, see Chapter 3.2: *Health cost of physical inactivity*.

Table 2.8: Total cost by type of activity, public and private hospital admissions, 2018-19

Activity Type	Public hospital physical activity cost ($)	Public (% of total)	Private hospital physical activity cost ($)	Private (% of total)
Leisure activity, not elsewhere classified	129,159,475	27	14,671,613	12
Team ball sports	116,524,810	24	42,427,454	36
Wheeled nonmotored sports	64,353,662	13	9,466,800	8
Wheeled motor sports	37,995,043	8	2,452,506	2
Individual water sports	20,090,924	4	3,328,739	3
Equestrian activities	16,839,885	3	1,620,468	1
Individual athletic activities	15,767,256	3	4,046,909	3
Other specified sport and exercise activity	12,193,328	3	2,981,563	3
Ice and snow sports	11,401,548	2	7,153,678	6
Team bat or stick sports	8,835,589	2	2,443,023	2
Adventure sports	7,236,969	2	1,356,104	1
Racquet sports	7,135,381	1	2,377,273	2
Combative sports	7,032,261	1	1,566,388	1
Unspecified sport and exercise activity	5,506,228	1	17,607,391	15
Aesthetic activities	4,810,875	1	1,044,620	1
Acrobatic sports	4,179,044	1	647,105	1
Target and precision sports	3,620,892	1	1,916,724	2
Boating sports	2,868,109	1	597,850	1
Aero sports	2,743,942	1	233,195	0.2
Power sports	1,364,997	0.3	312,792	0.3
Other school-related recreational activities	1,301,049	0.3	111,417	0.1
Multidiscipline sports	247,750	0.1	71,566	0.1
Team water sports	32,583	0.0	14,806	0.0
Total	**481,241,600**	**100**	**118,449,981**	**100**

The types of physical activity contributing to the cost of injuries resulting in admissions to hospital varies between males and females (Table 2.9). Team ball sports accounted for 31% of physical activity related injuries for males, and 18% for females. One third (33%) of injuries for females were due to *leisure activity, not elsewhere classified*, but only 20% for males.

These differences in cost between activities reflect differences in overall participation in an activity, risk of injury for each activity, and the type of injury sustained.

Table 2.9: Total cost of injuries for all admitted patients by type of activity and sex, 2018-19

Activity Type	Males ($)	Male (% of total)	Females ($)	Female (% of total)
Team ball sports	122,775,481	31	36,167,004	18
Leisure activity, not elsewhere classified	79,645,527	20	64,185,562	33
Wheeled nonmotored sports	57,708,208	14	16,107,327	8
Wheeled motor sports	36,943,739	9	3,503,810	2
Individual water sports	17,864,231	4	5,555,432	3
Unspecified sport and exercise activity	15,181,942	4	7,931,677	4
Ice and snow sports	9,842,769	2	8,712,456	4
Team bat or stick sports	9,077,478	2	2,201,133	1
Individual athletic activities	8,579,989	2	11,234,169	6
Other specified sport and exercise activity	8,255,447	2	6,919,444	4
Combative sports	6,956,602	2	1,642,047	1
Racquet sports	6,533,792	2	2,978,863	2
Equestrian activities	5,093,271	1	13,367,082	7
Adventure sports	4,465,606	1	4,127,467	2
Target and precision sports	3,220,463	1	2,317,152	1
Boating sports	2,615,908	1	850,051	0.4
Aero sports	2,266,694	1	710,442	0.4
Acrobatic sports	1,820,456	0.5	3,005,694	2
Aesthetic activities	1,373,550	0.3	4,481,945	2
Power sports	1,263,310	0.3	414,479	0.2
Other school-related recreational activities	787,094	0.2	625,371	0.3
Multidiscipline sports	191,110	0.0	128,207	0.1
Team water sports	35,713	0.0	11,676	0.0
Total	**402,498,380**	**100**	**197,178,488**	**100**

3 Improving health cost estimates

The information and preliminary findings (Box 3.1) presented in this section represents initial work to improve estimates of health costs of:

- physical activity related injuries outside of hospitals,
- physical inactivity, and
- health costs avoided from being physically active.

Box 3.1 Preliminary findings

- Seven studies have been undertaken in Australia that can contribute to estimate the prevalence and cost of physical activity injuries treated outside of hospitals (Table 3.1);
- The cost of managing health conditions due to physical inactivity (such as coronary heart disease and type 2 diabetes) was estimated to be $968 million in 2018-19; and
- Participation in physical activity is estimated to save the health system $484 million per year on avoided disease costs (health costs on related conditions are reduced by 6% due to participation in physical activity).

The health cost of physical inactivity is measured as the cost of conditions given the current levels of inactivity in Australia ($968 million), while the benefit ($484 million) can be interpreted as the additional cost on top of the current $968 million that would be expected if the whole population was sedentary ($1.5 billion).

These estimates are conservative due to the limited number of conditions modelled as outcomes of inactivity, and under estimate the costs and benefits due to physical (in)activity. Further work will be undertaken to more fully describe the benefits due to physical activity as well as the potential additional costs that might be incurred through increased physical activity. This is described in more detail in section 3.2: *Health cost of physical inactivity*, along with proposed methods to address this data gap.

3.1 Non-hospital treated injury: literature review

Not all injuries are treated in an emergency department or during a hospital admission. General practitioners, physiotherapists, and sports medicine physicians are common locations where treatment of lower severity injuries may occur. Data relating to the activities undertaken when injuries occurred is not available in these settings.

This component of the study is designed as a scoping review of the extent of injuries from sport and physical activity that do not result in presentation to a hospital. A scoping review is useful when the aim is to explore a body of literature and examine the characteristics and findings of the research. Like a systematic review, a scoping review uses reproducible search methods and allows for the inclusion and presentation of a wide range of study designs.

The data from this review will be used to estimate the total prevalence of injuries, and the contribution of sport and physical activity to injuries. This will then be used to estimate the spending on physical activity related injuries that occur outside of hospitals.

Search strategy

Combinations of the standard terms of sport or physical activity, injury, epidemiology, population-based and Australia were used in several databases (e.g. PubMed- example presented below, GoogleScholar). Journals that are known to publish epidemiological studies of sports injury were individually searched (e.g. Journal of Science and Medicine in Sport, British Journal of Sports Medicine). The references of included studies were scanned for further relevant publications. Publications are being further explored using online tools and programs such as Web of Science (Clarivate Analytics, subscription access), Connected Papers (www.connectedpapers.com) and Semantic Scholar (www.semanticscholar.org) to assist in identifying links with citing or cited work.

Inclusion and exclusion criteria

The results are limited to those which are written in English language. No limits on publication dates are applied. Population wide health surveys, prospective cohort studies and retrospective audits or surveys were included. A final number of included manuscripts is not provided as further searches and inclusions will take place.

Population health surveys/cohorts

Only a few Australian studies have been undertaken to determine population wide injury rates attributable to sport and/or physical activity (Table 3.1). Noting different time periods and study methods, estimates of injury incidence from physical activity over a 12 month period ranged from 16% to 22%. It was found that many of the injuries were minor to moderate in nature (abrasions, soft tissue trauma) and would not be reported within hospital or emergency department data sets. Leading treatment sources were self (33.9%), followed by physiotherapist (26.6%) and general practitioner (15.6%). No treatment was reported for 16.4%. Individual study methods and results are reported in Table 3.1.

Table 3.1: Summary of studies presenting data using population health surveys or cohorts to report sport and recreation injury in Australia.

Author, year	Aim	Duration (year), place	Data source	Age Sex	Injury findings (count/prevalence or rate)
Grimmer, 2000	to establish the prevalence of injury sustained from recreational and sporting activities by ordinary (nonelite) adolescents.	12 months (1997) Adelaide, South Australia	Paper based questionnaire administered at the school of all students.	11-12 & 15-16 yrs ~50% female	936 injured students of 3538 students 82.9% of injuries in 20 activities (of 142 activities listed). One injury per four students. One injury per three participations
Stevenson et al, 2003 Finch et al, 2002 Stevenson et al, 2000	to report the incidence of injury in Australian football, hockey, basketball and netball	2 years (1997-1998) Perth, Western Australia	Western Australian Sports Injury Study	mean=23 yrs (range 9–56) 46% female	1512 included. 16 injuries / 1000 hours of sports participation. 70% (n=677) of sample sustained at least one injury over the two seasons. Total of 1,499 injuries recorded.
Mummery, 2002	to determine the incidence of medically attended sport and recreation injuries	12 months (2000), Queensland	randomised household, CATI survey	18-94 years 49% female	1337 included, 191 people reported 222 injuries (16.6%)
Finch & Cassell, 2006	to estimate the rate of sport and active recreation injury in a defined population	12 months (year not stated) Latrobe Valley, Victoria	Randomised household, CATI survey	5+ years 51.9% female	1084 included 648 sport/PA participants. 5.2% (95% CI: 4.8, 5.6) sustained an injury.
Spinks, 2006	to calculate injury incidence for these common physical activities in children	12 months (2001-2003) Brisbane, Queensland	Childhood Injury Prevention Study	4-12 years 45% females	504 injuries in 315 children, from 744 in total sample. 67.7/100 children. 78.6% of injuries in Sports/ PA
Mitchell, 2010	to describe the frequency of self-reported injury and the source of injury treatment from participation in organised sport	12 months (2005) New South Wales	NSW Population Health Survey	16+ years % by sex unclear	11273 participants. 30.9% (95% CI: 28.2–33.6) injured in sport. Physio and GP most common treatment provider. Half of injured sports participants did not require formal treatment: one-third self-treated and one-fifth had no treatment.
Stokes, 2020	to examine the prevalence of self-reported injury in a longitudinal sample of young adults	Multiple (2010 & 2012) Victoria	International Youth Development Study	19-24 years 66% female	2010: 55.5% of 1187 were injured, 56.3% (53.3-59.3) from sport. 2012: 54.6% of 1137 were injured, 55.1% (52.1-58.2) from sport.

yrs= years; CATI=computer assisted telephone interview; GP=general practitioner; physio=physiotherapist

International studies

Population wide studies from the UK (Uitenbroek, 1996), USA (Conn, 2003, and Sheu, 2016), Finland (Parkkari, 2004, article requested from author), Germany (Schneider, 2006), Netherlands (Schmikli, 2009), Spain (Pons-Villanueva, 2010) and Denmark (Bueno, 2018) are also summarised. Findings suggest up to 20% of a population will experience a sports injury each year, noting different time periods, methods and definitions applied.

The National Health Interview Survey from the USA, found 25.9 injury episodes per 1000 population per year reported in 2003-12, increasing to 34.1 episodes reported in 2016 (Sheu, 2016). In the Netherlands, 20% of the responding sports participants experienced a sports injury each year. A German National Health survey reported a sports injury occurred in 3.1% of the adult population and 5.6% of the active adult population. Finally, in Denmark, 18.4% of adults and 19.3% of children reported having had one or more injuries in the 12 months previous that led to time off physical activity and/or contact to with the health care system.

Injury records from health or sports medicine clinics

Given that the majority of injuries are not treated in emergency departments or through hospital admissions, further literature was evaluated to better understand the treatment patterns for physical activity injuries in the community. This includes treatment through general practitioners, physiotherapists, and sports medicine clinics.

Seven publications reported data from attendance at a sports medicine clinic (Table 3.2). It was found that for every hospital admission, there were 11 emergency department presentations and 12 GP visits (Cassell, 2003). The most common sports involved were Australian football (13.3%), distance running (12.3%), and netball/basketball (8.6%). The most common injuries were sprains of the knee (7%), sprains of the ankle (6%) and anterior cruciate ligament injuries (4%)

Table 3.2: Summary of studies presenting data using Injury records from health or sports medicine clinics to report sport and recreation injury in Australia.

Author, year	Aim	Duration (year), place	Data source	Age Sex	Injury findings (count/prevalence or rate)
Hume & Marshall, 1994	to describe the nature extent and severity of sports injuries in New Zealand	12 months (1988), New Zealand	multiple sources in study – results focus on data of Dunedin Sports Injury Clinic	30% female (injured) 15-19 years most common	620 injuries treated
Jago & Finch, 1998	to obtain data on sporting and recreational injury that present to a general practice clinic	12 months (year not stated) Melbourne, Victoira	survey administered in four 2-week periods at 3 monthly intervals over 12 months.	median age 24 years, IQR range 20-28 (mean 25 years) 20.5% female	78 sport/rec injuries (~9% of all injuries)
Baquie, 1997	To document the diagnoses at a sports medicine clinic	12 months (1994-1995) Melbourne, Victoria	questionnaire administered at a single sports medicine clinic	age not reported sex not reported	2429, 58.7% considered overuse injuries 27.2% considered acute.
Finch & Kennihan, 2001 Finch & Mitchell, 2002	To describe the profile of sports injury patients who attend sports medicine clinics	12 months (1996-1998) Melbourne, Victoria	questionnaire administered across five sports medicine clinics	median 25.4 years (6.8-81.6) 31.2% female	6479 sports injury reported during SMIS1 and 1682 cases during SMIS2.
Gabbe & Finch, 2001 (data from study by Finch & Kenihan 2001)	to present a detailed profile of Australian football injuries presenting to sports medicine clinics.	12 months (1996-1997) Melbourne, Victoria	questionnaire administered across five sports medicine clinics	median 23.2 years (7.3-55.6) 1.1% female	1868 football injuries reported
Cassell et al, 2003	to quantify and describe injuries from sport and active recreation that were treated medically	12 months (1994-1995) Latrobe Valley, Victoria	Extended Latrobe Valley Injury Surveillance project (presentations to general practitioners)	4+ years of age 33% female	1003 injuries treated by GP. Corresponds to 187 per 10 000 resident population (4+ yrs (95% CI 160 to 214)
Thomas & Finch. 2011	to describe the types of patients who attended a dedicated sports medicine practice in a regional town	3 months (2009) Dubbo, NSW	audit of records from one rural sports medical practice	all ages 41% female	421 injured patients seen from which 42% had conditions/injuries from workplaces and 35% from sport.

3.2 Health cost of physical inactivity

Physical inactivity is an important risk factor for health, and is estimated to be responsible for 2.5% of disease burden in Australia (AIHW 2021a). In the Australian Burden of Disease Study 2018 (ABDS), physical inactivity is causally linked to the burden from type 2 diabetes, bowel cancer, dementia, coronary heart disease and stroke, as well as uterine and breast cancer in females. Other conditions may be related to physical inactivity, but have not been included in current burden estimates produced through the ABDS due to limitations of data quality and available evidence. An overview of the methods for modelling physical inactivity is detailed in box 3.2.

Box 3.2: Modelling physical inactivity

The estimated contribution of a risk factor to disease burden is calculated by comparing the observed risk factor distribution with an alternative and hypothetical distribution (the counterfactual scenario). For physical activity, the theoretical minimum risk distribution is compared with what is currently observed in the population. The relative risk of conditions is estimated on the basis of differences in disease outcomes for varying levels of physical activity compared to the minimal risk group, and combined with data on levels of activity undertaken in the population, to generate the population attributable fraction (PAF).

Physical activity is measured by the Metabolic Equivalent of Tasks (METs) performed across the Australian population, and classified into eight levels. Each of the categories has a relative risk for various conditions, with the highest risk being the most sedentary group.

Various studies have used different condition sets to estimate the health costs from physical inactivity, and the differences in disease inclusions may lead to large differences in the outcomes. The AIHW models 7 conditions (breast cancer, bowel cancer, coronary heart disease, dementia, type 2 diabetes, stroke, uterine cancer), while the Global Burden of Disease Study models 5 conditions (colorectal cancer, breast cancer, ischaemic heart disease, ischaemic stroke, type 2 diabetes). Other studies have included conditions outside of these sets, such as falls and depression.

Details of methods used to estimate levels of physical activity undertaken are available in the Australian Burden of Disease Study: methods and supplementary material 2018 publication (AIHW 2021c).

The ABDS risk factor of physical inactivity largely adheres to the scope from the Australian physical activity guidelines to estimate activity levels in terms of activities counted as physical activity (all physical activity domains, such as leisure, transport, occupational and household chores). This is to ensure that an accurate measure of total physical activity levels undertaken in Australia are included. However, it should be noted that the level of activity considered lowest risk for this analysis is different to the recommended level of physical activity in the Australian guidelines, as the purpose is to calculate total disease risk due to all levels of physical activity. Further information is available in the Frequently Asked Questions for the Australian Burden of Disease Study 2018: Interactive data on risk factor burden.

Cost of physical inactivity

The health costs of treating conditions associated with physical inactivity was estimated to be $968 million (13% of health costs for linked conditions) in 2018-19 (Table 3.3). Total attributable spending was greatest for *coronary heart disease* ($361 million), *type 2 diabetes* ($317 million), and *bowel cancer* ($122 million). The proportion of spending on each condition that is due to physical inactivity varies. Attributable spending as a proportion of total disease spending was highest for *type 2 diabetes* (20%), *uterine cancer* (15%) and *coronary heart disease* (15%).

Table 3.3: Disease spending attributed to physical inactivity, and total disease spending, 2018-19

Condition	Attributable cost to physical inactivity ($)	Total health costs ($)	Attributable cost to physical inactivity (%)
Type 2 diabetes	317,200,800	1,565,024,043	20%
Uterine cancer	13,031,838	84,375,656	15%
Coronary heart disease	360,961,859	2,337,756,692	15%
Bowel cancer	121,625,310	1,004,201,520	12%
Dementia	56,186,383	479,301,943	12%
Stroke	58,336,457	656,961,874	9%
Breast cancer	41,091,902	1,293,474,965	3%
Total	**968,434,549**	**7,421,096,692**	**13%**

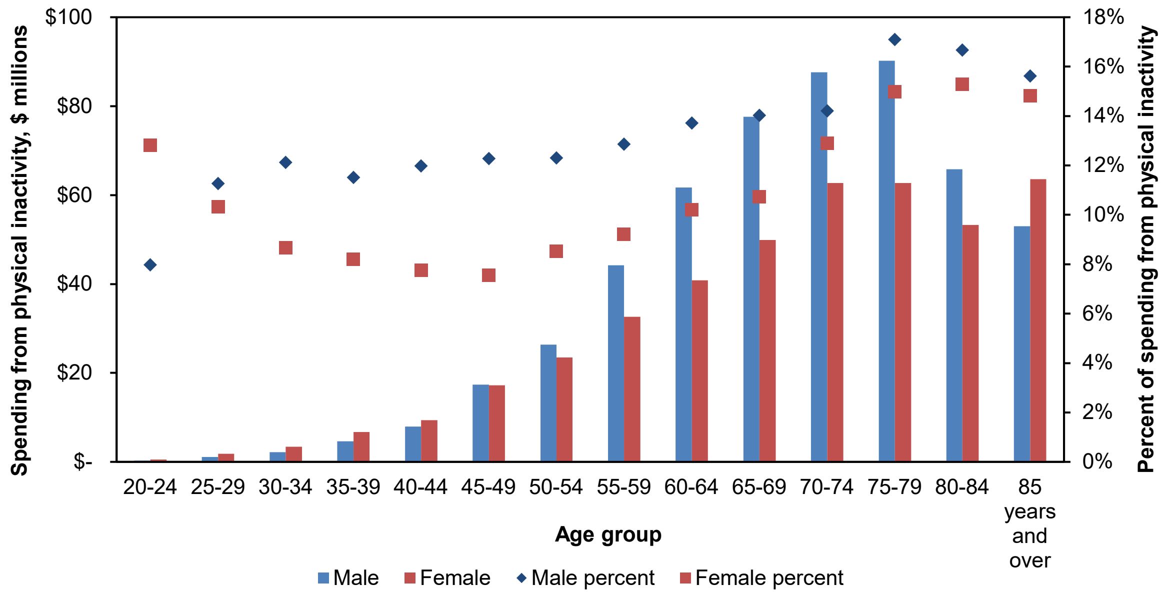
Total disease spending attributable to physical inactivity was higher for males ($540 million) than females ($428 million, Table 3.4). While males have slightly higher spending on diseases in general, the proportion of disease spending attributed to physical inactivity was higher for males (14% compared to 12%).

Table 3.4: Disease spending attributable to physical inactivity and total disease spending, by sex, 2018-19

Sex	Condition	Attributable cost to physical inactivity ($)	Total health costs ($)	Attributable cost to physical inactivity (%)
Male	Type 2 diabetes	177,558,755	920,180,262	19
	Coronary heart disease	246,585,451	1,684,612,964	15
	Dementia	24,034,011	210,244,625	11
	Bowel cancer	63,504,662	560,871,827	11
	Stroke	28,237,305	347,017,046	8
	Breast cancer	295,967	10,722,708	3
	Male total	**540,216,152**	**3,733,649,431**	**14**
Female	Type 2 diabetes	139,642,045	644,843,781	22
	Coronary heart disease	114,376,408	653,143,729	18
	Uterine cancer	13,031,838	84,375,656	15
	Bowel cancer	58,120,648	443,329,693	13
	Dementia	32,152,372	269,057,318	12
	Stroke	30,099,152	309,944,828	10
	Breast cancer	40,795,935	1,282,752,257	3
	Female total	**428,218,397**	**3,687,447,261**	**12**

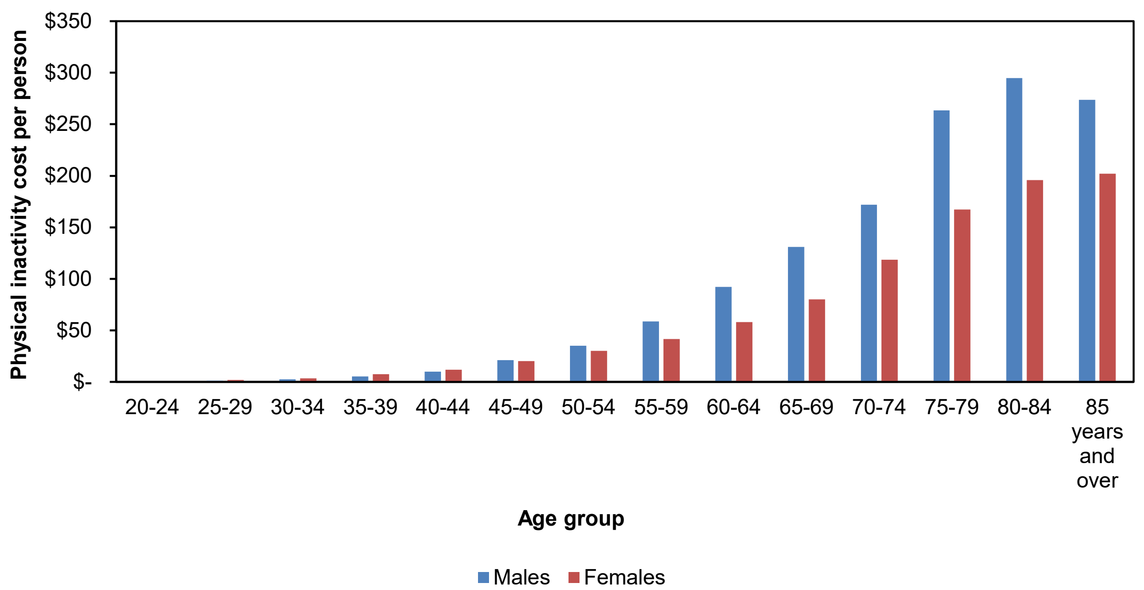
Spending on conditions attributed to physical inactivity varies over ages between males and females (Figure 3.1). For males, the proportion of associated spending is lowest in younger age groups and increases steadily with age (from 8% at ages 20-24, to 16% for those 85 and older). For females, attributed spending is high in younger age groups (13% for ages 20-24) before decreasing until age 50, after which point spending increases to 15% at ages 85 and older. With the exception of ages 20-24, the proportion of spending on conditions associated with physical inactivity is higher for males in all age groups than for females.

Figure 3.1: Spending attributed to physical inactivity by sex and age, 2018-19



The physical inactivity cost per person is about the same for males and females younger than 45 years old. The per person cost increases steadily with age and is highest for males aged 80-84 at $295. For females, the per person cost is highest for those aged over 85, at $202.

Figure 3.2: Per person spending attributed to physical inactivity by sex and age, 2018-19



Proposed updates to physical inactivity measurement

The current analysis is likely to underestimate the full impact of physical inactivity on health, and therefore underestimate the benefits experienced due to participation in physical activity. The AIHW is in the process of reviewing the methodology to include all the conditions that have been included in other studies and compare the impact of their inclusion on the estimates reported in this project. Additional work will seek to find evidence for the inclusion of any other conditions, such as back pain, metabolic syndrome or depression.

Physical inactivity can lead to increases in the prevalence of other health risk factors. This includes overweight and obesity, high blood plasma glucose, low bone mineral density, high cholesterol, and high blood pressure (Myers, 2019; Alghadir, 2015). Each of these risk factors are causally attributed to a wide range of conditions in the ABDS (Table 3.5), of which some are linked to physical inactivity, and many are not directly captured through the physical inactivity risk factor.

Table 3.5: Relevant additional risk factors and linked diseases

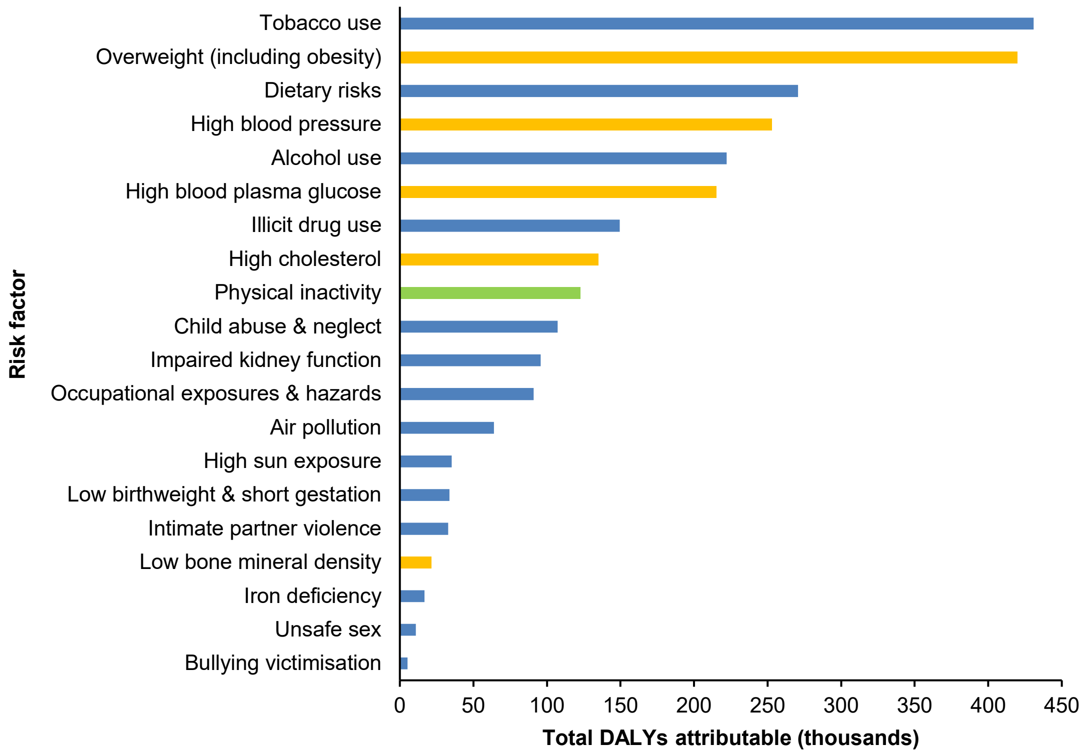
Risk factor	Risk factor exposure	Definition of exposure	Linked disease
High blood plasma glucose	Intermediate hyperglycaemia; diabetes	High fasting plasma glucose	Chronic kidney disease, **coronary heart disease**, **stroke**
	Diabetes	Self-reported diabetes	Bladder cancer, **bowel cancer**, **breast cancer**, cataract and other lens disorders, **dementia**, glaucoma, liver cancer, lung cancer, ovarian cancer, pancreatic cancer, peripheral vascular disease
	Diabetes	Diabetes	Chronic kidney disease, **type 2 diabetes**, type 1 diabetes, other diabetes
High blood pressure	High blood pressure	Systolic blood pressure	Aortic aneurysm, atrial fibrillation and flutter, cardiomyopathy, chronic kidney disease, **coronary heart disease**, **dementia**, hypertensive heart disease, inflammatory heart disease, other cardiovascular diseases, peripheral vascular disease, rheumatic heart disease, **stroke**, non-rheumatic valvular disease
High cholesterol	High cholesterol	LDL cholesterol	**Coronary heart disease, stroke**
Low bone mineral density	Low bone mineral density		Hip fracture, humerus fracture, other fractures, tibia and ankle fracture
Overweight & obesity	Overweight & obesity	Body mass index	Acute lymphoblastic leukaemia, acute myeloid leukaemia, asthma, atrial fibrillation and flutter, back pain and problems, **bowel cancer**, **breast cancer**, cataract and other lens disorders, chronic kidney disease, chronic lymphocytic leukaemia, chronic myeloid leukaemia, **coronary heart disease**, **dementia**, gallbladder and bile duct disease, gallbladder cancer, gout, hypertensive heart disease, kidney cancer, liver cancer, myeloma, non-hodgkin lymphoma, oesophageal cancer, osteoarthritis, other leukaemias, ovarian cancer, pancreatic cancer, **stroke**, thyroid cancer, **type 2 diabetes**, **uterine cancer**

Note: conditions listed in **bold** are conditions that are currently linked to the physical inactivity risk factor

Figure 3.2 shows that the risk factors overweight & obesity, high blood pressure, high blood plasma glucose, and high cholesterol all account for more total Disability Adjusted Life Years (DALYs, a measure of the disease burden experienced in a population) in Australia than physical inactivity itself, and therefore are important mediators to account for in modelling. Given that coronary heart disease and stroke are also linked to high cholesterol, and coronary heart disease and dementia are linked to high blood pressure, some component of the physical inactivity risk factor may be 'overcounted' when causally attributing total population burden with current mediation factors. Conversely, if total burden related to physical inactivity (including through mediating factors) is to be estimated, then omitting mediation through these risk factors on the range of conditions associated will vastly underestimate burden from inactivity.

The methodological update will evaluate the evidence available for mediation through these risk factors, and derive model inputs to update the physical inactivity estimates to include all possible links to other risks and conditions.

Figure 3.2: Leading risk factors by total DALYs, 2018.



Note: physical inactivity is coloured green, related risk factors are coloured yellow.

3.3 Health costs avoided from being physically active

Physical activity has many health benefits, and reduces the risk of developing various chronic health conditions. This component of work aims to quantify the health system costs that are avoided through this reduction in disease burden from participation in physical activity.

It is not possible to directly observe the avoided health costs from participating in physical activity. Therefore, to estimate the avoided health costs, we must first examine the costs to the health system if no-one was physically active. This hypothetical condition is termed the 'counterfactual', as it's 'counter-to-the-fact' that people are active in the population. This counterfactual is estimated in a similar way to the method outlined in Box 3.1: *Modelling* *physical inactivity*, using ABDS relative risks, population age and size, and proportion of the population in each grouping of physical activity to estimate the population attributable fraction (PAF). However, rather than using the group with the *highest* possible level of physical activity as the comparator for a population risk analysis, the *lowest* level of activity is compared to the level of activity actually undertaken in the Australian population.

This PAF is applied to the condition costs to calculate the risk factor cost. The cost estimates that result from this process are the estimated cost of cancer, cardiovascular diseases, diabetes, and other conditions that may have occurred without the protective effects from physical activity. The difference between the observed expenditure and the counterfactual represents the health system savings from physical activity.

Estimates of benefits from physical activity presented here are preliminary, and relate only to conditions currently linked to the physical inactivity risk factor. Work is being undertaken to expand the scope of conditions that are related to physical inactivity, to more completely reflect the health burden from this risk factor. These estimates of health cost offsets from physical activity will be updated and expanded following methodological updates to the estimation of physical inactivity risks.

Through this method, it was estimated that participation in physical activity saved the health system $484 million in 2018-19 (Table 3.6). This represents a saving of 6% of potential total health costs for linked conditions. The benefit of physical activity can be interpreted as the difference between the costs associated with current levels of inactivity in Australia ($968 million) and the expected physical inactivity costs if the whole population was sedentary ($1.5 billion). As outlined above, these estimates are conservative, and further work will be undertaken to more fully describe the benefits due to physical activity.

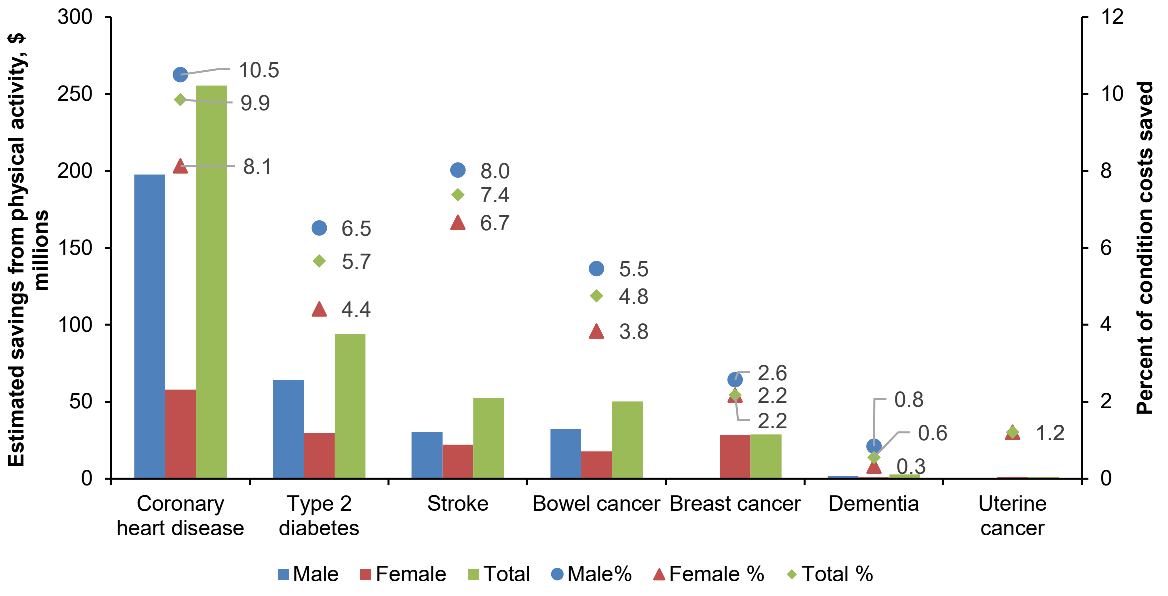
The benefit for males is about twice as much for males as females ($327 million compared to $158 million). The percent of total health costs avoided on related diseases for males was 8% and 4% for females.

Table 3.6: Total health savings due to participation in physical activity, estimated total spending on linked conditions, and percent of spending avoided, by sex, 2018-19

Sex	Benefit ($)	Estimated spending ($)	Savings (%)
Male	326,517,793	4,060,167,224	8.0
Female	157,791,909	3,845,239,169	4.1
Total persons	**484,309,701**	**7,905,406,393**	**6.1**

Health costs avoided were highest for *coronary heart disease* ($255 million, or 10%), followed by *type 2 diabetes* ($94 million, or 6%) and *stroke* ($52 million, or 7%, Figure 3.3). Most of the benefit of coronary heart disease is observed for males ($198 million, compared to $58 million for females). The greatest benefit for males was due to spending avoided on coronary heart disease, type 2 diabetes, and bowel cancer. For females, the greatest benefit was due to spending avoided on coronary heart disease, type 2 diabetes, and breast cancer.

Figure 3.3: Health savings on linked conditions due to participation in physical activity, estimated spending, and percent of spending avoided, by sex, 2018-19



Total health costs avoided increased with age and were highest between ages 55 to 74 for both males and females (Table 3.7). As a percentage of total estimated spending, proportional health savings were highest in younger age groups (7% and 12% for males and females), with benefits decreasing over time to 3% and 5% respectively. This is due to lower spending in general on linked conditions at younger ages.

Table 3.7: Total health savings due to participation in physical activity, and percent of spending on linked conditions avoided, by sex and age group, 2018-19

	Female			Male		
Age	**Benefit($)**	**Per person**	**Savings (%)**	**Benefit($)**	**Per person**	**Savings (%)**
20-24	343,468	$0.40	7.3	554,682	$0.62	12.0
25-29	1,050,163	$1.12	5.6	1,049,243	$1.11	9.9
30-34	2,034,327	$2.14	4.9	1,935,319	$2.09	9.6
35-39	3,771,993	$4.29	4.4	4,798,644	$5.52	10.6
40-44	4,915,088	$6.14	3.9	7,853,619	$9.92	10.6
45-49	10,414,752	$12.23	4.3	16,855,043	$20.52	10.6
50-54	11,629,592	$14.89	4.0	25,206,979	$33.65	10.5
55-59	18,585,684	$23.74	4.9	38,995,425	$51.81	10.2
60-64	19,757,229	$28.05	4.7	46,853,178	$70.15	9.4
65-69	26,290,255	$42.21	5.3	54,696,717	$92.40	9.0
70-74	19,600,786	$37.16	3.9	58,210,153	$114.48	8.6
75-79	14,081,154	$37.62	3.2	30,877,482	$90.32	5.5
80-84	11,777,763	$43.34	3.3	22,042,693	$98.92	5.3
85 years and over	13,539,654	$43.04	3.0	16,588,615	$85.70	4.6
Total	**157,791,909**	**$16.35**	**4.1**	**326,517,793**	**$35.20**	**8.0**

Health costs avoided from physical activity are greatest for public and private admitted patients ($170 million and $124 million), followed by pharmaceuticals ($77 million, Table 3.8). Most of the cost savings for admitted patients in public and private hospitals is due to lower spending on coronary heart disease ($93 million and $96 million respectively). For type 2 diabetes, one third of the benefit related to reduced pharmaceutical spending ($31 million of the total $94 million).

Table 3.8: Health savings on linked conditions due to participation in physical activity, by area of expenditure, $ millions, 2018-19

Area of expenditure	Bowel cancer	Breast cancer	Coronary heart disease	Dementia	Stroke	Type 2 diabetes	Uterine cancer	Total
Allied health*	0.02	0.04	0.34	0.03	0.24	2.54	0.00	3.21
Diagnostic imaging	0.22	0.37	2.45	0.10	1.18	0.12	0.01	4.45
General practice	0.79	0.46	7.38	0.13	1.17	7.77	0.01	17.72
Pathology	0.19	0.04	2.24	0.03	0.19	5.26	0.00	7.94
Pharmaceutical	18.29	10.10	15.89	0.11	1.51	31.38	0.05	77.33
Private hospital admitted patient	9.41	4.63	96.47	0.15	8.71	3.83	0.32	123.51
Public hospital admitted patient	11.93	6.28	92.93	1.23	29.48	27.37	0.37	169.59
Public hospital emergency department	0.02	0.01	11.57	0.05	5.18	0.16	0.00	16.99
Public hospital outpatient clinic	6.36	5.22	15.30	0.76	3.87	13.41	0.20	45.12
Specialist	2.86	1.61	10.89	0.08	0.84	2.08	0.08	18.43
Total	**50.09**	**28.76**	**255.46**	**2.68**	**52.38**	**93.91**	**1.03**	**484.31**

Note: * allied health spending in the disease expenditure database does not capture all spending on allied health, such as physiotherapy.

Future directions

The preliminary analysis presented in this report represents the first steps towards a complete evaluation of the net impact of physical activity on the Australian health system. It was found that the cost of treating injuries caused by physical activity through the hospital system was $764 million. This is an underestimate of the total cost of physical activity related injuries, as this does not capture the cost of injuries outside of hospitals, or the long term impact of them, such as osteoarthritis. This will be explored further, and included in future reporting. The cost of physical activity related injuries treated outside of hospitals will be estimated, as will the long term outcomes of injuries. The investment into prevention of sports injuries will also be explored.

The cost of treating conditions linked to physical inactivity are substantial ($968 million), and would be much higher if Australians did not undertake any physical activity. However, the estimates of costs related to physical inactivity, and the benefits of physical activity are currently under-estimated. Work will be undertaken to expand the epidemiological model of physical inactivity to better capture the risk of other associated conditions and risk factors. Together with complete injury cost data, this will provide a fuller understanding of the net benefits of physical activity participation.

Appendix A: Technical notes

Disease expenditure database

The main source of information for this report is the AIHW's Disease Expenditure Database. It contains estimates of spending by Australian Burden of Disease Study condition, age group, and sex for admitted patient, emergency department, and outpatient hospital services, out-of-hospital medical services, and prescription pharmaceuticals.

The methods used for estimating disease spending is a mixture of 'top-down' and 'bottom-up' approaches, where total spending across the health system is estimated and then allocated to the relevant conditions based on the available service use data.

Although this approach produces consistency, good coverage and totals that add up to known expenditure, it is not as comprehensive for any specific disease as a detailed 'bottom-up' analysis, which would include the actual costs incurred for that disease. A lack of amenable data sources means that a more granular 'bottom-up' analysis is not possible.

Estimates in the Disease Expenditure Database have been derived by combining information from the:

- National Hospital Morbidity Database (NHMD)
- National Public Hospitals Establishments Database (NPHED)
- National Non-admitted Patient Emergency Department Care Database (NNAPEDC)
- National Non-admitted Patient Databases (aggregate, NAPAGG, and unit record, NAPUR)
- National Hospital Costs Data Collection (NHCDC)
- Private Hospital Data Bureau (PHDB) collection
- Bettering the Evaluation and Care of Health (BEACH) survey
- Medicare Benefits Schedule (MBS)
- Pharmaceutical Benefits Scheme (PBS)
- Health Expenditure Database.

It is not technically appropriate or feasible to allocate all spending on health goods and services by disease. For example, neither administration expenditure nor capital expenditure can be meaningfully attributed to any particular condition due to their nature. For the purposes of this report, $136 billion, or 73% of recurrent spending, was attributed to specific diseases and injuries. This expenditure includes payments from all sources of funds, such as the Australian and State and Territory Governments, Private Health Insurance, and out of pocket payments by patients.

Some components of recurrent expenditure are allocated differently between the health expenditure Australia database, and the disease expenditure study. This approach was taken to reflect patterns of healthcare use for particular conditions, which is the focus of this body of work, rather than health funding arrangements. Spending estimates in hospitals are slightly higher than in the Health Expenditure Database, while spending on referred medical services are lower. This is discussed further in the *Disease Expenditure 2018–19 Study: Overview of analysis and methodology* report.

Risk factors

A risk factor is any determinant that causes (or increases the likelihood of) one or more diseases or injuries. As well as providing estimates of fatal and non-fatal burden, burden of disease methodology allows death and health loss to be attributed to specific underlying (or linked) risk factors. Quantification of the impact of risk factors assists evidence-based decisions about where to direct efforts to prevent disease and injury and to improve population health.

The basic steps of estimating risk factor attributable burden are:

1. select risk factors
2. identify linked diseases based on convincing or probable evidence in the literature that the risk factor has a causal association with increased prevalence or mortality
3. define the exposure to the risk factor that is not associated with increased risk of disease (the theoretical minimum risk exposure distribution, or TMRED, or counterfactual)
4. estimate the population attributable fractions (PAFs) by either a direct method or the comparative risk assessment method:
   (a) if PAFs appropriate to the disease and population in question are available from a comprehensive data source (such as a disease register), they are estimated directly from this data source (named a direct PAF in this report) and do not require steps 5, 6 and 7
   (b) if not, PAFs are created using the comparative risk assessment method, which involves steps 5, 6 and 7
5. define the amount of increased risk (relative risk) of morbidity or mortality for the linked disease due to exposure to the risk factor
6. estimate exposure to each risk factor in the population
7. use these inputs to calculate the PAF. The PAF has a value between 0 and 1, where 0 means there was no burden attributable to the risk factor and 1 means that all the burden for the linked disease was attributable to the risk factor.

The burden attributable to each risk factor is calculated by applying the PAFs for each linked disease to the relevant year of life lost and year lived with disease.

For further information, refer to the *Australian Burden of Disease Study: methods and supplementary material 2018*.

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Abbreviations

ABDS	Australian Burden of Disease Study
AIHW	Australian Institute of Health and Welfare
ASC	Australian Sports Commission
BEACH	Bettering the Evaluation and Care of Health
DALY	Disability Adjusted Life Year
ICD	International Statistical Classification of Diseases and Related Health Problems
LDL	Low Density Lipoprotein
MBS	Medicare Benefits Schedule
MET	Metabolic Equivalent of Tasks
NAPAGG	National Non-admitted Patient Database (Aggregate)
NAPUR	National Non-admitted Patient Database (Unit record)
NHCDC	National Hospital Costs Data Collection
NHMD	National Hospital Morbidity Database
NNAPEDC	National Non-admitted Patient Emergency Department Care
NPHED	National Public Hospitals Establishments Database
PA	Physical activity
PAF	Population Attributable Fraction
PHDB	Private Hospital Data Bureau Collection
PBS	Pharmaceutical Benefits Scheme

Glossary

Admission: An admission to hospital. The term **hospitalisation** is used to describe an episode of hospital care that starts with the formal admission process and ends with the formal separation process. The number of separations has been taken as the number of admissions; hence, admission rate is the same as separation rate.

average length of stay: The average of the length of stay for admitted patient episodes. Calculated by dividing total patients days in a given period by the total number of hospital separations in that period.

burden of disease and injury: Term referring to the quantified impact of a disease or injury on an individual or population, using the **disability-adjusted life year (DALY)** measure.

disability-adjusted life year (DALY): A year of healthy life lost, either through premature death or equivalently through living with disability due to illness or injury. It is the basic unit used in **burden of disease and injury** estimates.

International Classification of Diseases (ICD): The World Health Organization's internationally accepted statistical classification of death and disease. The 10th revision (ICD-10) is currently in use. The Australian modification of the ICD-10 (ICD-10-AM) is used for diagnoses and procedures recorded for patients admitted to hospitals.

non-admitted patient: A patient who receives care from a recognised non-admitted patient service/clinic of a hospital, including emergency departments and outpatient clinics.

principal diagnosis: The diagnosis listed in hospital records to describe the problem that was chiefly responsible for hospitalisation.

private hospital: A health-care provider facility, other than a public hospital, that has been established under state or territory legislation as a hospital or freestanding day procedure unit and authorised to facilitate the provision of hospital services to patients. A private hospital is not defined by whether it is privately owned but by whether it is not a public hospital (as defined below). Private hospital expenditure includes expenditures incurred by a private hospital in providing contracted and/or ad hoc treatments for public patients.

public hospital: A health-care provider facility that has been established under state or territory legislation as a hospital or as a freestanding day procedure unit. Public hospitals are operated by, or on behalf of, the government of the state or territory in which they are established and are authorised under that state/territory's legislation to provide or facilitate the provision of hospital services to patients. Public hospitals include some denominational hospitals that are privately owned. Australian Defence Force hospitals are not included in the scope of public hospitals.

injury cases: Estimated as the number of injury separations, less those records where the mode of admission was 'Admitted patient transferred from another hospital'. These transfers are omitted to reduce over-counting.

physical activity: Australia's Physical Activity and Sedentary Behaviour Guidelines (2014) recommend that:

- Young people (13-17 years) accumulate at least 60 minutes of moderate to vigorous physical activity everyday, from a variety of activities including some vigorous.
- Adults (18-64 years) should be active most days of the week, accumulate 150 to 300 minutes moderate intensity physical activity or 75 to 150 minutes of vigorous intensity physical activity (or an equivalent combination each week), and do muscle strengthening activities on at least two days each week.
- Older Australians (65 years and over) should accumulate at least 30 minutes of moderate intensity physical activity on most, preferably all, days.

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The purpose of this project is to quantify the health spending related to physical activity within the Australian population. This was done by assessing costs due to immediate and long-term risk of injuries, and the avoided health spending due to better health status. This initial report presents estimates of hospital spending related to emergency departments and hospital admissions (where diagnosis and external cause data is available).

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