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The social and economic costs of ADHD in Australia

Report prepared for the Australian ADHD Professionals Association

July 2019

Deloitte Access Economics

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Acknowledgements

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Glossary

ABODS	Australian Burden of Disease Study
ABS	Australian Bureau of Statistics
ADHD	attention deficit hyperactivity disorder
AIC	Australian Institute of Criminology
AIHW	Australian Institute of Health and Welfare
AWE	average weekly earnings
DALY	disability adjusted life year
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders, 4th Edition
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, 5th Edition
ER	emergency room
GBD	Global Burden of Disease
GP	general practitioner
HKD	hyperkinetic disorder
IEP	Individualised Educational Plans
MBS	Medicare Benefits Schedule
MRR	mortality rate ratio
NCCD	Nationally Consistent Collection of Data on School Students with Disability
NDI	National Death Index
NHIS	National Health Interview Survey
NHMRC	National Health and Medical Research Council
ODD	oppositional defiant disorder
PAF	population attributable fraction
PBS	Pharmaceutical Benefits Scheme
SSG	student support group
VSL(Y)	value of a statistical life (year)
YLD	year of healthy life lost due to disability
YLL	year of life lost due to premature death
YMM	Young Minds Matter

Executive summary

Key findings

- ADHD affects approximately 281,200 children and adolescents (aged 0-19) and 533,300 adults (aged 20+) in Australia.
- The total cost of ADHD in Australia in 2019 is $20.42 billion, which includes financial costs of $12.83 billion and wellbeing losses of $7.59 billion. Productivity losses due to ADHD are substantial ($10.19 billion).

Background

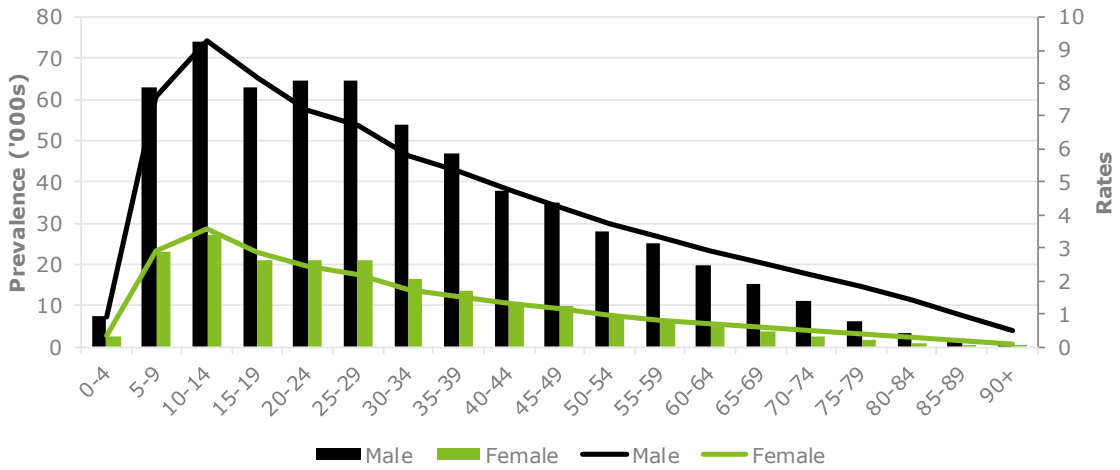
Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder that affects over 800,000 people in Australia today. ADHD is characterised by symptoms of inattention, impulsivity, and in some cases excessive levels of hyperactivity. Diagnosis is provided once symptoms are deemed by a specialist clinician to meet the diagnostic criteria. There is no one single known cause of ADHD; it is a syndrome that arises from an interaction of genetic, social and environmental factors. Despite the uncertainty of the cause of ADHD and the variation in the reported prevalence, it is clear that in Australia today, the social and economic cost of ADHD is large.

Prevalence

The reported prevalence of ADHD in Australia varies widely depending on the method used to assess the syndrome. There is some disagreement in the community over whether ADHD is under or over-diagnosed. Despite this, it is recognised as the most common neurodevelopmental disorder in children and adolescents. Prevalence estimates, both domestically and internationally vary considerably, however it is noted that higher income countries tend to have higher prevalence rates of ADHD.

In Australia, the prevalence of ADHD in children (under 14 years of age) was estimated to be 4.2%, and for adults (between 18 and 44 years of age) prevalence was estimated at 4.0%. Prevalence for adults over the age of 45 drops significantly, to 1.8%. Prevalence is higher for males than it is for females (a ratio of 2-3:1), with ADHD highest during childhood and declining with age. Prevalence of ADHD in children aged up to 14 years is 5.8% and 2.3% in males and females respectively; meaning a total of 197,400 children (14 years and younger) have ADHD. A breakdown of estimated prevalence by age and gender is shown in Chart i.

Chart i Estimated prevalence of ADHD, by age and gender, 2019



Source: Deloitte Access Economics analysis based on GBD (2017) and Ebejer et al (2012).

Social and economic costs of ADHD

The total social and economic costs of ADHD in 2019 were estimated to be $20.42 billion. Per person with ADHD, the cost is $25,071.

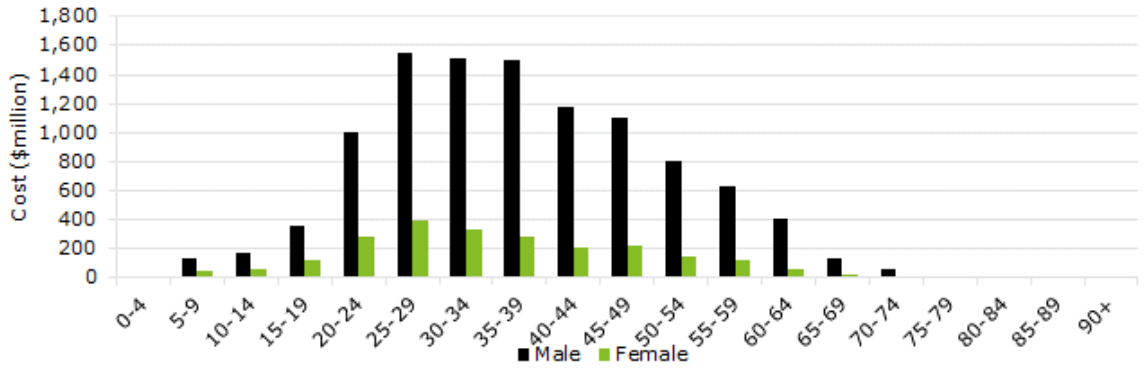
Table i Total costs of ADHD in 2019, by component

Cost component	Total ($bn)	Per person ($)
Health system costs	0.81	1,000
Productivity costs	10.19	12,509
Other financial costs	1.82	2,238
Education	0.11	130
Crime and justice	0.31	377
Deadweight loss[1]	1.41	1,730
Total economic costs	**12.83**	**15,747**
Loss of wellbeing	**7.59**	**9,324**

Source: Deloitte Access Economics calculations. Note: components may not sum due to rounding.

Chart ii depicts the cost of ADHD by age and gender. Costs are concentrated in earlier to middle aged years due to the distribution of ADHD prevalence and the fact that people in their prime working years incur higher productivity costs as a result of ADHD.

Chart ii Financial costs of ADHD in 2019, by age and gender

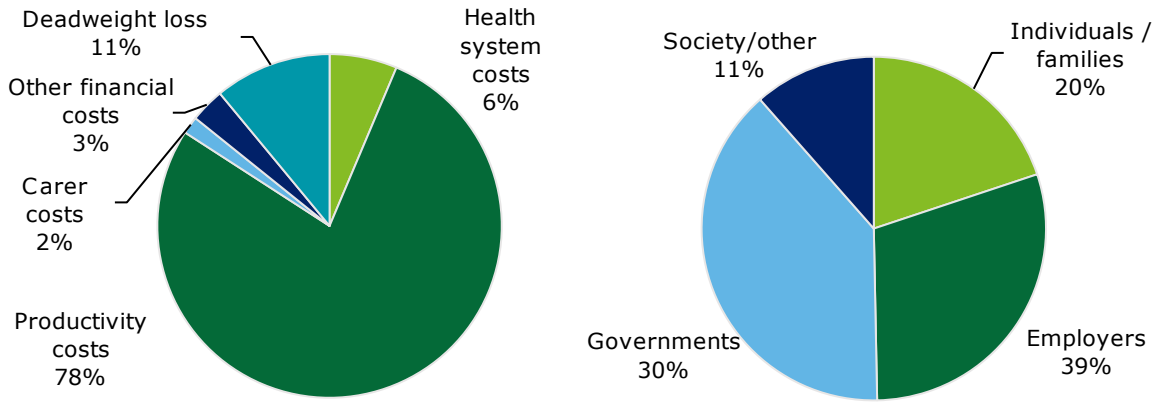


Source: Deloitte Access Economics.

Productivity costs make up 81% of total financial costs, which is followed by deadweight losses (11%), health system costs (6%), and other costs including educational and crime and justice costs (3%) (Chart iii). Employers were estimated to bear the largest share of financial costs (39%) followed by governments (30%), individuals and their families (20%) and society and other payers (11%).

[1] Deadweight losses are costs associated with the act of taxation, which create distortions and inefficiencies in the economy. Imposing taxes on a market reduces the efficiency of resource allocation within that market because it changes the price of those goods or services being taxed. For example, an increase in income tax rates will increase the relative price of work compared to leisure and therefore create a disincentive to work. Similarly businesses may be discouraged from operating in Australia if company tax rates were too high.

Chart iii Percentage share of total financial costs of ADHD by cost component (LHS) and payer (RHS)



Source: Deloitte Access Economics.

Wellbeing costs

In addition to imposing significant financial costs, ADHD results in suffering that leads to a significant loss of wellbeing for those affected. Wellbeing costs total $7.59 billion in 2019. Per person, the wellbeing cost of ADHD is $9,324 per person in 2019.

Future directions

This report has found ADHD imposes significant economic and wellbeing costs on the Australian population. ADHD can have lifelong impacts, including on educational achievement, occupational attainment, and the increased likelihood of crime and interaction with the criminal justice system. These impacts place significant pressure on Australian society and its institutions.

As such, there is a continued need to raise awareness of the socioeconomic burden of ADHD in Australia and educate and inform key stakeholders including individuals, education systems, workplaces, and society in an attempt to reduce the burden and lifelong impact that ADHD may have. There are likely substantial opportunities for targeted policy interventions to help mitigate this costly condition.

Deloitte Access Economics

1 Background

Deloitte Access Economics was commissioned by the Australian ADHD Professionals Association (AADPA) to quantify the economic burden of attention deficit hyperactivity disorder (ADHD) in Australia.

The AADPA is a not-for-profit organisation that aims to provide a unified professional perspective on the causes, diagnosis, management and treatment of ADHD.

This report has been structured in the following manner:

- **Chapter 1** describes the condition and discusses the approach taken to estimate the costs of ADHD.
- **Chapter 2** presents prevalence estimates for ADHD.
- **Chapter 3** estimates the costs of ADHD to the health system by type of cost, and by payer.
- **Chapter 4** discusses the productivity costs due to ADHD.
- **Chapter 5** outlines other financial costs that arise from ADHD, including education and justice costs, and the costs of crime due to ADHD.
- **Chapter 6** estimates the burden of disease due to ADHD.
- **Chapter 7** summarises the total costs of ADHD.

1.1 What is ADHD?

ADHD is a mental health disorder and recognised as the most common of the neurodevelopmental disorders that usually start in childhood. ADHD is defined by age-inappropriate levels of inattention, impulsivity and hyperactivity.[2] Onset is classically in early childhood and is the most prevalent mental disorder of childhood and adolescence.[3] While ADHD prevalence decreases with age, ADHD often persists and remains relatively common in adults (chapter 2). There is also evidence that ADHD can present for the first time in adolescence or adulthood for some people.[4] Whilst these individuals would not meet the age of onset criterion in formal diagnostic tools their problems and impairments are similar to those with persistent ADHD with earlier onset. The prevalence of ADHD is higher in males than in females.

ADHD is typically separated into three presentations:

- **Hyperactive-impulsive presentation**: behaviours can include not being able to remain seated in a classroom, being unable to play or take part in leisure activities quietly, talking excessively, trouble waiting his/her turn and often interrupting or intruding on others.
- **Inattentive presentation:** behaviours can include not being able to focus on details, not following through on instructions and not seeming to listen when spoken to directly.
- **Combined presentation:** meeting the criteria for both hyperactive-impulsive and inattentive types.

The contribution of hyperactivity, impulsivity and inattention to an individual's presentation of ADHD varies from person to person and often changes across their lifespan.

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[2] Erskine, H. E., Norman, R. E., Ferrari, A. J., Chan, G. C., Copeland, W. E., Whiteford, H. A., & Scott, J. G. (2016). Long-term outcomes of attention-deficit/hyperactivity disorder and conduct disorder: a systematic review and meta-analysis. Journal of the American Academy of Child & Adolescent Psychiatry, 55(10), 841-850.

[3] Lawrence, D., Johnson, S., Hafekost, J., Boterhoven de Haan, K., Sawyer, M., Ainley, J., & Zubrick, S. R. (2015). The mental health of children and adolescents: report on the second Australian child and adolescent survey of mental health and wellbeing. *Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing*. Department of Health, Canberra.

[4] Agnew-Blais, J. C., Polanczyk, G. V., Danese, A., Wertz, J., Moffitt, T. E., & Arseneault, L. (2016). Evaluation of the persistence, remission, and emergence of attention-deficit/hyperactivity disorder in young adulthood. JAMA Psychiatry, 73(7), 713-720.

1.2 Diagnosis of ADHD

ADHD is typically diagnosed by a paediatrician, psychiatrist or psychologist.[5] Given there is no reliable biological test for ADHD, the assessment process involves a comprehensive evaluation of information gathered from a number of sources (e.g. the individual, parents, spouses, teachers, other family members). A full assessment includes: clinical examination; clinical interviews; assessment of familial and educational needs; and assessment tools and rating scales.

Formal diagnosis is made when the nature, frequency and duration of the patient's symptoms fulfil the criteria set out in one of two medical classification systems: the *Diagnostic and Statistical Manual of Mental Disorders, 5th Edition*[6] (DSM-5[7]) or the *International Statistical Classification of Diseases and Related Health Problems, 11th revision*[8] (ICD-11). In the DSM-5, six or more symptoms (five symptoms for adults) of inattention and/or hyperactivity and impulsivity must be present for at least 6 months, and the symptoms must be inappropriate for the individual's developmental level.[9] Symptoms may include: often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g. loses focus, side-tracked); or often leaves seat in situations when remaining seated is expected.

For the DSM-5 there are a number of further criteria where the practitioner must be satisfied, including that the symptoms:

- were present before the individual was 12 years old
- are present in multiple settings (such as at home and school or work)
- are not better explained by another disorder
- clearly interfere with quality of life and functioning.

The DSM-5 was introduced in 2013, replacing the previous DSM-IV which included revisions to the diagnostic criteria for ADHD which aim at better identifying ADHD symptoms across the lifespan. These revisions include:

- additional examples of how symptoms may manifest in adolescence and adulthood
- a reduction from six to five in the minimum number of symptoms in either symptom domain required for older adolescents and adults
- change from *onset of symptoms and impairments* before age 7 to *onset of symptoms* before age 12
- change from *evidence of impairment* to *evidence of symptoms* in two or more settings
- autism spectrum disorder is no longer an exclusionary diagnosis.[10]

In summary, under DSM-5 adolescents and adults are more likely to receive an ADHD diagnosis than under DSM-IV due to the expansion of the age of symptom onset and reduction in the number of symptoms required for ADHD diagnosis in older adolescents and adults. Therefore

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[5] Australian Psychological Society. (January 2019). ADHD in Children. Retrieved from https://www.psychology.org.au/for-the-public/Psychology-topics/ADHD-in-children.
[6] American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition. 2013.
[7] The DSM-5 was introduced in 2013, replacing the DSM-IV, including revisions to the diagnostic criteria for ADHD. While the specific criteria have not been fundamentally changed, they have been augmented with specific examples of possible symptom presentation in children, adolescents, and adults. The DSM-5 revisions include modifications to each of the ADHD diagnostic criteria, largely to provide examples of how ADHD may present in adults and to change the age of onset criterion from age 7 to age 12. The scope of some symptoms was also revised (e.g. to describe a general impact on functioning rather than a clinically relevant impact on functioning). Source: Epstein, J. N., and Loren, R.E. (2013). Changes in the Definition of ADHD in DSM-5: Subtle but Important. *Neuropsychiatry (London),* Oct 1; 3(5): 455–458.
[8] World Health Organization. The ICD-11 Classification of Mental and Behavioural Disorders. Available at: https://icd.who.int/browse11/l-m/en Accessed April 2019. The ICD-11 was introduced in June 2018 and will formally replace the previous ICD-10 in May 2019. The ICD-11 will be more comparable to the DSM-5 than the ICD-10. Studies that have used the ICD-10 will be describing a more severely affected group.
[9] Center for Disease Control. (December 2018). Attention-Deficit/Hyperactivity Disorder (ADHD) – Symptoms and Diagnosis. Retrieved from https://www.cdc.gov/ncbddd/adhd/diagnosis.html.
[10] Epstein, J. N., and Loren, R.E. (2013). Changes in the Definition of ADHD in DSM-5: Subtle but Important. *Neuropsychiatry* (London), Oct 1; 3(5): 455–458.

studies using DSM-IV may underestimate the prevalence of ADHD especially for adolescents and adults compared with the DSM-5 criteria.

The ICD-10 classified ADHD as hyperkinetic disorder (HKD), which was defined as a persistent and severe impairment of psychological development, characterised by early onset; a combination of overactive, poorly modulated behaviour with marked inattention and lack of persistent task involvement; and pervasiveness over situations and persistence over time of these behavioural characteristics. As such this defined a more severely affected group than either DSM-IV or DSM-5. The recently published ICD-11 has included a classification for ADHD that is more similar to the DSM-5 definition and it is therefore anticipated that the cases defined by the two systems will also be more alike.[11]

The ICD and DSM systems are both widely used and accepted, although in Australia, most of the research and clinical practice of psychiatry is based on the DSM-5. As such, this report largely focuses on the DSM-5 (or earlier versions).

1.3 Risk factors and comorbidities of ADHD

Like many complex neurodevelopmental syndromes, ADHD is a highly heritable disorder involving multiple genes each with a small effect.[12] In addition to genetic factors, there are environmental risk factors for childhood symptoms of ADHD including maternal smoking and low birth weight.[13] Children with ADHD often have increased difficulties with reading, motor performance, emotional regulation and social interaction.[14] ADHD is associated with social, criminal and financial problems in adolescence and adulthood. Higher rates of academic failure, self-esteem problems, relationship difficulties, low socioeconomic status, injuries and accidents, substance abuse and interactions with the justice system are just some of those noted in the literature.[15]

Prevalence of ADHD in children and adolescents is associated with a range of socio-demographic characteristics. These include:[16]

- The prevalence of ADHD is lowest in children and adolescents living in original or intact families with two parents. The prevalence of ADHD is, on average, twice as high in children and adolescents from single parent or carer families.
- The prevalence of ADHD is positively correlated with households of lower socioeconomic status.
- Children and adolescents from families with the highest level of education of a parent or carer have the lowest prevalence of ADHD. The prevalence of ADHD is twice as high in children and adolescents from families with the lowest level of parent or carer education compared to the highest level of parent or carer education.
- The prevalence of ADHD in children and adolescents with both parents or carers not in employment is twice as high as children or adolescents in families where one parent or carer is employed.

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[11] World Health Organization. The ICD-11 Classification of Mental and Behavioural Disorders. Available at: https://icd.who.int/browse11/l-m/en Accessed April 2019.
[12] Demontis, D., Walters, R. K., Martin, J., Mattheisen, M., Als, T. D., Agerbo, E., ... & Cerrato, F. (2019). Discovery of the first genome-wide significant risk loci for attention deficit/hyperactivity disorder. *Nature genetics, 51*(1), 63..
[13] Sciberras, E., Mulraney, M., Silva, D. & Coghill, D. (2017). Prenatal Risk Factors and the Etiology of ADHD-Review of Existing Evidence. Curr Psychiatry Rep 19, 1.
[14] Ebejer, J. L., Medland, S. E., Van Der Werf, J., Gondro, C., Henders, A. K., Lynskey, M., ... & Duffy, D. L. (2012). Attention deficit hyperactivity disorder in Australian adults: prevalence, persistence, conduct problems and disadvantage. *PLoS One*, 7(10), e47404.
[15] Le, H. H., Hodgkins, P., Postma, M. J., Kahle, J., Sikirica, V., Setyawan, J., ... & Doshi, J. A. (2014). Economic impact of childhood/adolescent ADHD in a European setting: the Netherlands as a reference case. *European child & adolescent psychiatry*, 23(7), 587-598.
[16] Lawrence, D., Johnson, S., Hafekost, J., Boterhoven de Haan, K., Sawyer, M., Ainley, J., & Zubrick, S. R. (2015). The mental health of children and adolescents: report on the second Australian child and adolescent survey of mental health and wellbeing. *Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing*. Department of Health, Canberra.

Overall, prevalence of ADHD in Australia is higher in children and adolescents living in families with lower levels of income, education and employment and with poorer family functioning.[17]

ADHD is often comorbid with one or more disorders. Around 65% of those with ADHD also have another disorder.[18] Oppositional defiant disorder (ODD) is the most common comorbidity in children with ADHD, with reported rates ranging between 40% and 60%.[19] Other common comorbidities in children with ADHD include learning disabilities (46% of children with ADHD, compared with 5% of children without ADHD), conduct disorder (27%, compared with 2%), anxiety (18%, compared with 2%), depression (14%, compared with 1%), and speech problems (12%, compared with 3%).[20] It has also been found that 28% of those diagnosed with autism spectrum disorder are also diagnosed with ADHD.[21]

1.4 Treatment and interventions of ADHD

Multimodal therapy is recommended for the treatment of ADHD in all age groups. Specific best practice treatment guidelines differ slightly by age. Psychoeducation and basic environmental manipulations is recommended as treatment for all age groups. Where this treatment is not enough, medication is recommended as a first line treatment with parent training offered to those children and adolescents with additional oppositional behaviours.[22]

Both children and adults with ADHD tend to exhibit fewer symptoms after treatment with stimulant class medications, although treatment of very young children (under 6 years of age) with medication should only be used when there are severe functional disturbances which are unresponsive to behavioural interventions and educational support.[23] Evidence suggests stimulant treatments generally have strong effects on ADHD symptoms, while psychosocial interventions produce improvements in academic and organisational domains.[24]

There is strong evidence that treatment of ADHD produces tangible short-term benefits, and some evidence suggests that people with ADHD who receive treatment have improved long-term outcomes compared to people with ADHD who do not receive treatment.[25] However, the current literature is not sufficient to fully attribute the effects of treatment characteristics (such as combinations, dosage, frequency and intensity), to the prevention of negative long-term outcomes in adulthood.[26]

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[17] Ibid.
[18] Holden, S. E., Jenkins-Jones, S., Poole, C. D., Morgan, C. L., Coghill, D., & Currie, C. J. (2013). The prevalence and incidence, resource use and financial costs of treating people with attention deficit/hyperactivity disorder (ADHD) in the United Kingdom (1998 to 2010). Child and adolescent psychiatry and mental health, 7(1), 34.
[19] Banaschewski T., Rohde L.A. Phenomenology. In: Banaschewski T., Zuddas A., Asherson P., Buitelaar J., Coghill D., Danckaerts M., et al., editors. ADHD and Hyperkinetic Disorder. 2nd ed. Oxford: Oxford University Press; 2015. p. 5 -17.
[20] Larson, K., Russ, S. A., Kahn, R. S., & Halfon, N. (2011). Patterns of comorbidity, functioning, and service use for US children with ADHD, 2007. Pediatrics, 127;462.
[21] Simonoff, E., Pickles, A., Charman, T., Chandler, S., Loucas, T., & Baird, G. (2008). Psychiatric disorders in children with autism spectrum disorders: prevalence, comorbidity, and associated factors in a population-derived sample. *Journal of the American Academy of Child & Adolescent Psychiatry*, 47(8), 921-929.
[22] National Institute for Health and Care Excellence (NICE). (2018). NICE guideline [NG87] Attention deficit hyperactivity disorder: diagnosis and management. https://www.nice.org.uk/guidance/ng87
[23] Subcommittee on Attention-Deficit/Hyperactivity Disorder. (2011). ADHD: clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. Pediatrics.
[24] Chan, E., Fogler, J. M., & Hammerness, P. G. (2016). Treatment of attention-deficit/hyperactivity disorder in adolescents: a systematic review. Journal of the American Medical Association, 315(18), 1997-2008.
[25] The main outcome variables studied were academic, antisocial behaviour, driving, non-medicinal drug use and addiction, obesity, occupation, services use, self-esteem and social function. Shaw, M., Hodgkins, P., Caci, H., Young, S., Kahle, J., Woods, A. G., & Arnold, L. E. (2012). A systematic review and analysis of long-term outcomes in attention deficit hyperactivity disorder: effects of treatment and non-treatment. BMC medicine, 10(1), 99.
[26] Chan, E., Fogler, J. M., & Hammerness, P. G. (2016). Treatment of attention-deficit/hyperactivity disorder in adolescents: a systematic review. Journal of the American Medical Association, 315(18), 1997-2008.

1.5 Estimating the costs of ADHD in Australia

This section describes the approach taken to estimate the costs of ADHD in Australia, and outlines some of the key economic terms, how costs are borne by members of society, and some of the underlying methodology presented throughout the following chapters. Specific methodologies for each of the costs associated with ADHD are outlined further in the chapter where they are discussed.

The costs of ADHD in Australia were estimated for the financial year 2018-19 (referred to as 2019) using a prevalence approach to cost estimation. A prevalence approach measures the number of people with ADHD at a point in time, and estimates the costs incurred due to ADHD for a given year (e.g. 2019). The costs from remitted cases (i.e. people who have had ADHD in the past, but no longer do) are generally excluded using this approach, although discussion has been included for some of the costs remitted cases incur throughout the report.

The broad types of costs associated with ADHD included in this report are:[27]

- **financial costs to the Australian health system**, which include the costs of running hospitals and residential aged care facilities, GP and specialist services reimbursed through Medicare and private funds, the cost of pharmaceuticals and of over-the-counter medications, allied health services (in particular psychologists), research and other health system expenditures (such as health administration).
- **productivity costs,** which include reduced workforce participation, reduced productivity at work, loss of future earnings due to premature mortality, and the value of informal care (lost income of carers of children with ADHD).
- **other costs,** which include costs of government services, including education and the justice system, and the brought forward funeral costs due to premature mortality.
- **transfer costs,** which comprise the deadweight losses, or reduced economic efficiency, associated with the need to raise additional taxation to fund provision of government services.
- **wellbeing costs,** which are the costs associated with reduced quality of life and impaired functioning, and premature death[28] that result from ADHD. Wellbeing costs are measured in terms of the years of life, or healthy life, lost using the burden of disease methodology.

The costs of ADHD are borne by different individuals or sectors of society. Understanding how the costs are shared helps to make informed policy and healthcare decisions regarding interventions. While people with ADHD are most severely affected by the condition, other family members and society also face costs as a result of ADHD.

From the employer's perspective, work loss or absenteeism can lead to costs such as higher wages (i.e. accessing skilled replacement short-term labour) or alternatively lost production, idle assets and other non-wage costs. Employers might also face costs such as rehiring and retraining due to premature mortality.

Australian governments typically bear costs associated with the health system and other government services such as education and justice (noting there are also out of pocket expenditures and other payers). The analysis in this report shows the first round impacts on government and employers. No second round or longer term dynamic impacts are modelled (i.e. changes in wages or labour market outcomes associated with the economic burden of ADHD).

Any future costs ascribed to ADHD for the year 2019 were estimated in net present value terms to reflect the value of utility today rather than in the future. Taking inflation, risk and positive time

[27] Cost of illness methodology would typically include administrative costs and other financial costs associated with government and non-government programs such as respite programs, community palliative care, and any out-of-pocket expenses – e.g. formal care, and transport and accommodation costs associated with receiving treatment. These costs were excluded from the scope of the report as the costs are likely relatively minor.
[28] Some mortality due to ADHD occurs through other pathways, for example accidents due to ADHD.

preference into consideration, a real discount rate of 3% is traditionally used in discounting healthy life, and is also used in discounting other cost streams in this report, for consistency.[29]

It is possible to estimate each of these costs using a top down or bottom up approach. The top down approach provides the total costs of a program element (e.g. the health system) due to a condition. A bottom up approach involves estimating the number of cases incurring each cost item, and multiplying the number of cases by the average cost of each item. A bottom up approach was used to estimate most of the costs of ADHD in this report.

A top down approach using national datasets can be more desirable to ensure that the sum of parts is not greater than the whole, although these data are typically difficult to obtain for people with ADHD as there are a range of confounding factors.

In attributing productivity costs to ADHD, controlling for confounding factors is important. For example, children with ADHD are more likely to come from lower socioeconomic status backgrounds than children without ADHD.[30] Lower socioeconomic status in childhood is also correlated with a range of poor health outcomes in adulthood.[31] Similarly, children and adults with ADHD may have a number of comorbidities (section 1.3), which may contribute to worse employment outcomes or increased health costs.

[29] Generally, the minimum option that one can adopt in discounting expected healthy life streams is to set values on the basis of a risk free assessment about the future that assumes future flows would be similar to the almost certain flows attaching to a long-term Government bond. Another factor to consider is inflation (price increases), so that a real rather than nominal discount rate is used. If there is no positive time preference, the real long term government bond yield indicates that individuals will be indifferent between having something now and in the future. In general, however, people prefer immediacy, and there are different levels of risk and different rates of price increases across different cost streams.

[30] Kvist, A.P., Nielsen, H.S. and Simonsen, M., (2013). The importance of children's ADHD for parents' relationship stability and labor supply. *Social Science & Medicine*, *88*, pp.30-38.

[31] Cohen, S., Janicki-Deverts, D., Chen, E. and Matthews, K.A., (2010). Childhood socioeconomic status and adult health. *Annals of the New York Academy of Sciences*, *1186*(1), pp.37-55.

2 Epidemiology

There is much research on the prevalence of ADHD, with varying global and regional estimates.[32] The variation is due to different methods used to assess ADHD which can vary from the method of reporting symptoms (teacher versus parent versus both), measures (diagnostic versus symptom measures) and other factors.

Due to the differences in measurement of ADHD, prevalence estimates around the world range from as little as 1% up to 20%.[33] Due to the varying estimates of worldwide prevalence, a targeted literature review was undertaken to identify literature relevant to Australia, for the purpose of determining childhood, adolescent and adult prevalence of ADHD in Australia. The literature was then applied to demographic data to model the number of people with ADHD in Australia for 2019.

Estimates of prevalence in children (0 to 14 years) and adults (15 years and over) have been separated in this report due to the differing methods used, quality of evidence available, and different definitions used in the DSM-5 (e.g. only five symptoms for adults, rather than six for children). 2019 prevalence rates in children and adults are discussed in section 2.1 and 2.2 respectively.

Key findings

- The most recent results from the Global Burden of Disease study show that the prevalence of ADHD in Australia is 4.1% in children aged 0-14 years.
- ADHD is more likely to persist into adulthood in Australia than in comparable countries. Based on a local persistence study, 3.0% of Australian adults (15+) have ADHD. Males are more likely to have ADHD (4.9%) than females (1.5%).
- There are an estimated 814,500 people with ADHD in Australia in 2019.
- ADHD was estimated to cause 64 deaths in 2019, based on the findings of a cohort study conducted in Denmark.

2.1 Prevalence in children (0 to 14 years)

International estimates of ADHD prevalence in children vary, often explained by different analytical methodologies employed, such as the use of differing diagnostic criteria.[34] The Global Burden of Disease (GBD) study, which provides an estimate for prevalence of ADHD in Australia in 2017 was ultimately used as the source of prevalence in this report for children rather than the recent Young Minds Matter (YMM) survey. The rationale and methods used are discussed further below.

The YMM survey is an interview of 6,000 Australian families, which looked at the emotional and behavioural development of children and young people aged between 4 and 17 years.[35] The YMM

[32] Thomas, R., Sanders, S., Doust, J., Beller, E., & Glasziou, P. (2015). Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics*, 135(4), e994-e1001.
[33] Polanczyk, G., De Lima, M. S., Horta, B. L., Biederman, J., & Rohde, L. A. (2007). The worldwide prevalence of ADHD: a systematic review and metaregression analysis. *American journal of psychiatry*, 164(6), 942-948.
[34] Polanczyk, G. V., Willcutt, E. G., Salum, G. A., Kieling, C., & Rohde, L. A. (2014). ADHD prevalence estimates across three decades: an updated systematic review and meta-regression analysis. *International journal of epidemiology*, 43(2), 434-442.
[35] Lawrence D, Johnson S, Hafekost J, Boterhoven De Haan K, Sawyer M, Ainley J, Zubrick SR (2015) The Mental Health of Children and Adolescents. *Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing*. Department of Health, Canberra.

survey uses face-to-face diagnostic interviews with parents and carers of 4 to 17 year olds and a self-report questionnaire.[36]

The YMM survey found that ADHD was the most common mental disorder in Australian children and adolescents, followed by anxiety disorders, major depressive disorder and conduct disorder. Reported prevalence of ADHD in Australian children may range between 2.4% and 7.4%.[37,38,39] As noted by Sibley et al (2016),[40] surveys that employ parent interviews, often yield higher prevalence and persistence rates than studies employing alternate reporting methods.

Given the uncertainty around parent-reported prevalence of ADHD, prevalence rates were sourced from the GBD study rather than relying on one single Australian survey. The GBD study pools results from a range of studies, controls for study quality, and ensures that each study was representative of the general population rather than a special population (e.g. prison inmates). Thus, the GBD estimates address potential sources of bias in sample and methodological techniques.

To calculate prevalence in 2019, prevalence rates of ADHD in male and female children (0 to 14 years) from the GBD study were applied to the 2019 population. Approximately 197,400 children aged 0 to 14 years had ADHD in 2019.

Table 2.1 Childhood prevalence estimate, 2019

Age	Male		Female	
	Rate (%)	Estimate ('000)	Rate (%)	Estimate ('000)
0-4	0.9	7.3	0.3	2.6
4-9	7.6	63.1	2.9	23.1
10-14	9.3	74.1	3.6	27.2
0-14	**5.8**	**144.4**	**2.3**	**53.0**

Source: GBD (2017) and Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

2.2 Adult prevalence and persistence (15 years and above)

Worldwide prevalence of ADHD (all ages) is estimated to be between 2% and 5%[41]. Calculating prevalence of ADHD in adolescent and adult populations is more complex than childhood prevalence due to the limited evidence in Australia. Furthermore, for literature available, estimates vary considerably due to methodological differences.[42]

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[36] The YMM questionnaire was based on specific diagnostic modules from the Diagnostic Interview Schedule for Children Version IV (DISC-IV) and a specifically developed module to determine impact on functioning. The YMM study aligned the responses to the interview with the DSM-IV criteria.

[37] Lawrence D., Johnson S., Hafekost J., Boterhoven De Haan K., Sawyer M., Ainley J., Zubrick S. R. (2015). The Mental Health of Children and Adolescents. *Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing*. Department of Health, Canberra..

[38] Graetz, B. W., Sawyer, M. G., Hazell, P. L., Arney, F., & Baghurst, P. (2001). Validity of DSM-IV ADHD subtypes in a nationally representative sample of Australian children and adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, 40(12), 1410-1417.

[39] Gomez, R., Harvey, J., Quick, C., Scharer, I., & Harris, G. (1999). DSM-IV AD/HD: confirmatory factor models, prevalence, and gender and age differences based on parent and teacher ratings of Australian primary school children. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, 40(2), 265-274..

[40] Sibley, M. H., Swanson, J. M., Arnold, L. E., Hechtman, L. T., Owens, E. B., Stehli, A., Abikoff, H., Hinshaw, S. P., Molina, B., Mitchell, J. T., Jensen, P. S., Howard, A. L., Lakes, K. D., Pelham, W. E., MTA Cooperative Group (2016). Defining ADHD symptom persistence in adulthood: optimizing sensitivity and specificity. J*ournal of child psychology and psychiatry, and allied disciplines*, 58(6), 655-662.

[41] Polyzoi, M., Ahnemark, E., Medin, E., & Ginsberg, Y. (2018). Estimated prevalence and incidence of diagnosed ADHD and health care utilization in adults in Sweden - a longitudinal population-based register study. *Neuropsychiatric disease and treatment*, 14, 1149-1161. doi:10.2147/NDT.S155838

[42] Sibley, M. H., Swanson, J. M., Arnold, L. E., Hechtman, L. T., Owens, E. B., Stehli, A., Abikoff, H., Hinshaw, S. P., Molina, B., Mitchell, J. T., Jensen, P. S., Howard, A. L., Lakes, K. D., Pelham, W. E., MTA Cooperative

Although prevalence of ADHD is widely thought to decrease with age, estimates still suggest that it is one of the most common adult psychiatric disorders.[43] A summary of international prevalence estimates in adulthood is provided in Table 2.2. Prevalence estimates typically vary from close to 2% up to 5%.

Table 2.2 Summary of prevalence of ADHD in adults in international settings

Study	Country and setting	Age range	Prevalence estimate
Bitter et al (2010)	Survey of 3,529 adult patients presenting to primary care in Hungary.	18-60	2.5% based on full DSM-IV criteria.
Bunting et al (2013)	Nationally representative household survey of 4,340 adults in Northern Ireland.	18+	1.3% based on DSM-IV criteria.
Ebejer et al (2012)	Survey of 3,795 participants on the Australian Twin Registry (and family members).	21-49	1.1% based on full DSM-IV criteria, increasing to 2.3% and 2.7% when relaxing age of onset and problem symptoms criteria.
Fayyad et al (2007)	Survey of 11,422 participants across ten countries in the Americas, Europe and the Middle East.	18-44	3.4% based on DSM-IV. Prevalence rates in lower income countries were lower (1.9%) compared with higher income countries (4.2%).
De Zwaan et al (2012)	Survey of 1,655 adults in Germany.	18-64	4.7% based on DSM-IV criteria.
Kessler et al (2006)	Nationally representative household survey of 3,199 participants in the National Comorbidity Survey Replication in the United States.	18-44	4.4% based on DSM-IV criteria.
Simon et al (2009)	Systematic review and meta-regression of six studies in multiple countries.	17-84	2.5% pooled prevalence based on DSM-IV.
Weighted average			**2.8%**

Source: as noted in table.

Given the variation in adult prevalence rates across studies, and noting that higher income countries tend to have higher prevalence rates, an Australian study was used to estimate the persistence of ADHD into adulthood.

As with prevalence estimates, persistence of ADHD (the rate at which that the condition continues into adulthood) varies widely in the literature, depending on the study design. Some of the main drivers of variation include the definition of ADHD and methodological considerations (e.g. structured interviews versus rating scales, self-reported versus parent/other-reported information).[44] Caye et al (2016) reported that persistence of ADHD into adulthood ranges from

Group (2016). Defining ADHD symptom persistence in adulthood: optimizing sensitivity and specificity. J*ournal of child psychology and psychiatry, and allied disciplines*, 58(6), 655-662.

[43] Das, D., Cherbuin, N., Butterworth, P., Anstey, K. J., & Easteal, S. (2012). A population-based study of attention deficit/hyperactivity disorder symptoms and associated impairment in middle-aged adults. *PloS one*, 7(2), e31500.

[44] Sibley, M. H., Swanson, J. M., Arnold, L. E., Hechtman, L. T., Owens, E. B., Stehli, A., Abikoff, H., Hinshaw, S. P., Molina, B., Mitchell, J. T., Jensen, P. S., Howard, A. L., Lakes, K. D., Pelham, W. E., MTA Cooperative Group (2016). Defining ADHD symptom persistence in adulthood: optimizing sensitivity and specificity. J*ournal of child psychology and psychiatry, and allied disciplines*, 58(6), 655-662.

11% to 75%.[45] Selected international studies on persistence rates are provided in Appendix Table A.1.

In calculating the number of people with ADHD in 2019, we have used the average persistence rates reported in an Australian based study by Ebejer et al (2012). Ebejer et al (2012) provided persistence rates in a sample from the Australian Twin Registry (ATR), which included 1,369 men and 2,426 women.[46]

Ebejer et al (2012) calculated persistence from the age of 14 onwards, for three non-exclusive diagnostic definitions of ADHD respectively: (i) full DSM-IV criteria; (ii) excluding the age 7 onset criterion (no age criterion); (iii) participant experienced difficulties due to ADHD symptoms (problem symptoms).[47] The average rates of persistence were 55.3% (full DSM-IV criteria), 50.3% (no age criterion), and 40.2% (problem symptoms), meaning persistence of ADHD is more likely when the full diagnostic criteria are met.[48] To estimate prevalence, we have taken an average of persistence rates for each of the diagnostic definitions, for each age and gender group. The average decline in prevalence with a one unit increase in age was calculated and then extrapolated to estimate further decline in prevalence for older age groups.[49] The persistence rates were then applied to prevalence at age 14 from the GBD study to estimate the decline in prevalence rates with age. Chart 2.1 shows the estimated prevalence rates based on this approach, along with prevalence rates from other selected studies.

The final prevalence rates and number of people estimated to have ADHD in 2019, using the methods described above, are shown in Table 2.3. The overall prevalence in 2019, including children, adolescents and adults was estimated to be 3.2%, representing 814,500 Australians. This estimate is higher than the 2017 GBD study, which estimated the prevalence of ADHD at 2.0%. However, the higher rate is not unexpected given that adult prevalence rates are likely to increase with the changes to the DSM-5 diagnostic criteria, which supports adopting a higher prevalence estimate in Australia.[50] Moreover, the estimates are still within the expected range of approximately 2% to 5% in adults and are in line with the estimates calculated for high-income countries.[51]

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[45] Caye, A., Spadini, A. V., Karam, R. G., Grevet, E. H., Rovaris, D. L., Bau, C. H. D., …, Kieling, C. (2016). Predictors of persistence of ADHD into adulthood: A systematic review of the literature and meta-analysis. European Child & Adolescent Psychiatry, 25(11), 1151-1159. Retrieved from https://doi.org/10.1007/s00787-016-0831-8.

[46] There are still some limitations to the study design employed by Ebejer et al (2012). For example, the persistence rates are subject to recall bias as it is a retrospective study. Similarly, it is difficult to accurately measure changes in ADHD symptoms over time. However, as noted by Caye et al (2016), there are no prospective, population-based studies that address the issue of persistence rates of ADHD into adulthood. As such, it is unlikely that any studies that present better estimates of persistence. As such, we have used Ebejer et al (2012) to estimate adult prevalence of ADHD due to its applicability to the Australian population. Ebejer, J. L., Medland, S. E., Van Der Werf, J., Gondro, C., Henders, A. K., Lynskey, M., ... & Duffy, D. L. (2012). Attention deficit hyperactivity disorder in Australian adults: prevalence, persistence, conduct problems and disadvantage. *PLoS One*, 7(10), e47404.

[47] Being a retrospective study, the results are vulnerable to an increased recall bias by participants. The study is also limited by the use of computer assisted telephone interviews, and the inability for symptoms to be accurately measured across time. However as noted by Caye et al (2016), there are no prospective, population-based studies that address the issue of persistence rates of ADHD into adulthood; meaning there are no studies that present better alternatives for persistence for the purposes of this report.

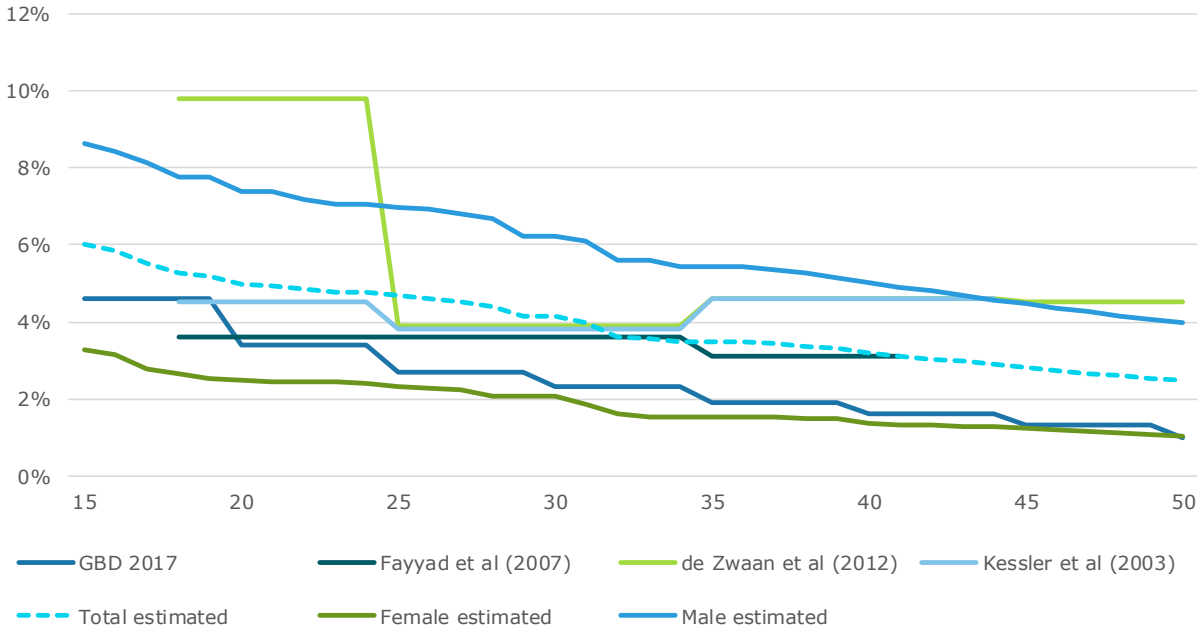
[48] Ebejer, J. L., Medland, S. E., Van Der Werf, J., Gondro, C., Henders, A. K., Lynskey, M., ... & Duffy, D. L. (2012). Attention Deficit Hyperactivity Disorder in Australian Adults: Prevalence, Persistence, Conduct Problems and Disadvantage. *PLoS ONE* 7(10): e47404.

[49] The compound annual growth rate (CAGR) method was used to determine the average reduction on persistence. This was calculated from the age of 14, to the last age of each category and applied to each subsequent age.

[50] Epstein, J. N., and Loren, R.E. (2013). Changes in the Definition of ADHD in DSM-5: Subtle but Important. *Neuropsychiatry (London),* Oct 1; 3(5): 455–458.

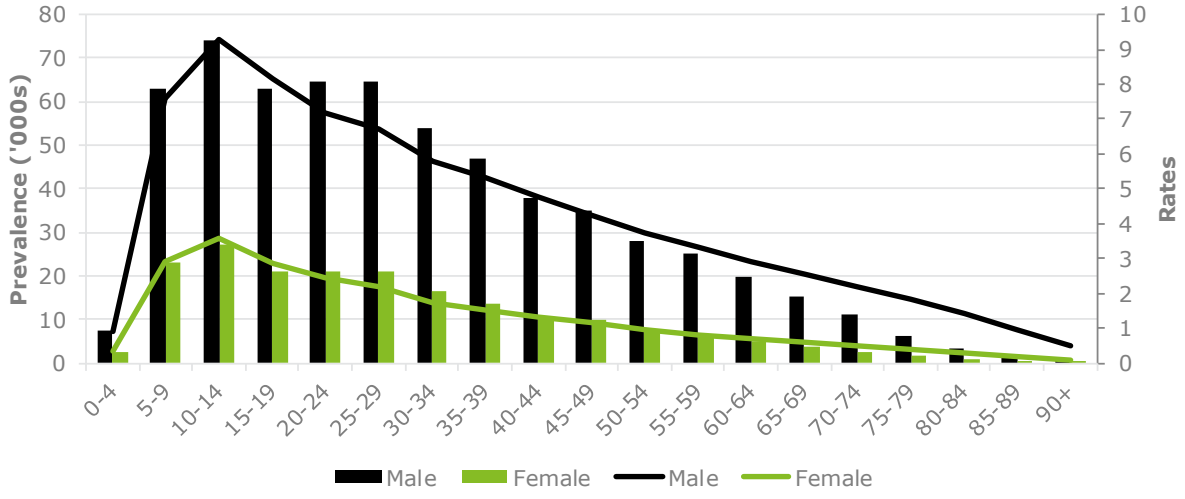
[51] Fayyad, J., Sampson, N. A., Hwang, I., Adamowski, T., Aguilar-Gaxiola, S., Al-Hamzawi, A., ... & Gureje, O. (2017). The descriptive epidemiology of DSM-IV adult ADHD in the world health organization world mental health surveys. *ADHD Attention Deficit and Hyperactivity Disorders*, *9*(1), 47-65.

Chart 2.1 Selected international prevalence estimates; and estimated prevalence



Source: as noted; and Deloitte Access Economics analysis based on GBD (2017) and Ebejer et al (2012).

Chart 2.2 Estimated prevalence of ADHD, by age and gender, 2019



Source: Deloitte Access Economics analysis based on GBD (2017) and Ebejer et al (2012).

Table 2.3 Estimated prevalence of ADHD (rates and thousands of people with ADHD), 2019

Age	Prevalence (%)			Prevalence ('000)		
	Male	Female	Total	Male	Female	Total
0-4	0.9	0.3	0.6	7.3	2.6	9.9
5-9	7.6	2.9	5.3	63.1	23.1	86.2
10-14	9.3	3.6	6.5	74.1	27.2	101.3
15-19	8.1	2.9	5.6	62.8	21.0	83.8
20-24	7.2	2.4	4.9	64.7	20.8	85.5
25-29	6.7	2.2	4.5	64.6	20.9	85.4
30-34	5.8	1.7	3.7	54.0	16.5	70.5
35-39	5.3	1.5	3.4	47.1	13.5	60.6
40-44	4.8	1.3	3.0	37.9	10.5	48.4
45-49	4.2	1.1	2.7	34.9	9.7	44.7
50-54	3.8	1.0	2.3	28.2	7.5	35.7
55-59	3.3	0.8	2.0	25.1	6.4	31.5
60-64	2.9	0.7	1.8	19.7	4.9	24.6
65-69	2.5	0.6	1.5	15.1	3.6	18.7
70-74	2.2	0.5	1.3	11.3	2.5	13.8
75-79	1.8	0.4	1.1	6.3	1.5	7.8
80-84	1.4	0.3	0.8	3.2	0.8	4.0
85-89	1.0	0.2	0.5	1.2	0.4	1.6
90+	0.5	0.1	0.2	0.3	0.1	0.5
Total	**4.9**	**1.5**	**3.2**	**620.9**	**193.6**	**814.5**

Source: GBD (2017) and Deloitte Access Economics analysis based on GBD (2017) and Ebejer et al (2012).

2.3 Mortality due to ADHD

There is restricted evidence to indicate an increased mortality rate due to ADHD, however a limited number of studies have determined that the odds of dying are significantly higher among people who reported an ADHD diagnosis at one point in their life, when compared to a controlled sample with no history of ADHD diagnosis. Two studies, the first a Danish based prospective study of almost 2 million individuals[52] and the second, a US study using data linkages from the 2007 National Health Interview Survey (NHIS) and the National Death Index (NDI)[53] both identify a statistically significant negative association between ADHD diagnosis and mortality. These studies provide some of the first evidence suggesting a causal link between ADHD and mortality outcomes.

Dalsgaard et al (2015) found that a diagnosis of ADHD significantly increased mortality rates, even when adjusted for comorbidities. The study found that people who had been diagnosed with ADHD had an all-cause mortality rate of 5.85 per 10,000 person-years compared with 2.21 per 10,000 person-years in controls, corresponding to a twofold increased mortality rate ratio (MRR). Women had higher mortality (3.01:1) than men (1.93:1). The increased mortality in individuals with ADHD was mainly driven by deaths from unnatural causes, with accidents being the most common cause of death. Even when adjusting for potential confounding from other conditions (e.g. the interaction

[52] Dalsgaard, S., Østergaard, S. D., Leckman, J. F., Mortensen, P. B., & Pedersen, M. G. (2015). Mortality in children, adolescents, and adults with attention deficit hyperactivity disorder: a nationwide cohort study. *The Lancet, 385*(9983), 2190-2196.

[53] London, A. S., & Landes, S. D. (2016). Attention deficit hyperactivity disorder and adult mortality. *Preventive medicine*, 90, 8-10.

between conduct disorder and ADHD), ADHD was significantly associated with increased mortality, with a MRR of 1.5:1.

In the US study by London and Landes (2016), ADHD was found to be associated with significantly higher odds of dying for adults, and results suggested that accidents may be an underlying cause of death more often for people with ADHD than those without (13.2% versus 4.3%). However, it was noted that accidents only account for a proportion of the reported deaths amongst this cohort, with other causes of death, not linked to ADHD or accidents, still contributing to overall death rates.

No Australian specific estimates of increased mortality are available. However, the Dalsgaard et al (2015) study provides a reliable fully adjusted[54] MRR to use in our calculations for the purpose of this report.

The MRR (1.5:1) was applied to general population mortality rates in Australia to estimate the mortality due to ADHD. The Dalsgaard study only considers the risk of mortality from ADHD until 30 years of age, so it was conservatively assumed that there is no increased risk of mortality for adults who are older than this.

Overall, it was estimated that there were 64 deaths due to ADHD in 2019 in Australia. Approximately 85% of these deaths were in males, and most were between the ages of 15 to 29, reflecting the increased rate of accidents and injuries in this cohort.

Table 2.4 Mortality attributed to ADHD in 2019

Age	Male	Female	Person
0-4	2	1	3
5-9	3	1	3
10-14	4	1	5
15-19	10	2	12
20-24	17	2	19
25-29	18	3	21
Total	**55**	**9**	**64**

Source: Dalsgaard et al (2015) and Deloitte Access Economics analysis.

[54] Fully adjusted for age, calendar year, sex, parental history of psychiatric disorders, maternal and paternal age at time of delivery, parental education and parental employment status.

3 Health system costs

Health system costs comprise the costs of running hospitals, general practitioner (GP) and specialist services funded through Medicare and patient contributions, the cost of prescribed and over-the-counter pharmaceuticals, allied health services, research, residential aged care services, and 'other' costs such as health administration.

Health system costs in Australia are primarily paid for by governments, with individuals and their families contributing through out-of-pocket payments. Private health insurers and other payers (e.g. worker's compensation) also pay for some health services.

The following sections provide an overview of the health system costs due to ADHD in Australia for 2019. Due to data limitations, it was only possible to estimate health system costs for a subset of all health expenditures. Specifically, data were available to estimate hospital, GP, specialist and psychologist service costs using a bottom up approach. However, no suitable bottom up data on the costs of allied health other than psychologists were identified for inclusion in the report.

Consequently, the health system costs presented here largely relate to government expenditure (hospitals, MBS, PBS and research-related). Future research could continue to focus on the out of pocket costs (e.g. for allied health services and complementary and alternative therapies) for individuals with ADHD and their families.

Key findings

- The total health system costs due to ADHD were estimated to be $814.5 million in 2019, or $1,000 per person with ADHD.
- Almost all health system costs were incurred within hospitals ($361.1 million) or in out-of-hospital care ($361.9 million), which represents 89% of all costs to the health system.
- Governments bore more than 80% of the estimated health system costs, noting it was not possible to estimate costs for a range of allied health services.

3.1 Hospital

To estimate the hospital costs attributable to ADHD in Australia in 2019, the average number of annual hospital visits attributed to ADHD was multiplied by the average cost per visit. This was then multiplied by prevalence to estimate the total annual hospital costs attributable to ADHD in Australia.

Children with ADHD have been shown to be more likely to experience injuries due to accidents than children without ADHD. This is likely because of their tendencies toward impulsive, overactive behaviour.[55] One study has estimated the incidence and cost of accidents among individuals with ADHD using an administrative database. Analyses were conducted for the whole population, adults alone, children under age 12, and adolescents aged 12 to 18 years. ADHD patients in all age groups were more likely than a matched control group to have at least one accident claim: children, 28% compared with 18%; adolescents, 32% compared with 23%; and adults, 38% compared with 18%.[56]

[55] Matza, L. S., Paramore, C., & Prasad, M. (2005). A review of the economic burden of ADHD. *Cost Effectiveness and Resource Allocation*, 3:5.
[56] Swensen, A., Birnbaum, H. G., Hamadi, R. B., Greenberg, P., Cremieux, P. Y., & Secnik, K. (2004). Incidence and costs of accidents among attention-deficit/hyperactivity disorder patients. *Journal of Adolescent Health*, 35(4), 346-e1.

One study found that compared with controls, children under 4 years with ADHD had a greater mean number of visits to the emergency room (0.23 compared with 0.16).[57] The difference of 0.07 additional emergency room visits was used to estimate the average number of annual hospital visits attributed to ADHD for children.

Adults with ADHD were also found to have higher hospital use, compared with control groups in a US study. Results reveal a higher prevalence of visits to the emergency room (ER) among individuals diagnosed with ADHD (14.34% compared with 10.26%), as well as a significantly greater mean number of visits to the ER for those sent to the ER (1.56 compared with 1.33). This difference of 0.23 was used to estimate the average number of annual hospital visits attributed to ADHD for adults in Australia.[58] The ADHD cohort were also significantly more likely to be admitted as inpatients (6.71% compared with 4.09%) and, among those hospitalised, the ADHD cohort had significantly more admissions (1.44 compared with 1.22).[59] The UK study by Holden et al (2013) also found additional hospital admissions for the adult ADHD cohort compared with a control group (0.2 compared with 0.1).[60] Given the comparability between hospital admissions and emergency department visits, no additional costs were assigned to emergency department visits.

People with ADHD usually present to hospital for injury or poison, respiratory disease, ear disease and neurological conditions.[61] With the exception of injury or poisoning, these are likely to be comorbidities that are commonly associated with ADHD.[62] The average cost per hospital visit was calculated using a weighted average of the total actual cost for DRGs X60A (injuries with catastrophic or severe complications), X62A (poisoning/toxic effects of drugs and other substances with catastrophic or severe complications) and X64A (other injury, poisoning and toxic effect diagnosis with catastrophic or severe complications), weighted according to the number of separations. The 2014-15 cost values were updated to 2019 dollars using Australian Institute of Health and Welfare (AIHW) health expenditure inflation, which was estimated to be $2,537 per hospital admission, on average.[63]

Table 3.1 Hospital costs attributable to ADHD

Cost type	Average cost per visit ($)	Average number of annual visits	Average cost per patient ($)	Prevalence	Estimated annual cost ($m)
Admissions (child)	2,537	0.07	178	281,187	49.9
Admissions (adult)	2,537	0.23	583	533,329	311.2
Total					**361.1**

Source: Deloitte Access Economics analysis.

[57] Chan, E., Zhan, C., & Homer, C. J. (2002). Health care use and costs for children with attention-deficit/hyperactivity disorder. *Arch Paediatric Adolescent Medicine*, 156:504-511.
[58] No robust Australian evidence comparing hospital admission in Australian adults compared to controls was identified in the literature review. However, these estimates are comparable to results from the National Health Survey in Australia (Australian Bureau of Statistics, 2016), where results show that a sample of Australians with ADHD were admitted to hospital an additional 0.2 times compared to matched controls (not adjusted for confounding factors).
[59] Secnik, K., Swensen, A., & Lage, M. J. (2005). Comorbidities and Costs of Adult Patients Diagnosed with Attention-Deficit Hyperactivity Disorder. *Pharmacoeconomics*, 23 (1): 93-102.
[60] Holden, S. E., Jenkins-Jones, S., Poole, C. D., Morgan, C. L., Coghill, D., & Currie, C. J. (2013). The prevalence and incidence, resource use and financial costs of treating people with attention deficit/hyperactivity disorder (ADHD) in the United Kingdom (1998 to 2010). *Child and adolescent psychiatry and mental health*, 7(1), 34.
[61] Silva, D., Colvin, L., Hagemann, E., Stanley, F., & Bower, C. (2014). Children diagnosed with attention deficit disorder and their hospitalisations: population data linkage study. European Child & Adolescent Psychiatry, 23, 1043–1050.
[62] Chan, E., Zhan, C., & Homer, C. J. (2002). Health care use and costs for children with attention-deficit/hyperactivity disorder. *Arch Paediatric Adolescent Medicine*, 156:504-511.
[63] Independent Hospital Pricing Authority, National Hospital Cost Data Collection, Public Hospitals Cost Report, Round 20 (Financial year 2015-16) https://www.ihpa.gov.au/publications/national-hospital-cost-data-collection-public-hospitals-cost-report-round-20-0

3.2 Out-of-hospital health costs

For people with ADHD, out-of-hospital health costs may include visits to a/an:

- GP
- specialist (paediatrician, psychiatrist)
- allied health clinician (occupational therapist, psychologist)
- complementary and alternative medicine provider.

To estimate the out-of-hospital health costs attributable to ADHD in Australia in 2019, the average number of annual out-of-hospital visits attributed to ADHD was multiplied by the average cost per visit. The average annual cost per patient was then multiplied by prevalence to estimate the total annual out-of-hospital costs attributable to ADHD in Australia.

Out-of-hospital costs related to ADHD were estimated for GPs, specialists and some allied health services (e.g. psychologists) in section 3.2.1. However, due to evidence considerations it was not possible to estimate costs for complementary and alternative medicine services (other allied health services). The evidence for these other allied health services is discussed in section 3.2.2.

3.2.1 GP, specialist and psychologist costs

A UK study of clinically diagnosed children (aged 6 to 17 years) and adults with ADHD found that people with ADHD have a greater number of primary care appointments and specialist attendances compared with a control group. Over the first five years following diagnosis, children had 4.2 more primary care appointments and 2.2 more specialist attendances per year on average. For adults, the group with ADHD had 8.1 more primary care appointments and 2.4 more specialist attendances per year on average.[64] These values were used to estimate the average number of annual GP and specialist attendances attributed to ADHD for children and adults in Australia.[65]

These estimates of average annual GP and specialist attendances attributed to ADHD are consistent with other, related studies. For example, an Australian study of children with ADHD by Sciberras et al (2013) found they have higher MBS costs compared with children without ADHD, and these costs appear to increase with age.[66] Similarly, a US study found that children with ADHD had 9.9 times more specialist mental health visits (1.35 per year compared with 0.14 per year), 3.4 times more pharmacy fills (11.25 per year compared with 3.30 per year), and 1.6 times more primary care visits (3.84 per year compared with 2.36 per year) than children without ADHD.[67] In a US study of adults, the ADHD cohort were also more likely to access out-of-hospital health services. Specifically, compared with control individuals, adults diagnosed with ADHD were significantly more likely to visit a psychiatrist (27.53% compared with 2.22%) or a psychologist (16.03% compared with 1.83%). In addition, the ADHD cohort were significantly more likely to visit a GP (57.77% compared with 51.20%), and among those who visited a GP, the ADHD cohort had significantly more visits (7.18 compared with 5.00).[68]

The use of allied health and complementary and alternative medicine treatments for children and adults with ADHD is discussed separately in Section 3.2.2.

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[64] Holden, S. E., Jenkins-Jones, S., Poole, C. D., Morgan, C. L., Coghill, D., & Currie, C. J. (2013). The prevalence and incidence, resource use and financial costs of treating people with attention deficit/hyperactivity disorder (ADHD) in the United Kingdom (1998 to 2010). *Child and adolescent psychiatry and mental health*, 7(1), 34.

[65] No robust Australian evidence comparing GP and specialist attendances in Australian children or adults compared to controls was identified in the literature review. However, these estimates are comparable to results from the National Health Survey in Australia (Australian Bureau of Statistics, 2016), where results show that a sample of Australians with ADHD attended an average annual additional 1.62 GP consultations and 1.92 specialist consultations compared to matched controls (not adjusted for confounding factors).

[66] Sciberras, E., Lucas, N., Efron, D., Gold, L., Hiscock, H., & Nicholson, J. M. (2017). Health Care Costs Associated With Parent-Reported ADHD: A Longitudinal Australian Population–Based Study. *Journal of attention disorders*, 21(13), 1063-1072.

[67] Guevara, J., Lozano, P., Wickizer, T., Mell, L., & Gephart, H. (2001). Utilization and cost of health care services for children with attention-deficit/hyperactivity disorder. *Pediatrics*, 108(1), 71-78.

[68] Secnik, K., Swensen, A., & Lage, M. J. (2005). Comorbidities and costs of adult patients diagnosed with attention-deficit hyperactivity disorder. *Pharmacoeconomics*, 23(1), 93-102.

The average cost of a GP service for adults was calculated based on Medicare Statistics data to be $35.82. The average cost was derived using the total benefits provided for GP attendances ($7.8 billion), the number of GP services (155 million), the proportion of services which were bulk billed (86.1%), and the average out of pocket cost ($37.39).[69] The average cost per consultation was estimated to be $55.52 in 2019 terms. However, patients may present to GPs with more than one problem, and therefore the entire cost is not directly attributable to ADHD. The average cost ($55.52) was divided by the average number of problems (1.55) based on Britt et al's (2016) report into General Practice Activity in Australia.[70] The average cost of a specialist attendance for children and adults was estimated using the MBS fee for general specialist attendances ($86.85).[71]

Table 3.2 Core out-of-hospital health costs attributable to ADHD

Cost type	Average cost per consultation ($)	Average number of annual visits	Average annual cost, per patient ($)	Prevalence (cases)	Total annual cost ($m)
Child				281,187	
GP	35.8	4.2	150		42.3
Specialist	86.8	2.2	191		53.7
Total					96.0
Adult				533,329	
GP	35.8	8.1	290		154.7
Specialist	86.8	2.4	208		111.2
Total					265.9
Total					**361.9**

Source: Deloitte Access Economics analysis.

3.2.2 Other allied health services

People with ADHD and their families may use allied health services (such as parent skills training, cognitive and behavioural therapy, education psychology or occupational therapy), and complementary and alternative medicine therapies (such as diet modification or naturopathy) as part of their treatment. In standard medical practice, families often receive advice on the behavioural management of their child with ADHD and are often referred to a psychologist for ongoing management. Children with ADHD often have mild fine-motor difficulties and may also be referred to an occupational therapist. There is also reported use of other complementary and alternative therapies reported in the Australian setting including: diet modification, naturopathy, chiropractic therapy, aromatherapy, kinesiology, and acupuncture.[72] In addition to a medical practitioner, the source of referral for an allied health or complementary and alternative medicine therapy also includes family and friends, private allergy centres and school teachers.[73]

There is some evidence from the USA and Europe that indicates children and adolescents with ADHD use a range of therapies for treatment. A 2018 study of children and adolescents with ADHD

[69] Formula: (Benefits+(Services×(1-Bulk billed rate/100)×Out of pocket cost). Sources: Annual Medicare Statistics 2018 http://www.health.gov.au/internet/main/publishing.nsf/Content/Annual-Medicare-Statistics; AIHW Patients' out-of-pocket spending on Medicare services, 2016–17 https://www.myhealthycommunities.gov.au/our-reports/out-of-pocket-spending/august-2018
[70] Britt et al estimate an average number of problems of 1.55, total services were divided by this amount.
[71] MBS online, Item 104: professional attendances, http://www9.health.gov.au/mbs/fullDisplay.cfm?type=item&q=104&qt=item
[72] Stubberfield, T. G., Wray, J. A., & Parry, T. S. (1999). Utilization of alternative therapies in attention-deficit hyperactivity disorder. *Journal of paediatrics and child health*, 35(5), 450-453.
[73] Ibid.

in the USA found that 20% had used cognitive behavioural therapy.[74] Similarly, a study of pre-schoolers with ADHD in the USA found they are much more likely to use occupational therapy, physical therapy, speech therapy, and special education than those without. It would be expected this cohort would have high non-pharmacological treatment utilisation given medication is not the recommended first line treatment for that age group.[75] These results are consistent with the European studies that indicate children and adolescents with ADHD are more likely to use behavioural therapies than a control cohort.[76] However, these studies do not report on the average health service utilisation for these treatments and it is unclear whether the results are transferable to the Australian healthcare setting.

There are a small number of Australian based studies that estimate the proportion of children and adolescents with ADHD using allied health and complementary and alternative medicine therapies. Taken together, these studies indicate at least one third of children and adolescents with ADHD in Australia use a form of allied health or complementary and alternative medicine therapy.[77] No studies were identified in Australian settings that explore the service utilisation of these therapies. In Australia, the Royal Australian College of GPs and National Health and Medical Research Council (NHMRC) guidelines recommend allied health and behavioural therapies as part of the treatment of ADHD. However, the guidelines do not specify a recommended number of sessions, instead leaving it up to the treating clinician to recommend based on the characteristics of each case.

The AIHW[78] provides the only recent estimate of allied health costs due to ADHD in Australia, finding that the allied health costs were $12.8 million in 2015-16. The AIHW used data collected from the Bettering the Evaluation and Care of Health program, better known as BEACH, to estimate this cost component. To do this, the AIHW allocates costs for GP-referred health services (including allied health) based on the recorded diagnosis. Costs due to ADHD may be understated using this approach as the underlying data require GPs to record ADHD as the diagnosis (that is, GPs must identify and diagnose ADHD during each encounter). As GPs are not the primary treatment provider for ADHD in Australia, ADHD would not be routinely considered during consultations, which can lead to lower costs due to under-diagnosis.

As there are no bottom up sources, and due to the uncertainty over the average service utilisation of allied health and complementary and alternative therapies used by people with ADHD in Australia, this has been excluded from the heath system cost estimates. However, as indicated from the limited number of studies in an Australian setting, this could constitute approximately one third of ADHD patients. This would also contribute to additional health system costs. Allied health treatments are eligible for a Medicare rebate in Australia, although they may incur an additional out-of-pocket co-payment. Complementary and alternative medicine treatment options

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[74] Danielson, M. L., Visser, S. N., Chronis-Tuscano, A., & DuPaul, G. J. (2018). A national description of treatment among United States children and adolescents with attention-deficit/hyperactivity disorder. *The Journal of pediatrics*, 192, 240-246.

[75] Marks, D. J., Mlodnicka, A., Bernstein, M., Chacko, A., Rose, S., & Halperin, J. M. (2008). Profiles of service utilization and the resultant economic impact in preschoolers with attention deficit/hyperactivity disorder. *Journal of pediatric psychology*, 34(6), 681-689.

[76] De Ridder, A., and De Graeve, D. (2006). Healthcare Use, Social Burden and Costs of Children With and Without ADHD in Flanders, Belgium. *Clinical Drug Investigation*. Volume 26, Issue 2, pp 75–90. Kohlboeck, G., Romanos, M., Teuner, C. M., Holle, R., Tiesler, C. M., Hoffmann, B., ... & Bauer, C. P. (2014). Healthcare use and costs associated with children's behavior problems. European child & adolescent psychiatry, 23(8), 701-714.

[77] Concannon, Pe., and Tang, YP. (2005). Management of attention deficit hyperactivity disorder: A parental perspective. *Journal of Paediatric and Child Health*, 41, 625–630. Leggett, C., and Hotham, E. (2011). Treatment experiences of children and adolescents with attention-deficit/hyperactivity disorder. *Journal of Paediatric and Child Health*, 47, 512–517. Sinha, D., and Efron, D. (2005). Complementary and alternative medicine use in children with attention deficit hyperactivity disorder. *Journal of Paediatric and Child Health*, 41, 23–26. Stubberfield, T. G., Wray, J. A., & Parry, T. S. (1999). Utilization of alternative therapies in attention-deficit hyperactivity disorder. Journal of paediatrics and child health, 35(5), 450-453.

[78] Australian Institute of Health and Welfare (AIHW). (2019). Disease expenditure in Australia, retrieved from https://www.aihw.gov.au/reports/health-welfare-expenditure/disease-expenditure-australia/contents/summary, accessed June 2019.

are not covered by Medicare in Australia and would constitute an out-of-pocket cost for people with ADHD and their families.

3.3 Pharmaceuticals

A 2018 study of 13 countries across Australia, Asia, North America and Europe found that while prevalence of ADHD medication use among children and adults varies across countries, this has increased over time in all countries and regions.[79] The core pharmacotherapy options for treatment of ADHD are methylphenidate (e.g. Ritalin 10), methylphenidate extended release (e.g. Concerta and Ritalin LA), dexamphetamine (e.g. Dexamfetamine), atomoxetine (e.g. Strattera), lisdexamfetamine (e.g. Vyvanse) and extended release guanfacine (e.g. Intuniv). These medications are rarely prescribed for other conditions, except narcolepsy which has a prevalence in Australia of approximately 0.05%.[80] Due to this small prevalence in comparison with the prevalence of ADHD, we have not controlled for this in the pharmaceutical cost estimates. With the exception of dexamphetamine, these medications are prescribed for both adults and children. Standard dosage is one tablet per day with the dosage strength dependent on the age of the patient. An Australian study of children with ADHD found that core ADHD medication costs increase with age.[81]

A top down approach was used to measure the costs of ADHD pharmacotherapy treatment options using Pharmaceutical Benefits Schedule (PBS) data, which is a measure of total expenditure.[82] Total pharmaceutical expenditure for ADHD prescriptions is outlined in Table 3.3. Extended release guanfacine (e.g. Intuniv) was listed on the PBS in September 2018 for the treatment of ADHD.[83] The first six months of PBS data that is available at the time of reporting indicates approximately 16,000 services for extended release guanfacine.[84] For this reason, extended release guanfacine has been excluded from the cost calculations.

Table 3.3 Core ADHD medications costs FY2019

Drug type	Government expenditure by drug type ($m)	Patient contribution ($m)	Total cost ($m)	Cost per script ($)
Methylphenidate	25.4	13.8	39.2	50
Dexamphetamine	4.0	6.0	10.0	33
Atomoxetine	6.6	1.0	7.6	131
Lisdexamfetamine	28.1	5.8	33.8	117
Total annual cost	**64.1**	**26.6**	**90.6**	**-**

Source: Deloitte Access Economic analysis of PBS Item Reports.[85]

3.4 Research

Research expenditure is included within health system estimates as, in the absence of ADHD, there would not be a need for any research into the condition. To estimate health research expenditure

[79] Raman, S. R., Man, K. K., Bahmanyar, S., Berard, A., Bilder, S., Boukhris, & Karlstad, Ø. (2018). Trends in attention-deficit hyperactivity disorder medication use: a retrospective observational study using population-based databases. *The Lancet Psychiatry*, 5(10), 824-835.
[80] https://www.snoreaustralia.com.au/narcolepsy.php
[81] Sciberras, E., Lucas, N., Efron, D., Gold, L., Hiscock, H., & Nicholson, J. M. (2017). Health Care Costs Associated With Parent-Reported ADHD: A Longitudinal Australian Population–Based Study. *Journal of attention disorders*, 21(13), 1063-1072.
[82] PBS Item Reports 2014 to 2018, retrieved from http://medicarestatistics.humanservices.gov.au/statistics/pbs_item.jsp
[83] Minister for Health (September 2018). Media release. http://www.health.gov.au/internet/ministers/publishing.nsf/Content/health-mediarel-yr2018-hunt114.htm
[84] PBS Item Reports 2018, retrieved from http://medicarestatistics.humanservices.gov.au/statistics/pbs_item.jsp accessed 3 April 2019.
[85] PBS Item Reports 2014 to 2018, retrieved from http://medicarestatistics.humanservices.gov.au/statistics/pbs_item.jsp accessed 3 April 2019.

on ADHD in Australia in 2019, this report utilised the NHMRC grants database. The database outlines all NHMRC research grant funding between 2000 and 2015 and provides a description of the projects and key outcomes achieved.[86]

It was estimated that the NHMRC provided a total of $14.2 million in research funding towards ADHD from 2000 to 2015. This was based on a keyword search, for the terms listed below. Following the keyword search, grant descriptions were reviewed to ensure the funding was for ADHD.

- ADHD
- attention deficit disorder
- attention deficit hyperactivity disorder
- hyperactivity

Expenditure associated with research for ADHD in 2019 dollars (adjusted using the Consumer Price Index) is $15.7 million. Taking an average across the periods, the equivalent annual funding allocated to ADHD research in 2019 was estimated to be $820,000.

3.5 Summary of health system costs

The health system costs presented in this report largely relate to government expenditure (hospitals, MBS, PBS and research-related). Overall, the total health system cost of ADHD was estimated to be $814.5 million in Australia in 2019, which is $1,000 per Australian with ADHD, although it likely exceeds this amount as it was only possible to estimate health system costs for a subset of all health expenditures due to data limitations. For example, no suitable data on the costs of allied health were identified for inclusion in the report.

The AIHW[87] recently estimated that ADHD cost the Australian health system approximately $130 million in 2015-16 using both top down and bottom up approaches to estimate costs:[88] the AIHW estimated total expenditure across the health system and then allocated this expenditure to health conditions based on service use data. These estimates are substantially lower than those presented here, largely due to methodological differences and challenges in assigning health costs to any one health condition. The AIHW's approach uses a range of techniques and data sources to allocate health expenditure to more than 200 health conditions, including injuries. Where the sum of expenditure on all conditions exceeds total health expenditure, the AIHW scales expenditure down. It is possible for health expenditure due to any one condition to be higher as a result and it largely depends on how conditions are defined and allocated across datasets. For example, it is not likely that injury costs are attributed to ADHD using such an approach as ADHD may not be recorded as a diagnosis and it does not complicate the costs of care in hospital per se.

Furthermore, health system costs in our report have largely been estimated by comparing costs for children and adults with ADHD to matched control groups, after adjusting for confounding factors. These differences in average costs were then multiplied by prevalence to estimate total costs (a bottom up approach, as outlined in section 1.5). Some top down data sources have also been used, such as for estimating pharmaceutical expenditure.[89] The major advantage of estimating costs bottom up using matched control groups for any particular condition is that costs are associated with individual people, rather than episodes of care. As such, the estimates

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[86] National Health and Medical Research Council (NHMRC). (2017). NHMRC Research Funding – Disease/disorders or health condition based data collections. Retrieved from https://www.nhmrc.gov.au/grants-funding/research-funding-statistics-and-data.

[87] Australian Institute of Health and Welfare (AIHW). (2019). Disease expenditure in Australia, retrieved from https://www.aihw.gov.au/reports/health-welfare-expenditure/disease-expenditure-australia/contents/summary, accessed June 2019.

[88] As outlined in section 1.5, a top down approach provides the total costs of a program element (e.g. hospital costs) due to a condition. A bottom up approach involves estimating the number of cases incurring each cost item, and multiplying the number of cases by the average cost of each item. A bottom up approach was used to estimate most health system costs of ADHD in this report.

[89] Pharmaceutical expenditure has been estimated using medications listed for use in treating ADHD. The costs in the AIHW disease expenditure database and this report are reasonably comparable when accounting for the growth in lisdexamfetamine, which was only listed on the PBS during 2015-16.

presented here attribute expenditure for other reasons to the underlying condition. For example, an Australian study has found that children under 4 years of age with ADHD are 73% more likely to be admitted for injury and poisoning (where the injury or poisoning is the principal reason for admission) compared to matched controls.[90] These costs are attributed to the underlying ADHD in our study, rather than to the consequent injury.

Moreover, GP and specialist costs in our study were also estimated using a bottom up approach where the underlying study estimated incremental service use for people with ADHD compared to matched controls. The AIHW report used data from the Bettering the Evaluation and Care of Health program, better known as BEACH, to estimate these cost components. As outlined in section 3.2.2, costs due to ADHD may be understated using this approach as GPs are not the primary treatment provider for ADHD in Australia. Consequently, ADHD would not be routinely considering during consultations, although again, it may be an underlying reason for the encounter and subsequent costs.

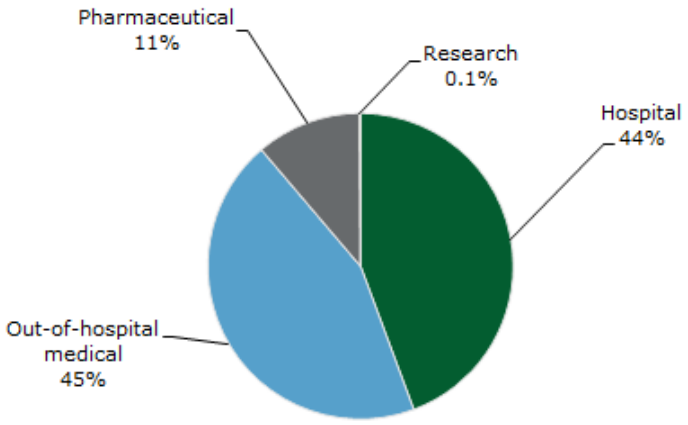
Table 3.4 Total health system expenditure 2019

Category	Annual cost ($m)	Proportion of total cost %	Per person with ADHD ($)
Hospital	361.1	44.3	443
Out-of-hospital	361.9	44.4	444
Pharmaceuticals	90.7	11.1	111
Research	0.8	0.1	1
Total	**814.5**	**100.0**	**1,000**

Source: Deloitte Access Economics analysis.

The largest component of health expenditure was hospital and out-of-hospital services which combined were estimated to account for the majority (89%) of health system costs associated with ADHD in Australia in 2019. This was followed by pharmaceuticals (11%) and research (0.1%), as shown in Table 3.4 and Chart 3.1.

Chart 3.1 Health system costs by sector (% of total)



Source: Deloitte Access Economics analysis.

[90] Silva, D., Colvin, L., Hagemann, E., Stanley, F., & Bower, C. (2014). Children diagnosed with attention deficit disorder and their hospitalisations: population data linkage study. European Child & Adolescent Psychiatry, 23, 1043–1050.

Health system costs in Australia are financed through a split of public funds (federal and state and territory governments) and private funds (out-of-pocket and private health insurance). Funding is administered through a number of different programs and jurisdictions. This includes the Commonwealth's Medicare Benefits Schedule (MBS), which provides full or partial rebates under a fee-for-service model, and the National Health Reform Agreement, which provides activity based funding for free treatment in public hospitals. There is also a substantial component of private funding which includes private health insurance and out-of-pocket costs.

While noting that it wasn't possible to estimate costs related to allied health services, governments bore a considerable proportion (more than 80%) of the estimated health system costs of ADHD. Individuals and their families bore approximately 10% and other payers (e.g. private health insurers) bore the rest of the included costs.

4 Productivity costs

ADHD has a negative impact on the individual's ability to function and to engage in work or schooling. The productivity costs of ADHD are significant in terms of reduced workforce participation, absenteeism and presenteeism.

A human capital approach was adopted to estimate the productivity losses due to ADHD in Australia. The human capital approach involves calculating the difference in employment or production between people with ADHD and that of the general population, multiplied by average weekly earnings (AWE).

The four potential productivity losses due to ADHD include:

- reduced workforce participation, which may occur either through disadvantages in job-seeking (e.g. difficulty in searching for work or keeping a job) or self-selection out of the labour force;
- temporary absenteeism where a worker may take time off work due to their ADHD, while remaining in the workforce;
- presenteeism, or lower productivity at work, where a worker produces less due to lower capacity to work; and
- premature mortality, where a person who dies early due to ADHD would no longer receive future income streams (in discounted net present value terms).

Key findings

- Productivity losses of ADHD associated with absenteeism, presenteeism, reduced workforce participation and premature mortality were estimated to be $9.98 billion in 2019, or on average $17,483 for every Australian living with ADHD.
- ADHD may also be associated with long-term reductions in productivity through reduced educational outcomes of children and adolescents with ADHD, although more evidence is needed to robustly estimate these impacts.
- Informal carer costs were estimated to be $210.4 million, or on average $748 for every Australian child (0-19 years old) with ADHD.

4.1 Absenteeism

Australians with ADHD may be temporarily absent from paid employment due to their condition, and it is measured as the additional number of days per year that an employee with ADHD takes off work compared to the general population (or another comparator).

A targeted literature review was conducted to estimate the impact of ADHD on workplace absenteeism. Studies were included if they controlled for sociodemographic factors and comorbidities when comparing the outcomes of the ADHD cohort with the general population, although current ADHD status was usually self-reported. Studies were further excluded if they did not use a validated productivity tool. The identified studies are summarised as follows.

- In 2012, a sample of 108 Australian adults aged 18-44 with ADHD lost an additional **16% of work time due to absenteeism** associated with their ADHD compared with controls, controlling for socioeconomic and comorbidity variables[91]

[91] Able S, Haynes V, Vietri J, Kopenhafer L, Novick D, Upadhyaya H, et al. (2013) ADHD among adults in Europe, Australia, Japan, and the United States: Socio-demographics, comorbidities, health care resource use and work productivity. ADHD Atten Def Hyp Disord. 2013; 5: 236.

  - Similar estimates exist for Europe (14.5% difference with 19.4% for ADHD versus 4.9% for controls), the United States (5.5% difference with 8.0% for ADHD versus 2.5% for controls), and Japan (15.8% difference with 17.8% for ADHD versus 2.0% for controls)[92] [93]
- In 2001-2003, a sample of 2,399 American adults aged 18-44 with ADHD lost an **additional 13.6 work days per year**, controlling for age, sex, race, education and occupation[94]
- In 1999-2001, a sample of 2,252 American adults aged 18-65 with ADHD lost an **additional 14 work days per year**, controlling for age, gender, region and insurance type[95]
- In 2005-2006, a sample of 173 American adults from one manufacturing firm had a higher probability of missing work due to sickness, and lost an **additional 9.4% of work time** compared to controls (not statistically significant).[96]

The average additional days absent from work for people with ADHD was estimated by calculating a weighted average, based on study sample size, across each of these studies. The percent of work time lost due to absence was converted to an average number of days lost based on the Australian population average number of hours worked per week for average work time.[97] It was calculated that people with ADHD have **on average an additional 16 days absent from work** each year.

To estimate the costs of absenteeism associated with ADHD the average additional days absent from work was then applied to Australian general population employment rates and AWE by age and gender. Additional costs were also included for management time associated with the absence from work and the overtime premium to maintain work output.[98] Absenteeism associated with ADHD was estimated to cost $2.86 billion in 2019, which is $5,010 per working age Australian living with ADHD.

4.2 Presenteeism

Presenteeism refers to reduced productivity while an employee is at work. Presenteeism is measured as the average number of hours per day that an employee loses to reduced performance or impaired function as the result of their condition. Presenteeism is not as easily measured as absenteeism, but it has the potential to incur significant costs to employers by reducing the quality and efficiency of work produced by employees.

A targeted literature review was conducted to estimate the impact of ADHD on presenteeism. Studies were included if they controlled for sociodemographic factors and comorbidities when comparing the outcomes of the ADHD cohort with the general population, although current ADHD status was usually self-reported. Studies were further excluded if they did not use a validated productivity tool. The identified studies are summarised as follows.

- In 2012, a sample of 108 Australian adults aged 18-44 with ADHD reported **51% of their work time was impaired due to their ADHD compared to 25%** in controls, after adjusting for socioeconomic and comorbidity variables[99]

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[92] Kirino, E., Imagawa, H., Goto, T. and Montgomery, W., 2015. Sociodemographics, comorbidities, healthcare utilization and work productivity in Japanese patients with adult ADHD. *PloS One*, *10*(7), p.e0132233.
[93] Able, S.L., Haynes, V. and Hong, J., 2014. Diagnosis, treatment, and burden of illness among adults with attention-deficit/hyperactivity disorder in Europe. *Pragmatic and observational research*, *5*, p.21.
[94] Kessler, R.C., Adler, L., Ames, M., Barkley, R.A., Birnbaum, H., Greenberg, P., Johnston, J.A., Spencer, T. and Üstün, T.B., 2005. The prevalence and effects of adult attention deficit/hyperactivity disorder on work performance in a nationally representative sample of workers. *Journal of Occupational and Environmental Medicine*, *47*(6), pp.565-572.
[95] Secnik, K., Swensen, A. and Lage, M.J., 2005. Comorbidities and costs of adult patients diagnosed with attention-deficit hyperactivity disorder. *Pharmacoeconomics*, *23*(1), pp.93-102.
[96] Kessler, R.C., Lane, M., Stang, P.E. and Van Brunt, D.L., 2009. The prevalence and workplace costs of adult attention deficit hyperactivity disorder in a large manufacturing firm. *Psychological medicine*, *39*(1), pp.137-147.
[97] Australian Bureau of Statistics, http://www.abs.gov.au/ausstats/abs@.nsf/mf/6202.0. This includes part time and full time employment.
[98] On average, the costs of manager time and the overtime premium increase the cost of absenteeism by 58% compared to AWE alone.
[99] Able, S.L., Haynes, V. and Hong, J., 2014. Diagnosis, treatment, and burden of illness among adults with attention-deficit/hyperactivity disorder in Europe. *Pragmatic and observational research*, *5*, p.21.

- In 2001-2003, a sample of 2,399 American adults aged 18-44 with ADHD lost an **additional 21.6 work days per year**, due to presenteeism, controlling for age, sex, race, education and occupation[100]
- A study of Japanese adults with ADHD reported a **40% impairment of worktime** for adults with ADHD compared to non-ADHD adults[101]
- In 2014, a sample of 100 American adults and 326 European adults reported a **15% and 29% reduction in work productivity** for individuals with ADHD, compared to those without.[102]

The average reduction in work output for people with ADHD was estimated by calculating a weighted average, based on study sample size, across each of these studies. It was calculated that people with ADHD have **on average 14% reduction in work output each year**, compared with the general population.

To estimate the costs of presenteeism due to ADHD the average additional reduction in productivity while at work was then applied to Australian general population employment rates and AWE by age and gender. Presenteeism associated with ADHD was estimated to cost $3.90 billion in 2019, which is $6,825 per working age Australian living with ADHD.

4.3 Reduced workforce participation

ADHD may result in reduced employment either through disadvantages in job-seeking (for example difficulty in searching for work or keeping a job) or self-selection out of the labour force. This can lead to significant productivity losses in the form of lost wages and other costs to the individual, such as reduced social engagement.

A targeted review of relevant literature was conducted to estimate the impact of ADHD on workforce participation. One study in an Australian setting was identified that reported on lifetime probability of employment for people with ADHD.[103] However for the purposes of estimating the cost of ADHD, the study by Fletcher et al (2014) is most suitable due to the robustness of the methodology (e.g. clinically diagnosed ADHD, results controlled for age, gender, high school test scores, health, education and school/family/occupation fixed effects) and disaggregation of the results.[104] Using a sample of 600 American adults, the study found those who were diagnosed with ADHD in childhood or adolescence were **10% less likely to be employed** than a population comparison group by the time they were 30 years old.

The findings of Fletcher et al (2014) are conservative compared with the results of other studies.

- In a 1999-2013 longitudinal study of 309 American adults with childhood ADHD, **49% were employed at age 25** compared with 68% for a control group[105]
- In 2003, a sample of 500 American adults aged 18-64 with self-reported ADHD had an **employment rate of 34%** compared to 59% employment for a matched comparison group[106]

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[100] Kessler, R.C., Adler, L., Ames, M., Barkley, R.A., Birnbaum, H., Greenberg, P., Johnston, J.A., Spencer, T. and Üstün, T.B., (2005). The prevalence and effects of adult attention deficit/hyperactivity disorder on work performance in a nationally representative sample of workers. *Journal of Occupational and Environmental Medicine*, *47*(6), pp.565-572.
[101] Kirino, E., Imagawa, H., Goto, T., & Montgomery, W. (2015). Sociodemographics, comorbidities, healthcare utilization and work productivity in Japanese patients with adult ADHD. *PLoS One*, 10(7), e0132233.
[102] Able, S.L., Haynes, V. and Hong, J., 2014. Diagnosis, treatment, and burden of illness among adults with attention-deficit/hyperactivity disorder in Europe. *Pragmatic and observational research*, *5*, p.21.
[103] Ebejer, J. L., Medland, S. E., Van Der Werf, J., Gondro, C., Henders, A. K., Lynskey, M., ... & Duffy, D. L. (2012). Attention deficit hyperactivity disorder in Australian adults: prevalence, persistence, conduct problems and disadvantage. PLoS One, 7(10), e47404.
[104] Fletcher, J.M., 2014. The effects of childhood ADHD on adult labor market outcomes. *Health economics*, *23*(2), pp.159-181.
[105] Altszuler, A.R., Page, T.F., Gnagy, E.M., Coxe, S., Arrieta, A., Molina, B.S. and Pelham, W.E., (2016). Financial dependence of young adults with childhood ADHD. *Journal of abnormal child psychology*, *44*(6), pp.1217-1229.
[106] Biederman, J. and Faraone, S.V., (2006). The effects of attention-deficit/hyperactivity disorder on employment and household income. *Medscape General Medicine*, *8*(3), p.12.

- A 2013 study of 23-32 year old American males diagnosed with clinically diagnosed ADHD in childhood had **an employment rate of 75.2%, compared with 88.6%** for the control group. The study controlled for parental education.[107]

To estimate the costs of reduced employment due to ADHD the relative reduction in employment was applied to Australian general population employment rates[108] and AWE[109] by age and gender. Reduced employment associated with ADHD was estimated to cost $3.09 billion in 2019, or $5,417 per working age Australian with ADHD.

4.4 Long-term reductions in productivity due to educational outcomes

ADHD is associated with lower educational outcomes in childhood and adolescence, compared with educational outcomes in typically developing children. A 2006 study of American and Canadian children aged 4-12 years with symptoms of ADHD found large negative effects on early education outcomes, such as test scores, grade repetition and special education placement. This study used a broad sample of children and estimated sibling fixed effects models to control for unobserved family effects.[110]

A follow up study extended these findings to a sample of older American children and found that children with ADHD face longer term educational disadvantages, including lower grade point averages, increases in suspension and expulsions, and fewer completed years of schooling. However, nearly all of these results were not robust to the inclusion of family fixed effects, suggesting that short-term consequences of educational outcomes do not lead to longer term educational consequences in a straightforward manner.[111]

There is also evidence from the Australian setting of negative education effects for children with ADHD. The Young Minds Matter study of Australian 4-17 year olds with ADHD found impacts on school functioning. For example, the average number of days off school due to ADHD was 4 days for 4-11 year old and rose to 9 days for 12-17 year olds.[112] While these negative education outcomes for people with ADHD may reduce productivity outcomes later in life, there is insufficient evidence to conclusively estimate this impact.

4.5 Premature mortality

In addition to the productivity losses associated with reduced employment, absenteeism or presenteeism, productivity losses may occur when a person dies prematurely due to their condition or illness. These productivity losses represent a loss of future income for the individuals, which can be a tax revenue source for government. The productivity loss due to premature mortality is estimated (in net present value terms) by multiplying the number of deaths due to ADHD for each age and gender group (section 2.3) by their expected future earnings.[113]

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[107] Kuriyan, A. B., Pelham, W. E., Molina, B. S., Waschbusch, D. A., Gnagy, E. M., Sibley, M. H., ... & Kent, K. M. (2013). Young adult educational and vocational outcomes of children diagnosed with ADHD. Journal of abnormal child psychology, 41(1), 27-41.

[108] Australian Bureau of Statistics (ABS). (2018). Labour Force, Australia, Detailed, Quarterly, Aug 2018, 6291.0.55.003.

[109] Australian Bureau of Statistics (ABS). (2018). Average Weekly Earnings, Australia, May 2018, 6302.0.

[110] Currie, J., and Stabile, M. (2006). Child mental health and human capital accumulation: The case of ADHD. *Journal of Health Economics*, 25 1094–1118.

[111] Fletcher, J., and Wolfe, B. (2007). Child mental health and human capital accumulation: The case of ADHD revisited. *Journal of Health Economics*, 27 (2008) 794–800.

[112] Lawrence, D., Johnson, S., Hafekost, J., Boterhoven de Haan, K., Sawyer, M., Ainley, J., & Zubrick, S. R. (2015). The mental health of children and adolescents: report on the second Australian child and adolescent survey of mental health and wellbeing. *Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing*. Department of Health, Canberra.

[113] Expected future earnings for each age and gender group were estimated by assuming that employment rates are stable over time, so that a person who is aged 15 to 19 today will be employed at the same rate as a person who is aged 20 to 24 today in 5 years' time. Similarly, average weekly earnings were estimated in a similar way, assuming no real growth in wages (a conservative approach).
All lifetime earnings were estimated in discounted NPV terms using a discount rate of 2.0% - a wage growth rate which adjusts expected long term nominal bond returns (a proxy for positive time preference) by target inflation and expected productivity growth. In the latest Intergenerational report prepared by the Treasury, long term yields over the next 40 years are expected to return to 6%, while productivity growth and inflation are expected to be 1.5% and 2.5%, respectively.

The forgone income from premature mortality due to ADHD was estimated to be $132.1 million in 2019. Given that most deaths occur in males, and their higher AWE, most of the forgone income is in males ($119.7 million).

4.6 Informal carer costs

Carers are people who provide care to others in need of assistance or support. An informal carer provides this service free of charge and does so outside of the formal care sector. An informal carer will typically be a family member or friend of the person receiving care, and usually lives in the same household as the recipient of care. People can receive informal care from more than one person.

While informal carers are not paid for providing this care, informal care is not free in an economic sense. Time spent caring involves forfeiting time that could have been spent on paid work, or undertaking leisure time activities. As such, informal care can be valued as the opportunity cost associated with the loss of economic resources (labour) and the loss in leisure time valued by the carer. To estimate the dollar value of informal care, the opportunity cost method measures the formal sector productivity losses associated with caring, as time devoted to caring responsibilities is time which cannot be spent in the paid workforce.

Working carers of children and adolescents diagnosed with ADHD can incur productivity losses for a variety of reasons, such as the need to attend in-school conferences, pursue or revise special education services, and manage accidents.[114] Missing work may impact a parent's job performance and/or lead to altered employment, such as switching from full-time to part-time, or quitting jobs, both of which can negatively impact long-term career trajectories. In this study, almost a third of caregivers reported altering their employment status, which included reduced working hours or resignations, because of their child/adolescent's ADHD.[115] The estimates presented here focus largely on missed work time (including lower participation in the workforce), rather than job performance or other carer productivity costs.

To estimate the costs of informal care for Australians with ADHD, it was necessary to estimate the proportion of people with ADHD receiving support from an informal carer, and also the additional hours of care that are provided to Australians with ADHD.

To estimate the proportion of people with ADHD receiving support from an informal carer, we have assumed only children and adolescents who use health services (63% of children aged 6-8 years, which was applied to all children and adolescents due to a lack of evidence) would have received informal care from a caregiver.[116] Balancing this, it was assumed that no adults receive support from an informal carer.

The additional hours of care provided by parental carers of children with ADHD was estimated using the average missed hours of work. The review did not identify any studies in an Australian setting that reported the additional hours of care provided by parental carers of children with ADHD in comparison to those without. In a multi-country European study by Flood et al (2016), carers of children and adolescents aged 6-17 with medicated ADHD reported missing an average of 3.8 hours of work every four weeks, attributed to their child's ADHD.[117] This estimate may overstate the average number of hours of carers for all children with ADHD, as children with un-

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[114] Zhao, X., Page, T. F., Altszuler, A. R., Pelham, W. E., Kipp, H., Gnagy, E. M., ... & Macphee, F. L. (2019). Family Burden of Raising a Child with ADHD. *Journal of abnormal child psychology*, 1-12.
[115] Flood, E., Gajria, K., Sikirica, V., Dietrich, C.N., Romero, B., Harpin, V., Banaschewski, T., Quintero, J., Erder, M.H., Fridman, M. and Chen, K., 2016. The Caregiver Perspective on Paediatric ADHD (CAPPA) survey: understanding sociodemographic and clinical characteristics, treatment use and impact of ADHD in Europe. *Journal of affective disorders*, *200*, pp.222-234.
[116] Efron, D., Moisuc, O., McKenzie, V., & Sciberras, E. (2016). Service use in children aged 6–8 years with attention deficit hyperactivity disorder. *Archives of disease in childhood, 101*(2), 161-165.
[117] Flood, E., Gajria, K., Sikirica, V., Dietrich, C.N., Romero, B., Harpin, V., Banaschewski, T., Quintero, J., Erder, M.H., Fridman, M. and Chen, K., 2016. The Caregiver Perspective on Paediatric ADHD (CAPPA) survey: understanding sociodemographic and clinical characteristics, treatment use and impact of ADHD in Europe. *Journal of affective disorders*, *200*, pp.222-234.

medicated ADHD, which may be less severe and require less informal care, are excluded. However, the majority of children with ADHD are medicated (78% in this study).

Overall, informal carer costs were estimated to be $210.4 million in Australia in 2019.

The findings of the Flood et al (2016) study are consistent with the findings of Zhao et al (2018) that parents of children with ADHD have a greater occupational and socio-emotional burden. While the focus in this report was on the carer time, due to a lack of robust evidence to quantify the change in roles in Australia, a recent longitudinal study has found the burden on families can be substantial.[118] The study was conducted in American adolescents aged 14 to 17 years with clinically diagnosed ADHD, and it examined the family burden associated with a range of challenges including costs such as purchasing medications or missing time at work, and less tangible costs such as marital tension or wellbeing impacts. For parents of children with ADHD 20% changed job responsibilities (compared with 3% in the control group), 11% quit a job or got fired (compared with 0% in the control group) and 27% needed additional childcare (compared with 10% in the control group).[119] Income loss due to missing work was also greater for the ADHD carers group compared to the control group. Other indirect costs to families may include costs of childcare, academic support, and legal services.

4.7 Summary of productivity losses

Overall, the total productivity cost of ADHD was estimated to be $10.19 billion in 2019, or $12,509 per Australian with ADHD, or $17,851 per working age Australian with ADHD.

Table 4.1 Productivity costs due to ADHD in Australia in 2019

Cost component	Total cost ($bn)	Cost per person ($)
Absenteeism	2.86	3,511
Presenteeism	3.90	4,782
Reduced workforce participation	3.09	3,796
Premature mortality (including search, hiring and training costs)	0.13	162
Informal care	0.21	258
Total	**10.19**	**12,509**

Source: Deloitte Access Economics analysis.

Presenteeism accounts for 38% of productivity costs associated with ADHD in 2019. Presenteeism was followed by reduced workforce participation (31%), absenteeism (28%) and premature mortality (1%) as shown in Chart 4.1. In addition, informal carer costs were estimated to be $210.4 million, or on average $748 for every Australian child or adolescent (0-19 years old) with ADHD.

Individual and company taxation rates were used to estimate the share of productivity costs that are borne by individuals and their families (caregivers), governments and employers. The respective tax rates used in the calculation of deadweight losses were:

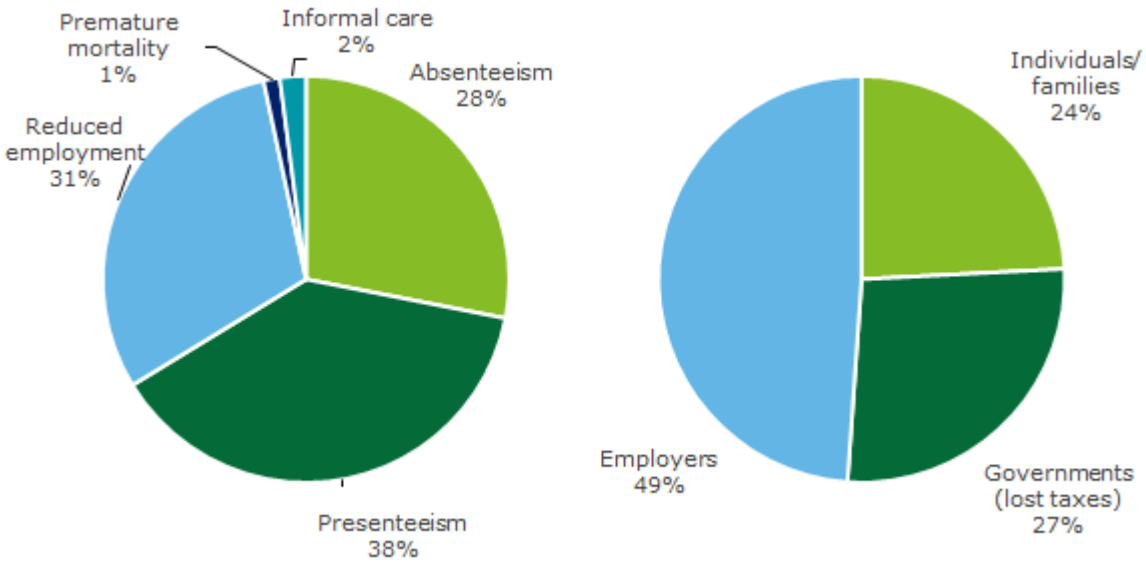
- 23.4% average personal income tax rate, and 12.6% average indirect tax rate; and
- 22.9% average company tax rate.

The forgone taxation revenue is estimated in section 5.3.1: employers bore 49% of total productivity costs, which was followed by government (27%), through lost taxation revenue, and

[118] Zhao, X., Page, T. F., Altszuler, A. R., Pelham, W. E., Kipp, H., Gnagy, E. M., ... & Macphee, F. L. (2019). Family Burden of Raising a Child with ADHD. *Journal of abnormal child psychology*, 1-12.
[119] Ibid.

individuals or their families (24%) as shown in Chart 4.1. Families bore 66% of the costs of informal care, followed by government (34%) in the form of lost taxes.

Chart 4.1 Productivity costs by component (LHS) and payer (RHS)



Source: Deloitte Access Economics analysis.

5 Other financial costs

Many services, and subsequently costs, occur through services provided for a broad range of conditions, and are not specifically provided to those with ADHD. In certain instances these services are being accessed more frequently by people with ADHD (such as children accessing educational support and adjustment services), or people with ADHD being overrepresented in the use of other government services (such as interactions with the justice system). Other financial costs include the deadweight losses resulting from higher taxes and government spending to support the provision of government services.

There are several international studies that have attempted to quantify the non-medical costs of ADHD, using various methodologies and focusing on different economic aspects (such as the burden on families, or the resultant economic impact of ADHD on the individual). For this study, a conservative approach has been taken to estimating other financial costs due to the limited availability of Australian evidence. Where the literature is of sufficient quality and relevance, data were presented from both Australian and international studies.

Key findings

- Total other costs; comprising of educational, crime and justice, reduced taxation revenue and deadweight losses of taxation payments are estimated to be $1.82 billion.
- Educational costs comprise of over 37,000 supplementary adjustments costing an estimated $106 million.
- Costs of crime and to the justice system of jurisdictions are estimated to be $307 million.
- The deadweight loss from all government expenditure of services and programs for people with ADHD is estimated to be $1.41 billion.

5.1 Education costs

Schools, as they currently operate, can be distracting environments – not necessarily catering to the unique functional needs of each student with ADHD. Within these environments, students can become bored, hyperactive, and angry and may become disruptive. Schools should – and do, in light of recent policy changes – seek to modify teaching and learning environments to better cater for individual student needs, which can increase education related costs.

Nevertheless, children diagnosed with ADHD do not always succeed in existing school environments and may experience learning difficulties.[120] There is international evidence suggesting that children with ADHD are more likely to display disruptive behaviour in the

[120] Frazier, T. W., Youngstrom, E. A., Glutting, J. J., & Watkins, M. W. (2007). ADHD and achievement: Meta-analysis of the child, adolescent, and adult literatures and a concomitant study with college students. *Journal of learning disabilities*, 40(1), 49-65.

classroom,[121] leading to suspension, expulsion, disciplinary action or reduced or delayed educational completion rates.[122,123,124,125,126]

These impacts can have short-term costs on the educational system such as the cost borne from disruption to class, and longer-term costs including impacts on the individuals' occupational status, further educational attainment, and income.[127,128] However due to a lack of robust Australian literature and official statistics, some of these impacts on education could not be costed.

Where the impacts of ADHD are identified, classroom supports and adjustments may be provided to children with ADHD through general programs and funding for schools, or as supplementary funding for children with various learning difficulties or disability.

Due to the varying levels or service provision within schools, data on the use and cost of these services within Australia is limited. It has, however, been found that students with ADHD are accessing educational, behavioural and other services within schools more frequently than students without ADHD,[129] which can lead to higher costs.[130]

Internationally, there is also evidence of the increased use of school-based educational support services for people with ADHD. While the education systems are often very different, the evidence supports the need for supplementary supports for children with ADHD. In one US based study, more than half of students accessed educational support services, including individualised learning plans, case management, and vocational support.[131] Another US based study found the annual incremental cost to the US educational system per student with ADHD was $5,007, compared with $318 for a student from the comparison group (no ADHD) in 2011 US dollars. The cost estimate was based on (1) ADHD children who are eligible for special education services under specific US based programs, (2) students with ADHD who repeated a grade, and (3) the cost of disciplinary acts committed by ADHD students.[132]

Only one Australian study was identified that assessed service use for children with ADHD in Australian schools. This longitudinal study of school-aged children with ADHD was based in Victorian schools (59% government, 20% catholic, 15% independent), and therefore does not account for differences in educational and funding models across jurisdictions. Overall, the study reported that 60% of participants with ADHD access school-based support services. These services for students included social support (36%), Individualised Educational Plans (IEPs; 22%), Student

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[121] These are not wholly educational costs per se but disruption can affect other students.
[122] Breslau, J., Miller, E., Chung, W. J. J., & Schweitzer, J. B. (2011). Childhood and adolescent onset psychiatric disorders, substance use, and failure to graduate high school on time. *Journal of psychiatric research*, 45(3), 295-301.
[123] Fletcher, J., & Wolfe, B. (2008). Child mental health and human capital accumulation: the case of ADHD revisited. *Journal of health economics*, 27(3), 794-800.
[124] LeFever, G. B., Villers, M. S., Morrow, A. L., & Vaughn III, E. S. (2002). Parental perceptions of adverse educational outcomes among children diagnosed and treated for ADHD: A call for improved school/provider collaboration. Psychology in the Schools, 39(1), 63-71.
[125] Biederman, J., Monuteaux, M. C., Doyle, A. E., Seidman, L. J., Wilens, T. E., Ferrero, F., ... & Faraone, S. V. (2004). Impact of executive function deficits and attention-deficit/hyperactivity disorder (ADHD) on academic outcomes in children. *Journal of consulting and clinical psychology*, 72(5), 757.
[126] Fried, R., Petty, C., Faraone, S. V., Hyder, L. L., Day, H., & Biederman, J. (2016). Is ADHD a risk factor for high school dropout? A controlled study. *Journal of attention disorders*, 20(5), 383-389.
[127] Barkley, R. A., Murphy, K. R., & Fischer, M. (2010). *ADHD in adults: What the science says*. Guilford Press.
[128] Barkley, R. A., Fischer, M., Smallish, L., & Fletcher, K. (2006). Young adult outcome of hyperactive children: adaptive functioning in major life activities. *Journal of the American Academy of Child & Adolescent Psychiatry*, 45(2), 192-202.
[129] Capriotti, M. R., & Pfiffner, L. J. (2017). Patterns and predictors of service utilization among youth with ADHD-predominantly inattentive presentation. *Journal of attention disorders*, 1087054716677817.
[130] Marks, D. J., Mlodnicka, A., Bernstein, M., Chacko, A., Rose, S., & Halperin, J. M. (2008). Profiles of service utilization and the resultant economic impact in preschoolers with attention deficit/hyperactivity disorder. *Journal of pediatric psychology*, *34*(6), 681-689.
[131] Murray, D. W., Molina, B. S., Glew, K., Houck, P., Greiner, A., Fong, D., ... & Abikoff, H. B. (2014). Prevalence and characteristics of school services for high school students with attention-deficit/hyperactivity disorder. *School mental health*, 6(4), 264-278.
[132] Robb, J. A., Sibley, M. H., Pelham, W. E., Foster, E. M., Molina, B. S., Gnagy, E. M., & Kuriyan, A. B. (2011). The estimated annual cost of ADHD to the US education system. *School mental health*, 3(3), 169-177.

Support Groups (SSGs; 18%), counselling (17%), mentoring (15%), and homework support (9%).[133]

As discussed above, services and adjustments provided within Australian schools to students with ADHD vary. The Nationally Consistent Collection of Data on School Students with Disability (NCCD) provides an outline of various adjustments that may be provided to enable a student with disability to access and participate in education on the same basis as other students. The NCCD notes that not all adjustments are included in the NCCD and that educational adjustments made solely for reasons other than disability, for example disadvantage (due to disrupted schooling and/or poverty), and are not included in the NCCD.

The four levels of adjustments and loading for various disability as defined by the Department of Education and NCCD are:[134,135]

- **Support provided within quality differentiated teaching practice**: These adjustments are provided through usual school processes, without drawing on additional resources, and by meeting proficient-level Teaching Standards (AITSL) – no additional funding.
- **Supplementary adjustments**: These adjustments are supplementary to the strategies and resources already available for all students within the school - $4,764 per student per annum.
- **Substantial adjustments**: These adjustments are for more substantial support needs and are provided with considerable adult assistance - $16,561 per student per annum.
- **Extensive adjustments**: These adjustments are for high support needs, provided with extensive targeted measures and sustained levels of intensive support. The adjustments are highly individualised, comprehensive and ongoing - $35,390 per student per annum.

Most students with ADHD who are in need of adjustments are likely to be captured under support provided within *quality differentiated teaching practice* – that is, through ordinary schooling processes and resources. There is, however, a small proportion who have additional behavioural and learning development needs, and would likely qualify for additional resourcing.

Typical examples of adjustments that are likely to occur through *supplementary adjustment* funding, which includes modifying or tailoring learning programs; modifying instruction using a structured task-analysis approach; separate supervision or extra time to complete assessment tasks; providing course materials in accessible forms; programs or interventions to address the student's social/emotional needs; and specialised technology.

The number of students with ADHD who qualify for additional resourcing was based on the number of students who access IEPs and SSGs (22% and 18% respectively).[136] The midpoint (20%) was used for the purposes of modelling, which was applied to prevalence in school aged children to estimate the number of students who would qualify for, and access additional supports in school due to ADHD. This equated to 37,500 students across Australia in 2019.[137]

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[133] Zendarski, N., Sciberras, E., Mensah, F., & Hiscock, H. (2018). Factors Associated With Educational Support in Young Adolescents With ADHD. *Journal of attention disorders*, 1087054718804351.
[134] Department of Education and Training. (n.d.). What is the Government doing to support students with disability?, *Department of Education and Training, Australian Government*. Retrieved from https://www.education.gov.au/what-government-doing-support-students-disability
[135] Disability loading by NCCD level of adjustment is based on 2019 primary school student loading.
[136] Zendarski, N., Sciberras, E., Mensah, F., & Hiscock, H. (2018). Factors Associated With Educational Support in Young Adolescents With ADHD. *Journal of attention disorders*, 1087054718804351.
[137] This estimate is supported by the 2015 Young Minds Matter Survey which found that ADHD had a severe impact on schooling in 13% of students and a moderate impact in a further 31% of students. Given the survey is a self-reported measure, it is possible that not all students with a moderate impact would be eligible for, or require, additional supports.
Lawrence D., Johnson S., Hafekost J., Boterhoven De Haan K., Sawyer M., Ainley J., Zubrick S. R. (2015). The Mental Health of Children and Adolescents. *Report on the second Australian Child and Adolescent Survey of Mental Health and Wellbeing*. Department of Health, Canberra.

It was assumed that most students with ADHD who require extra support would only need a low level adjustment, such as the supplementary adjustment. Schools receive an additional $4,764 per annum for each student who is eligible for supplementary adjustments.[138]

As children with ADHD often have comorbid conditions, it is reasonable to assume that not all of their support needs are due to ADHD alone. To account for comorbid conditions, the average funding was divided by the average number of comorbid conditions, in the absence of better data (i.e. assuming that each condition contributes equally to the need for additional supports). Around 33% of children with ADHD have one comorbid disorder, 15% have two, 18% have three and the remaining 33% are estimated to have only ADHD.[139] Using these data, it was assumed that the cost of providing supplementary adjustments to students with ADHD was approximately $2,827 per annum due to their ADHD alone.

The total cost of educational support was therefore estimated to be $106 million in 2019 (=37,500 * $2,827).

5.2 Cost of crime and justice system

People with ADHD are more vulnerable to engage in antisocial and criminal behaviour, likely due to their impulsive actions and behaviours, disengagement from education and comorbidities that develop in adolescence such as conduct disorder and substance use disorders.[140] This section estimates the cost of ADHD to the Australian criminal justice system.

Australian and international research suggests that a disproportionately high number of individuals with ADHD are involved in criminal activity and within the criminal justice system: internationally the prevalence of ADHD in incarcerated populations has been estimated at 25.5%, although there are significant differences across countries.[141] An Australian study conducted in NSW found that 17% of inmates screened positive for a full ADHD diagnosis (DSM-IV), which is considerably higher than the prevalence in the general population.[142]

Not only are people with ADHD overrepresented in prisons both domestically and internationally, there is evidence to suggest that the cost of incarceration for people with ADHD is significantly higher than those without ADHD. One UK based study estimated that the annual incremental cost of inmates with ADHD was £590 more than inmates without ADHD.[143] This cost comprises both medical treatment costs within the correctional facility, and behavioural related prison costs.[144]

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[138] Department of Education and Training. (n.d.). What is the Government doing to support students with disability?, *Department of Education and Training, Australian Government*. Retrieved from https://www.education.gov.au/what-government-doing-support-students-disability

[139] Larson, K., Russ, S. A., Kahn, R. S., & Halfon, N. (2011). Patterns of comorbidity, functioning, and service use for US children with ADHD, 2007. Pediatrics, 127;462.

[140] Erskine, H. E., Norman, R. E., Ferrari, A. J., Chan, G. C., Copeland, W. E., Whiteford, H. A., & Scott, J. G. (2016). Long-term outcomes of attention-deficit/hyperactivity disorder and conduct disorder: a systematic review and meta-analysis. Journal of the American Academy of Child & Adolescent Psychiatry, 55(10), 841-850.

[141] Young, S., Moss, D., Sedgwick, O., Fridman, M., & Hodgkins, P. (2015). A meta-analysis of the prevalence of attention deficit hyperactivity disorder in incarcerated populations. *Psychological medicine*, *45*(2), 247-258.

[142] Moore, E., Sunjic, S., Kaye, S., Archer, V., & Indig, D. (2016). Adult ADHD among NSW prisoners: prevalence and psychiatric comorbidity. *Journal of attention disorders*, 20(11), 958-967.

[143] Young, S., González, R. A., Fridman, M., Hodgkins, P., Kim, K., & Gudjonsson, G. H. (2018). The economic consequences of attention-deficit hyperactivity disorder in the Scottish prison system. *BMC psychiatry*, 18(1), 210.

[144] Responsibility for inmate medical costs within Australian prisons lie with the state or territory in which the inmate is incarcerated. The health services may be delivered by government (through the respective departments of health and/or corrective services), purchased through contractual arrangements or provided by a combination of the two. The cost of providing these services is not met through Medicare because of the operation of section 19(2) of the Health Insurance Act 1973 (Commonwealth). It is likely that extra costs (both medical and operational) for Australian inmates with ADHD occur, as established in the UK study by Young (2018). However medical and behavioural related costs were not included due to a lack of Australian based data to verify the findings within the UK study.

A population attributable fraction (PAF) approach was used to estimate the additional crime and justice system related costs due to ADHD in Australia.[145] PAFs refer to the proportion of one outcome (e.g. the number of crimes) that can be attributed to a particular condition (ADHD). ABS data on the prevalence rate of offences and convictions in Australia in 2018 was used as an input to estimate the PAFs.[146]

Erskine et al (2016) estimated the increased odds of people with ADHD engaging in a variety of criminal activities. Odds ratios were estimated for violence-related arrests (3.36, 95% CI 2.31-5.70), convictions (2.01, 95% CI 1.25-3.24), criminal acts (1.81, 95% CI 0.94-3.50), drug related arrests (1.69, 95% CI 0.75-3.77), arrests (2.43, 95% CI 1.62-3.65) and incarceration (2.53, 95% CI 1.38-4.63).[147] Each of these odds ratios show that people with ADHD are more likely to commit a particular crime, be involved in a criminal act, be arrested and/or convicted or incarcerated than people without ADHD.[148]

The individual inputs and resulting PAF for criminal acts, and sentencing (either sentencing to a correctional facility or community service order) are shown in Table 5.1. It was estimated that 1.49% of total criminal acts could be attributed to ADHD. Similarly, 0.18% and 0.07% of sentences to a correctional facility or community service order could be attributed to ADHD in Australia. This represents an extra 8,500 criminal acts and an extra 1,400 imprisonments or community service orders due to ADHD in 2019.[149]

[145] PAFs were calculated using the following method based on Eide and Heuch (2001). Equations 1 and 2 were solved simultaneously to obtain estimates for q1 and q2. The PAF is then estimated using equation 3.

(1) q1.s1+q2.s2 = p1
(2) q1/(1-q1)/(q2/(1-q2)) = OR
(3) PAF = ((q1-q2).s1)/p1.

where:

- q1 is the probability of having the outcome (e.g. sentencing) given that an individual has ADHD, while q2 is the probability of the same outcome given that an individual does not have ADHD and p1 is the probability of the outcome in the general population.
- s1 is the proportion of the population with ADHD, while s2 is the proportion of the population without ADHD.

Eide G., Heuch I. (2001). Attributable fractions: fundamental concepts and their visualization. *Statistical methods in Medical Research, 10*:159-193.

[146] Australian Bureau of Statistics, 2019, Recorded Crime – Offenders, 2017-18, cat. no. 4519.0, viewed 20 March 2019, https://www.abs.gov.au/ausstats/abs@.nsf/mf/4519.02017-18

[147] Erskine, H. E., Norman, R. E., Ferrari, A. J., Chan, G. C., Copeland, W. E., Whiteford, H. A., & Scott, J. G. (2016). Long-term outcomes of attention-deficit/hyperactivity disorder and conduct disorder: a systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, 55(10), 841-850.

[148] The odds ratio provided by Erskine et al (2016) does not specify the type of crime that has been committed, and the estimates presented here may be confounded by differing methodologies in the underlying studies (e.g. a different definition of criminal activity may have been used across studies). Therefore, applying this odds ratio to the Australian rate of offences may be subject to some bias. Given that Australian evidence supports a higher prevalence of ADHD in prison populations, these odds ratios have been accepted and used in this study.

[149] Calculations exclude those under the age of 14 years or over the age of 65 years.

Table 5.1 Criminal and justice system outcomes and ADHD, 2019

Outcome	Population wide prevalence (%)	Odds ratio (95% CI)	PAF (%)	Total cases	Cases attributed to ADHD
Criminal act (all)	1.95	1.81 (0.94-3.50)	1.49	487,101	8,492
Sentencing to correctional facility	0.18	2.01 (1.25-3.24)	0.18	45,181	1,006
Sentencing to community service order	0.08	2.01 (1.25-3.24)	0.07	18,836	420

Source: ABS (2019), Erskine (2016) and Deloitte Access Economics calculations.

To determine the average cost of a criminal act, and the average cost of convictions; estimates have been sourced from the Australian Institute of Criminology (AIC). Inflated to 2019 Australian dollars, the estimated cost per criminal act (excluding the cost of community service orders and correctional facilities) was estimated to be $24,000.[150] This cost includes the average costs of policing, prosecution, courts, legal aid and other jurisdictional costs, although it does not include intangible costs such as lost output and productivity due to the crime. The AIC was also used to estimate the net cost of community service orders, and a year of imprisonment, at $6,500 and $61,000 respectively. These costs include productivity losses and reduced taxation income, as well as the cost of the correctional system.[151]

The total cost of crime due to ADHD, including the cost to the justice system, was estimated to be $307 million in 2019.

5.3 Deadweight losses

Transfer payments represent a shift of resources from one economic entity to another, such as raising taxes from the entire population to provide welfare payments to Australians with ADHD. Transfer costs are important when adopting a whole-of-government approach to policy formulation and budgeting. Publically funding costs means the government must effectively increase tax revenue to achieve a budget neutral position. Alternatively, if all ADHD could be avoided, the government would not need to raise as much tax revenue.

The act of taxation creates distortions and inefficiencies in the economy, so transfers also involve real net costs to the economy, known as deadweight losses. Imposing taxes on a market reduces the efficiency of resource allocation within that market because it changes the price of those goods or services being taxed. For example, an increase in income tax rates will increase the relative price of work compared to leisure and therefore create a disincentive to work. Similarly businesses may be discouraged from operating in Australia if company tax rates were too high.

Accordingly, although taxation transfers are not real costs of themselves they have been estimated, along with public funding of health care to calculate the cost associated with a loss in allocative efficiency. The following sections outline the reduced taxation revenue available to government and deadweight losses associated with taxation required to fund public systems (e.g. health, justice and education).

5.3.1 Taxation revenue

Reduced earnings from lower employment participation and lower output result in reduced taxation revenue collected by the Australian Government. As well as forgone income taxation, there would also be a fall in indirect (consumption) taxes, as those with lower incomes spend less on the consumption of goods and services. Lost taxation revenue was estimated by applying an average personal income tax rate and average indirect taxation rate to lost earnings.

[150] Smith, R., Jorna, P., Sweeney, J. and Fuller, G. (2015). Counting the costs of crime in Australia. Canberra: *Australian Institute of Criminology*.
[151] Morgan, A. (2018). How much does prison really cost? Comparing the costs of imprisonment with community corrections. Research Report, (5), COV-COV.

The average rates of taxation were derived by dividing net income tax and net indirect tax by the taxable income. This method was also used to derive the average company tax rate, which was then applied to lost company earnings (through reduced output). Again, net tax for companies was divided by the total taxable income for companies. The respective tax rates used in the calculation of deadweight losses were:

- 23.4% average personal income tax rate, and 12.6% average indirect tax rate; and
- 22.9% average company tax rate.

Applying these tax rates to the total productivity impacts (including informal care costs), the total lost individual income was estimated to be $1.27 billion (including lost carer taxes), while the total lost company revenue was estimated to be $1.48 billion in 2019.

5.3.2 Deadweight loss of taxation payments and administration

Societal inefficiencies, known as deadweight losses, increase when taxes are raised above the level that they would otherwise have been in the absence of ADHD. Thus, the inclusion of deadweight losses in this analysis implicitly assumes that governments maintain a budget neutral position despite the decreased tax revenue and increased government spending due to ADHD. This requires that governments increase taxes above what they would have been in the absence of ADHD to:

- maintain the same amount of tax revenue despite a smaller pool of taxable income from individuals and taxable profits from businesses (see section 5.3.1); and
- pay for additional government spending in areas such as health care, education, and the justice system as a result of ADHD.

To estimate the deadweight loss due to lost taxation revenue, taxes were assumed to be maintained by taxing individuals and companies more as necessary (to replace the lost tax, and to raise funds to cover the additional spending). Each tax in the economy imposes various burdens on the efficiency of society. Previous analyses have reported the marginal burden of various government taxes.[152] [153] These are:

- income tax: $0.26 for every $1 raised;
- company tax: $0.51 for every $1 raised;
- goods and services tax: $0.19 for every $1 raised; and
- state taxes impose a range of marginal burdens from taxes on gambling, insurance, motor vehicles, and payroll, and stamp duties.

The analysis assumes that additional tax revenue to maintain a budget neutral position is raised in the same proportions from the sources of tax from which it is currently being raised. Thus, weighted by the source of tax revenue:

- reduced income for individuals results in a 25% efficiency loss
- reduced income for employers results in a 51% efficiency loss
- welfare payments, health and other Commonwealth Government expenditure results in a 30% efficiency loss
- state and territory government expenditure results in a 48% efficiency loss.

Table 5.1 shows the estimated reduced income and health expenditure payments, the applied efficiency loss of raising taxation, and the resulting deadweight losses due to ADHD in 2019. All rates of efficiency loss include a 0.8% administrative loss which covers expenses of administering taxation.[154] The total deadweight losses due to ADHD were estimated to be $1.41 billion in 2019.

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[152] Cao L., Hosking A., Kouparitsas M., Mullaly D., Rimmer X., Shi Q., Stark W., Wende S. (2015). Understanding the economy-wide efficiency and incidence of major Australian taxes', The Australian Government the Treasury, Canberra.
[153] KPMG Econtech. (2010). CGE analysis of the current Australian tax system. Report for the Australian Government the Treasury, March, Canberra.
[154] Australian Taxation Office (ATO). 2016. Annual report 2015-16, Canberra, October.

Table 5.1 Deadweight losses due to ADHD in 2019

Cost component	Total cost ($m)	Rate of efficiency loss (%)	Resulting deadweight loss ($m)
Lost consumer taxes	1,197.9	25	294.7
Lost company taxes	1,475.3	51	748.0
Lost carer taxes	71.5	25	17.6
Commonwealth health expenditure	517.0	30	154.6
State and territory health expenditure	147.8	48	71.0
Other government expenditure	413.4	30	123.6
Total	**3,822.9**	**-**	**1,409.5**

Source: Deloitte Access Economics analysis.

5.4 Summary of other financial costs

Overall, the total cost of ADHD outside the health system and productivity-related costs was estimated to be $1.82 billion in 2019, or $2,238 per Australian with ADHD. These costs are considered conservative, as not all aspects of education and crime, nor other costs that may fall onto society, have been considered due to the lack of robust Australian data.

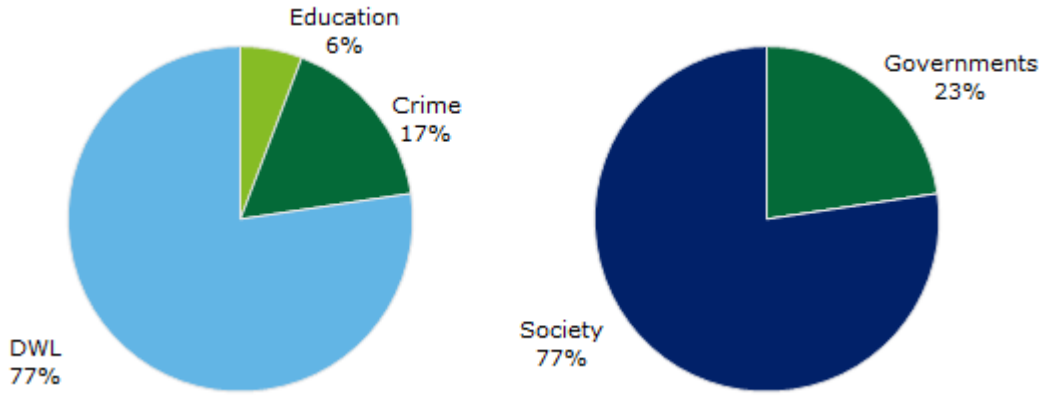
Table 5.2 Other financial costs due to ADHD in 2019

Cost component	Total cost ($m)	Cost per person ($)
Education	106.0	130
Crime and justice	307.5	377
Deadweight losses	1,409.5	1,730
Total	**1,822.9**	**2,238**

Source: Deloitte Access Economics. Note: components may not sum due to rounding.

Other financial costs due to ADHD make up 14.2% of all financial costs. This is comprised of deadweight losses (77%), education (6%) and justice and crime costs (17%), as shown in Chart 5.1.

Chart 5.1 Other financial costs by component (LHS) and payer (RHS)



Source: Deloitte Access Economics.

6 Burden of disease

There are substantial wellbeing losses due to ADHD. For example, ADHD is among the 15 leading causes of disability in children and adolescents aged 5-19 years.[155]

This chapter adopts the burden of disease methodology to quantify the impact of ADHD on wellbeing. The approach is non-financial, where life and health can be measured in terms of DALYs.

Key findings

- ADHD was estimated to cost Australians 40,890 DALYs in 2019.
- The total cost associated with the loss of wellbeing was estimated to be $7.6 billion by converting DALYs to a dollar value using the VSLY. This is a non-financial cost.

6.1 Valuing life and health

The burden of disease methodology was developed by the World Health Organization and is a comprehensive measure of mortality and disability from conditions for populations around the world. The burden of disease methodology is a non-financial approach, where life and health can be measured in terms of DALYs. DALYs include both years of life lost due to premature death (YLLs) and years of healthy life lost due to disability (YLDs). One DALY equals one year of healthy life lost.

Disability weights are assigned to various health states, where zero represents a year of perfect health and one represents death. Other health states are given a weight between zero and one to reflect the loss of wellbeing due to a particular condition. For example, a disability weight of 0.2 is interpreted as a 20% loss in wellbeing relative to perfect health for the duration of the condition.

The burden of disease as measured in DALYs can be converted into a dollar figure using an estimate of the value of a statistical life (VSL). The VSL is an estimate of the value society places on an anonymous life. The Department of the Prime Minister and Cabinet (2014) provided an estimate of the 'net' VSLY (that is, subtracting financial costs borne by individuals). This estimate was $182,000 in 2014 dollars, which inflates to around $197,315 in 2019 dollars for the VSLY using the Consumer Price Index.[156]

The methodology the global burden of disease study uses to calculate disability weights may underestimate the burden of ADHD as it estimates burden in terms of health loss and does not take into account impacts beyond the disorder's direct health outcomes. For example, it does not take into account the burden placed on an individual's family or on societal systems such as welfare or criminal justice,[157] which were outlined in previous chapters of this report.

6.2 Estimating burden of disease due to ADHD

As noted, DALYs comprise both YLDs and YLLs. The YLDs associated with ADHD were estimated by applying a representative disability weight to the prevalence of ADHD.

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[155] Erskine, H. E., Ferrari, A. J., Polanczyk, G. V., Moffitt, T. E., Murray, C. J., Vos, T., ... & Scott, J. G. (2014). The global burden of conduct disorder and attention-deficit/hyperactivity disorder in 2010. *Journal of Child Psychology and Psychiatry*, 55(4), 328-336.

[156] Department of Prime Minister and Cabinet. (2014). Best Practice Regulation Guidance Note: Value of Statistical Life, Australian Government, Canberra. Retrieved from https://www.pmc.gov.au/sites/default/files/publications/Value_of_Statistical_Life_guidance_note.pdf.

[157] Erskine, H. E., Ferrari, A. J., Polanczyk, G. V., Moffitt, T. E., Murray, C. J., Vos, T., ... & Scott, J. G. (2014). The global burden of conduct disorder and attention-deficit/hyperactivity disorder in 2010. *Journal of Child Psychology and Psychiatry*, 55(4), 328-336.

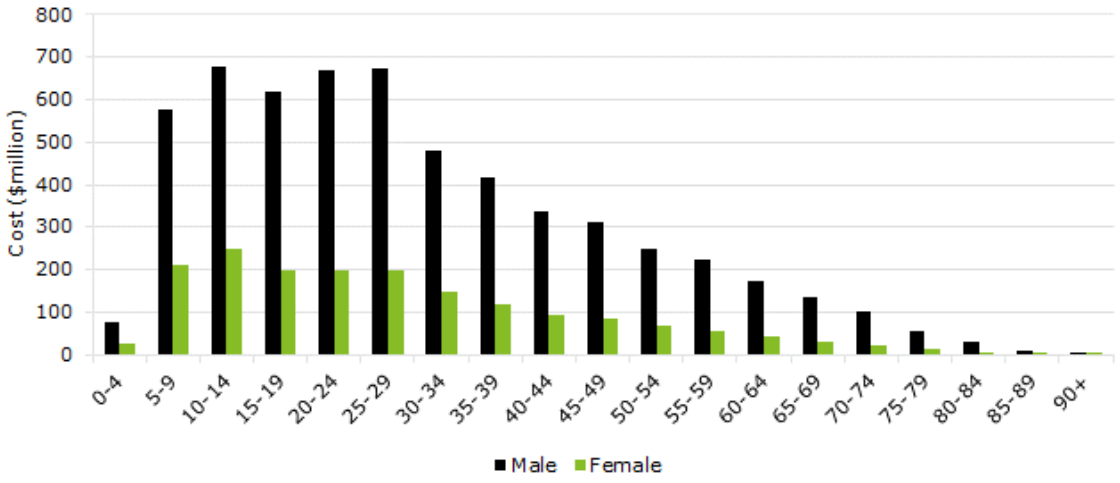
To estimate the disability weight, data were collected from the Global Burden of Disease (GBD) study; the disability weights from the GBD are also used by the AIHW in the Australian Burden of Disease study (ABODS). The GBD provides disability weights for ADHD. The disability weight is 0.045 which would be applied across all those in the population with ADHD.

The YLLs are calculated through analysis of the mortality rate of people with ADHD and comparing it to their expected lifespan in the absence of ADHD.[158] YLLs due to ADHD were estimated by multiplying the number of deaths in each age and gender group (section 2.3) by the expected years of life remaining at the age of death. Average life expectancy was obtained from the ABODS.

Overall, it was estimated that there are 36,653 YLDs, and 4,236 YLLs (without discounting) were due to ADHD. Thus, there an estimated 40,890 DALYs due to ADHD in 2019.

Converting the DALYs to a dollar estimate using the VSLY (and discounting future dollars at 3% per annum), the total cost associated with the loss of wellbeing was estimated to be $7.59 billion in 2019. DALYs were estimated to be higher in males than in females, peaking at 10 to 14 years, largely reflecting the greater prevalence in males, and in children and adolescents.

Chart 6.1 Loss of wellbeing associated with ADHD in Australia



Source: Deloitte Access Economics.

[158] Institute for Health Metrics and Evaluation. (2018). Global Burden of Disease. Retrieved from http://www.healthdata.org/gbd.

7 Cost summary

Key findings

- In 2019 an estimated 814,500 Australians were living with ADHD.
- Treating ADHD is costing our health system more than $814.5 million each year, or $1,000 per Australian living with ADHD.
- The total financial costs associated with ADHD were estimated to be $12.83 billion and the total loss of wellbeing $7.59 billion, which equates to a total cost of $20.42 billion in 2019.
- This report has identified several gaps in the literature on the economic burden of ADHD in Australia.

7.1 Summary of costs

The burden of ADHD in Australia is considerable and growing. This report found an estimated 814,500 Australians were living with ADHD. Treating ADHD is costing our health system $814.5 million each year, or $1,000 per Australian living with ADHD.

Additionally, ADHD costs our society in other ways. Productivity costs make up 79% of total financial costs, which is followed by deadweight losses (11%), health system costs (6%), and other costs including educational and crime and justice costs (3%). Employers were estimated to bear the largest share of financial costs (39%) followed by governments (30%), individuals and their families (20%) and society and other payers (11%).

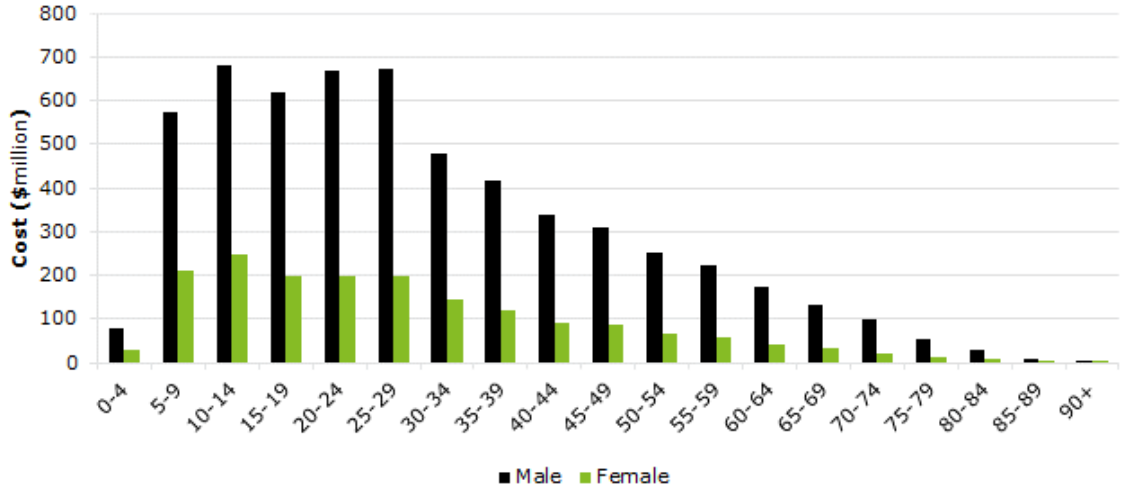
In addition to the substantial financial costs associated with ADHD, 40,890 DALYs were lost due to ADHD in 2019, which, using the VSLY, is a cost of $7.6 billion. The total financial costs associated with ADHD were estimated to be $12.8 billion in 2019, which equates to $15,747 per person with ADHD. The costs associated with ADHD in Australia in 2019 are summarised by cost component in Table 7.1. The costs by age and gender are summarised in Chart 7.1.

Table 7.1 Total costs associated with ADHD, Australia 2019

Category	Total cost ($bn)	Per person ($)	Proportion of total (%)
Health system	0.81	1,000	4.0
Absenteeism	2.86	3,511	14.0
Presenteeism	3.90	4,782	19.1
Reduced employment	3.09	3,796	15.1
Premature mortality (including search, hiring and training costs)	0.13	162	0.6
Informal care	0.21	258	1.0
Education	0.11	130	0.5
Crime and justice system	0.31	377	1.5
Deadweight loss	1.41	1,730	6.9
Total financial costs	**12.83**	**15,747**	**62.8**
Loss of wellbeing (non-financial)	**7.59**	**9,324**	**37.2**
Total costs	**20.42**	**25,071**	**100.0**

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Chart 7.1 Total costs associated with ADHD by age and gender, Australia 2019



Source: Deloitte Access Economics analysis.

7.2 Discussion

This report is the first to quantify the economic burden of ADHD in children and adults in Australia. One important finding of this project is the limited literature in the Australian setting. In particular, this report identified gaps relating to the costs of hospital and out-of-hospital services, and allied health and behavioural therapies for people with ADHD in Australia. A substantial proportion of people with ADHD reportedly use complementary and alternative therapies for the treatment of ADHD and this is also an area with a need for further research into the effectiveness of these treatments.

While no other Australian studies have used cost of illness methods to estimate the cost of ADHD, there are a number of studies in other country settings that have estimated the economic burden of ADHD. While the different health systems are not directly comparable to the Australian setting due to differences in treatment practices and therefore health system utilisation, they do indicate a comparable level of economic burden. For example, Matza et al (2005) estimated the economic burden of ADHD in children and adults in the USA using data from 22 studies. Results of the medical cost studies consistently indicated that children with ADHD had higher annual medical costs than either matched controls (difference ranged from $503 to $1,343) or non-matched controls (difference ranged from $207 to $1,560) without ADHD (results in 2004 US dollars). Similarly, studies of adults found significantly higher annual medical costs among adults with ADHD (ranging from $4,929 to $5,651) than among matched controls (ranging from $1,473 to $2,771) (results in 2004 US dollars).[159]

A 2017 US study by Gupte-Singh et al estimated the economic burden of ADHD among children and adolescents. The ADHD cohort had an estimated 58.4% higher expenditure than the non-ADHD cohort, with an estimated annual incremental cost of ADHD of $949.25 (2011 US dollars).[160] Similarly, a 2007 study of US children and adolescents by Pelham et al estimated the economic impact of ADHD including the costs of ADHD treatment-related and other health care costs, education, parental work loss and juvenile justice. The study estimated an annual cost of illness of ADHD in children and adolescents of $14,576 per person (2005 US dollars).[161]

[159] Matza, L. S., Paramore, C., & Prasad, M. (2005). A review of the economic burden of ADHD. Cost effectiveness and resource allocation, 3(1), 5.
[160] Gupte-Singh, K., Singh, R. R., & Lawson, K. A. (2017). Economic burden of attention-deficit/hyperactivity disorder among pediatric patients in the United States. *Value in Health*, 20(4), 602-609.
[161] Pelham, W. E., Foster, E. M., & Robb, J. A. (2007). The Economic Impact of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents. *Ambulatory Pediatrics*, 7, pp.121–131.

A 2014 economic impact study of ADHD in children and adolescents in Europe by Le et al found the average total ADHD related costs ranged from €9,860 to €14,483 per patient (2012 euros). These costs included healthcare, education, social services, and productivity losses of family members.[162] A 2018 study by Quintero et al estimated the health care and societal costs of ADHD in Spain. The estimated average annual cost of ADHD per child or adolescent was €5,733 (2012 euros). Direct costs accounted for 60.2% of total costs of which 27.2% of total costs was attributed to a psychologist/educational psychologist and 15.5% to pharmacotherapy. Among the included non-medical costs, 65.2% of those costs were due to caregiver expenses.[163]

One recent study by Zhao et al (2019) estimated the cost of raising a child with ADHD, using a longitudinal sample from the US. This study reported that the total economic burden over the course of a child's life to families was five times greater than children without ADHD, at US$15,036 compared to US$2,848 for children without ADHD.[164] This extra burden on the family was largely due to parents being more likely to change jobs, and having lower productivity.

In conclusion, ADHD imposes significant economic and wellbeing costs on the Australian population, and it can have lifelong impacts on individuals, including on educational achievement, occupational under attainment, and the increased likelihood of crime and interaction with the criminal justice system. These impacts place significant pressure on Australian society and its institutions.

As such, there is a continued need to raise awareness of the socioeconomic burden of ADHD in Australia and educate and inform key stakeholders including individuals, education systems, workplaces, and society in an attempt to reduce the burden and lifelong impact that ADHD may have. There are likely to be substantial opportunities for targeted policy interventions to help mitigate this costly condition.

[162] Le, H. H., Hodgkins, P., Postma, M. J., Kahle, J., Sikirica, V., Setyawan, J., ... & Doshi, J. A. (2014). Economic impact of childhood/adolescent ADHD in a European setting: the Netherlands as a reference case. *European Child and Adolescent Psychiatry* 23:587–598.
[163] Quintero, J., Ramos-Quiroga, J. A., San Sebastián, J., Montañés, F., Fernández-Jaén, A., Martínez-Raga, J., ... & Eiris, J. (2018). (2018). Health care and societal costs of the management of children and adolescents with attention-deficit/hyperactivity disorder in Spain: a descriptive analysis. *BMC Psychiatry*, 18:40.
[164] Zhao, X., Page, T. F., Altszuler, A. R., Pelham, W. E., Kipp, H., Gnagy, E. M., ... & Macphee, F. L. (2019). Family Burden of Raising a Child with ADHD. *Journal of Abnormal Child Psychology* https://doi.org/10.1007/s10802-019-00518-5.

Appendix A Persistence rates

Table A.1 Various persistence rates of ADHD from childhood into adulthood

Study design, author, year	Total sample (N)	Childhood ADHD (N)	Persistence rate (%)
Retrospective, population based			
Yang et al, 2013	1,382	196	74.7
Ebejer et al, 2012	**3,795**	**49**	**55.3**
Lara et al, 2009	11,422	629	50.0
Kessler et al, 2006	3,197	346	36.3
Barbaresi et al, 2013	5,718	232	29.3
Total/weighted average	*25,514*	*1,452*	*46.9*
Prospective, clinical based			
Cheung et al, 2015	-	110	79.0
Li et al, 2013	-	258	65.8
Clarke et al, 2011	-	36	63.2
Francx et al, 2015	-	101	58.4
Breyer et al, 2014	-	150	52.6
Chang et al, 2011	-	192	51.0
Russel et al,2007	-	158	40.7
Biederman et al, 2011	-	110	35.0
Biederman et al, 2012	-	96	33.3
Roizen et al, 2012	-	103	11.0
Total/weighted average		*1,314*	*50.3*

Source: Adapted from Caye et al, (2016).[165]

[165] Caye, A., Spadini, A. V., Karam, R. G., Grevet, E. H., Rovaris, D. L., Bau, C. H. D., . . . Kieling, C. (2016). Predictors of persistence of ADHD into adulthood: A systematic review of the literature and meta-analysis. European Child & Adolescent Psychiatry, 25(11), 1151-1159. Retrieved from https://doi.org/10.1007/s00787-016-0831-8

Limitation of our work

General use restriction

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