Deloitte.
Access Economics

Migraine in Australia Whitepaper

Prepared for Novartis Australia

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Glossary

Acronym	Full name
AIHW	Australian Institute of Health and Welfare
ARC	Australian Research Council
AR-DRG	Australian refined diagnosis-related groups
BEACH	Bettering the Evaluation and Care of Health
CPI	consumer price index
DALY	disability adjusted life year
DHS	Department of Human Services
DoH	Department of Health
DSS	Department of Social Services
GBD Study	Global Burden of Disease Study
GP	general practitioner
IBMS	International Burden of Migraine Study
IBMS-II	second International Burden of Migraine Study
ICHD-2	second International Classification of Headache Disorders
ICHD-3	third International Classification of Headache Disorders
IHME	Institute for Health Metrics and Evaluation
IHS	International Headache Society
MBS	Medicare Benefits Schedule
NHMRC	National Health and Medical Research Centre
NHS	National Health Service
UK	United Kingdom
USA	United States of America
VSL	value of a statistical life
VSLY	value of a statistical life year
WHO	World Health Organization
YLD	years of healthy life lost due to disability
YLL	years of life lost due to premature death

Foreword by the Brain Foundation

I am very pleased and extremely grateful to Novartis for funding this exemplary health economic research about migraine in Australia and the world. l have tended to be conservative in my estimation of the extent of migraine because I lacked fundamental research like this upon which to base my claims.

It will now be possible to communicate this robust evidence in the wider community, with employer groups, give GPs a greater insight into the enormity and impact of the disorder and inform politicians with confidence that the problem has been quantified in terms of economic burden and impost upon the quality of life for those suffering and their families.

With respect to the wider community, migraine is not well understood and an earlier survey indicated there was not much sympathy for those who do suffer. It was interesting to find from that survey that 85% of the national sample of those over 18 said that they had treated a headache at least once in the last year. Many of those were probably infrequent and not suffering migraine nor chronic headache so their treatment was self-medication and quickly resolved. So, it is reasonable to assume the majority believe some over the counter medications will give quick relief. We must now use the information to change that view.

Part of educating the wider community will be to call for their support by donating for research. Other sources clearly indicate that, relative to the size and impact of migraine, there is very little support from Government. The Brain Foundation, through its Division, Headache Australia, will soon launch a new, highly interactive course for primary healthcare physicians. The course was designed by Professor Tissa Wijeratne and his team of neurologists who gathered the latest, evidence-based clinical advances for the diagnosis, treatment and management of headache.

The Deloitte White Paper means that the problem is clearly identified and enormous. The paper is fundamental to a new, strategic positioning of migraine in the health care sector. We now have a renewed interest from specialists in what promises to provide the most significant advances ever for migraineurs. The information provided by the Deloitte Research is a vital component.

Gerald Edmunds RFD MB BA

Secretary General, Brain Foundation

Foreword by Painaustralia

Ongoing chronic pain is a major issue in Australia. It affects millions of men, women and children. Pain does not discriminate on the basis of age, gender, race, religion or socio economic status, and all of us know someone who suffers from it. A highly complex condition, chronic pain does not always result from accident or injury and may not be detectable in a scan or other diagnostic tool.

Unmanaged chronic pain can have wide-reaching impacts. It can cause severe emotional and psychological devastation – from major depression and anxiety to suicide. Pain is the major factor in at least 40 per cent of forced early retirements and often results in financial stress, pressure on relationships, and inability to socialise or participate in previously enjoyable activities. Sometimes pain patients struggle to be believed and can feel stigmatised.

Migraine is a particularly disabling chronic pain condition. It can bring an otherwise healthy individual to their knees, severely reducing their quality of life. Painaustralia often hears stories relating to migraine and chronic pain. Steve, who had worked in the same career for more than 30 years, developed migraines spontaneously. They became progressively worse until he could no longer work. He spent two years orbiting from the bed to the lounge. For Maria, migraine meant she could only work part-time, she could no longer travel, and her social life was cut short. She spent a small fortune on specialists and various treatments, but says the psychological impact of the pain was the most difficult to handle.

The Migraine in Australia Whitepaper presents for the first time a staggering picture of migraine in this country. There are 4.9 million of us suffering from the condition – 7.6 per cent with 15 or more migraine days per month. The total economic cost from migraine alone is a whopping $35.7 billion – $14.3 billion of health system costs, $16.3 billion of productivity costs, and $5.1 billion of other costs. There are also significant wellbeing costs for these individuals and their families.

The majority ($6.8 billion) of health system costs were incurred within hospitals (for hospital admissions and emergency department presentations). Another $5.6 billion was for health professionals such as neurologists, headache specialists and diagnostic testing. For a condition that is not considered a direct cause of mortality, and which in many cases has no cause or cure, these costs seem disproportionately high, while funding for migraine research is clearly inadequate.

Migraine management often requires more than prescribing a medication. Like other pain conditions, holistic and person-centred care that embraces a combination of medical, physical and psychological therapies – known as multidisciplinary (or interdisciplinary) pain management – is proven and effective for many people.

Access to appropriate care for people in pain is a key issue in Australia, one that Painaustralia is eager to address with the development of a national action plan for chronic pain management. We are grateful to Novartis and Deloitte Access Economics for underwriting and producing this invaluable insight into migraine in Australia, which will inform our plan and broader work in the pain sector. We join with them and Painaustralia member the Brain Foundation in calling for more support and investment into practical and strategic solutions to the problem of migraine in Australia.

Carol Bennett

CEO, Painaustralia

Executive summary

Key findings

- 4.9 million people in Australia suffer from migraine. 71% of migraine sufferers are women and 86% are of working age.
- 7.6% of migraine sufferers experience chronic migraine (≥15 migraine days per month).
- The total economic cost of migraine in Australia is $35.7 billion. This consists of:
  - $14.3 billion of health system costs;
  - $16.3 billion of productivity costs; and
  - $5.1 billion of other costs.
- Migraine also imposes significant wellbeing costs on sufferers.

Background

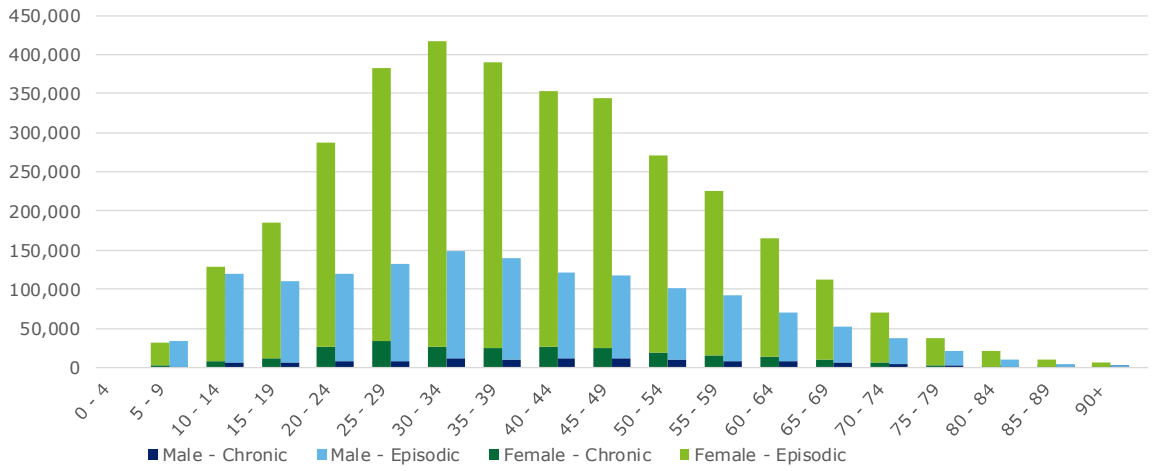
Migraine is a neurological condition that affects 4.9 million Australians. Migraine is characterised by recurrent attacks of moderate to severe headache. Migraine pain is typically pulsating, affecting one side or area of the head. During a migraine attack, patients may experience nausea, vomiting, and sensory sensitivity such as phonophobia and photophobia that significantly affects their lives. Despite its impact, migraine is underdiagnosed and undertreated.

Epidemiology

20.55% of Australians suffer from migraine. Prevalence is higher for women, with 28.66% of women experiencing migraine compared to 11.96% of men (Institute for Health Metrics Evaluation (IHME), 2016). 7.6% of Australian migraine sufferers experience a severe form of migraine known as chronic migraine, defined as 15 or more migraine days per month (Buse et al., 2012).

Chart i depicts the prevalence of episodic and chronic migraine by gender and chronic/episodic migraine status. Females aged 25 to 29 face the highest prevalence rate of chronic migraine (3.7% of this cohort), while the highest prevalence rate of episodic migraine (42.3%) occurs in females aged 35 to 39. Migraine prevalence (rate and cases) is higher among females than males in every age group, and prevalence (rate and cases) for males is more stable across age groups.

Chart i: Prevalence by gender and episodic/chronic status (number of persons)



Source: Deloitte Access Economics analysis

Economic cost of migraine

Total economic costs of migraine in 2018 are estimated to be $35.7 billion in 2018. $8.1 billion (23%) of these costs are attributable to chronic migraine and $27.6 billion (77%) are attributable to episodic migraine (Table i). Per person, the cost of chronic migraine is $21,706 per chronic migraine sufferer and $6,137 per episodic migraine sufferer (Table ii).

Table i: Total costs by chronic and episodic migraine, total ($ million)

Cost component	Chronic migraine	Episodic migraine	Total
Health system	2,773	11,500	14,273
Productivity	4,129	12,188	16,317
Carer	84	-	84
Deadweight loss	1,065	3,949	5,014
Total economic costs	**8,051**	**27,637**	**35,688**

Source: Deloitte Access Economics

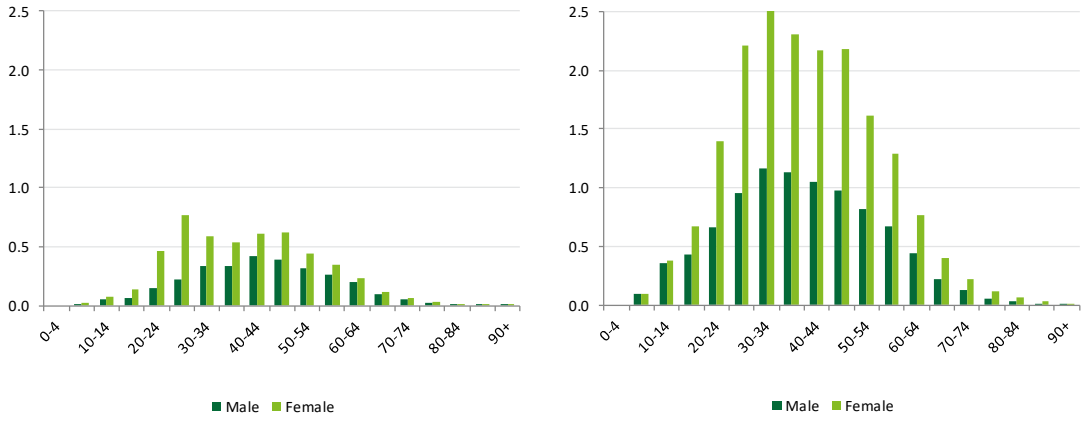
Table ii: Total costs by chronic and episodic migraine, per person ($)

Health system component	Chronic migraine	Episodic migraine
Health system	7,476	2,554
Productivity	11,132	2,707
Carer and welfare	225	0
Deadweight loss	2,872	877
Economic costs per person	**21,706**	**6,137**

Source: Deloitte Access Economics

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

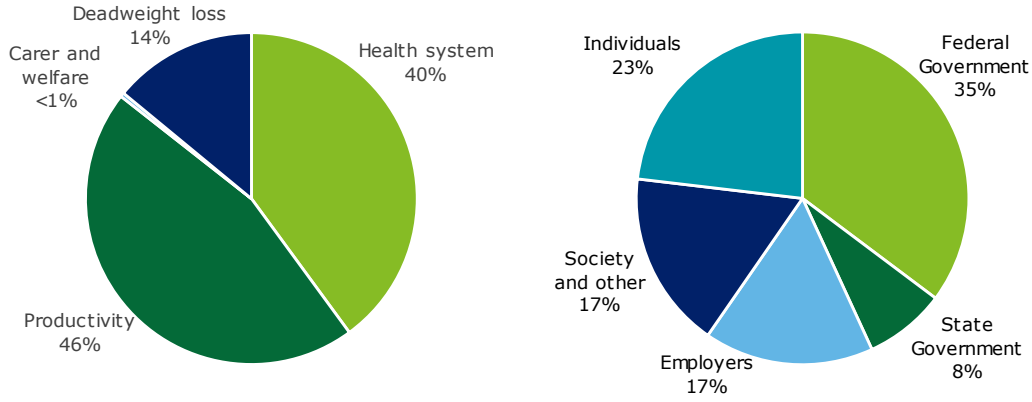
Chart ii: Costs by age and gender for chronic (LHS) and episodic (RHS) migraine ($ billion)



Source: Deloitte Access Economics

Productivity costs make up the largest share of total costs at 46%, as illustrated in Chart iiia. Health system costs make up 40% of total costs, deadweight loss 14%, and carer costs less than 1%. Governments bear the largest share of costs with the Federal Government bearing 35% and State and Territory Governments bearing 8%. Individuals bear 23% of costs and employers and the rest of society each bear 17% of costs, as illustrated in Chart iiib.

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



Source: Deloitte Access Economics

Wellbeing costs

In addition to imposing significant financial costs, migraine results in pain and suffering that leads to a significant loss of wellbeing for those affected. Wellbeing costs total $40.0 billion in 2018. Of these costs, $13.5 billion (34%) are attributable to chronic migraine and $26.5 billion (66%) are attributable to episodic migraine. Per person, the wellbeing cost of chronic migraine is $36,440 per person and $5,885 per episodic migraine sufferer.

Future directions

This report has found migraine imposes significant economic and wellbeing costs on the Australian population. As it currently stands, some of the 4.9 million people with migraine incur significant financial costs, in addition to severe reductions in their quality of life. Beyond the individuals affected, families, carers, federal and state governments and society all incur significant costs due to migraine. As such, there is a need to raise awareness of the socioeconomic burden of migraine in Australia and educate and inform key stakeholders including individuals, workplaces, and society.

Deloitte Access Economics

1 Background

1.1 Purpose of the report

The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) produces the only assessment of prevalence, incidence, and years lived with disability (YLDs) for a comprehensive list of diseases and injuries, and for all countries from 1990 to the present (Vos et al., 2017). Migraine[1], which includes medication overuse headache as a sequela of migraine, has become the second largest cause of disability in 2016, comprising 5.6% of global YLDs (Vos et al, 2017). Migraine ranked in the top ten of YLDs in all 195 countries and territories in 2016.

"People who don't have migraines don't understand how painful and how debilitating they are" ***Male, academic teacher, 28***

Given the high impact on life quality and costs, there is a clear need to increase awareness of the burden of migraine and for effective treatment and prevention. In developing this whitepaper, we have developed and assembled evidence to demonstrate the socioeconomic burden of migraine in Australia, including health system, productivity and carer costs, other financial costs and the loss of wellbeing. We have highlighted why migraine treatment and prevention needs to be prioritised. The report aims to educate and inform a variety of stakeholders including the healthcare sector and the general public about the economic consequences of migraine, and the need for effective treatment.

1.2 Pathophysiology of migraine

Migraine is a neurological condition that involves recurrent attacks of moderate to severe headache. Migraine pain is typically pulsating and affects one side or area of the head. During a migraine attack, patients may experience nausea, vomiting, and sensory sensitivity such as phonophobia and photophobia that significantly affects their lives (Mannix et al., 2016). Migraine has a genetic aspect, with many sufferers having first degree relatives who also suffer from the disorder (Goadsby, 2012). Despite the severe impact on the lives of patients and their carers migraine is underdiagnosed and undertreated (Burton et al., 2009).

The causes of migraine are not fully understood, however both genetic and environmental factors are likely to play a role in triggering a migraine attack. Migraine has traditionally been considered a vascular disorder due to the throbbing nature of the pain, however more recently this has been considered an incomplete explanation. Migraines can be triggered by dietary, environmental, hormonal, physical and emotional factors, and different triggers may cause different types of migraine attacks, even for the same person.

"[With migraine] I couldn't have any light on, had to lie down, had to stay in bed, just sleep, basically." ***Male, car dealer, 40***

According to the migraine literature and Headache Australia[2], a migraine attack has four phases:

- the *premonitory stage*, occurring up to hours before a headache and including fatigue, irritability, difficulty concentrating, mood change, yawning, stiff neck, phonophobia, and/or nausea;
- the *aura phase*, with symptoms of sensory or language disturbance;
- the *headache phase* lasting up to 72 hours without treatment, consisting of throbbing pain, nausea, vomiting and sensory sensitivity; and

[1] In 2016, medication overuse headache was removed as a cause and, instead, characterised as a sequela of migraine and tension-type headache. Despite this change in definition, migraine was the second (to low back pain) leading cause of YLDs in GBD studies in 1990, 2006 and 2016 (Vos et al., 2017).
[2] http://headacheaustralia.org.au/wp-content/uploads/2015/05/V2208_BF_Headache_Australia_Week_8pp_A5_ZFold_V3.pdf

- the *postdrome phase,* occurring hours to days after resolution of headache. Symptoms include tiredness, weakness, cognitive difficulties, mood change, residual head pain, light-headedness, and gastrointestinal symptoms (Charles, 2013).

Migraine can be characterised as episodic (0-14 headache days per month) or chronic (15 or more headache days per month). There are many different types of migraines, with varying symptoms and severity. The IHS ICHD-3 defines migraine without aura; and migraine with aura, including:

- migraine with typical aura (in which aura consists of visual and/or sensory and/or speech/language symptoms, but no motor weakness);
- migraine with brainstem aura (aura symptoms clearly originating from the brainstem, previously called basilar artery migraine);
- hemiplegic migraine (migraine with aura including motor weakness); and
- retinal migraine (repeated attacks of monocular visual disturbance, including scintillations, scotomata or blindness) (IHS, 2018).

Complications of migraine include:

- status migrainosus (a debilitating migraine attack lasting for more than 72 hours);
- persistent aura without infarction (aura symptoms persisting for one week or more without evidence of infarction on neuroimaging);
- migrainous infarction (one or more migraine aura symptoms occurring in association with an ischaemic brain lesion in the appropriate territory demonstrated by neuroimaging, with onset during the course of a typical migraine with aura attack); and
- migraine aura-triggered seizure (IHS, 2018).

1.3 Current treatment landscape of migraine in Australia

The current treatment landscape for migraine is complex. A stepped approach to migraine management based on an escalating pattern of migraine frequency is generally accepted by clinical experts (Stark & Stark, 2008). This involves minimising regular use of acute treatments and aggressively pursuing prophylaxis. However, there is a "bewildering array of options for migraine prophylaxis" in Australia (Stark & Stark, 2008).

"I would want more awareness about migraine; people think it's just a headache" ***Female, 39***

Table 1.1 provides an overview of the range of treatments accepted for migraine management in Australia, and their respective market access arrangements. Specifically, whether the medicines have a registered indication for migraine approved by the Therapeutic Goods Administration (TGA), or the Pharmaceutical Benefits Scheme (PBS) for which a subsidy for use in migraine specifically applies.

Table 1.1: Stepped approach to migraine management in Australia

			Migraine-specific indication	
Stepped approach	**Medicine category**	**Medicine(s)**	**TGA**	**PBS**
Simple pain relief medicine	Simple analgesics	Non-steroidal anti-inflammatory drugs (NSAIDs)	N/A	
Anti-migraine (acute) medicines	Anti-migraine (acute) medicines	Triptans: eletriptan, naratriptan, rizatriptan, sumatriptan, zolmitriptan	Y	Y
Preventive therapy	Anti-migraine preparations	Pizotifen	Y	General[1]
	Cardiovascular medicines	Propranolol, atenolol, metoprolol, verapamil,	Propranolol	General
			Clonidine	General

	candesartan, lisinopril, clonidine	Metoprolol	N
Antidepressant medicines	Amitriptyline	N	N
Anti-epileptic medicines	Sodium valproate, topiramate, gabapentin	Topiramate only	Y (in addition to seizures)
Chronic migraine treatment	Botulinum toxin A	Y	Y

[1]PBS general schedule 'anti-migraine preparation' classification.

As shown in Table 1.1, there are a wide range of treatments available for the management of migraine, with varying access arrangements in Australia. Many accepted therapies do not necessarily have corresponding TGA (or PBS) approval for use in migraine specifically, meaning that these medicines are prescribed off-label in many cases. Further, off-label use of these medicines is so well-accepted in practice that the PBS restriction for the use of Botulinum Toxin A in chronic migraine include medicines for which migraine is not specifically indicated (amitriptyline) or, in the case of methysergide and cyproheptadine, no longer available on the Australian market:

> *Patients must have experienced an inadequate response, intolerance or a contraindication to at least three prophylactic migraine medications prior to commencement of treatment with botulinum toxin type A neurotoxin (prophylactic migraine medications are propranolol,* ***amitriptyline****, methysergide, pizotifen, cyproheptadine or topiramate)*[3].

Although research in this area is lacking, there are also a range of treatments and lifestyle changes that help some people who suffer from migraines. These include transcutaneous nerve stimulation, relaxation (yoga and meditation), massage, aromatherapy, biofeedback and hypnotherapy. While acknowledged, due to their variable use and limited evidence of effectiveness, the costs of lifestyle changes and allied health services have not been considered in detail in this report.

"I spend $300 a month on pain killers and massages to help me cope with my Migraines..." ***Female, Construction IT, 43***

1.4 Report structure

This report outlines the prevalence of migraine across a number of life domains. The report is set out as follows:

- Section 2 outlines the costing methodology, research strategy and consultation process;
- Section 3 outlines the epidemiology of migraine, including prevalence, frequency and duration of migraine in Australia;
- Sections 4, 5 and 6 outline the costs of migraine with respect of the health system, productivity and other financial costs, respectively; and
- Section 7 outlines the wellbeing (burden of disease) costs of migraine.

[3] Drug Utilisation Sub-Committee (2017), Botulinum Toxin Type A for Chronic Migraine: 24 Month Predicted Versus Actual, June 2017.

2 Methodology

The socioeconomic burden of migraine in Australia was estimated using best practice cost-of-illness methodology applying a prevalence approach. This approach involves estimating the number of people with migraine in a base period (2018) and the costs attributable to the condition in that period. The analysis was based on the data collected in a targeted data scan and literature review.

2.1 Costing methodology

This section outlines our costing methodology. Specific methodologies for each of the costs associated with migraine are outlined further in the chapters focusing on each domain.

Costs were categorised by cost type as:

- Costs to the healthcare system including hospital inpatient and outpatient costs, out of hospital medical, pathology, imaging and allied health costs, and overheads such as attributable capital allocations and migraine research;
- Productivity losses due to absenteeism, presenteeism (reduced productivity while at work) and reduced workforce participation;
- Other financial costs such as reduced carer productivity (if family members take time off work to care for someone with migraine) and deadweight losses (society-wide efficiency losses arising from loss of taxation revenue due to reduced workforce participation and higher government expenditures); and
- Loss of wellbeing: measured by years of healthy life lost to migraine.

Different costs of disease are borne by different individuals or sectors of society. Understanding how the costs are shared helps to make informed decisions regarding interventions. While people with migraine are most severely affected by the condition, family members and other parts of society also face costs due to migraine.

From the employer's perspective, depending on the impact of migraine, work loss or absenteeism will lead to costs such as higher wages (that is, accessing skilled replacement short-term labour) or alternatively lost production, idle assets and other non-wage costs.

Australian governments typically bear costs associated with the health system and community services (noting there are also out of pocket expenditures and other payers such as private health insurers), although in reality taxpayers (society) pay for these services through taxes. 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 migraine).

2.2 Targeted literature review and data scan

A targeted review of literature and databases was undertaken to identify the most relevant information for this report. Specifically, the following websites and databases were explored and data/information was extracted if relevant:

- US National Library of Medicine's PubMed database;
- Institute for Health Metrics and Evaluation (IHME) Global Burden of Disease Results Tool;
- Australia Institute of Health and Welfare (AIHW) data;
- Medicare Australia statistics on PBS and Medicare Benefits Scheme (MBS) expenditure;
- Independent Hospital Pricing Authority national hospital cost data;
- International Headache Society's (IHS) International Classification of Headache Disorders 3rd edition (ICHD-3); and
- Australian Bureau of Statistics Data.

2.3 Patient stories and patient organisation consultation

Patient stories are presented in caption throughout the report. Novartis Australia worked with Raw Innovation and Kantar Health to conduct in-depth interviews with migraine patients diagnosed by a General Practitioner (GP) or neurologist in Australia through their "Patient Immersion Program". The stories provide powerful moments of truth about what people really think about living with migraine.

As these patient stories are fully de-identified, where the source documents do not contain personal information, we were fortunately able to present the patient stories in the report to provide a personal perspective on the lived experience of migraine.

Painaustralia and the Brain Foundation (Headache Australia) were consulted on the findings in this report and provided validation of the sources and assumptions in terms of their appropriateness, accuracy and consistency with practical experience.

3 Epidemiology

The prevalence of migraine refers to the proportion of a population who have migraine in a given time period. Research on the prevalence of migraine may refer to the lifetime prevalence (the proportion of the population who have had migraine at some point in their lifetime), one-year prevalence (the proportion of the population who have had migraine in the last year) or the prevalence over a different period. In this report, a targeted literature review was undertaken to estimate the one-year prevalence of migraine in Australia.

Key findings

- Migraine prevalence in Australia is estimated to be 20.55%, or 11.96% for males and 28.66% for females.
- 7.61% of those with migraine experience chronic migraine (≥15 migraine days per month).
- 86% of people with migraine are of working age (15-65).

3.1 Prevalence of migraine

Migraine prevalence in this report has been sourced from the 2016 Global Burden of Disease (GBD) study, which is based out of the Institute for Health Metrics and Evaluation (IHME) at the University of Washington. The GBD study provides a standardised analytical approach for estimating prevalence (as well as incidence and YLDs) by age, sex, cause, year, and location. Given the global and validated nature of the study, it optimises the comparability of data collected by varying methods or different case definitions to find a consistent set of estimates.

"Family history of Migraine - mum and brother suffer migraines - he is one of the lucky ones having migraine once a week"
Male, solicitor, 33

Migraine prevalence in Australia is estimated to be 20.55%, 28.66% for females, and 11.96% for males as set out in Table 3.1. The global prevalence of migraine is estimated to be around 14.67%, 19.29% for females 10.03% for males (IHME, 2018). While Australian migraine prevalence is significantly higher than the global estimate, the estimate of prevalence for high-income countries is 17.87% overall (10.71% for men and 24.47% for women), which is closer to the Australian estimate (IHME, 2018).

Table 3.1: Migraine prevalence in Australia and globally in 2016 as per IHME GHDx (2018) (%)

	Australia		High-income		Global	
Age	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
1-4	0.00	0.00	0.00	0.00	0.00	0.00
5-9	4.12	4.00	3.57	4.04	3.15	1.82
10-14	17.51	15.41	13.65	12.93	14.07	8.18
15-19	25.50	14.58	21.97	12.39	19.14	10.82
20-24	33.86	13.49	29.60	11.76	22.21	12.23
25-29	41.01	14.18	36.28	12.84	25.74	13.77
30-34	44.28	16.05	39.39	14.77	28.90	15.08
35-39	45.15	16.27	40.88	15.15	30.20	15.20
40-44	44.07	15.36	39.87	14.30	29.55	14.38
45-49	40.35	14.40	36.47	13.34	27.82	13.45

50-54	34.59	13.36	31.00	12.20	25.47	12.33
55-59	28.90	12.18	25.59	10.91	22.49	10.95
60-64	23.55	10.63	20.77	9.55	18.62	9.13
65-69	18.12	8.76	15.86	7.88	14.85	7.37
70-74	13.80	7.39	12.10	6.71	11.79	6.08
75-79	10.33	6.06	9.13	5.59	9.26	4.91
80-84	7.76	5.00	6.89	4.68	7.14	4.06
85-89	5.86	4.15	5.26	3.86	5.57	3.39
90-94	4.52	3.60	4.14	3.40	4.47	3.05
95 and over	4.12	3.75	3.84	3.57	4.21	3.23
All Ages	**28.66**	**11.96**	**24.47**	**10.71**	**19.29**	**10.03**

Source: IHME GHDx, 2018.

In addition to the 2016 GBD estimates outlined above, a targeted literature scan on migraine literature produced a number of other estimates, outlined in Table 3.2. While prevalence rates vary depending on the source, all research found a significant gender difference in migraine prevalence, with significantly more women suffering from migraines than men. Appendix A contains further detail on each of these estimates.

Table 3.2: Targeted literature review findings for migraine prevalence

Source	Population	Females (%)	Males (%)	All (%)
Global Burden of Disease Study (2016), *IHME (2018)*	Australia	28.7	11.7	20.6
	Global	19.3	10.0	14.7
	High-income countries	24.5	10.7	17.9
American Migraine Prevalence and Prevention Study, *Lipton et al. (2007)*	US	17.1	5.6	11.7
BEACH Study, *Britt et al. (2011)*[b]	Australia	15.5	5.4	11.3
Meta-analysis of 302 studies, *Woldeamanuel & Cowan (2017)*[c]	Global	13.8	6.9	11.6
ABS National Health Survey (2014-15)[a]	Australia	8.9	3.5	5.2
Blue Mountains Eye Study, *Mitchell et al. (1998)*[d]	Australia, over 49 years	22	10	17

a) Point prevalence of migraine that has that have lasted, or is likely to last, for six months or more.
b) Point prevalence.
c) Meta-analysis including lifetime prevalence (28% of studies), one-year prevalence (58.2%), two-year prevalence (1.6%), 6-12 month prevalence (4.7%), and 3-month prevalence (7%).
d) Lifetime prevalence.

3.2 Frequency of migraine attacks

Migraine can be categorised as chronic or episodic depending on the frequency of migraine attacks. Chronic migraine is defined by the International Classification of Headache Disorders (ICHD) as headache occurring on 15 or more days/month for more than 3 months, which, on at least 8 days/month, has the features of migraine headache (IHS, 2018). Episodic migraine refers to migraine sufferers with fewer than 15 headache days per month.

"In terms of, like, really strong ones where I'm bed-ridden, that's, um, probably only maybe about three or so maybe a month for them" ***Female, stay at home mum***

Within episodic migraine there is significant variation in the number of migraine days experienced. Stewart at al. (2010) found that 5.3% of people with episodic migraine had between 30 and 44 headache days in a three-month period, bringing them close to the threshold for chronic migraine. Episodic migraine can progress to chronic migraine, with approximately 2.5% of persons with episodic migraine developing new-onset chronic migraine each year (Bigal et al., 2008).

Analysis of data from the 2005 survey by the American Migraine Prevalence and Prevention study found that chronic migraine accounted for 7.68% of all migraine cases, but varied across different age groups. Among females with migraine, 7.45% had chronic migraine, and among males with migraine, 8.47% had chronic migraine. With the exception of the estimate for females in the age bracket of age 18-29, rates of chronic migraine within the total migraine sample broadly increased with age for both genders (Buse et al., 2012). Table 3.3 shows the age and gender stratified prevalence of chronic migraine within the migraine population. These stratified estimates have been applied to the Australian migraine population. When applied to Australia's demographic structure, the overall prevalence of chronic migraine in Australia is 7.61%.

Table 3.3: Prevalence of chronic migraine within the total migraine population by gender and age (%)

Age	Females	Males
12-17	6.20	5.03
18-29	8.95	6.28
30-39	6.25	7.60
40-49	7.34	9.90
50-59	7.19	9.80
≥ 60	8.37	11.70

Note: estimates have been adjusted for sociodemographic factors (race, ethnicity, geographic region, population density, income and household size).

Source: Buse et al., 2012.

For comparison, analysis of the IBMS study estimated the prevalence of chronic migraine in 10 countries (Payne et al., 2011), outlined in Table 3.4. Australia had the highest prevalence of chronic migraine of all countries surveyed, with 10.7% of migraine sufferers having chronic migraine. This estimate was not used in this analysis as the sample size was relatively small and age and sex stratified prevalence was not available.

Table 3.4: Chronic and episodic migraine as a proportion of total migraine, by country (%)

Country	Chronic migraine	Episodic migraine
Australia	10.7	89.3
Brazil	5.7	94.3
Canada	8.1	91.9
France	3.9	96.1
Germany	3.6	96.4
Italy	5.6	94.4
Spain	8.0	92.0
Taiwan	1.2	98.8
UK	5.3	94.7
USA	8.6	91.4

Source: Payne et al., 2012.

3.3 Duration of migraine attacks

Of the General Practice (GP) patients who reported attack frequency in the Australian Bettering the Evaluation and Care of Health (BEACH) study, 55.7% had less than one migraine per month, 18.5% had one per month, and 25.8% had two or more per month (Britt et al., 2011). The reported migraine frequency did not differ between males and females.

A review of clinical records of 182 patients with chronic migraine who were evaluated using the Migraine Disability Assessment (MIDAS) questionnaire at the New England Center for Headache found that the mean number of headache days in a three-month period was 66.7 days for chronic migraine and 15.5 for episodic migraine (Bigal et al., 2003). Analysis of the International Burden of Migraine Study found similar results, with mean headache days in a three-month period of 64.4 days for chronic and 10.4 days for episodic migraine (Payne et al., 2011).

Other research has found that the average duration of a migraine attack was a mean of 29.2 hours and a median of 24.0 hours (Kelman, 2006). Significantly, longer headache durations were seen for females (mean of 31.1, median of 24.0 hours) compared with males (mean of 19.1, median of 12.0 hours). It was also found that almost 50% of patients described peak onset of the migraine within one hour (Kelman, 2006). Migraine duration varies by chronic and episodic migraine, with a mean duration of 65.1 hours for chronic and 38.8 hours for episodic migraine without medication and 24.1 hours for chronic and 12.8 hours for episodic migraine with medication (Katsarava et al., 2012).

"I have complete shutdown so when I feel it coming on everything gets turned off, no more lights camera action it's off, phones are off, computer is off and I get home as soon as possible." ***Male, lecturer, 30***

3.4 Mortality attributable to migraine

Migraine is not considered to be a direct cause of mortality and no deaths are attributed to migraine in the GBD study (Vos et al., 2015). A targeted review of literature on migraine and mortality indicated that while some studies have cited migraine as a risk factor for all-cause mortality (Gudmundsson et al., 2010) the majority of studies have found that migraine does not increase the risk of all-cause mortality (Schurks et al., 2011; Mahmoud et al., 2018).

For the purposes of estimating the cost of migraine in 2018, mortality is not included as a cost of migraine; however, the association between migraine and increased risk of mortality is discussed below.

3.4.1 Migraine and cardiovascular disease

Migraine headache is associated with an increased risk of cardiovascular and cerebrovascular events, driven by higher risk of ischaemic and haemorrhagic stroke, myocardial infarction (heart attack) and other cardiovascular disease (for example angina).

A recent meta-analysis of 16 observational cohort studies found that migraine was associated with a higher risk of major adverse cardiac and cerebrovascular events (Mahmoud et al., 2018). The analysis reviewed thirteen studies examining the association between migraine and stroke, and found that people with migraine had a higher risk of both ischaemic and haemorrhagic stroke (unadjusted risk ratio of 1.32, 95% confidence interval 1.03 to 1.68). The analysis included seven studies relating to myocardial infarction, finding migraine was associated with an increased risk (unadjusted risk ratio of 1.37, 95% confidence interval 1.10 to 1.71) (Mahmoud et al., 2018).

A previous meta-analysis by Schurks et al. (2009) found that migraine was associated with increased risk of ischaemic stroke, myocardial infarction and other cardiovascular disease. Nine of the studies analysed related to migraine and ischaemic stroke (pooled relative risk of 1.73, 95% confidence interval 1.31 to 2.29). Eight studies related to migraine and myocardial infarction (pooled relative risk of 1.12, 95% confidence interval 0.95 to 1.32) and five to migraine and death due to cardiovascular disease (pooled relative risk of 1.03, 95% confidence interval 0.79 to 1.34) (Schurks et al., 2009).

People experiencing migraine with aura are at increased risk of mortality from cardiovascular disease, particularly stroke, relative to those with migraine without aura (Gudmundsson et al, 2010; Mahmoud et al., 2018). Risk of mortality is also higher for people with migraine aged less than 45, smokers, and women using oral contraceptives (Schurks et al, 2009; MacGregor, 2011).

The mechanism of association between migraine and adverse cardiovascular events has not been definitively established. Bigal et al. (2009) suggests that the association may be causal, as a result of shared risk factors, a result of common comorbidities or a combination of these factors.

While not well established, some studies have suggested that there may be a causal link between migraine with aura and stroke, positing that repetitive episodes of cortical spreading depression may predispose people to ischaemia, perfusion changes and chronic inflammation (Bigal et al., 2009). Potential causal links have not been identified for other types of cardiovascular events.

There is strong evidence that there are shared risk factors for both migraine and cardiovascular disease. A number of studies have identified migraine as a systemic vascular disorder, noting that people with migraine have increased risk of cardiovascular disease even in the absence of conventional risk factors (Gudmundsson et al., 2010; Kurth et al., 2016). There is also evidence of shared genetic risk factors between migraine and cardiovascular disease (Winsvold et al., 2015).

People with migraine have a higher prevalence of cardiovascular risk factors, for example hypertension, higher body mass index, and hypercholesterolemia, however, as most studies control for these factors they are unlikely to explain the association between migraine and cardiovascular disease (Kurth et al., 2016).

3.4.2 Migraine and comorbidities

In addition to cardiovascular disease, migraine is comorbid with a number of medical conditions, including hypothyroidism, asthma, and endometriosis, irritable bowel syndrome, fibromyalgia, chronic fatigue syndrome, Meniere's disease, epilepsy and interstitial cystitis (MacGregor, 2011). Migraine is also comorbid with psychological conditions including depression and anxiety (Schurks et al., 2011).

"[I] become anxious at the beginning of a headache - will it become a migraine?"
Male, solicitor, 33

4 Health system costs

Health system costs include the costs of running hospitals, GP and specialist services funded through Medicare and patient contributions, the cost of prescribed and over-the-counter pharmaceuticals, allied health services, research and 'other' direct costs such as health administration. Health system costs in Australia are primarily paid for by government, but there are also other sources including out-of-pocket payments and funding from other parties such as private health insurers.

Sanderson et al. (2013) undertook analysis based on the second IBMS (IBMS-II) on headache-related health resource utilisation of people with chronic and episodic migraine in the last three months across six countries, including Australia. This study also found that chronic migraine was generally associated with higher health resource use than episodic migraine. There were 50 survey responses from Australia in this study with health resource utilisation data for people with chronic migraine, and 63 responses from Australia for people with episodic migraine. The other countries included in this study were the USA, Canada, France, the UK, and Germany. Hospitalisation for headache was significantly more frequent in Canada and Australia than the other included countries. In both chronic migraine and episodic migraine, respondents from Australia reported the highest proportion of headache-related provider visits in the prior 3 months, at 64% of people with chronic migraine and 36% of people with acute migraine (Sanderson et al., 2013).

As no overall health system migraine costs in Australia were available, health system costs were estimated using a bottom-up approach. The use of different health system resources by people suffering from migraine has been estimated based on a targeted literature search of Australian and international evidence. Where international estimates were used, Australian costs were applied, with the exception of pharmaceutical costs. The following section provides an overview of the estimated health system costs due to migraine in Australia in 2018.

Key findings

- The total health system costs due to migraine were estimated to be $14.3 billion in 2018, with $2.8 billion attributable to chronic migraine and $11.5 billion attributable to episodic migraine.
- The majority of health system costs were incurred within hospitals ($6.8 billion in 2018 for hospital admissions and emergency department presentations) or using the services of other health professionals such as Neurologists / headache specialists and diagnostic testing ($5.7 billion in 2018)
- Federal and State Governments bear approximately 76% of health system costs, while individuals and families bear 16% and other parties (such as private health insurers) bear 8% of health system costs.

4.1 Hospital expenditure

4.1.1 Hospital admission

There is no available data specifically related to hospital expenditure due to migraine in Australia. While hospital separation statistics by Australian refined diagnosis-related groups (AR-DRG) for 2015-16 showed that there were 40,487 separations with the code for both minor complexity and major complexity headache (B77Z), it is not known what proportion of these were due to migraine (AIHW, 2018).

In the IBMS and IBMS-II, participants with both chronic and episodic migraine were surveyed on the frequency of visits to various health care professionals occurring over the preceding three months for headache treatment or diagnostic evaluation. IBMS found that the proportion reporting a hospitalisation in the last three months for migraine treatment ranged from 3.6% in

"Occasionally I am in hospital for a morphine shot" ***Female, Construction IT, 43***

Spain to 1.3% in France. In the UK only, the use of hospital services was found to be significantly higher for chronic migraine compared to episodic migraine (Bloudek et al., 2012). Sanderson et al. (2013) found that based on the IBMS-II hospitalisation for headache amongst people with migraine was significantly more frequent in Canada and Australia, as shown in Table 4.1.

To determine admitted patient expenditure, the proportion of people who responded that they had been admitted to a hospital in the last three months in Australia as per Sanderson et al. (2013) was applied to the whole year.

Table 4.1: Hospital admission for headache in the last three months amongst people with chronic migraine (CM) and episodic migraine (EM) (%)

USA		Canada		France		UK		Germany		Australia	
CM	EM	CM	EM	CM	EM	CM	EM	CM	EM	CM	EM
14	6	22	16	17	12	14	0	14	10	**24**	**11**

Source: Sanderson et al., 2013.

The cost of hospital separations was based on the average of Australian refined diagnosis related groups (AR-DRG) cost weights relating headache, as reported by the Independent Hospital Pricing Authority (IHPA) for financial year 2015-16 (IHPA, 2018). In 2015-2016, the average cost for 'Headaches, Major Complexity' was $4,137 and the average cost for 'Headaches, Minor Complexity' was $1,711. These costs include the cost of treatments provided in hospital, as well as overhead costs such as salaries and medical equipment. The average cost for minor and major headache complexity was used ($2,924) which was then inflated to 2018 dollars using the AIHW health cost inflation data ($3,110).

4.1.2 Emergency department

While there is no data on migraine specifically, the AIHW report on emergency department care in 2016-17 reports that 'headache' was the 20th most common principal diagnosis for patients who were subsequently admitted to the hospital (2,376,774 presentations) (AIHW, 2017). There is no data on how many of these were due to migraine.

Friedman et al. (2007) undertook a study of patients who had presented to the emergency room with non-traumatic headache, in which patient interviews and their emergency records were used to independently classify the records through the ICHD. It was found that 64% of participants had a primary headache (without a secondary cause), and of this group 60% had a migraine. Survey results in Gerth et al. (2001) of an adult migraine population found that respondents reported 0.53 emergency room visits related to migraine per year.

To determine admitted patient expenditure, the proportion of people who responded having visited the emergency department in the last three months in Australia as per Sanderson et al (2013) was applied to a whole year. The estimated number of people who visited the emergency department was multiplied by the average cost of a non-admitted emergency department presentation in 2015-16 at $517 (IHPA, 2018), inflated to 2018 dollars using AIHW health cost inflation data ($550).

Table 4.2 shows the results from the IBMS-II. Sanderson et al. (2013) found that based on the IBMS-II 38% of people with chronic migraine and 27% of people with episodic migraine reported having visited the emergency department in the last three months.

Table 4.2: Emergency department visits for headache in the last three months amongst people with chronic migraine (CM) and episodic migraine (EM) (%)

USA		Canada		France		UK		Germany		Australia	
CM	EM	CM	EM	CM	EM	CM	EM	CM	EM	CM	EM
42	27	52	35	16	14	14	8	16	12	**38**	**27**

Source: Sanderson et al., 2013.

4.2 Non-hospital health services

4.2.1 General Practitioner services

The most recent report from the BEACH program on General Practice Activity in Australia 2015-2016 found that migraine was in the top most frequently managed chronic problems (Britt et al., 2016). This study estimated that migraine forms 1.1% of the total chronic problems managed by GPs or a rate of 0.6 per 100 encounters (Britt et al., 2016). To calculate the number of migraine related GP consultations, the number of GP encounters in 2016-17 (DoH, 2017) were multiplied by the rate of GP encounters managing migraines from Britt et al. (2016). This resulted in approximately 0.87 million migraine related GP consultations. The average cost per GP consultation was calculated by adding the 2018 Medicare Benefits Schedule (MBS) rebate for a 20-minute GP consultation ($37.05) and the 2016-17 average patient contribution ($34.96) from Medicare data (DoH, 2018a, 2018b) and inflating using health inflation to 2018 dollars. The total cost of migraine GP consultations was calculated to be $63.5 million.

Bloudek et al. (2012) found that over half (54.5%) of European participants with chronic migraine reported visiting a primary care physician for headache over the previous 3 months, compared to 29.8% of people with episodic migraine. This was similar across the five European countries in the study (UK, France, Germany, Italy and Spain). As a result, the estimate we have used based on the BEACH study is likely to be conservative.

4.2.2 Neurology and specialist outpatient services

Bloudek et al. (2012) found that utilisation of a neurologist/headache specialist was significantly higher for people with chronic migraine compared to episodic migraine. Nearly one-third (30.7%) of people with chronic migraine reported having visited a neurologist/headache specialist in the last three months, compared to 9.7% of people with episodic migraine.

As Australian data was not available, data from the UK was used to estimate the use of neurology and other medical specialists (Bloudek et al., 2012). Based on this data, it was estimated that, in Australia, people with chronic migraine visit a neurologist or headache specialist 1.7 times per year and other specialists (including psychologists, psychiatrists, social workers, pain specialists, and gynaecologists) 1.2 times per year. People with episodic migraine are estimated to visit a neurologist or headache specialist 0.4 times per year and other specialists once per year.

"My migraines increased and then… the medication wasn't working. I just, I wanted to die, because there was nothing, I wanted to take my head off, and just put it, when I had the migraine, put it on the side and re-attach when the migraine was finished..." ***Female, 42***

The cost of a neurologist visit was estimated to be $427 in 2015-16 dollars (IHPA, 2018) ($457 in 2018 dollars). This data was used as Medicare data does not distinguish between specialists, and IHPA data indicates that neurologists are more expensive than specialists more broadly. The cost of other specialist visits was estimated to be $401 based on Medicare data (DoH, 2018b). The same split of 80% paid by government and 20% paid by individuals is applied to both types of visit.

4.2.3 Diagnostic testing

While blood tests are not generally used to diagnose migraine, they may be used to rule out other causes or for monitoring for certain medications, such as valproic acid for migraine prophylaxis (Evans, 2009).

Use of blood tests for headache related treatment / diagnostic evaluation were utilised more by people with chronic migraine than with episodic migraine amongst participants in the UK, France, Germany, and Spain. The range of people with chronic migraine who had undertaken blood tests in the last three months was 21.20% (Germany) and 12.30% (in the UK). People with episodic migraine who had undertaken blood tests in the last three months ranged from 9.1% (in Italy) to 4.0% (in the UK).

Most migraines can be diagnosed without diagnostic testing using a comprehensive history and neurologic and focused general physical examinations, however in some cases diagnostic testing is necessary to distinguish primary from secondary causes that may share similar features (Evans, 2009). This is particularly the case for older age groups, where secondary headaches resulting from serious pathology are more likely.

Data from the UK (Bloudek et al., 2012) was used to estimate that people with chronic migraine undergo diagnostic testing and blood tests an average of 1.8 times per year and people with episodic migraine undergo diagnostic testing 0.6 times per year and blood tests 0.4 times per year.

The cost of diagnostic testing was estimated to cost $488 per test using Medicate data for 'diagnostic imaging' (DoH, 2018b). 79% of this cost is borne by the government and the remaining 21% by the patient. The cost of blood tests was estimated to cost $238 per test using Medicate data for 'pathology' (DoH, 2018b). 89% of this cost is borne by the government and the remaining 11% by the patient.

4.2.4 Other treatments

4.2.4.1 Botulinum Toxin-A

Bloudek et al. (2012) found that the proportion of people with chronic migraine who reported using Botulinum toxin-A (Botox) for headache treatment ranged from 3.6% (Italy) to 0% (France and Germany). For people with episodic migraine, this ranged from 1.9% (Spain) to 0.6% (UK). Using data for the UK, it was estimated that people with chronic migraine receive Botox 0.4 times per year and that people with episodic migraine do not use Botox.

The cost of administering Botox injections is estimated at $125, with 80% of the cost paid by the government under the Medicare Benefits Schedule and the remaining 20% of the cost paid by patients (DoH, 2018b). This is the cost of the injection only, as the cost of the Botox drug is included in pharmaceutical costs.

4.2.4.2 Occipital nerve block procedures

Bloudek et al. (2012) reported that the proportion of people with chronic migraine undergoing occipital nerve block procedures for headache treatment ranged from 12.3% (UK) to 0% (France and Germany). For people with episodic migraine, this ranged from 2.20% (Spain) to 0.40% (France). Based on the UK data, it was estimated that people with chronic migraine undergo occipital nerve blocks 3.3 times per year and that people with episodic migraine undergo occipital nerve blocks 0.2 times per year.

Occipital nerve blocks were estimated to cost $38 dollars with 85% paid by government and 15% by patients based on Medicare data (DoH, 2018b. This is likely to be an underestimate of the true cost, as data on patient contributions above the Medicare fee amount are not available.

4.2.4.3 Acupuncture

Bloudek et al. (2012) found that between 12.7% (Spain) and 5.5% (Italy) of people with chronic migraine had used acupuncture for headache treatment in the last three months. Of people with episodic migraine, this ranged from 3.5% (UK) to 6.9% (Germany). Based on UK data, it was estimated that people with chronic migraine receive acupuncture 0.3 times per year and that people with episodic migraine receive acupuncture 0.4 times per year.

The price of acupuncture was estimated to be $83 per treatment. This was estimated using the average price for a follow up 45-minute appointment from 20 acupuncture providers in Australian capital cities.

4.3 Pharmaceutical costs

Due to the range of accepted pharmaceutical treatments for migraine including over-the-counter medicines as well as prescription medicines, some of which do not have a migraine-specific indication, precise Australian-specific treatment costs were challenging to estimate.

"I spend $300-500 per week at [the] chemist to treat migraine" ***Male, builder, 43***

Pharmaceutical Benefits Scheme (PBS) data available from Medicare Australia was examined for those medicines for which a PBS item code specific to migraine was available. PBS expenditure on migraine-specific medicines is shown in Table 4.3.

Table 4.3: Annual PBS expenditure on migraine-specific medicines

Medicine	Indication	PBS item code(s)	Expenditure (2018, inflated)
Triptans	Acute relief of migraine attack	5290K, 5291L, 8298R, 9734H, 10551H, 9313E, 10694W, 1849H, 8144P, 8341B, 8885P, 8266C	$10,661,980
Pizotifen	General schedule (anti-migraine preparation)	3074T	$1,693,236

Source: Department of Health, 2018a.

However, as there are a range of other medicines that are well-accepted as being used in the management of migraine, including over-the-counter, acute and preventive medicines, that were unable to be extracted from PBS data without a corresponding item code for migraine, relevant literature was sourced that provided a more complete estimate of the total pharmaceutical costs of migraine.

Pharmaceutical costs associated with migraine have been derived using data from the International Burden of Migraine Study. This study provided detailed estimates of annual per person medicine costs including expenditure on preventative medicines, acute medicines and other medicines including other-the-counter analgesics used by people with both chronic and episodic migraine in Canada and the United States (Stokes et al., 2011).

To estimate Australian pharmaceutical costs, Canadian (rather than the alternative, United States) estimates were used as they were found to be most appropriate due to greater similarities between the Canadian and Australian health systems and therefore treatment-related patterns of use. In addition, the available treatments included in the cost analysis include those medicines for which people with migraine in Australia are also managed. This includes over-the-counter medicines, simple analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), triptans, antidepressants, anti-epileptics and cardiovascular medicines.

Estimates of annual per person pharmaceutical expenditure on migraine in Canada were inflated to 2018 prices and converted to Australian dollars. Per person, pharmaceutical expenditure was estimated to be $331 per year for episodic migraine and $992 per year for chronic migraine.

4.4 Lifestyle changes and allied health services

Although research in this area is lacking, there are a range of treatments and lifestyle changes that help some people who suffer from migraines. These include transcutaneous nerve stimulation, relaxation (yoga and meditation), massage, aromatherapy, biofeedback and hypnotherapy. The costs of lifestyle changes and allied health services have not been estimated in this study, however they may be significant and largely out-of-pocket.

In addition, people who suffer from migraine are often encouraged to think about potential 'triggers' for their migraine, and try to make lifestyle changes such as limiting alcohol, avoiding flickering lights, food groups or chemicals, or preventing hunger.

Transcutaneous nerve stimulation is a method of pain relief that involves delivering a small electrical current to the body through electrodes attached to the skin. Bloudek et al. (2012) found that the proportion of people with chronic migraine who reported the use of transcutaneous nerve stimulation in the last three months for headache treatment ranged from 10.90% (Spain) to 0% (France). For people with episodic migraines, this ranged from 3.80% (UK) to 1.10% (France). Allais et al. (2003) found that transcutaneous nerve stimulation was effective in reducing the number of headache days experienced by sufferers.

"In addition to taking the medication, you should look at the more holistic side…sleep, diet, exercise, stress managment, psychologist, counselling, support workers..." ***Male, academic teacher, 28***

Lifestyle changes including relaxation and exercise may also be effective in treating and preventing migraine. For example, people with migraine who participated in a three-month trial of yoga recorded statistically significant reductions in the frequency, intensity, duration of attack, and medication score of migraine attacks, as well as a reduction in anxiety and depression (John et al., 2007).

Behavioural interventions can also be effective in preventing and treating migraine when used prophylactically on a regular basis. For example, cognitive behavioural therapy can help patients identify behaviours that may precipitate, increase, or maintain headaches (Buse & Andrasik, 2009).

4.5 Research

Research costs are based on the number of grants provided by the National Health and Medical Research Council (NHMRC) and the Australian Research Council (ARC). NHMRC data for all grants provided from 2000 to 1 March 2016 is publicly available (NHMRC, 2017). The NHMRC data contains a key word description of each grant, and this description was filtered for the word 'migraine'. This resulted in 31 studies with migraine as one of the key words between 2000 and 2016. To calculate total migraine research expenditure in 2018, the average per year funding of grants active in 2016 was calculated and then inflated to 2018 figures using health inflation. Total NHMRC funding for migraine in 2018 was estimated to be $1.38 million, or only 0.2% of overall NHMRC grant funding.

"[The] biggest frustration is not knowing the cause and why I get it" ***Female, 30***

The ARC also provides Commonwealth funding for research. A search for the word 'migraine' in the published database of all ARC funded projects since 2001 produced one study (ARC, 2017). This study commenced in 2009 and was funded to run for four years. No additional studies were identified based on the keyword 'headache'. No additional research costs were assumed based on research funding by the ARC, since the single study found would have completed well before 2018.

4.6 Results

Health system costs total $14.3 billion in 2018. $3.1 billion (20%) of these costs are attributable to chronic migraine and $11.5 billion (80%) billion are attributable to episodic migraine. Per person, the cost of chronic migraine is $7,476 per chronic migraine sufferer and $2,554 per episodic migraine sufferer (see Table 4.4 and Table 4.5). Health system costs by age and gender are displayed in Chart 4.1 and are determined by the prevalence of chronic and episodic migraine by age and gender.

Table 4.4: Health system costs by chronic and episodic migraine, total ($ million)

Health system component	Chronic migraine	Episodic migraine	Total
Admitted hospital	1,063	2,712	3,775
Emergency	310	2,675	2,985
Non-hospital	1,032	4,620	5,652
Pharmaceuticals	368	1,492	1,860
Research	0.1	1.3	1.4
Total	**2,773**	**11,500**	**14,273**

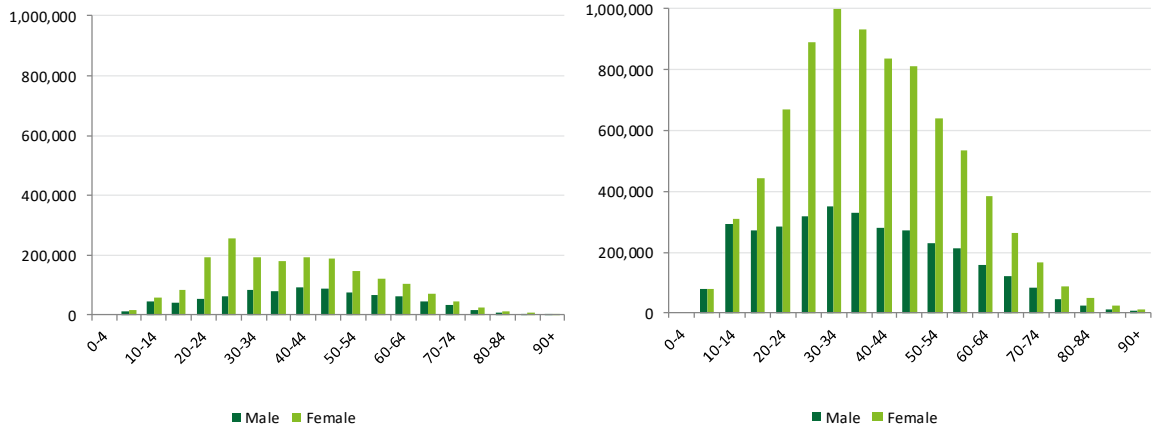
Source: Deloitte Access Economics

Table 4.5: Health system costs by chronic and episodic migraine, per person ($)

Health system component	Chronic migraine	Episodic migraine
Admitted hospital	2,866	602
Emergency	836	594
Non-hospital	2,781	1,026
Pharmaceuticals	992	331
Research	0.28	0.28
Total	**7,476**	**2,554**

Source: Deloitte Access Economics

Chart 4.1: Health system costs by age and gender for chronic migraine (LHS) and episodic migraine (RHS)

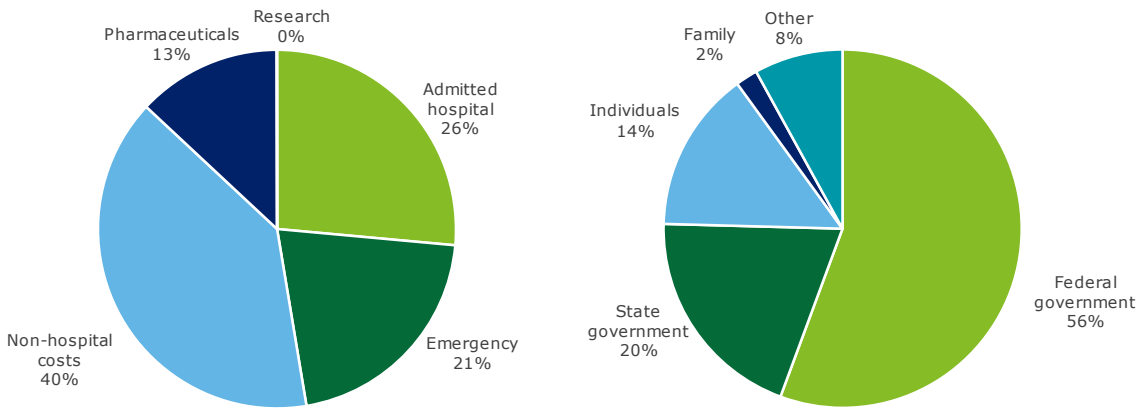


Source: Deloitte Access Economics

Non-hospital costs, including the costs of neurologists, other specialists and diagnostic testing make up the largest share of health system costs at 40%. Admitted and emergency hospital costs make up 26% and 21% of costs respectively. Pharmaceutical costs make up 13% of health system costs and research costs less than 1%, as illustrated in Chart 4.2.

The federal government bears 56% of total costs and state governments beat 20% of costs, for an overall government share of 76%. Individuals and families pay 16% of costs and other payers (predominantly private health insurers pay the remaining 8%, as illustrated in Chart 4.2b.

Chart 4.2: Health system cost by component (LHS) and payer (RHS) (%)



Source: Deloitte Access Economics

5 Productivity costs

This chapter describes the approach that was used to estimate productivity losses associated with migraine in Australia. The recurrent pain and the associated symptoms of migraine have a negative impact on the individual's ability to function, as approximately half of migraine sufferers require bed rest to manage their pain (Mannix et al., 2016). Almost all migraine sufferers experience reduced social activity and reductions in work capacity (Headache Australia, 2017c). While appropriate therapy from health care professionals can reduce the impact of migraine on worker productivity (Burton et al., 2009), the productivity costs of migraine are significant in terms of reduced workforce participants, absenteeism and presenteeism. A targeted literature scan was conducted to identify relevant data regarding the relationship between migraine and productivity.

We adopt a human capital approach to the estimation of productivity losses. This involves the calculation of the difference in employment between people with migraine and that of the general population, multiplied by average weekly earnings (AWE). Similarly, costs incurred through absenteeism and/or presenteeism are derived by multiplying the average number of weeks, as converted from the number of days and hours respectively lost, by AWE.

Key findings

- The productivity cost of migraine is $16.3 billion in 2018.
- People with chronic migraine are 19% less likely to be in paid employment than the general population. For people with episodic migraine this figure in 2.8%.
- Chronic migraine results in 5.2 days and episodic migraine results in 2.8 days of absenteeism per migraine sufferer per year.
- People with chronic migraine have a 6.8% reduction in productivity while at work, and people with episodic migraine have a 2.2% reduction in productivity while at work.

5.1 Reduced workforce participation

Migraine may result in reduced employment either through disadvantages in job-seeking (for example difficulty in searching for work or keeping a job due to frequent absences) 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.

"I can't go to work and that person solely relies on me and I can't get there, because I'm not able to do the work, because it just – like, it's just like a haze, sort of, comes over my eyes and I can't see properly" ***Female, nursing student, 24***

Stewart et al. (2010) found that people with chronic migraine are 19% less likely to be employed than the general population, while people with episodic migraine are 2.8% less likely to be employed than the general population, adjusted for age and gender. This is driven by low rates of full time employment among people with chronic migraine (37% compared to 48% of people will low frequency headaches, who are assumed to experience no employment effects) and high rates of short and long term medical leave (18% of people with chronic migraine compared to 9% of people with low frequency headaches). These results are in line with research by Stang et al. (1998), which found that 22.1% of people experiencing migraine with aura are kept from full time work.

Reduced workforce participation is translated into a dollar cost by applying the reduced participation rates to the Australian general population employment rates and average weekly earnings by age and gender.

5.2 Lost productive time

Lost productive time is comprised of absenteeism and presenteeism. While migraine causes significant absenteeism, the majority of lost productive time is a result of presenteeism, or reduced productivity while at work due to migraine.

5.2.1 Absenteeism

"In the last 3 months have taken 12 days off work" ***Female, 39***

Absenteeism is defined as the average number of days per year that an employee takes off work as a result of their condition. This can incur a productivity cost to employers if absenteeism rates for employees with migraine are higher than those for their employees without migraine.

Absenteeism rates increase with headache frequency and are substantially higher for chronic migraine than for episodic migraine. Estimates of absenteeism due to migraine range from 2.9 days to 10.7 days per year, as set out in Table 5.1.

This study uses the estimates from Stewart et al. (2010), as it is the only available data stratified by chronic and episodic migraine that accounts for both absenteeism and presenteeism. This is a conservative estimate, given that other studies have found significantly higher rates of absenteeism due to migraine.

Table 5.1: Absenteeism days per year

Study	All migraine	Chronic migraine	Episodic migraine
Edmeads & Mackell (2002)	9.14		
Goetzel et al. (2004)	10.7		
Stang et al. (2004)	7.9		
Fiane et al. (2006)	4.4	14.6	3.8
Kessler et al. (2010)	10.7		
Stewart et al. (2010)	2.9	5.2	2.8

Source: Deloitte Access Economics

The number of days of absenteeism is translated into a dollar cost by applying the time lost to absenteeism to the Australian general population employment rates and average weekly earnings by age and gender.

5.2.2 Presenteeism

In burden of disease analysis, presenteeism refers to "*the practice of continuing to go to work, especially when not working at a fully productive rate due to illness…often in an attempt to show commitment to one's employment"* (Safe Work Australia, 2018). This results in reduced productivity while an employee is at work, but suffering from migraine.

Presenteeism refers to 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 has the potential to incur significant costs to employers by reducing the quality and efficiency of work produced by employees. Relative to absenteeism, presenteeism may occur more frequently and have a larger effect (Van den Heuvel et al, 2010).

"I can't perform at work the way I used to, I can't concentrate" ***Female, 39***

Presenteeism resulting from migraine has been estimated at 24.7 days per year for chronic migraine and 8.2 days per year for episodic migraine (Stewart et al., 2010), which translates to 6.8% and 2.2% of the year respectively. This is likely to be a conservative estimate, as some estimates are significantly higher. For example, a study analysing the top physical and mental conditions affecting US

employees, Goetzel et al. (2004) estimated presenteeism resulting from migraine at 1.6 hours per day (equating to 20.5% of the working year), the highest of all conditions included in the study.

The impacts of absenteeism and presenteeism presented in Table 5.2 relate to reduced productivity due to headache pain of the working population with migraine, including those not reporting any reduction in productivity resulting from of migraine. Productivity costs are highly correlated with the number of headache days, with a smaller number of headache days (less than 10 days in a three month period) reporting only small changes in productivity (Stewart et al., 2010).

Table 5.2: Estimates of absenteeism and presenteeism

Age	Chronic migraine (days/year)	Episodic migraine (days/year)
Absenteeism	5.2	2.8
Presenteeism	24.7	8.2
Total	**29.9**	**10.9**

Source: Stewart et al., 2010.

Reduced productivity is translated into a dollar cost by applying the time lost to presenteeism to the Australian general population employment rates and average weekly earnings by age and gender.

5.3 Results

Productivity costs total $16.3 billion in 2018. $4.1 billion (25%) of these costs are attributable to chronic migraine and $12.2 (75%) billion are attributable to episodic migraine. Per person, the cost of chronic migraine is $11,132 per person and $2,707 per episodic migraine sufferer (see Table 5.3 and Table 5.4). Productivity costs by age and gender are displayed in Chart 5.1 and are concentrated in the working age population. Overall productivity and costs are exacerbated by the fact that migraine prevalence is highest during these years.

Table 5.3: Productivity costs by chronic and episodic migraine, total ($ million)

Productivity component	Chronic migraine	Episodic migraine	Total
Reduced workforce participation	2,784	4,772	7,556
Absenteeism	542	3,666	4,208
Presenteeism	803	3,750	4,553
Total	**4,129**	**12,188**	**16,317**

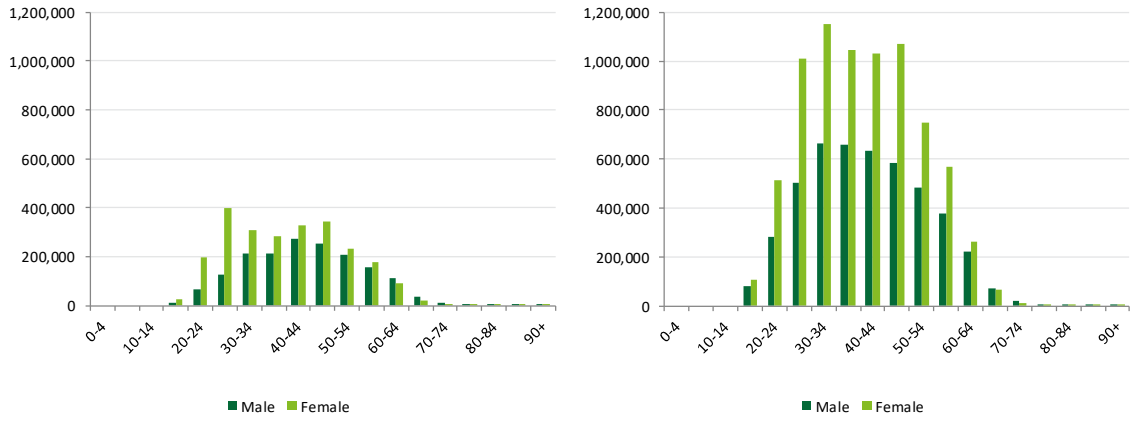
Source: Deloitte Access Economics.

Table 5.4: Productivity costs by chronic and episodic migraine, per person ($)

Productivity component	Chronic migraine	Episodic migraine
Reduced workforce participation	7,506	1,060
Absenteeism	1,462	814
Presenteeism	2,164	833
Total	**11,132**	**2,707**

Source: Deloitte Access Economics.

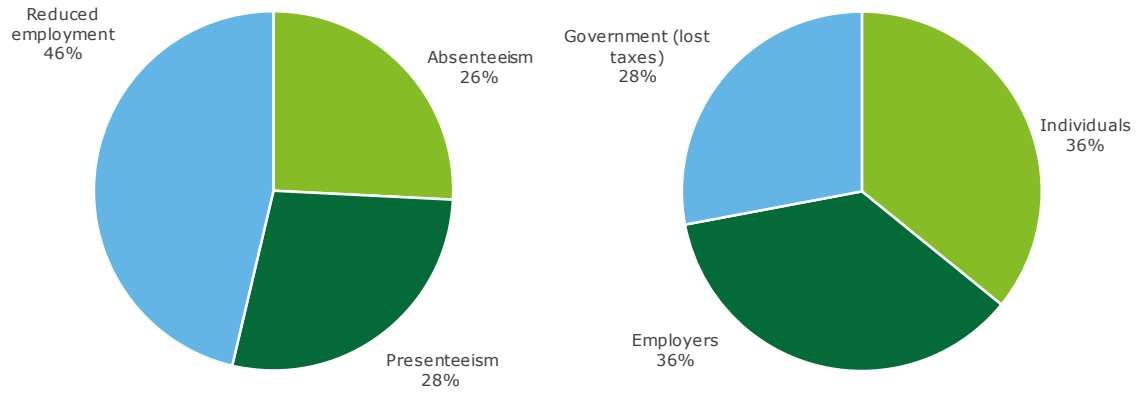
Chart 5.1: Productivity costs by age and gender for chronic migraine (LHS) and episodic migraine (RHS)



Source: Deloitte Access Economics.

The costs of reduced employment make up the largest share of productivity costs at 46%. Absenteeism and presenteeism make up 26% and 28% of costs respectively as illustrated in Chart 5.2a. The government bears 28% of total costs through lost taxes and employers and individuals bear 36% of costs, as illustrated in Chart 5.2b.

Chart 5.2: Productivity costs by a) component (LHS) and payer (RHS) (%)



Source: Deloitte Access Economics.

6 Other financial costs

This chapter describes the approach that was used to estimate carer costs, welfare costs and deadweight loss (the loss of economic efficiency caused by taxation) associated with migraine in Australia.

A range of informal care activities may be provided to individuals who have migraine. Migraine results in impairment and disability that not only affects the individual experiencing the migraine, but can also affect their family and friends. Severe migraines can limit the ability of the individual experiencing them to engage in day-to-day and self-care activities, requiring others to do these activities in their place.

People with migraine and their carers also receive welfare payments. Carers may receive the carer payment or carer allowance, while migraine patients may receive the disability support pension (DSP), sickness allowance or newstart allowance.

The act of taxation and redistribution creates distortions and inefficiencies in the economy, so transfers also involve real net costs to the economy, known as deadweight loss. This chapter calculates the deadweight loss resulting from lost taxation (which must be raised elsewhere) and government expenditure on welfare payments and the health system.

Key findings

- Carer costs are $90.7 million in 2018. This includes $83.6 million of lost productivity and $7.1 million in welfare payments to carers.
- Welfare paid to people with migraine totals $49.4 in 2018, including disability support pension, sickness allowance and newstart allowance payments.
- Deadweight loss is estimated at $5.0 billion in 2018.

6.1 Informal care costs

A range of informal care activities may be provided to individuals who have migraine. Informal care activities depend on the level of impairment and of the person, and can include:

- collecting any relevant prescriptions and organising and timing the administration of medication;
- assistance in day to day domestic activities such as cooking and laundry;
- ad-hoc tasks, such as shopping, transport and cleaning activities; and
- monitoring of the patient's physical and mental wellbeing.

Due to limited data available on informal care for migraine, it is difficult to separate the time that family and friends spend helping someone as a result disability or illness and the time when they are simply undertaking activities with the person unrelated to migraine. It is also problematic to estimate the cost of informal care as estimation needs to consider a range of factors including:

- the number of people receiving informal care;
- the amount of time devoted to informal care per day attributable to migraine;
- the number of days of informal care that is provided; and
- the value of time associated with informal care.

The opportunity cost method was used to estimate the cost of informal care. This method measures the value in alternative use of time spent caring, which is typically valued by productivity losses (or value of leisure time) associated with caring. It is based on the assumption that time spent providing informal care could be alternatively used within the paid workforce or in leisure activities. Using this approach, the value of informal care provided by one individual in any time t is:

$$V_{it} = t_{it} w_{it}$$

Where V_{it} is the value of informal care for an individual i in time t, t_{it} is the time provided and w_{it} is the net market wage (van den Berg et al. 2006).

"Support network –husband, other sufferers Mother, Grandmother and mother from mothers group" ***Female, stay at home mum***

For those who provide informal care but are not in paid work (e.g. children or those who have retired), the value of providing informal care is the value of the lost opportunity of undertaking leisure. This can be approximated by the willingness to pay to undertake leisure, or to avoid work. However, the value of leisure time is often proxied by an average age and sex specific wage rate (Brouwer and Koopmanschap 2000; Heitmueller 2007). If the value of non-work is more (less) than the average wage rate, the opportunity cost method will under (over) estimate the value of informal care.

The cost of informal care for migraine was based on the ABS survey of Disability Ageing and Carers, 2015 confidentialised unit record file (CURF) (ABS, 2015a). From this ABS data, both the average hours of care and the number of primary caregivers for migraine sufferers was estimated, as shown below in Table 6.1.

Table 6.1: Weekly hours of care provided by the primary care giver, to migraine sufferers, conditional on the individual receiving care.

Hours of care	Estimated Australian population
Total number of people providing care for migraine sufferers	2,668
1-9 hours	317
10-19 hours	656
20-29 hours	301
30-39 hours	379
40-59 hours	644
60 hours or more	370
Average weekly hours of care, given that care is provided	**32.7 hours**

Source: Deloitte Access Economics analysis of ABS, 2015.

The estimates obtained from the ABS survey of Disability Ageing and Carers, 2015 are conservative. For a carer to be included in this estimate, they must identify themselves as a caregiver "helping or supervising another member of the household who has a long term-health condition or disability" – Household survey questionnaire (ABS, 2015). In many cases, people may view the care they provide as only incidental, part of usual family assistance or unrelated to migraine. As a result, the data presented in Table 6.1 is unlikely to represent full coverage on the spectrum of care given to migraine sufferer. The data is likely only to capture the most intensive care given to individuals encountering the most severe migraines.

Given that sufferers of migraine may also require care for unrelated conditions, it is necessary to estimate the background level of care unrelated to migraine. This allows estimation of the additional care, which attributable to migraine, net of any care required for unrelated conditions.

Table 6.2: Weekly hours of care provided for any condition (background care requirements)

Hours of care	Estimated Australian population
Not a carer	22,429,560
1-9 hours	216,309
10-19 hours	143,870
20-29 hours	96,509
30-39 hours	66,369
40-59 hours	65,846
60 hours or more	217,468
Does not know hours of care provided	49,847
Total	**23,285,779**
Average weekly hours of care	**1.1 hours**

Source: Deloitte Access Economics analysis of ABS, 2015.

Using figures shown in Table 6.1 and Table 6.2 above, it was conservatively estimated that approximately 31.6 hours per week of care are required for approximately 2,700 chronic migraine sufferers. As chronic migraine has significantly greater impacts on the individual than episodic migraine (in terms of number of headache days), care requirements have been attributed to only chronic migraine sufferers. As reliable estimate of the care requirements by age and is unavailable, care requirements have also been assumed to apply evenly across age and gender, varying only by prevalence of the condition. The age and gender adjusted average weekly earnings of primary carers in Australia in 2018 was estimated to be $1,157 (ABS 2011c; ABS 2017).[4]

The annual cost of informal care for migraine sufferers is estimated to be $83.5 million in 2018.

6.2 Welfare costs

Transfer payments represent a shift of resources from one economic entity to another, such as raising taxes from the entire population to provide welfare payment to people with migraine (where welfare benefits are claimed). The act of taxation and redistribution creates distortions and inefficiencies in the economy, so transfers also involved real net costs to the economy, referred to as deadweight losses (as discussed in Section 6.3). The cost of the welfare payments themselves are not included in the cost of migraine.

There are currently three forms of support for people with migraine:

- the Disability Support Pension (DSP);
- the Sickness Allowance (SA);
- the Newstart Allowance (NSA).

"I don't know if I will be able to find a job, I wouldn't hire me as I am unreliable" ***Female, full time mum, 24***

The DSP is an income support payment for people who are unable to work for 15 hours or more per week at or above the relevant minimum wage, due to permanent physical, intellectual or psychiatric impairment (DHS, 2018). The SA is an income support payment for people who are unable to work or study temporarily because of an injury, illness or disability (DHS, 2018a). The NSA is an income support payment for people who are looking for work, or participating in approved activities that increases a person's likelihood of finding a job (DHS, 2018b).

A special data request was submitted to DSS to obtain information on the number of people who received either of these income support payments as a result of their migraine. This data only captures the number of people who put migraine as their first listed medical condition and was

[4] The age gender distribution of primary carers was estimated by Access Economics (2010).

current as of December 2017. Across all people with migraine, there were 2581 receiving the DSP, 962 receiving the NSA and 23 receiving the SA.

To determine the total payments made to people with migraine, the number of people receiving support was multiplied by the average yearly payments per person. Average yearly payments per person were calculated as total expenditure for the DSP and the SA, divided by the total number of people receiving each payment, equating to $21,412 per DSP recipient (DSS, 2017). These payments were adjusted to 2018 figures using CPI, and applied to the number of people with migraine receiving payments. Using this methodology, it was estimated that welfare payments to people with migraine are $57 million 2018.

It is likely that some of these people would have received these payments even in the absence of migraine (e.g. due to comorbidities), which must be netted out to estimate the additional welfare payments due to migraine (Tseng & Wilkins, 2002). Accordingly, it is estimated that approximately 13.2% of people receiving the DSP would receive some welfare in the absence of migraine. As such, it was estimated that $49.4 million in additional DSP payments would be paid to people with migraine in 2018.

Due to the small sample sizes of people receiving SA and NSA, a conservative approach has been taken, and both the SA and NSA have been excluded from this analysis.

The same approach was taken for estimating the size of carer allowance and carer payments. Data from DSS (2017) indicated that 366 people received the carer payments and 561 people received a carers allowance to care for someone with migraine as their primary condition. Using average weekly payment rates of $282 and $52 per week respectively (DHS, 2018), overall costs were estimated at $7.1 million.

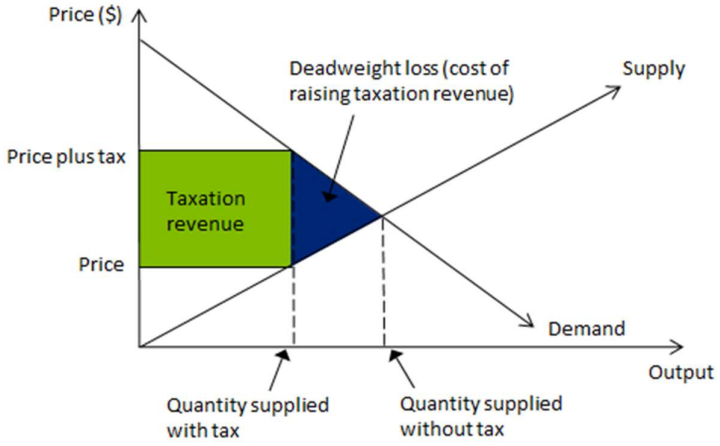
6.3 Deadweight loss (DWL) of taxation payments and administration

Transfer payments (government payments and taxes) are not a net cost to society, as they represent a shift of consumption power from one group of individuals to another in society. If taxation did not create distortions and inefficiencies in the economy, then transfers could be made without a net cost to society. However, these distortions do impose an efficiency loss on the economy.

"I couldn't have any light on, couldn't have any light, had to lie down, had to stay in bed, just sleep, basically." ***Male, car dealer, 40***

An efficiency loss is the loss of consumer and producer surplus, as a result of the imposition of a distortion to the equilibrium (society preferred) level of output and prices (Figure 6.1). Taxes alter the price and quantity of goods sold compared to what they would be if the market were not distorted, and thus lead to some diminution in the value of trade between buyers and sellers that would otherwise be enjoyed. The principal mechanism by which efficiency losses occur is the price induced reduction in output, removing potential trades that would benefit both buyers and sellers. In a practical sense, this distortion reveals itself as a loss of efficiency in the economy, which means that raising $100 of revenue requires consumers and producers to give up more than $100 of value.

Figure 6.1: Deadweight loss of taxation



Source: Deloitte Access Economics.

Rates of efficiency loss used in this report vary depending on the relative inefficiencies of the taxes used to raise the additional revenue:

- For Commonwealth Government expenditures including welfare payments to people with migraine and their carers and health system expenditure, an efficiency loss of 29.5% is applied based on a weighted average of the burdens of personal income tax, indirect taxes and company tax required to raise this revenue.
- For State Government expenditure on the health system, an efficiency loss of 37.8% is applied based on a weighted average of the deadweight loss associated with state taxes.
- For lost tax revenue on the income of employers, an efficiency loss of 50.8% is applied, reflecting the burden of raising company tax.
- For lost tax revenue from people with migraine, their carers and employers (which must be raised from another source), an efficiency loss 23.7% is applied, based on the cost of raising additional revenue from income and indirect taxes to replace the revenue forgone.

6.4 Results

Carer costs and deadweight loss resulting from welfare payments are attributed to chronic migraine due to the small number of carers and the greater severity of chronic migraine. Overall carer costs are $84 million, or $225 per person with chronic migraine, as outlined in Table 6.3 and Table 6.4. Deadweight loss costs are $5.1 billion, or $3,097 per person with chronic migraine and $887 per person with episodic migraine.

Carer and deadweight loss costs distributed by age and gender are displayed in Table 6.3. It is important to keep in mind that in the case of deadweight loss this represents where costs are incurred, as the costs of deadweight loss are borne by the whole of society.

Table 6.3: Other financial costs by chronic and episodic migraine, total ($ million)

Cost component	Chronic migraine	Episodic migraine	Total
Carer costs	84	0	84
Deadweight loss	1,065	3,949	5,014
Total	**1,149**	**3,949**	**5,097**

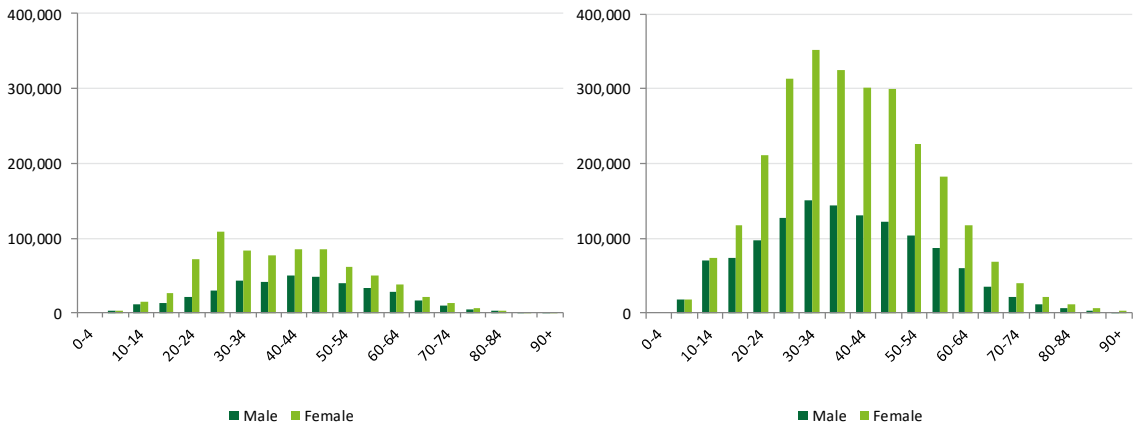
Source: Deloitte Access Economics.

Table 6.4: Other financial costs by chronic and episodic migraine, per person ($)

Cost component	Chronic migraine	Episodic migraine
Carer costs	225	0
Deadweight loss	2,872	877
Total	**3,097**	**887**

Source: Deloitte Access Economics.

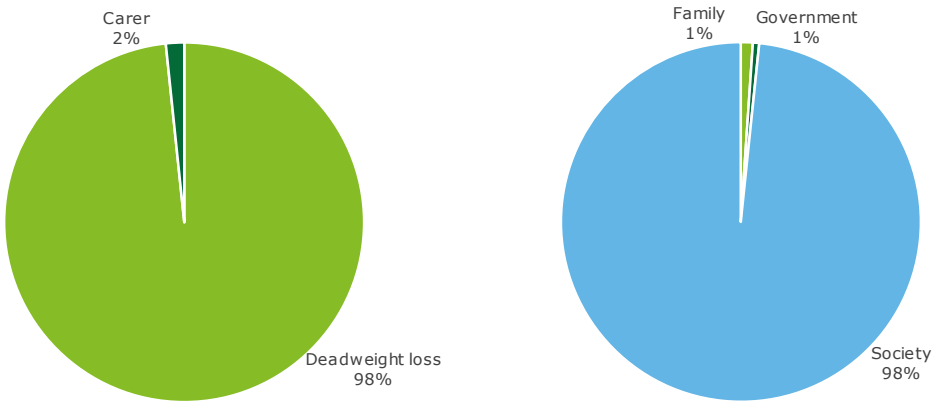
Chart 6.1: Productivity costs by age and gender for chronic migraine (LHS) and episodic migraine (RHS) ($)



Source: Deloitte Access Economics.

Deadweight loss makes up almost all of the other financial costs category (98%), carer costs making up the remaining 2%, as illustrated in Chart 6.2a. As a result, 98% of these costs are borne by society, with 1% borne by each individuals and families (Chart 6.2b).

Chart 6.2: Other financial costs by component (LHS) and payer (RHS) (%)



Source: Deloitte Access Economics.

7 Loss of wellbeing

"Pain. Unbearable pain. It's not a normal life. I don't know what's going to happen tomorrow or even in a few hours" Female, manager, 54

Migraine causes significant loss of wellbeing. The Migraine in America Survey found that 70% of sufferers are constantly worried about disappointing others and 52% feel embarrassed about having migraines, while 51% of those surveyed indicated migraines have affected their ability to maintain friendships (Herbert, 2015). Furthermore, migraine causes significant pain and suffering.

This chapter adopts the 'burden of disease' methodology to quantify the impact of migraine on wellbeing. The approach is non-financial, where pain, suffering and premature mortality are measured in terms of disability adjusted life years (DALYs).

Key findings:

Overall, people with migraine in Australia experienced:

- 201,000 DALYs overall, or around 0.18 DALYs per person with chronic migraine and 0.03 DALYs per person with episodic migraine.
  - There is no mortality resulting from migraine.
- The total burden of disease from migraine in 2018 was estimated to be $40.0 billion.

7.1 Valuing life and health

The burden of disease methodology was developed by the World Health Organization (WHO) 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. 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 quality of life that is lost due to a particular condition. For example, a disability weight of 0.2 is interpreted as a 20% loss in the quality of life relative to perfect health for the duration of the condition.

DALYs are composed of premature mortality (years of life lost due to premature death – YLL) and morbidity (years of healthy life lost due to disability – YLD) components:

$$DALYs = YLLs + YLDs$$

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 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 $196,636 in 2018 dollars for the VSLY using the Consumer Price Index (CPI).

7.2 Wellbeing costs

Globally, migraine imposes a significant burden of disease, amounting to 5.61% of total YLDs globally, making it the sixth highest cause of disability, and the third highest for people below 50 years (Steiner et al., 2016).

"I used to be very social, party, party, party… now I'm a different person. I cannot plan social events in advance" ***Female, real estate agent, 46***

The Global Burden of Disease (GBD) study (2015) defined a disability weight of 0.441 (with lower and upper bounds of 0.294 and 0.588 respectively) (Vos et al. 2015). This weighting

is based on migraine characterised by throbbing head pain and nausea that causes great difficulty in daily activities and sometimes confine the person to bed, where moving around, light, and noise make it worse (Vos et al. 2017a). The Institute for Health Metrics and Evaluation (IHME) based at the University of Washington estimated that the total disease burden of migraine in Australia in 2016 was 187,000 DALYs. There is no mortality from migraine.

Based on the number of headache days for chronic and episodic migraines from Payne et al. (2011), it is estimated that approximately:

- 133,000 DALYs are attributable to episodic migraine (average 10.4 headache days in previous 3 months); and
- 68,000 DALYs are attributable to chronic migraine (average 64.4 headache days in previous 3 months).

"It's like somebody is sitting there and hitting [you] with something on your head" ***Female, Auditor, mum of 3 and granny of 2, 54***

Applying these figures to 2018 population and demographics, the total burden of migraine in Australia in 2018 is approximately 201,000 DALYs. Applying the VSLY gives a wellbeing cost of $40.0 billion wellbeing cost.

7.3 Results

Wellbeing costs total $40.0 billion in 2018. $13.5 billion (34%) of these costs are attributable to chronic migraine and $26.5 (66%) billion are attributable to episodic migraine. Per person, the wellbeing cost of chronic migraine is $36,440 per person and $5,885 per episodic migraine sufferer (see Table 7.1 and Table 7.2). Wellbeing costs by age and gender are displayed in Chart 7.1 and are borne solely by the affected individuals.

Table 7.1: Productivity costs by chronic and episodic migraine, total ($ million)

Wellbeing component	Chronic migraine	Episodic migraine	Total
Burden of disease	13,516	26,499	40,015
Total	**13,516**	**26,499**	**40,015**

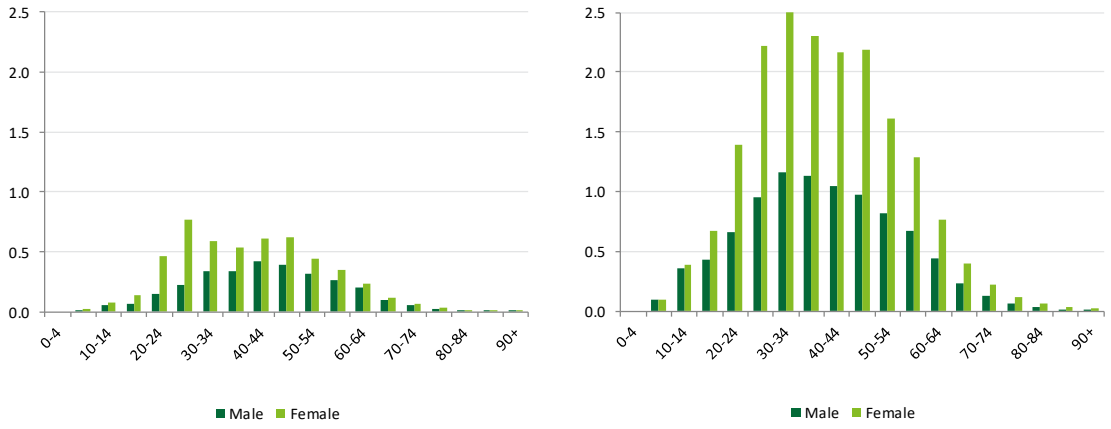
Source: Deloitte Access Economics.

Table 7.2: Productivity costs by chronic and episodic migraine, per person ($)

Wellbeing component	Chronic migraine	Episodic migraine
Burden of disease	36,440	5,885
Total	**36,440**	**5,885**

Source: Deloitte Access Economics.

Chart 7.1: Wellbeing costs by age and gender for chronic migraine (LHS) and episodic migraine (RHS) ($ billion)



Source: Deloitte Access Economics.

8 Conclusions

Summary of findings

Total economic costs of migraine were $35.7 billion in 2018. $8.1 billion (23%) of these costs are attributable to chronic migraine and $27.6 billion (77%) billion are attributable to episodic migraine (Table 8.1).

Per person, the cost of migraine is $84,879 per chronic migraine sufferer and $15,953 per episodic migraine sufferer. Excluding wellbeing costs, the economic cost of migraine is $21,706 per person with chronic migraine and $6,137 per person with episodic migraine (see Table 8.2).

Table 8.1: Total costs by chronic and episodic migraine, total ($ million)

Cost component	Chronic migraine	Episodic migraine	Total
Health system	2,773	11,500	14,273
Productivity	4,129	12,188	16,317
Carer	84	-	84
Deadweight loss	1,065	3,949	5,014
Total economic costs	**8,051**	**27,637**	**35,688**

Source: Deloitte Access Economics.

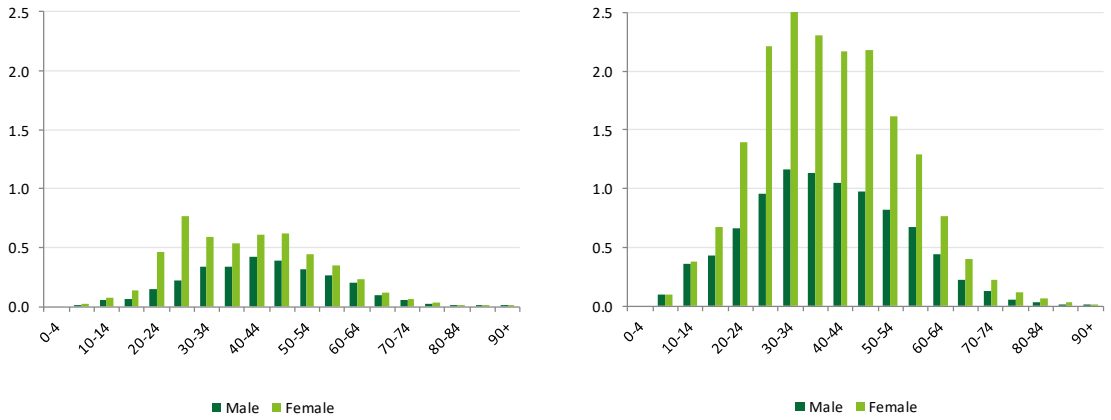
Table 8.2: Total costs by chronic and episodic migraine, per person ($)

Health system component	Chronic migraine	Episodic migraine
Health system	7,476	2,554
Productivity	11,132	2,707
Carer and welfare	225	0
Deadweight loss	2,872	877
Economic costs per person	**21,706**	**6,137**

Source: Deloitte Access Economics.

Chart 8.1 depicts the cost of migraine by age and gender. Costs are concentrated in the middle of the age range due to the distribution of migraine prevalence and the fact that people in their prime working years incur higher productivity costs as a result of migraine.

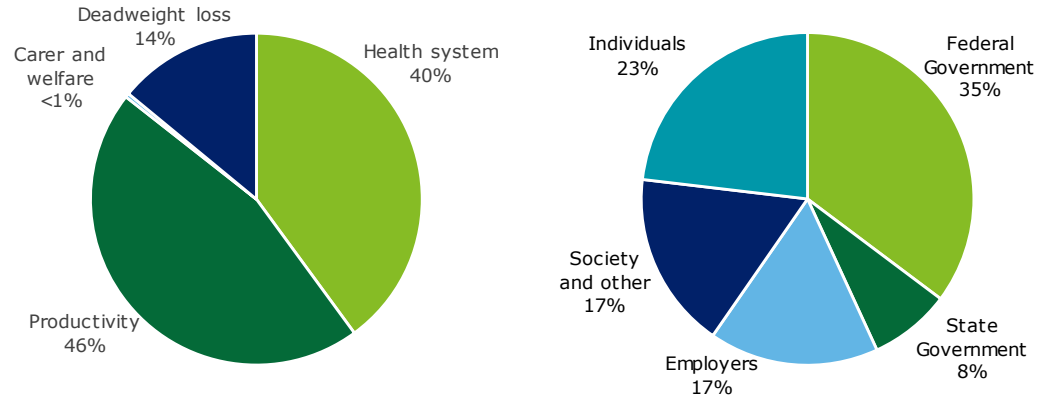
Chart 8.1: Total costs by age and gender for chronic migraine (LHS) and episodic migraine (RHS) ($ billion)



Source: Deloitte Access Economics.

Productivity costs make up the largest share of total costs at 46%, as illustrated in Chart 8.2a. Health system costs make up 40% of total costs, deadweight loss 14%, and carer and welfare costs less than 1%. Governments bear the largest share of costs with the Federal Government bearing 35% and State and Territory Governments bearing 8%. Individuals bear 23% of costs and employers and the rest of society each bear 17% of costs, as illustrated in Chart 8.2b.

Chart 8.2: Components of total costs by component (LHS) (%) and by payer (RHS) (%)



Source: Deloitte Access Economics.

Wellbeing costs

In addition to imposing significant financial costs, migraine results in pain and suffering that leads to a significant loss of wellbeing for those affected. Wellbeing costs total $40.0 billion in 2018. $13.5 billion (34%) of these costs are attributable to chronic migraine and $26.5 (66%) billion are attributable to episodic migraine. Per person, the wellbeing cost of chronic migraine is $36,440 per person and $5,885 per episodic migraine sufferer.

Future Directions

This report has found migraine imposes significant economic and wellbeing costs on the Australian population. As it currently stands, some of the 4.9 million people with migraine incur significant financial costs, in addition to severe reductions in their quality of life. Beyond the individuals affected, families, carers, federal and state governments and society all incur significant costs due to migraine. As such, there is a need to raise awareness of the socioeconomic burden of migraine in Australia and educate and inform key stakeholders including individuals, workplaces, and society.

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Appendix A: Additional information on prevalence

Prevalent migraine cases in Australia in 2018

Table A.1 outlines the estimated number of prevalent migraine cases in Australia in 2018.

Table A.1: Estimated number of prevalent migraine cases in Australia, 2018

	Chronic Migraine		Episodic migraine	
Age	**Female**	**Male**	**Female**	**Male**
0-4	-	-	-	-
5-9	2,000	1,661	30,264	31,361
10-14	7,999	6,039	121,015	114,028
15-19	11,485	5,598	173,758	105,698
20-24	25,748	7,478	261,936	111,601
25-29	34,317	8,370	349,110	124,903
30-34	26,063	11,273	390,938	137,055
35-39	24,338	10,601	365,063	128,887
40-44	25,889	12,098	326,827	110,102
45-49	25,216	11,687	318,332	106,361
50-54	19,440	9,844	250,932	90,601
55-59	16,208	8,968	209,219	82,547
60-64	13,759	8,240	150,625	62,184
65-69	9,458	6,153	103,540	46,433
70-74	5,892	4,272	64,505	32,238
75-79	3,174	2,370	34,746	17,883
80-84	1,733	1,275	18,974	9,619
85-89	907	618	9,929	4,665
90 and over	467	278	5,117	2,101
All Ages	**254,093**	**116,821**	**3,184,830**	**1,318,267**

Source: Deloitte Access Economics estimates based on IHME, 2016 and ABS, 2018.

Additional information on migraine prevalence

This section provides a discussion of migraine prevalence estimates found in the literature. In evaluating different estimates, consideration was given to the following:

- study design (for example, whether data is self-reported and if a clinical diagnosis is required);
- sample size;
- applicability to the Australian population;
- age of the study; and
- the level of detail provided.

Global Burden of Disease Study, 2016

Migraine prevalence in the 2016 GBD study is based on systematic reviews of representative, population-based surveys reporting the prevalence of migraine. Adjustments including age and sex splitting are made to data using DisMod (a software tool used to check the consistency of estimates of incidence, prevalence, duration and case fatality for diseases). One Australian study is noted in the GBD input data, the Blue Mountains Eye Study by Mitchell et al. (1998), which is discussed further below.

The study provides the most recent estimates of Australia-specific prevalence with migraine defined in accordance with the International Classification of Diseases 10th Edition criteria. While the methods used in this study are not documented in detail for migraine specifically, the GBD study publishes extensively on their methodology more broadly and collaborate extensively with specialists in the field.

In the 2016 GBD study, the definition of migraine was updated to include medicine overuse headache as a sequela of migraine. However, in 2015 medicine overuse headache only accounted for approximately 5% of the combined migraine and medication overuse headache cases in Australia. The 2016 GBD study reports an overall migraine prevalence of 20.55% in Australia, 17.87% in high-income countries and 14.67% globally, as set out in Table A.2.

Table A.2: Migraine prevalence in Australia and globally in 2016 as per IHME GHDx (2018) (%)

	Australia			Global		
Age	**Female**	**Male**	**All**	**Female**	**Male**	**All**
1-4	0.00	0.00	0.00	0.00	0.00	0.00
5-9	4.12	4.00	4.06	3.15	1.82	2.47
10-14	17.51	15.41	16.47	14.07	8.18	11.08
15-19	25.50	14.58	20.08	19.14	10.82	14.90
20-24	33.86	13.49	24.09	22.21	12.23	17.16
25-29	41.01	14.18	28.02	25.74	13.77	19.71
30-34	44.28	16.05	30.58	28.90	15.08	21.97
35-39	45.15	16.27	31.21	30.20	15.20	22.69
40-44	44.07	15.36	30.24	29.55	14.38	21.94
45-49	40.35	14.40	27.76	27.82	13.45	20.65
50-54	34.59	13.36	24.26	25.47	12.33	18.94
55-59	28.90	12.18	20.72	22.49	10.95	16.80
60-64	23.55	10.63	17.17	18.62	9.13	14.00
65-69	18.12	8.76	13.47	14.85	7.37	11.29
70-74	13.80	7.39	10.60	11.79	6.08	9.13
75-79	10.33	6.06	8.33	9.26	4.91	7.34
80-84	7.76	5.00	6.53	7.14	4.06	5.85
85-89	5.86	4.15	5.20	5.57	3.39	4.77
90-94	4.52	3.60	4.21	4.47	3.05	4.03
95 and over	4.12	3.75	4.03	4.21	3.23	3.97
All Ages	**28.66**	**11.96**	**20.55**	**19.29**	**10.03**	**14.67**

Source: IHME, 2018.

American Migraine Prevalence and Prevention Study, 2007

The American Migraine Prevalence and Prevention Study surveyed 162,576 individuals aged 12 years or older and assessed the one-year prevalence of migraine in the United States based on a validated

self-administered headache questionnaire. This study found a one-year prevalence of migraine of 11.7% overall, with 17.1% prevalence in women and 5.6% in men, using the second International Classification of Headache Disorders (ICHD-2) as their criteria for migraine. (Lipton et al., 2007).

While the study uses survey data, responses were validated using the ICHD-2 diagnostic criteria for migraine. The sample size is large although the study is of the US population and is over a decade old. A high level of detail is provided, including age and sex-stratification.

Table A.3 shows the estimated migraine prevalence by age and sex.

Table A.3: Migraine prevalence in the US as per Lipton et al. (2007) (%)

Age	Females	Males	All
12-17	7.3	4.9	
18-29	20.4	6.2	
30-39	28.1	9.0	
40-49	25.5	7.9	
50-59	18.2	5.9	
60+	6.4	2.1	
All ages	**17.1**	**5.6**	**11.7**

Source: Lipton et al., 2007.

The BEACH Study, 2011

The 2010-11 BEACH Study of general practice activity in Australia estimated that among general practice patients, 11.3% of surveyed patients (15.5% of females and 5.4% of males) suffer from migraine and have been diagnosed (Britt et al., 2011). The study consisted of 2,865 patients from 98 GPs. While the study is fairly recent, of a reasonably large sample size, and requires a diagnosis of migraine by GPs, the level of detail in the reported data is limited, with large age-ranges and sex-stratified estimates available only for the overall population. Table A.4 outlines the prevalence by age, noting that age and gender-stratified data is not available.

Table A.4: Migraine prevalence in Australia as per the 2010-11 BEACH Study (%)

Age	Females	Males	All
14-24	-	-	18.4
25-44	-	-	15.4
45-64	-	-	12.0
All ages	**15.5**	**5.4**	**11.3**

Source: Britt et al., 2011.

ABS National Health Survey, 2014-15

The 2014-15 National Health Survey is an Australia-wide health survey conducted by the Australian Bureau of Statistics. The survey was conducted in all states and territories and across urban, rural and remote areas of Australia (other than very remote areas) from July 2014 to June 2015, and included around 19,000 people in nearly 15,000 private dwellings. Participants were asked about *"any other conditions [you] may have that have lasted, or are likely to last, for six months or more"*, and shown a list of conditions including migraine. As such, data is self-reported and no medical diagnosis is required. Compared to all other relevant sources, this estimate is very conservative, which is likely due to the self-reported nature of the data. This study found that the prevalence of migraine in Australia is 6.2% (8.9% for females and 3.5% for males), as outlined in Table A.5.

Table A.5: Migraine prevalence in Australia as per the ABS National Health Survey, 2014-15 (%)

Age	Females	Males	All
0-14	0.9	1.0	1.1
15-24	9.5	3.8	6.8
25-34	14.2	4.6	9.3
35-44	13.4	5.0	9.2
45-54	13.8	3.8	8.9
55-64	8.1	3.7	6.2
65-74	6.3	5.0	5.6
75 and over	3.5	1.0	2.3
All ages	**8.9**	**3.5**	**6.2**

Source: ABS, 2017.

Meta-analysis by Woldeamanuel and Cowan, 2017

Woldeamanuel and Cowan (2017) conducted a systematic review and meta-analysis of community-based studies in order to assess the prevalence of migraine. The meta-analysis, involving 302 studies and over 6 million participants, found that global migraine prevalence was 11.6%, or 13.8% among females and 6.9% among males. This study did not stratify by age, however it was found that there was a statistically significant difference in prevalence among urban residents (11.2%) and rural residents (8.4%), and a statistically significant difference in prevalence between rural residents and school/college students (12.4%). While this study is recent, it does not provide an Australian-specific estimate, and it only uses one Australian-specific report that is based on data collected more than 20 years ago, and it provides a low level of detail. The meta-analysis included one Australian study, Mitchell et al. (1998), which is discussed below.

Blue Mountains Eye Study, 1998

Mitchell et al. (1998) report on migraine prevalence in older Australians based on the Blue Mountains Eye Study surveys of 3,654 individuals in 1992-1994. Mitchell et al. report an overall lifetime prevalence of 17% overall, 22% for women and 10% for men, based on International Headache Society criteria. While the study has a reasonable sample size, it includes only a subset of the population and measures lifetime rather than one-year prevalence. Furthermore, the study is two decades old. Table A.6 shows the age stratified migraine prevalence in Mitchell et al. (1998).

Table A.6: Migraine in older Australians in the Blue Mountains Eye Study (%)

Age	Females	Males	All
49-59	-	-	23
60-69	-	-	16
70-79	-	-	13
80+	-	-	9
All ages	**22**	**10**	**17**

Source: Mitchell et al., 1998.

Appendix B: Additional information on health system costs

The use of different health system resources by people suffering from migraine has been estimated based on a targeted literature search of Australian and international evidence.

This appendix contains additional findings of the targeted literature review into migraine health system costs.

Research has shown that people with migraine incur significant healthcare costs. However, healthcare system factors, such as accessibility, covered benefits, out-of-pocket expenses, physician reimbursement and condition awareness or culture may vary between countries resulting in differences in health resource use. Stang et al. (2004) found through linking US medical and pharmacy claims that total healthcare costs of a family with a person who suffers from migraines were 70% higher than those of a non-migraine family, with most of the difference concentrated in outpatient costs. Bloudek et al. (2012) analysed costs of healthcare for patients with migraine in five European countries (the UK, France, Germany, Italy and Spain) based on the IBMS, and found that chronic migraine was associated with significantly higher health care costs compared to episodic migraine, even when controlling for headache intensity and comorbidity. This study also found that the health care costs for chronic migraine vary significantly, ranging from €373.80 per person in Germany to €929.60 per person in the UK (costs incurred in the last 3 months). The most common headache-related medical resources (excluding medications) utilised by migraine participants were healthcare provider visits, diagnostic testing, and blood tests (Bloudek et al., 2012).

As no overall health system migraine costs in Australia were available, health system costs were estimated using a bottom-up approach. Where international estimates were used, Australian costs were applied, with the exception of pharmaceutical costs.

Appendix C: Additional information on productivity

This appendix contains additional findings of the targeted literature review into migraine productivity estimates.

Serrano et al. (2013) provides additional estimates of total lost productive time (combined absenteeism and presenteeism), and therefore does not allow for an analysis of the absenteeism and presenteeism effects separately. Further, for consistency, estimates of productivity and workforce participation in migraine were all derived from the same source (Stewart et al., 2010).

Table C6 shows estimates of lost productive time from Serrano et al. (2013) by age and gender. These estimates are lower than those reported in Stewart et al. (2010). Notably, males report a greater reduction in productivity than women for chronic migraine.

Table C6 : Estimates of lost productive time (combined absenteeism and presenteeism)

Age	Chronic migraine (days/year)		Episodic migraine (days/year)	
	Females	Males	Females	Males
25-34	7.3	7.9	5.4	4.9
35-44	9.9	14.6	4.7	6.1
45-54	15.2	20.0	5.2	5.8
55-64	13.2	14.7	4.4	5.1

Source: Serrano et al. (2013).

Limitation of our work

General use restriction

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