The economic cost of arthritis in New Zealand in 2018

Arthritis New Zealand

August 2018

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Acknowledgements

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List of acronyms

Acronym	Full name
ABS	Australian Bureau of Statistics
ACC	Accident Compensation Corporation
AIHW	Australian Institute of Health and Welfare
AWE	average weekly earnings
BMI	Body Mass Index
CI	confidence interval
DALYs	disability adjusted life years
DHB	District Health Board
DMARD	disease-modifying anti-rheumatic drug
GP	general practitioner
HLQ	Health and Labor Questionnaire
HPQ	Health and Work Performance Questionnaire
HQSC	Health Quality and Safety Commission
ICD	International Classification of Disease
ILAR	International League of Associations for Rheumatology
JIA	juvenile idiopathic arthritis
MAP	Mobility Action Programme
NSAID	non-steroidal anti-inflammatory drug
NZHPR	New Zealand Health Professionals in Rheumatology
NZHS	New Zealand health survey
NZRA	New Zealand Rheumatology Association
OECD	Organisation for Economic Co-operation and Development
SDAC	Survey of Disability, Ageing and Carers
WLQ	Work Limitations Questionnaire
WPAI	Work Productivity and Activity Impairment Questionnaire

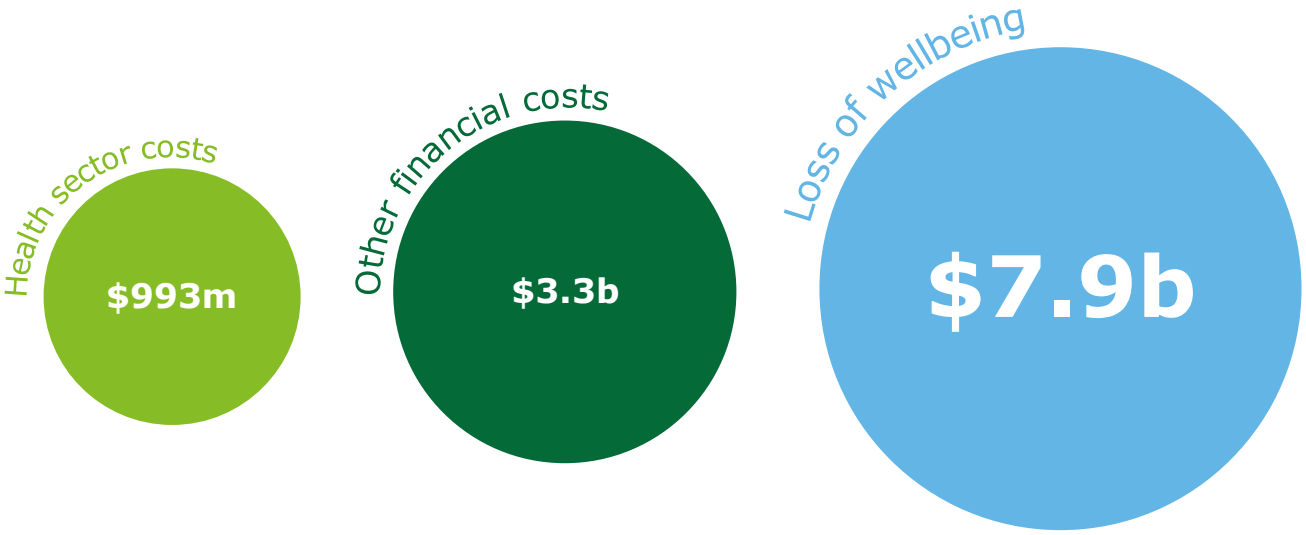
Executive summary

Arthritis is a long-term condition which can have a substantial impact on quality of life. It is an umbrella term used to describe a range of conditions affecting joints.

Costs associated with arthritis

The total cost of arthritis in New Zealand is estimated to be $12.2 billion in 2018. The costs of arthritis comprise both financial costs, which include health sector costs, productivity losses and the cost of caring for people with arthritis, as well as loss of wellbeing for people with arthritis (Figure i).

Figure i The cost of arthritis in New Zealand in 2018, by major cost components

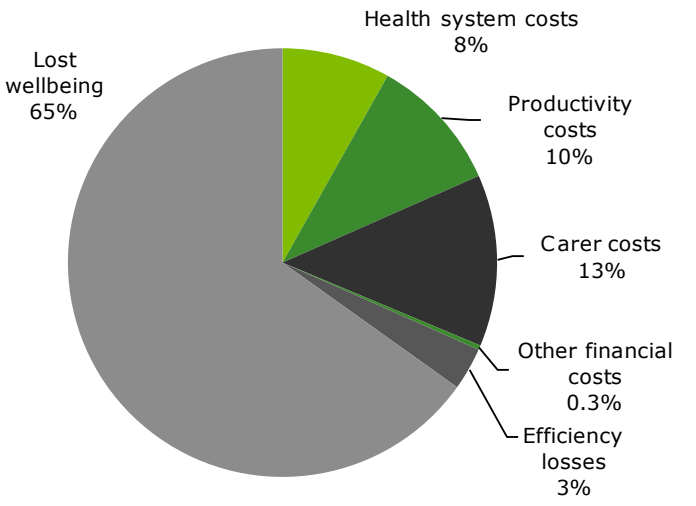


Source: Deloitte Access Economics analysis.

As shown in Chart i, of the $12.2 billion total cost, the loss of wellbeing makes up the largest proportion (65%), followed by the carer costs (13%) and productivity costs (10%).

- Loss of wellbeing costs are estimated to be $7.9 billion.
- Informal and formal carer costs are estimated to be $1.6 billion.
- Productivity costs are estimated to be $1.2 billion.
- Health system costs are estimated to be $992.5 million.
- Efficiency losses associated with lost tax revenues and government payments are estimated to be $390.7 million.
- Other financial costs are estimated to be $41.9 million.

Chart i Breakdown of 2018 costs of arthritis



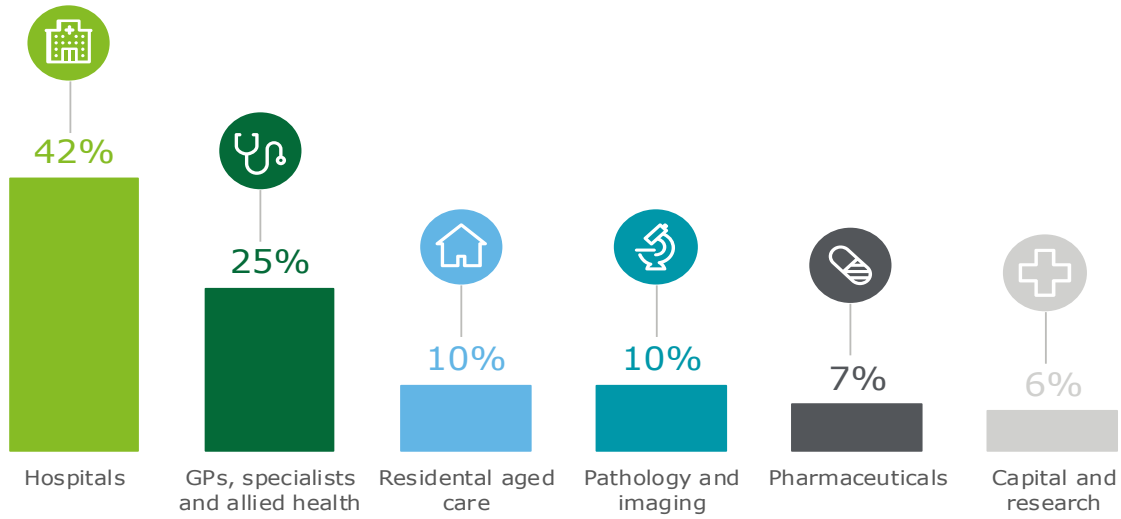
Source: Deloitte Access Economics analysis

Health sector costs

Health sector costs of arthritis are estimated to be $992.5 million in 2018, 23% of total financial costs. The relative share of each type of cost is shown in Figure ii.

- Hospital inpatient costs represent around one third of health sector costs ($321.0 million). Public inpatient costs are $244.0 million, and private inpatient costs are significantly lower at $77.0 million. Both public and private inpatient costs are dominated by osteoarthritic knee and hip surgeries.
- Hospital outpatient costs are estimated to be 10% of the total health sector costs ($102.7 million).
- The cost of general practitioner (GP) visits in 2018 is 4% of the total ($34.9 million). This share is higher than in 2010, where it was only 3%, with the difference being that in 2018 both the patient co-payment and the government's contribution were able to be included.
- Medical specialists and allied health services are estimated to be $210.0 million (21% of total health cost). The analysis was based on the data from the most recent Health Survey, and these data did not differentiate whether a consultation was with a medical specialist as an outpatient in a hospital or at their private rooms or clinic.
- Pathology and imaging together are estimated to be 10% of health sector costs ($96.4 million).
- The pharmaceutical cost share is 7% ($69.5 million).
- In 2018, the estimated cost for aged care is $97.9 million (10% of costs). This share is lower than in 2010 (12%), due to refinements in the approach used in 2018 which used New Zealand specific data.
- Research is estimated as 1% of health sector costs ($6.6 million).
- In addition, there is estimated capital expenditure of $53.5 million (5% of health sector costs) in 2018 for arthritis.

Figure ii Health sector costs of arthritis, by type, in New Zealand, 2018 (% of total)



Source: Deloitte Access Economics analysis.

Other financial costs

The productivity loss for individuals with arthritis is estimated at $1.2 billion in 2018, or $1,858 per person with arthritis. The costs are borne by individuals ($410.2 million); employers ($451.6 million) and government ($382.3 million). The productivity cost is due to arthritis causing reduced employment ($648.9 million); time off work ($262.6 million); and presenteeism[1] ($332.6 million).

Arthritis also impacts on families and other people who provide care to people with arthritis. The productivity loss due to informal care as a result of carers having lower employment levels is estimated at $1.5 billion in

[1] 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.

2018, or $2,311 per person with arthritis. [2] Each informal carer is estimated to provide, on average, 11.7 hours of care per week to people with arthritis. In addition, it is estimated that $29.4 million is spent on formal care services.

The remainder of the other financial costs in 2018 consists of:

- expenditure on aids, equipment and modifications of $40.3 million;
- services and programs provided by Arthritis New Zealand of $1.6 million; and
- efficiency losses associated with transfer payments and taxation, estimated to be $390.7 million.

Loss of wellbeing

Arthritis substantially reduces the amount of healthy years of life lived. The loss of wellbeing is estimated to cost an additional 44,930 disability adjusted life years (DALYs).[3] The loss of wellbeing costs account for around 65% of the total costs associated with arthritis in New Zealand in 2018. The net value of the lost wellbeing is estimated to be $7.9 billion. Due to the higher disability weight associated with rheumatoid arthritis relative to osteoarthritis and gout arthritis, rheumatoid arthritis contributes to a greater proportion of the loss of wellbeing.

Prevalence of arthritis in New Zealand

In 2018, approximately 670,000 New Zealanders aged 15 or over are living with at least one type of arthritis. This equates to 17.0% of the population aged 15 or over, or 1 in 6 people.

Chart ii Prevalence of arthritis by age and gender

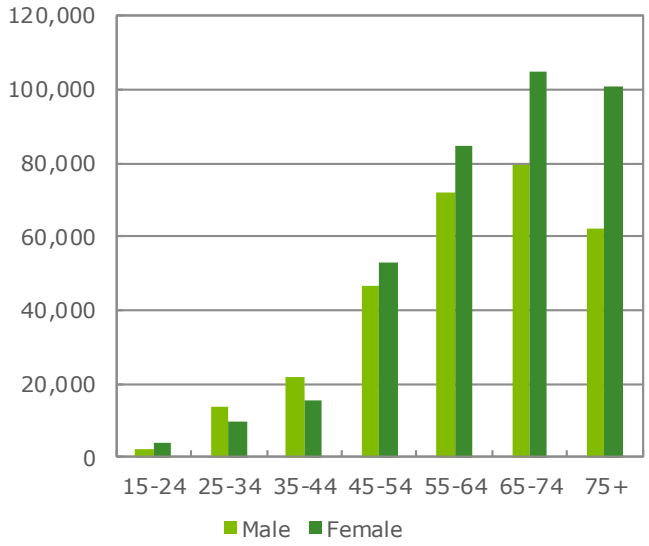
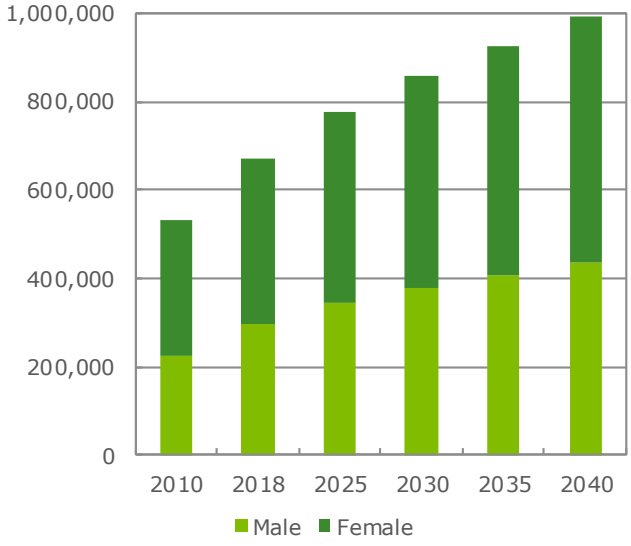


Chart iii Prevalence of arthritis 2010 to 2040



Source: Ministry of Health, 2017a and Deloitte Access Economics analysis.

Osteoarthritis is the most prevalent form of arthritis in New Zealand, followed by gout arthritis and rheumatoid arthritis (Chart iv). Gout arthritis is relatively more prevalent in the Māori and Pacific populations (Chart v). The prevalence of gout in the young Māori population is higher than for the non-Māori population, suggesting that gout arthritis is a significant health issue for the Māori population. This has implications for how services for this group are planned and delivered.

[2] As the age profile of carers was assumed to be the same as for the population with arthritis, this implicitly excludes informal carer costs of care provided to children.
[3] DALY terminology is globally adopted and understood, so is used in this report while acknowledging that some stakeholders would prefer different semantics.

Chart iv Prevalence of arthritis by type

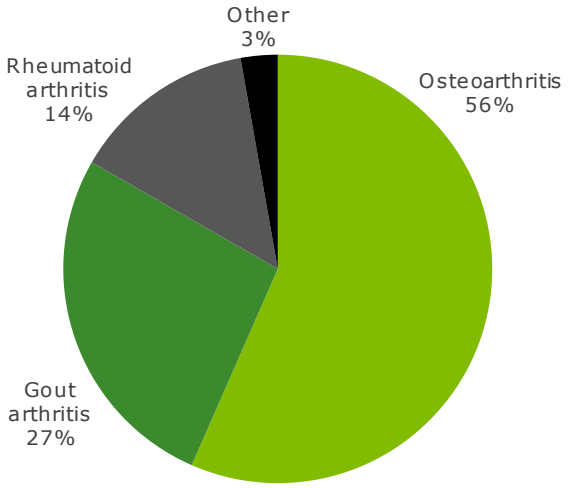
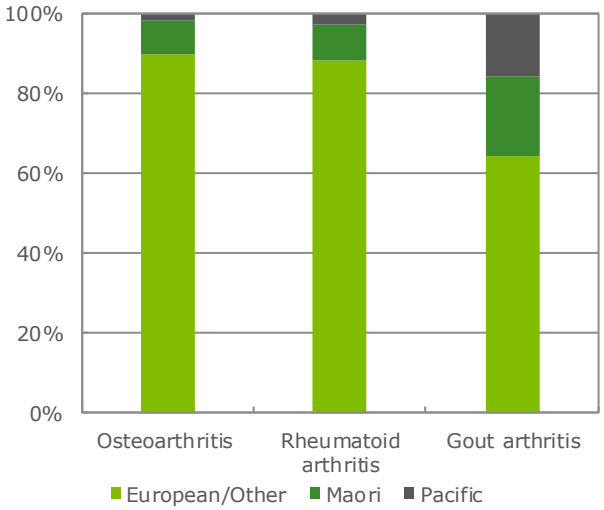


Chart v Proportion of different types of arthritis by ethnicity



Source: Ministry of Health (2017a) and Deloitte Access Economics analysis.

Arthritis can also affect children aged under 15 years of age. However, New Zealand specific data on the number of children with juvenile arthritis is not collected by the Ministry of Health and a detailed understanding of the prevalence is not currently available. The reported prevalence from international studies is between 0.07 and 4.01 per 1,000 children. Given differences in culture, ethnicity and background between New Zealand and other countries, it is inappropriate to apply these rates to the New Zealand population. As such, this report is limited to arthritis in the population aged 15 years or over.

Conclusion and recommendations

Arthritis is a highly prevalent condition that affects at least 17% of people in New Zealand aged over 15 years. Prevalence increases with age and, for people aged over 65 years, more than 45% have some form of arthritis. With an ageing population, by 2040 there are projected to be 1 million cases of arthritis in New Zealand. Arthritis is a large cost to the New Zealand economy. The total economic and wellbeing costs are estimated to be $12.2 billion in 2018, of which over $1.2 billion are production losses that directly impact New Zealand's gross domestic product, and a further $1 billion is spent on healthcare. Almost $8 billion is lost through reduced quality of life from disability and premature mortality.

Given the prevalence and cost of arthritis, a focus on cost-effective interventions for arthritis such as those targeted at reducing obesity, continued investment in research and development, and self-management education, are important to minimise costs. The recently funded Mobility Action Programme will fund evidence-based, consumer-focused programs, which improve access, health outcomes and consumer experience for people with musculoskeletal health conditions with a priority on providing services to Māori and other population groups that experience disparities in access to health services. However, policy support is needed to scale up successful programs and deliver best practice osteoarthritis management nationwide. This would entail recognition of arthritis as a national priority area for intervention.

In undertaking this analysis, we have found that there is a need for better data to be reported on arthritis by the New Zealand Government. In particular, we could not locate any publicly available data on the prevalence of juvenile arthritis and on elements of health expenditure, notably diagnostic imaging and medical services provided outside of hospitals. This makes it difficult to understand the full cost of arthritis to the economy and to assess whether people with arthritis are receiving appropriate services, or to identify the best targets for preventative health expenditure and track progress over time.

1 Introduction

Deloitte Access Economics was commissioned by Arthritis New Zealand to estimate the economic cost of arthritis in New Zealand in 2018. This analysis is the third in a series of reports on the economic cost of arthritis in New Zealand, following on from the reports prepared by Access Economics in 2005 and 2010.

1.1 Arthritis New Zealand

Arthritis New Zealand has been operating for over 50 years to improve the life of people affected by arthritis. Arthritis New Zealand facilitates the provision of quality services and programs, supporting those affected by arthritis through public awareness, information and advice, direct support, promoting the issues affecting people with arthritis and promoting research.

1.2 New Zealand health system

The New Zealand health system is characterised by a complex network of different organisations and individuals, each of which play a specific role in the administration, planning, funding, and delivery of different health and disability services. Like most developed countries, the New Zealand health system is a mixed public-private system but consists of a significant public infrastructure that is mainly supported by general taxation.

The Minister of Health (the Minister), in conjunction with the Ministry of Health and its business units, is responsible for deciding public health policy, in addition to presiding over regulation, the funding and performance management of national services, and health workforce planning. The Minister is also tasked with overseeing New Zealand's 20 district health boards (DHBs).

DHBs are responsible for the majority of the planning, purchasing and providing of health services in New Zealand. In addition to carrying out these duties within their own districts, DHBs are also required to collaborate to ensure the inclusive and equitable distribution of services across regions. As such, DHBs play a significant role in the New Zealand health system as the primary source of funding for primary care, hospital services, public health services, aged care services, and services provided by other non-government providers. DHBs are required to deliver services in accordance with the Minister's expectations, regarding key planning priorities and performance targets and measures, as outlined in their accountability documents, while ministerial oversight is facilitated by requirements for reporting for monitoring. Approximately three-quarters or more of public funds managed by the Ministry of Health are allocated to DHBs to perform their responsibilities.

Public health providers, including primary health organisations, which provide essential primary health care through general practice, and public health units, which focus on more regional concerns and priorities, are responsible for delivering the majority of health care.

1.3 Structure of the report

The remainder of the report has been structured as follows:

- **Chapter 2** provides background on arthritis, including a description of arthritis, diagnosis, treatment and care pathways in New Zealand, and the risk factors for arthritis;
- **Chapter 3** presents prevalence estimates for arthritis, including the prevalence for the three most common forms of arthritis – osteoarthritis, rheumatoid arthritis and gout arthritis;
- **Chapter 4** estimates the total loss of wellbeing due to arthritis in New Zealand;
- **Chapter 5** outlines the costs of arthritis to the New Zealand health system by type of cost;
- **Chapter 6** looks at the productivity costs and other financial costs associated with arthritis;
- **Chapter 7** calculates the total economic costs of arthritis in New Zealand in 2018; and
- **Chapter 8** concludes with key findings from the analysis.

2 Diagnosis, treatment and prevention

Arthritis is a long term condition which can have a substantial impact on quality of life. It is an umbrella term used to describe a range of conditions affecting joints. People of all ages, genders and ethnic backgrounds can have arthritis. There are over 140 types of arthritis, of which osteoarthritis, rheumatoid arthritis and gout arthritis are the most common forms in New Zealand (Arthritis New Zealand, 2018a). This chapter provides a description of arthritis, the treatment and prevention of arthritis, the risk factors associated with arthritis, and an overview of a potential model of care for improving the patient journey for people with arthritis in New Zealand.

2.1 Definition and symptoms of arthritis

Arthritis can affect many different parts of the joint and nearly every joint in the body. Arthritis can affect people in different ways but the most common symptoms are swelling, pain, stiffness and decreased range of motion. Symptoms may come and go and vary in their severity, with severe arthritis resulting in chronic pain and disability (Woolf and Pfleger, 2003). Some forms of arthritis can affect other parts of the body including eyes, lungs, skin, heart and kidneys (Arthritis Foundation, 2015).

In this report, 'arthritis' is used as a collective term, capturing all types of arthritic conditions. This report provides detailed disease burden estimates for arthritis in aggregate and individually for the three most common forms: osteoarthritis, rheumatoid arthritis and gout arthritis (see Appendix A for detailed definitions).

- **Osteoarthritis** is the most common form of arthritis. Osteoarthritis is characterised by degradation, destruction and eventual loss of articular cartilage. Osteoarthritis can affect any joint in the body, but more commonly occurs in the major weight-bearing joints such as hips, knees or lower spine.
- **Gout arthritis** occurs when uric acid levels build up in the blood causing excess urate to crystallise in one or more joints. Gout arthritis is characterised by sudden attacks of severe pain, swelling, redness, heat and stiffness in the affected joints. Gout arthritis can affect any joint, but most commonly the big toe.
- **Rheumatoid arthritis** is an autoimmune disease, characterised by inflammation of the joints. Common symptoms include swelling, pain and stiffness in the joints (usually in the morning). If rheumatoid arthritis is left untreated, joint damage may become irreversible, leading to significant deformity and disability. Other less common symptoms include weight loss, rheumatoid nodules and inflammation of other body parts such as eyes, lungs and blood vessels.

2.2 Treatment and prevention

Primary treatment with non-pharmacological components involve patients maintaining a healthy lifestyle, with emphasis on exercising and healthy eating. To assist in managing arthritis conditions patients can:

- lose weight (if overweight) to help protect joints from being overworked;
- participate in physical therapy to keep joints mobile;
- undergo surgery, which may be required to repair or replace damaged joints; and
- utilise walking sticks and splints to help if leg joints are affected.

These independent activities can assist in relieving symptoms for arthritis patients however due to the varying nature of each arthritis condition, specific treatments can prove more effective.

To aid the prevention of arthritis in New Zealand, the Ministry of Health initiated the Mobility Action Programme (MAP), which aims to shift expenditure away from hospital care and towards community-based early intervention programs for people with musculoskeletal disorders. The MAP aims to fund evidence-based, patient-focused programs, which improve access, health outcomes and patient experience for people with musculoskeletal health conditions. In addition, the MAP aims to prioritise services to Māori and other population groups that experience disparities in access to health services, as well as identify the most effective and affordable models that could be adapted and replicated across the health care system.

In total, approximately 6,000 people will participate in a MAP across 17 programs, provided by all 20 DHBs. March 2018 data show the MAP participation is higher for Māori and Pacific patients, as well as those rated 'most deprived', as compared to DHB proportions (Ministry of Health, 2018c). The MAP is set to run until 2019, and a formal economic evaluation of the MAP is due for release in 2020 (Baldwin et al, 2017).

Providing further support, there are specialist clinics catering to arthritis patients around the country. There is also a range of events around the country discussing exercise, managing pain and treatment options.

Pharmacological treatment involves the use of pharmaceutical medicines as a way to manage, and potentially cure, an ailment. The varying forms of arthritis require specific medicines. Due to the discomforting nature of arthritis, pain relief medicine such as paracetamol and anti-inflammatories are prescribed for all forms of the condition.

2.2.1 Osteoarthritis

Weight loss and exercise aid in relieving the pain of osteoarthritis, however alternative therapies such as acupuncture and massage, or nutritional changes, may relieve symptoms in some people. When osteoarthritis has caused extensive joint damage and causes severe pain, joint replacement surgery might be required.

Osteoarthritis pharmacological treatment focuses largely on relieving pain as it is an incurable condition (Southern Cross, 2017). These include standard pain relievers (e.g. paracetamol), non-steroidal anti-inflammatory drugs (NSAIDs) and corticosteroids (e.g. prednisone).

Baldwin et al (2017) argued in "An osteoarthritis model of care should be a national priority for New Zealand". Evaluation of the MAP, which will be undertaken over the next two years, could inform the development of a New Zealand osteoarthritis model of care. However, policy support is needed to scale up successful programs and deliver best practice osteoarthritis management nationwide. This would entail recognition of osteoarthritis as a national priority area for intervention.

2.2.2 Gout arthritis

Gout arthritis is a build-up of uric acid in the blood, which can then form crystals in the joints. Reducing the risk of an acute episode of gout includes:

- avoiding purines-rich food and drinks, as well as soft drinks, as these can increase the risk of a gout arthritis-attack;
- reducing excess weight if overweight, as extra weight slows down the removal of uric acid by the kidneys;
- consuming low-fat dairy foods, to help increase the excretion of uric acid; and
- drinking plenty of water as dehydration is a trigger to an attack (PHARMAC, 2017).

Gout arthritis is commonly treated with urate-lowering medicines (PHARMAC, 2017). These can be prescribed long-term to lower uric acid in the blood, dissolve the crystals, and reduce the potential for gout arthritis attacks. Treatment medicines include allopurinol and probenecid, or if allopurinol or probenecid are insufficient as treatment, other medicines can be prescribed (e.g. febuxostat or benzbromarone). Medicines to relieve the pain associated with gout arthritis attacks include colchicine, paracetamol, aspirin, triamcinolone, naproxen, diclofenac, ibuprofen, methylprednisolone and prednisone.

2.2.3 Rheumatoid arthritis

Non-pharmacological approaches for the treatment of rheumatoid arthritis include physiotherapy, hydrotherapy and occupational therapy. The desired outcome of these treatments is better mobility and a reduction in pain.

Rheumatoid arthritis is also frequently treated with pharmacological measures that stop the immune system from harming joints. For example, disease-modifying anti-rheumatic drugs (DMARDs), biological medicines, corticosteroids, and NSAIDs.

To ensure the consistent and high-quality treatment of rheumatoid arthritis, the New Zealand Rheumatology Association (NZRA) is a non-profit organisation, representing rheumatologists practising in New Zealand. Their main function is to promote and maintain the standards of rheumatology practised in New Zealand through overseeing the training of rheumatologists, hosting the NZRA annual scientific meeting and lobbying to improve the access of rheumatology services and treatments for patients.

2.2.4 Model of care

Recent research has identified that the model of care for osteoarthritis care in New Zealand is fragmented due to the lack of collaboration between health care providers (Arthritis New Zealand, 2018c). In 2014, Arthritis Australia proposed a model of care that aims to improve the management and support of people with arthritis. A patient journey framework consisting of five stages was used to develop the model, across the continuum of care of prevention, early diagnosis, early treatment, ongoing management, and advanced stage care and surgery. In developing this model, a multidisciplinary steering committee including experts from rheumatology, general practice, pharmacy, patient advocacy, allied health and key services was formed. Through assessment of local and international literature guidelines, standards and models of care, the committee proposed eight key recommendations:

- Increase public, health practitioner and policymaker awareness and understanding of arthritis and opportunities for prevention and improved management
- Prevent arthritis and support lifestyle modification to help people with arthritis manage their condition. Collaborate with other related organisations[4] to deliver programs relating to arthritis prevention and management.
- Support early diagnosis and intervention through utilisation of existing booking services to facilitate urgent referrals, improve education of health care professionals to promote early diagnosis and prevention, and provision of early assessment services in underserviced areas.
- Improve information, education and support for people to self-manage their condition by utilising practice and rheumatology nurses and allied professionals, develop national comprehensive condition specific information packs, and enhance referral pathways to information resources and support group.
- Provide equitable and timely access to multidisciplinary care for people with severe or inflammatory arthritis through established community based multidisciplinary arthritis teams, appropriate funding models to support delivery of multidisciplinary care in the private sector, and provision of specialist and multidisciplinary outreach clinics in rural and remote areas.
- Support best practice treatment and care that is specific to each form of arthritis including: support a target based treatment[5] approach for rheumatoid arthritis patients, promote conservative management of osteoarthritis in primary care, and improve access to timely and appropriate surgery.
- Build health workforce capacity to better manage people with arthritis by developing information and education resources for health professionals to support early diagnosis and appropriate treatment for people with arthritis, upskill nurses in general practice, and increase the number of rheumatologists in underserviced areas.
- Support quality improvement in arthritis care by developing a quality indicator framework and data sources to monitor management and quality of care, and increase investment in research funding for arthritis.

Although these key recommendations focus mainly on osteoarthritis and rheumatoid arthritis, patients with other forms of arthritis (e.g. gout arthritis) will also benefit from implementation of this strategy (Arthritis Australia, 2014). It should be noted that adoption of these key recommendations may require adjustment, depending on the local health care delivery model. The eight recommendations are essential to ensure timely prevention, diagnosis and treatment for arthritis throughout the patient journey. Examples of key actions for each stage of the patient journey are provided in Table 2.1.

[4] Organisations that are active in obesity (or other comorbidities) prevention and those that deliver healthy lifestyle and physical activity and sporting programs.
[5] This approach aims for clinical remission or low disease activity based on systematic measurement of treatment outcomes.

Table 2.1 Arthritis Australia's model of care

Stage	Examples of key actions
Arthritis prevention	• Promotion of healthy lifestyles including: a healthy diet, physical activity and avoidance of smoking and raising awareness that obesity, inactivity, joint injury and smoking can increase the risk of developing arthritis. • Raising awareness of the signs and symptoms of arthritis and that it can occur at any age, and the existence of effective treatment and management strategies. • Raising awareness of the importance of early intervention. In particular, symptoms of inflammatory arthritis that persist more than 4-6 weeks require prompt medical attention. • Information on symptoms and management of arthritis are made available and easily accessible.
Early diagnosis	• Information and resources are accessible for people with symptoms of arthritis for understanding of symptoms and identifying professional help requirements. • Health care professionals are trained and have access to tools, guidelines and resources to enhance their understanding of arthritis, in order to make a diagnosis and an appropriate referral. • Health care professionals are aware that people with inflammatory arthritis symptoms require urgent attention and prompt referral to multidisciplinary arthritis clinics to confirm the diagnosis. • Clinics can provide access to rheumatologists, and are supported by triage or early assessment services (conducted by trained health care professionals) to ensure urgent cases are assessed in a timely manner.
Early treatment	*Osteoarthritis:* • People with mild to moderate osteoarthritis are appropriately managed in primary care. • Individualised management plans are developed in collaboration with the patient. • Patients are provided with information and education to self-manage their condition effectively. • Regular reviews are scheduled. *Rheumatoid arthritis* • Patients receive a comprehensive assessment, including general health and psychological needs. • Individualised multidisciplinary care plans are developed which include evidence-based pharmacological and non-pharmacological treatments. • Patients are assigned a case coordinator and educator (rheumatology nurse) to provide information and ongoing support. • Rheumatologists provide DMARDs promptly when required, with regular reviews. • Appointments with multidisciplinary members are coordinated for patients' convenience. • Adequate funding is available if patients elect to go private for their treatment.
Ongoing management	• People with an advance case of osteoarthritis require intensive coordinated care for their condition. • People with well-controlled rheumatoid arthritis have access to ongoing management to a shared care arrangement by their GP and the multidisciplinary team. • Support is provided at all stages and across all health service providers to encourage people with arthritis to adopt healthy lifestyles. • People with arthritis have access to advice and programs to assist them to remain in the workforce.
Advanced stage care and surgery	• People are referred to the multidisciplinary clinic for triage, management and referral if advanced stage care and surgery may be required. • Protocol is in place to ensure patients receive timely referral and assessment. • Clear information regarding a procedure, its associated risks and benefits and effective preparation for surgery is provided before people decide to proceed with surgery. • People who are on the waiting list or not recommended for surgery receive appropriate care to manage pain, function and independence. • Multidisciplinary team members can help with access to home aids, equipment and modifications.

Source: Arthritis Australia (2014)

2.3 Risk factors for arthritis

The precise causes of arthritis remain unknown. However, a number of genetic and environmental factors have been found to be associated with the development of arthritis. Known risk factors associated with all forms of arthritis include:

- *Modifiable risk factors* such as excessive weight, manual and repetitive tasks, physical injuries, smoking and dietary.
- *Non-modifiable factors* such as age, gender and genetics.

Although people may have one or more risk factors, this does not necessarily mean they will develop arthritis. In general, however, the more risk factors a person has, and the greater severity of each risk factor, the greater the likelihood of developing arthritis. The following sub-sections individually discuss the presence of risk factors in osteoarthritis, rheumatoid arthritis and gout arthritis.

2.3.1 Osteoarthritis

Woolf and Pfleger (2003) noted a range of factors associated with at-risk population for osteoarthritis. Age, obesity and physically demanding activities or occupations were identified as relevant risk factors in the development of osteoarthritis in knees, hips and hands.

Age is the strongest risk factor in the progression of osteoarthritis. While osteoarthritis may begin at any age, it usually affects people over 40 years of age. This may be a result of cartilage changes with ageing, where the water content of the cartilage decreases, causing cartilage to be less resilient. Although the degeneration of joints associated with ageing can contribute to osteoarthritis, recent research suggests that the condition is not an inevitable consequence of growing old and may even be preventable (Anderson and Loeser, 2009).

Obesity is one of the most modifiable risk factors for osteoarthritis. Obesity refers to the accumulation of excessive fat in the body, defined in terms of Body Mass Index (BMI)[6]. Studies have found that the risk of developing hip and knee osteoarthritis increases by 11% and 35%, respectively when there is a 5-unit increase in BMI (Jiang et al, 2011; Jiang et al, 2012). The mechanism by which obesity increases the risk of developing osteoarthritis can be both mechanical and inflammatory. For example, the extra weight in obese patients can place heavier loads on their joints making them susceptible to joint injury. On the other hand, the correlation between obesity and hand osteoarthritis suggests that inflammatory factors are also at work.

In addition, *injuries* (particularly for knee osteoarthritis) and physically demanding activities can also contribute to the development of osteoarthritis. In particular, the risk of developing the condition were found to be higher in occupations associated with heavy physical work load, constant kneeling, squatting or standing, and repetitive movements (Yucesoy et al, 2015). For instance, farmers were found to have a higher risk for osteoarthritis (Croft et al, 1992; Thelin et al, 2004).

A number of studies have also found evidence of *genetic* influence in the development of osteoarthritis (Spector and MacGregor, 2004). Defects of a structural protein such as collagen, or modification of the metabolism of bone and cartilage have been thought to be linked with the genetic basis of osteoarthritis (Cimmino and Parodi, 2005 as cited in Access Economics, 2007). Genetic factors were found to account for at least 50% of the cases of hand and hip osteoarthritis (Palazzo et al, 2016).

2.3.2 Rheumatoid arthritis

The development and progression of rheumatoid arthritis encompass a range of genetic and environmental factors (Smolen, Aletaha and Mclnnes, 2016). The *hereditary* nature of rheumatoid arthritis is evident in literature, with genetic contribution to susceptibility estimated to be around 65% using Finnish data (MacGregor et al, 2000). Genome-wide association studies have characterised more than a hundred loci[7] associated with rheumatoid arthritis risk. Okada et al (2014) have, for instance, identified 98 biological candidate genes at 101 risk loci.

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[6] Body mass index (BMI) was calculated by dividing weight in kilograms by height in metres squared (kg/m²). Adults with BMI of 30.0 or greater (or equivalent) are identified as being obese.

[7] In genetics, a locus is the place a gene occupies on a chromosome.

Environmental factors can also place people at risk of developing rheumatoid arthritis, with *smoking, infection, dietary factors, environmental pollutants and urbanisation* thought to make a person prone to developing the condition (Tobon et al, 2009). For example, early research found women who smoked at least 25 cigarettes a day for more than 20 years had a 39% increased risk of rheumatoid arthritis relative to non-smoking women (Karlson et al, 1999).

Hormonal factors are also considered to increase the risk of developing rheumatoid arthritis, with women found to be three times more likely to have this condition than men, and oestrogen is known to have an effect on the immune system (Arthritis Australia, 2016).

2.3.3 Gout arthritis

As gout arthritis relates to the build-up of excess uric acid, risk factors for increased urate concentrations are considered to increase the risk of developing gout arthritis. Increasing age, male *gender and ethnic* origin are found to be associated with gout arthritis development (Dalbeth et al, 2016). In New Zealand, compared to Europeans, gout arthritis was found to be more prevalent in Māori (particularly in Māori men) and a stronger family history of gout arthritis in Māori was identified (Klemp et al, 1997). The association between certain ethnic groups and susceptibility to gout arthritis development suggests the importance of genetic predisposition.

As with other forms of arthritis, environmental factors also play a role in the progression of gout arthritis. Established *dietary* risk factors associated with gout arthritis include excessive consumption of alcohol, red meat and purine-rich food consumption, such as seafood (Singh, Reddy and Kundukulam, 2011). Recent research also found consumption of sugary beverages contributes to increase risk of gout arthritis (Choi et al, 2008; Batt et al, 2014). *Medications* are additionally associated with the risk of gout arthritis. Some medicines such as diuretics (tablets that drain water from the body) used to treat high blood pressure can cause gout arthritis (Hunter et al, 2006). In addition, *chronic diseases*, such as kidney diseases, diabetes and obesity, were found to be associated with the risk of gout arthritis (Singh et al, 2011). Hak et al (2010) also found that menopause increased the risk of gout arthritis in women, whereas post-menopausal hormone therapy modestly reduced the risk.

3 Prevalence

Key findings:

- The most recent New Zealand Health Survey data show there were 647,000 adults over the age of 15 with arthritis in New Zealand in 2016-17.
- In 2018, we estimate that there are 669,756 adults (17% of the national population) over the age of 15 with at least one type of arthritis.
- The prevalence of osteoarthritis and rheumatoid arthritis is higher for women than men.
- More men than women experience gout arthritis.
- Māori and Pacific men have a higher prevalence of gout than in Māori and Pacific females.
- The prevalence of arthritis also increases with age.
- The number of people adults over the age of 15 with arthritis in New Zealand is projected to be 778,755 by 2025 and 856,757 by 2030.
- By 2040, the number of adults with arthritis is projected to be 994,480 (21% of the national population), reflecting the demographic ageing of the New Zealand population and the higher arthritis prevalence

3.1 Prevalence in adults

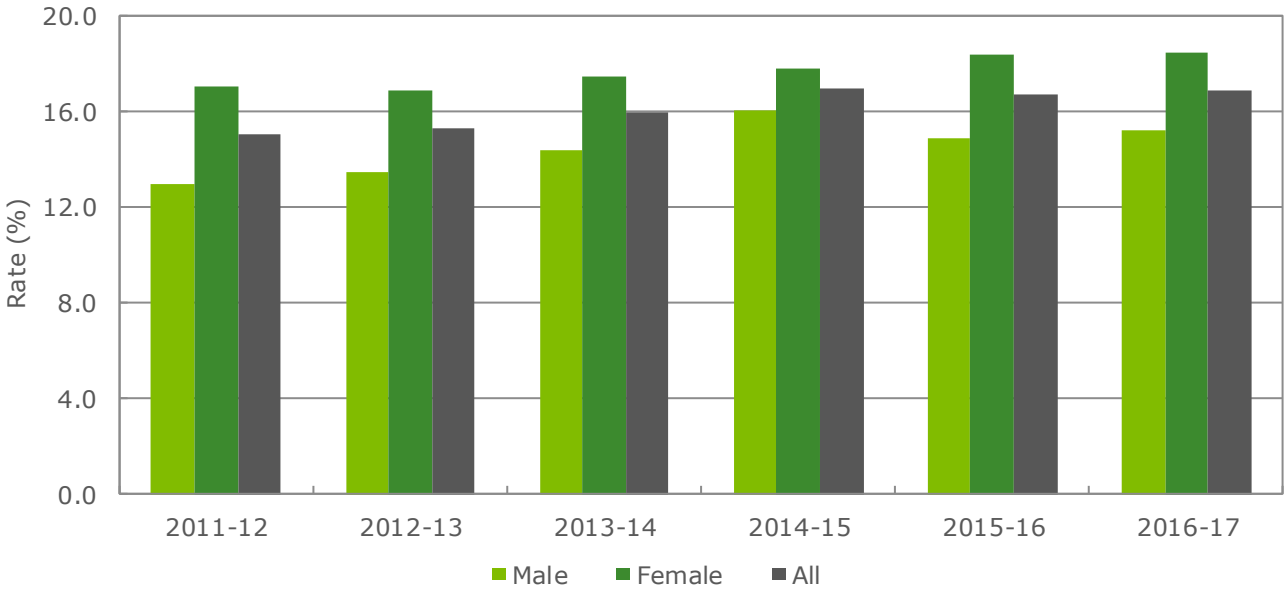
As in Access Economics (2005 and 2010), prevalence rates have been based on evidence from the New Zealand Health Survey (NZHS) conducted by the Ministry of Health. The NZHS provides prevalence data on arthritis (all types), osteoarthritis, rheumatoid arthritis and gout arthritis. This report estimates arthritis (overall, osteoarthritis and rheumatoid arthritis) prevalence based on the 2016-17 NZHS. The most recent NZHS was conducted between July 2016 and June 2017 and had over 13,000 adults and nearly 4,700 children (aged 0 to 14 years), including Māori, Pacific, Asian and European/Other people.

Although the NZHS also provides gout arthritis prevalence, a richer data set is available from the New Zealand Health Quality and Safety Commission (HQSC) and these data were used for the prevalence of gout arthritis for this report. Prevalence from the NZHS and the HQSC was evaluated to assess consistency with findings from international studies, particularly from countries with similar demographic profiles to that of New Zealand. The prevalence rates derived from the NZHS and the HQSC are similar to prevalence rates available from these studies, albeit slightly higher for rheumatoid arthritis (a detailed discussion regarding data sources is in Appendix B).

3.1.1 Overall prevalence trends

Chart 3.1 depicts a general increasing but stable trend in arthritis prevalence over time using the NZHS data. The overall prevalence rate has increased from 15.1% in 2011-12 to 16.9% in 2016-17. Looking at gender-specific prevalence, arthritis is consistently more prominent among women than men. The rate for women has increased from 17.1% in 2011-12 to 18.5% in 2016-17, whereas the rate for men started at 13.0% in 2011-12 and increased to 15.2% in 2016-17.

Chart 3.1 Arthritis prevalence rates by gender, New Zealand 2011-12 to 2016-17

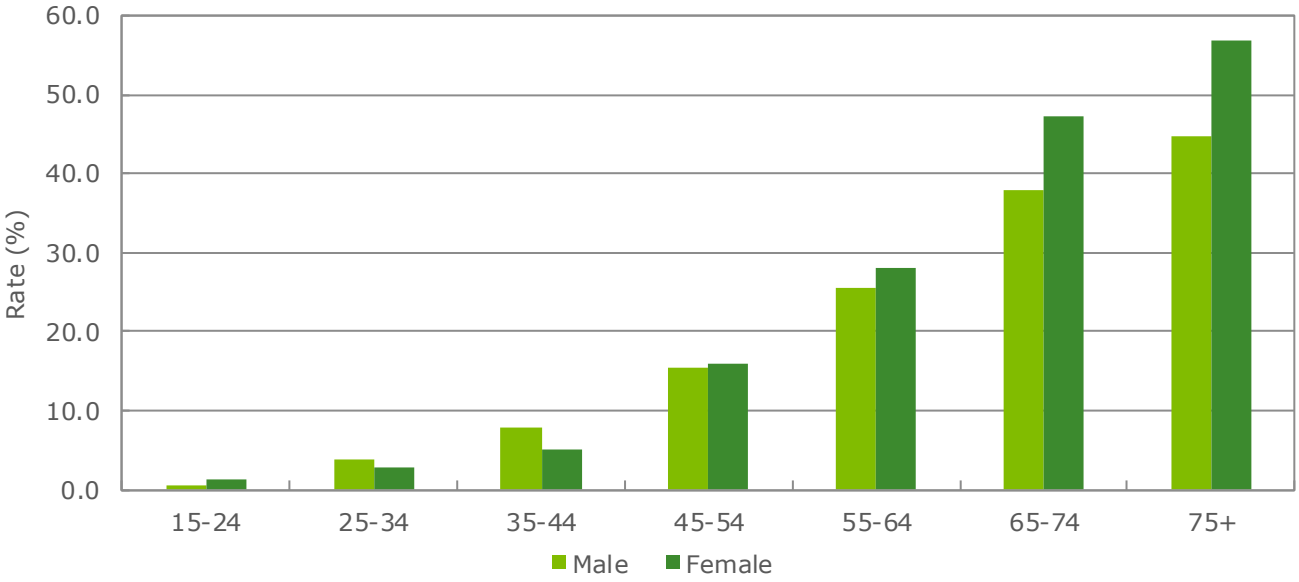


Source: NZHS, 2011-12 to 2016-17.

3.1.2 Prevalence by types of arthritis

In 2018, 669,756 New Zealanders over the age of 15 are estimated to be living with at least one type of arthritis, 16.9% of the national population. Of these people, an estimated 372,006 (55.5%) are female and 297,750 (44.5%) are male. Around 322,741 (48.2%) of New Zealanders with arthritis in 2018 are of working age (15 to 64 years), as shown in Chart 3.2.

Chart 3.2 Age-specific prevalence rates, arthritis, New Zealand, 2018

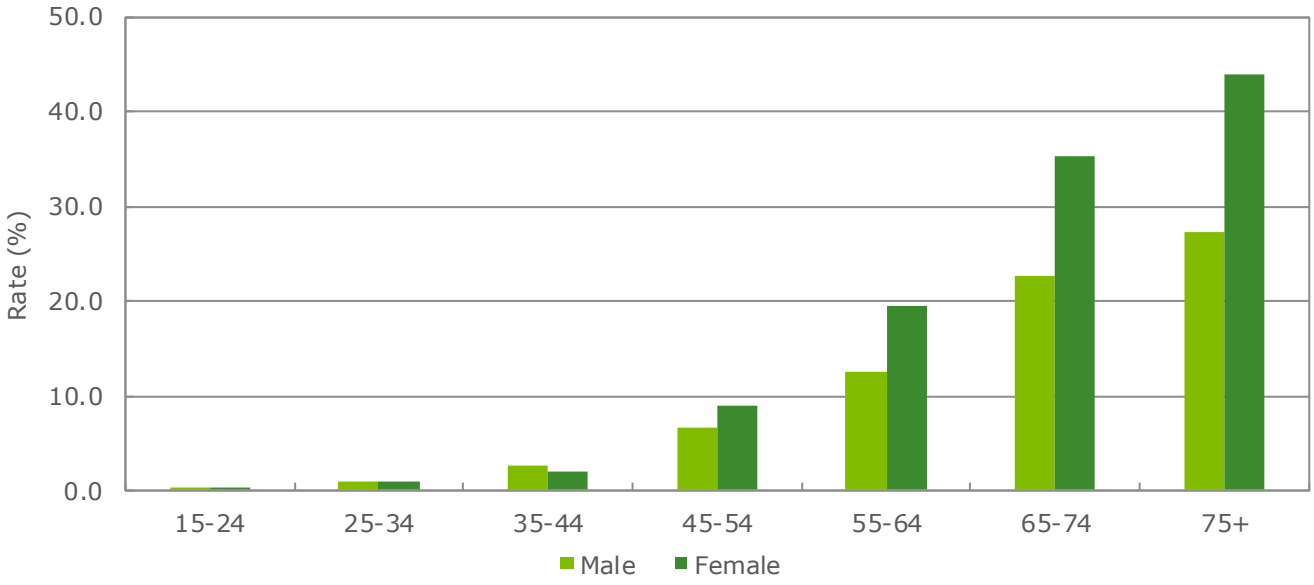


Source: Deloitte Access Economics estimates based on Ministry of Health, 2017a.

The increasing prevalence of arthritis in older age groups is consistent with the age-distribution of self-reported prevalence rates in New Zealand reported in other community-based surveys (Access Economics, 2005; Access Economics, 2007; Access Economics, 2010). Arthritis is more common in middle-aged men (25 to 44 years) than women of the same age. However, for people aged over 45 years, prevalence is higher amongst women than men, and this gap increases with age.

Age-specific prevalence of osteoarthritis and rheumatoid arthritis for men and women are shown in Chart 3.3 and Chart 3.4. Osteoarthritis is prevalent in older age groups for both men and women and is more common in women than men in the same age groups.

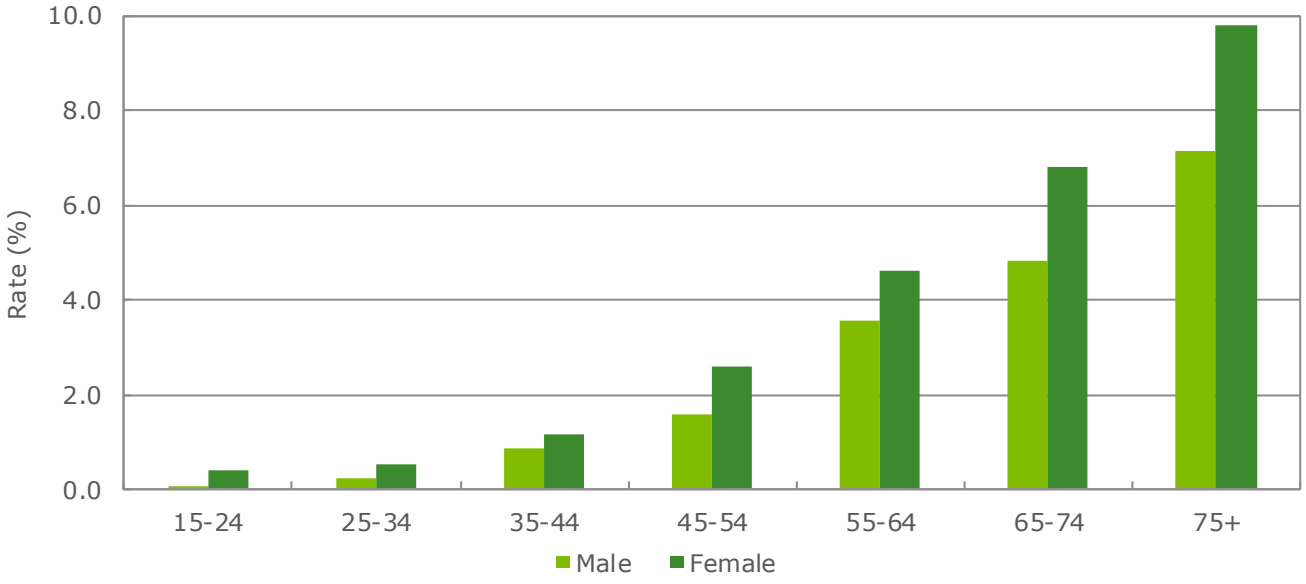
Chart 3.3 Age-specific prevalence rates, osteoarthritis, New Zealand, 2018



Source: Deloitte Access Economics estimates based on Ministry of Health, 2017a.

The prevalence rates of rheumatoid arthritis are lower than osteoarthritis. As illustrated in Chart 3.4, women experience rheumatoid arthritis at the earlier stage of their life than men do, and prevalence is higher for women in the same age groups. Similar to osteoarthritis, the gender gap generally increases with age.

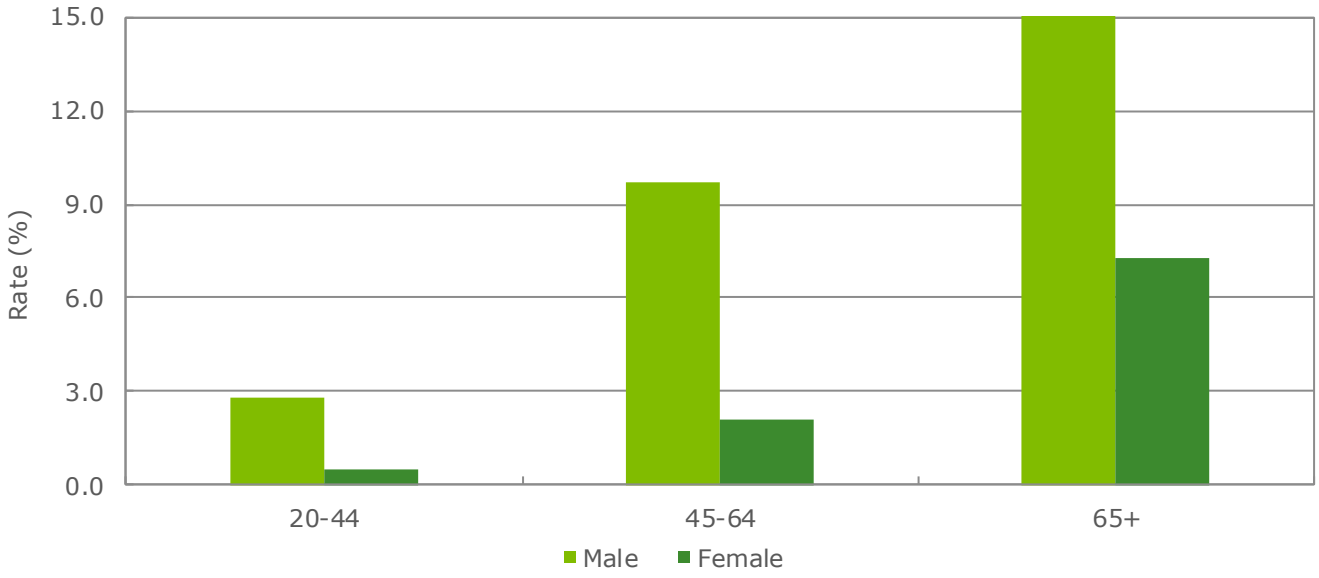
Chart 3.4 Age-specific prevalence rates, rheumatoid arthritis, New Zealand, 2018



Source: Deloitte Access Economics estimates based on Ministry of Health, 2017a.

Chart 3.5 shows age-specific prevalence of gout arthritis for men and women derived from the HQSC. Unlike osteoarthritis and rheumatoid arthritis, men are more likely to have gout arthritis than women of the same age. Only 0.5% women of the 20-44 age group are estimated to have gout arthritis in 2018.

Chart 3.5 Age-specific prevalence rates, gout arthritis, in New Zealand, 2018[8]



Source: Deloitte Access Economics estimates based on HQSC 2016.

3.1.3 Prevalence rates by ethnic group

As shown in Table 3.1 below, with statistically significant results marked in **bold**, the prevalence of arthritis varies by ethnic group. There is evidence of statistically significant standardised differences between ethnic groups derived from the 2016-17 NZHS. Māori men, for instance, were more likely to have arthritis than non-Māori men. Non-Asian adults were twice as likely to have arthritis as Asian adults, after adjusting for age and sex differences (Ministry of Health, 2017a).

Table 3.1 Comparison between ethnic groups and gender (standardised rate ratio)

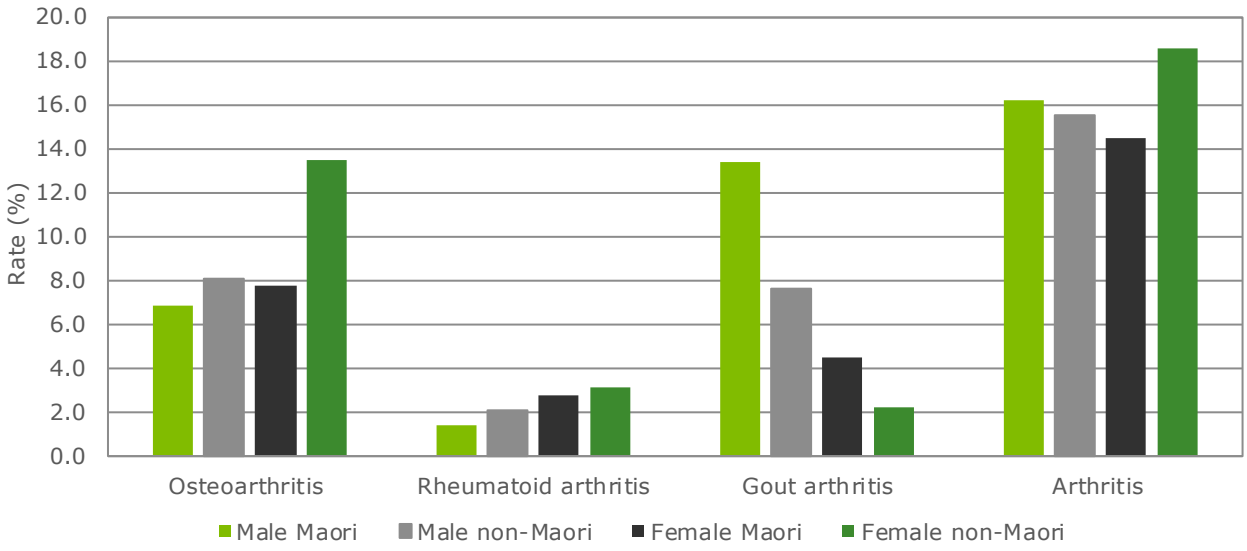
Population groups being compared	Adjusted ratio	(95% CI)	Adjustment variables[9]
Māori			
Māori vs non-Māori	**1.24**	(1.12 - 1.37)	Age, sex
Māori men vs non-Māori men	**1.43**	(1.25 - 1.64)	Age
Māori women vs non-Māori women	1.09	(0.96 - 1.24)	Age
Pacific			
Pacific vs non-Pacific	0.98	(0.80 - 1.21)	Age, sex
Pacific men vs non-Pacific men	1.2	(0.89 - 1.62)	Age
Pacific women vs non-Pacific women	0.81	(0.58 - 1.11)	Age
Asian			
Asian vs non-Asian	**0.54**	(0.42 - 0.71)	Age, sex
Asian men vs non-Asian men	**0.38**	(0.25 - 0.57)	Age
Asian women vs non-Asian women	**0.68**	(0.51 - 0.91)	Age

Source: Ministry of Health, 2017

[8] The HQSC only provides gout arthritis prevalence (%) for three age categories, 20-44, 45-64 and 65 or over.
[9] The NZHS reports ratios adjusted for differences in demographic factors between the groups. This allows for more accurate comparisons between groups. Adjusted ratios are computed using the predictive margins approach or model-adjusted ratios (NZHS, 2017, citing Korn and Graubard, 1999, Bieler et al, 2010). This method involves fitting a logistic regression model to the data from

- Raw prevalence rates for osteoarthritis is highest in non-Māori women (13.5%), which drives the same result for arthritis (Chart 3.6).
- Prevalence rates for rheumatoid arthritis are broadly similar across gender and ethnic groups, ranging from 1.3% to 3.1%.
- In contrast to osteoarthritis, gout arthritis is more prevalent in Māori men (13.4%). Across ethnic groups, prevalence rates are higher for men than women.

Chart 3.6 Raw prevalence rates (%) by type of arthritis, New Zealand, 2018

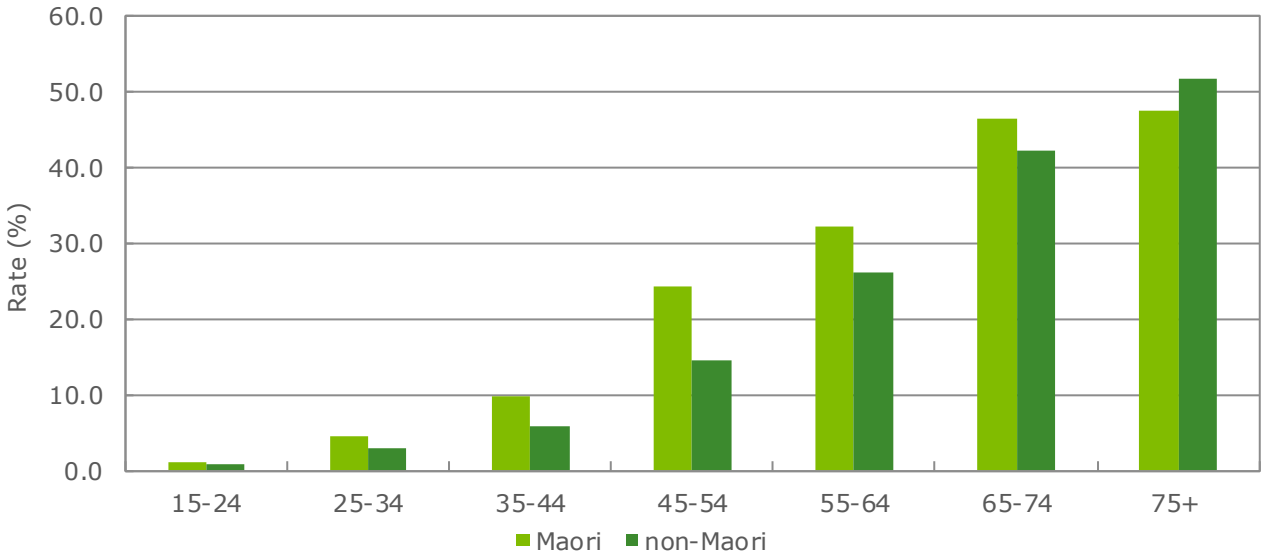


Source: NZHS 2016-17 and HSQC 2016.

The age distribution of arthritis in the Māori population is quite different from that of the total population (see Chart 3.7). While there are no significant differences in arthritis prevalence between Māori and non-Māori people in the older age cohort, arthritis is more prevalent in the young Māori population compare to the non-Māori population.

which parameters obtained are used to estimate the model-adjusted proportions for the group of interest and the comparison group. The ratio can then be computed using these proportions. The NZHS provides ethnic comparisons adjusted for age and sex.

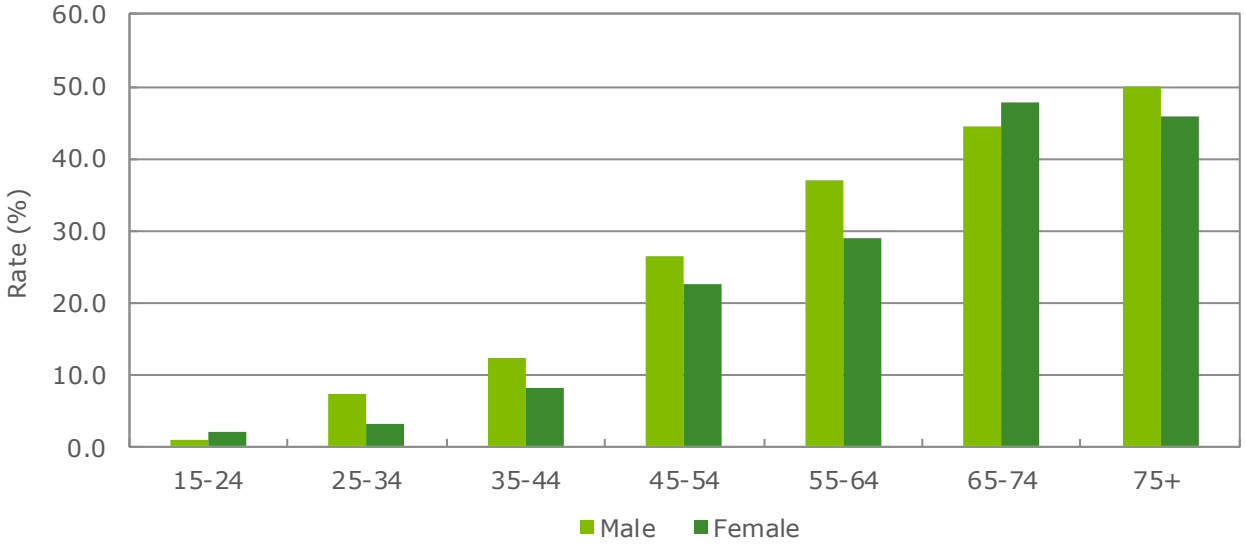
Chart 3.7 Age-specific prevalence rates, all arthritis, by ethnicity, New Zealand, 2018



Source: NZHS 2016-17.

Within the Māori population, arthritis is more common in middle age Māori men (25 to 64 years) than Māori women of the same age (see Chart 3.8). This pattern is quite different to the 2010 report's corresponding figure. Notably, in 2010, Māori men was reported to have lower prevalence rate than Māori women in the 75 years and over age group (30.9% compared to 56.9%). However, this discrepancy is likely due to the sample size issue, which was also noted in the 2010 report. These data should, therefore, be interpreted with care.

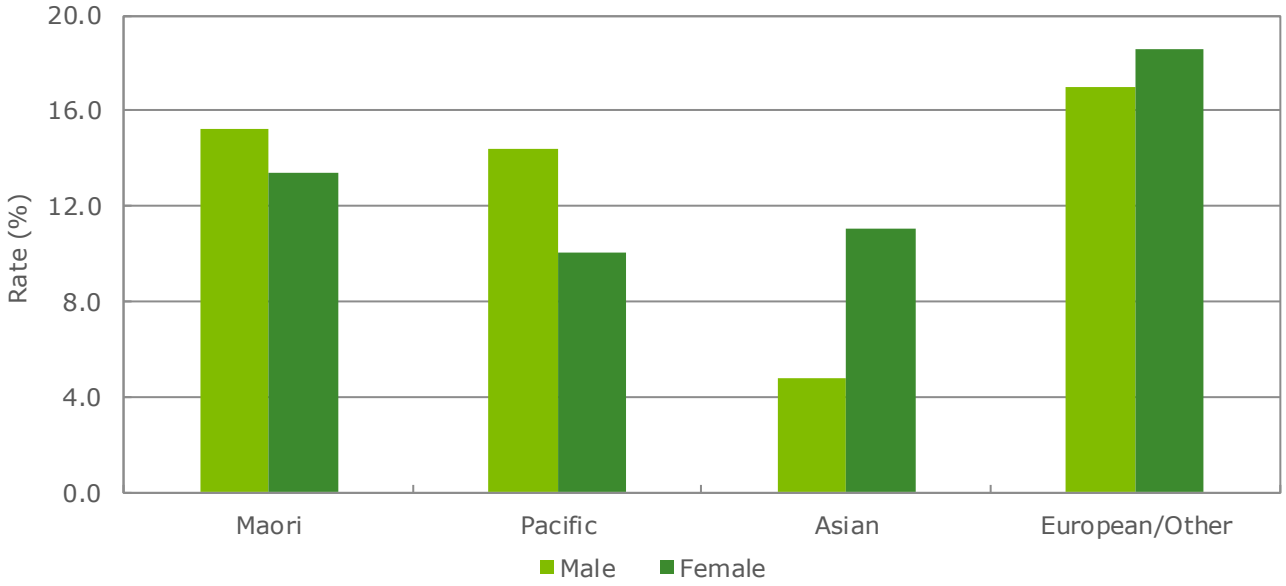
Chart 3.8 Age-specific prevalence rates, Māori, by gender, New Zealand, 2018



Source: NZHS 2016-17.

Prevalence rates for each type of arthritis by gender and a more detailed breakdown of ethnicity are depicted in Charts 3.8 to 3.10. Across all age groups, rates for arthritis (all types) are higher in European/Other for both women and men.

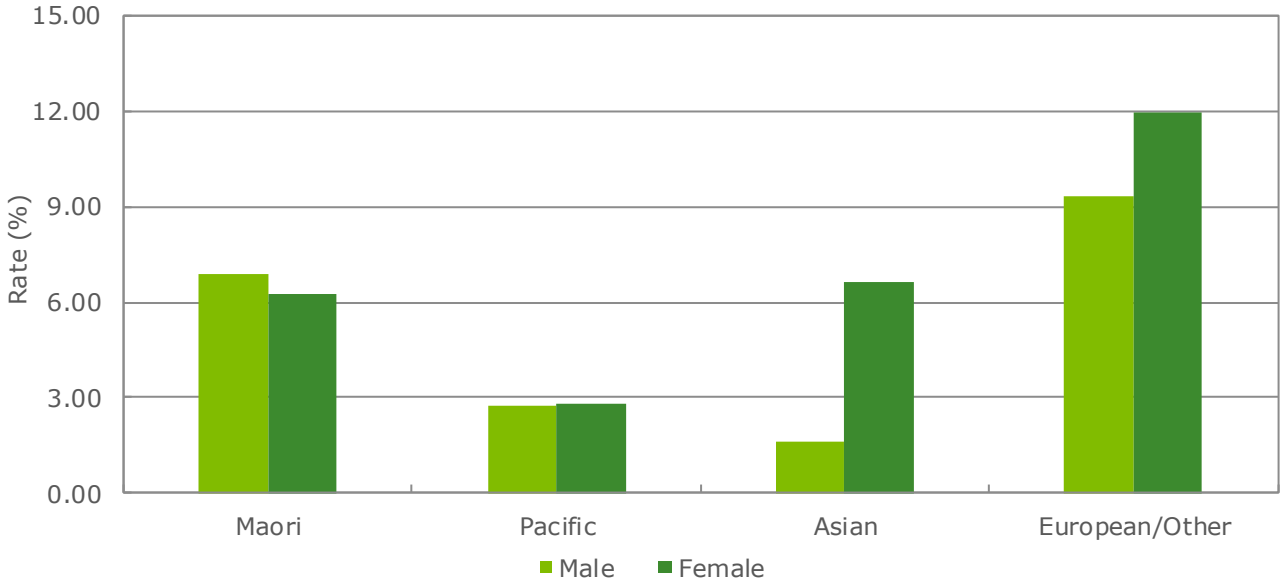
Chart 3.9 Gender-specific raw prevalence rate, arthritis, by ethnicity, New Zealand, 2013-14 to 2016-17



Source: NZHS 2016-17.

The prevalence rate for osteoarthritis is highest for the European/Other group. Across all ethnic groups, it is higher for women than men.

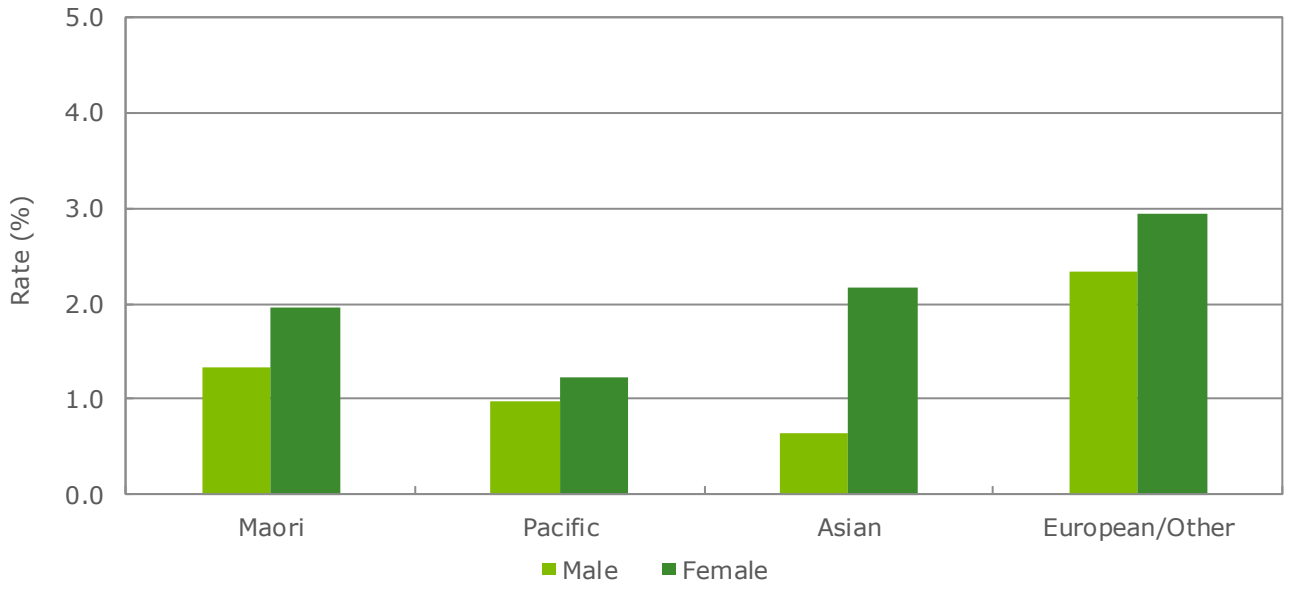
Chart 3.10 Gender-specific raw prevalence rate, osteoarthritis, by ethnicity, New Zealand, 2013-14 to 2016-17



Source: NZHS 2016-17.

There is less variation in prevalence rates for rheumatoid arthritis across ethnic groups. European/Other adults have the highest rates but the difference is smaller than for osteoarthritis. For all ethnic groups the prevalence rate for rheumatoid arthritis is higher for women than men.

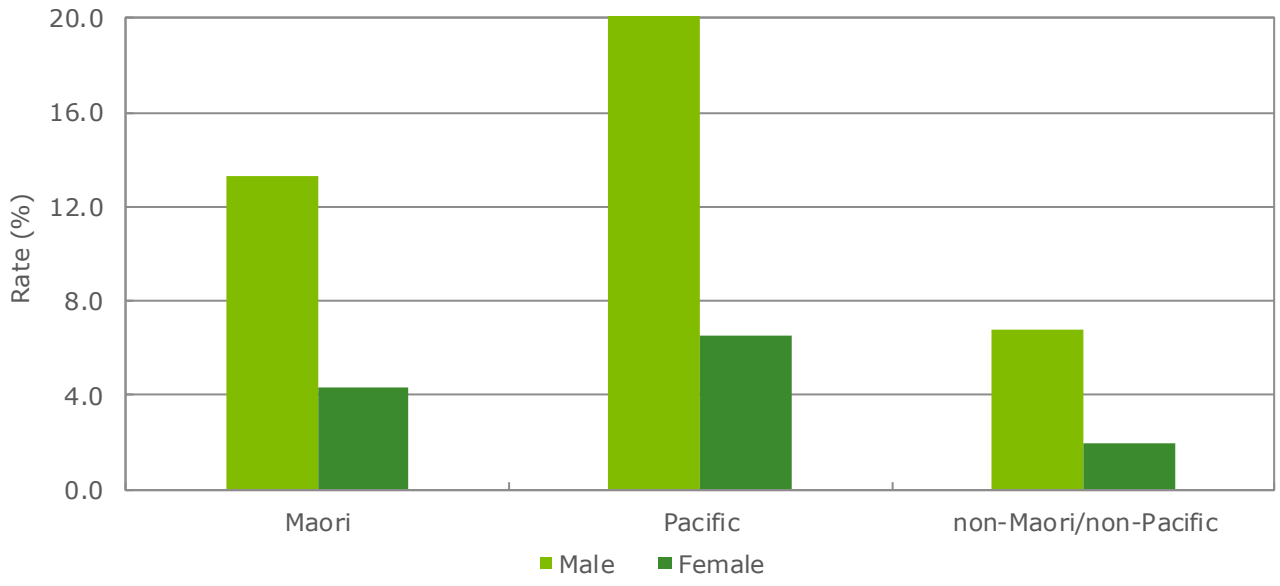
Chart 3.11 Gender-specific raw prevalence rate, rheumatoid arthritis, by ethnicity, New Zealand, 2013-14 to 2016-17



Source: NZHS 2016-17.

For gout arthritis, prevalence is higher for Māori and Pacific people and the rates are consistently higher for men across the three ethnic groups (see Chart 3.12).

Chart 3.12 Gender-specific raw prevalence rate, gout arthritis, by ethnicity, New Zealand, 2016[10]



Source: HQSC 2016.

3.2 Baseline prevalence 2018 to 2040

Prevalence rates derived from the 2016-17 NZHS (for arthritis, osteoarthritis and rheumatoid arthritis)[11] and the 2016 HQSC (for gout arthritis) were applied to population projections published by Statistics NZ (2016).

[10] The NZHSQC does not separately report the rate for Asian people. At a regional level, it should be noted that the rates for the Asian population were similar to the European/other group, and in some DHBs, the Asian population was small, so it was decided to combine these groups into non-Māori/non-Pacific.
[11] The 3-year average (from 2014-15 to 2016-17) prevalence rate was used in estimation.

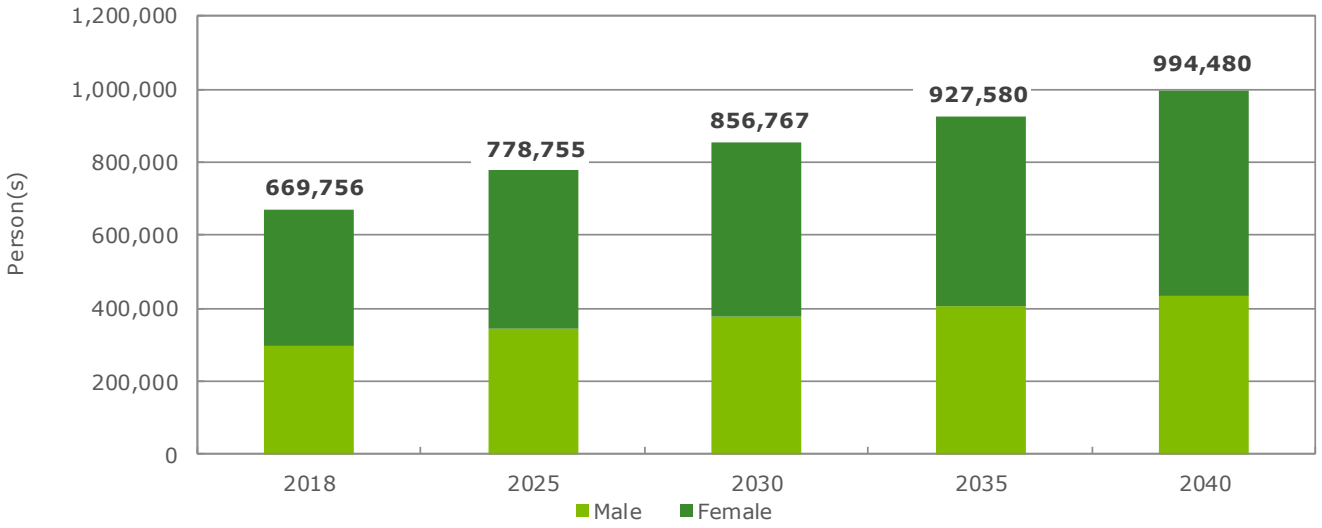
Statistics NZ presents a range of alternate population projections, including varying fertility, migration and deaths in the future. The scenario considered most likely to occur is published with a probability distribution. The median series was used to project prevalence rates.

It should be noted that these projections are estimates and may or may not occur. There are a wide range of population estimates that may occur and these estimates for arthritis are subject to that inherent variability. Furthermore, these projections represent the status quo, or in other words, no change in treatment, or risk factor patterns over the projection period. Obesity is, for example, an important risk factor for arthritis, and the potential impact on these baseline projections of possible changes in obesity rates was considered in Access Economics (2005). As such, caution should be used when interpreting and using these results.

Chart 3.13 shows the projected number of people with arthritis between 2018 and 2040. As with other developed countries, the demographic ageing in New Zealand is likely to increase the number of people with arthritis further, as more people move into the older age cohorts where arthritis is more prevalent.

- In 2018, it was estimated that 669,756 people over the age of 15 are living with at least one type of arthritis. This is higher than the 2020 projection previously reported in Access Economics, (2010).[12]
- Prevalence of arthritis is projected to increase to 778,755 New Zealanders by 2025. This will rise to around 856,767 people by 2030 and 927,580 people by 2035.
- By 2040, the number of people (age 15 years and over) with arthritis in New Zealand is projected to increase to 994,480 (or 20.5% of the national population).
- Prevalence of arthritis is projected to grow from approximately 372,006 women in 2018 to 560,167 in 2040, and 297,750 men in 2018 to 434,313 in 2040.

Chart 3.13 Projected prevalence (number of people with arthritis) 2018 to 2040, New Zealand



Source: Deloitte Access Economics projections based on NZHS 2016-17 and HQSC 2016.

Table 3.2 and Table 3.3 show detailed projections by age, gender and ethnicity for arthritis prevalence in 2018 and 2038[13].[14]

- Overall, prevalence is higher for non-Māori than Māori population (and the overall population).
- Māori men are more likely to have arthritis compared to non-Māori men (and all men), whereas Māori women are less likely to have arthritis.

[12] The 2010 report estimated that by 2020, 650,333 New Zealanders would have arthritis. The 2016-17 NZHS may pick up those whose arthritic conditions had been undiagnosed (because the condition was not recognised by the patient or the patients were unwilling to reveal it) in the previous health surveys. It is also possible that there had been a rise (more than what was previously anticipated) in the incidence of people with arthritis in the past 8 years.
[13] Statistic NZ provides subnational ethnic population projections up to 2038 only.
[14] While outside of the scope of analysis for this report, future research could identify if there are statistically significant differences in the prevalence of arthritis between rural and urban populations in New Zealand.

- In 2018, around 39,772 (or 16.2% of) Māori men have at least one type of arthritis (compared to 15.4% of non-Māori men). This increases to 65,907 (or 17.7%) in 2038.
- In 2018, 38,934 (or 14.4% of) Māori women have at least one type of arthritis (compared to 19.2% of non-Māori women). This increases to 67,340 (or 17.1%) in 2038.

Table 3.2 Arthritis prevalence (persons) by age, gender and ethnicity in New Zealand, 2018

Age	All ethnicities			Māori			Non-Māori		
	All	Male	Female	All	Male	Female	All	Male	Female
15-24	6,184	2,219	3,965	1,994	648	1,346	4,190	1,571	2,619
25-34	23,181	13,616	9,565	5,164	3,416	1,748	18,017	10,200	7,817
35-44	37,054	21,933	15,121	8,020	4,501	3,519	29,034	17,432	11,602
45-54	99,644	46,793	52,851	19,909	10,037	9,872	79,735	36,756	42,979
55-64	156,677	71,798	84,879	20,798	10,929	9,869	135,879	60,870	75,010
65-74	184,417	79,382	105,035	15,447	6,950	8,497	168,970	72,431	96,539
75+	162,598	62,008	100,590	7,373	3,290	4,083	155,225	58,718	96,507
Total	**669,756**	**297,750**	**372,006**	**78,706**	**39,772**	**38,934**	**591,050**	**257,978**	**333,073**
Rate (%)	**17.0**	**15.5**	**18.5**	**15.3**	**16.2**	**14.4**	**17.3**	**15.4**	**19.2**

Source: Deloitte Access Economics projections based on NZHS 2016-17.

Table 3.3 Arthritis prevalence (persons) by age, gender and ethnicity in New Zealand, 2038

Age	All ethnicities			Māori			Non-Māori		
	All	Male	Female	All	Male	Female	All	Male	Female
15-24	6,310	2,254	4,056	2,548	823	1,724	3,763	1,431	2,331
25-34	23,524	14,227	9,297	8,170	5,693	2,477	15,354	8,534	6,819
35-44	49,125	30,834	18,291	13,057	7,975	5,082	36,067	22,859	13,208
45-54	117,367	57,242	60,125	24,062	12,050	12,012	93,305	45,192	48,113
55-64	155,829	70,860	84,969	24,405	12,448	11,958	131,423	58,412	73,011
65-74	258,743	108,555	150,188	32,844	14,293	18,550	225,900	94,262	131,638
75+	359,147	139,857	219,290	28,161	12,625	15,536	330,987	127,232	203,754
Total	**970,045**	**423,831**	**546,215**	**133,246**	**65,907**	**67,340**	**836,799**	**357,924**	**478,875**
Rate (%)	**20.3**	**17.9**	**22.6**	**17.4**	**17.7**	**17.1**	**20.8**	**17.9**	**23.7**

Source: Deloitte Access Economics projections based on NZHS 2016-17.

Table 3.4 and Table 3.5 show a detailed breakdown of prevalence by age, gender and type of arthritis in the New Zealand population in 2018 and 2040. A similar story can be observed with greater prevalence in women depicted across the years, except in the case of gout arthritis. While all types of arthritis are more prevalent in older age cohorts, this is most evident in osteoarthritis.

Table 3.4 Prevalence by age, gender and type of arthritis in New Zealand, 2018

	Persons	%	Males	%	Females	%
Arthritis (all types)						
15-24	6,184	0.9	2,219	0.6	3,965	1.2
25-34	23,181	3.3	13,616	3.9	9,565	2.7
35-44	37,054	6.4	21,933	7.8	15,121	5.0
45-54	99,644	15.7	46,793	15.4	52,851	16.0
55-64	156,677	26.8	71,798	25.4	84,879	28.1
65-74	184,417	42.6	79,382	37.8	105,035	47.2
75+	162,598	51.6	62,008	44.7	100,590	56.9
Total	**669,756**	**17.0**	**297,750**	**15.5**	**372,006**	**18.5**
Osteoarthritis						
15-24	1,406	0.2	442	0.1	965	0.3
25-34	6,305	0.9	3,039	0.9	3,266	0.9
35-44	13,491	2.3	7,442	2.7	6,048	2.0
45-54	49,625	7.8	20,337	6.7	29,288	8.9
55-64	94,537	16.2	35,636	12.6	58,902	19.5
65-74	125,887	29.1	47,425	22.6	78,461	35.2
75+	115,160	36.5	37,715	27.2	77,445	43.8
Total	**406,411**	**10.4**	**152,036**	**7.9**	**254,375**	**12.7**
Rheumatoid arthritis						
15-24	1,448	0.2	110	0.0	1,338	0.4
25-34	2,718	0.4	868	0.2	1,850	0.5
35-44	6,003	1.0	2,451	0.9	3,552	1.2
45-54	13,418	2.1	4,809	1.6	8,609	2.6
55-64	23,966	4.1	10,075	3.6	13,891	4.6
65-74	25,254	5.8	10,113	4.8	15,141	6.8
75+	27,203	8.6	9,915	7.1	17,288	9.8
Total	**100,010**	**2.5**	**38,341**	**2.0**	**61,669**	**3.1**
Gout arthritis						
20-24	6,127	1.7	5,283	2.8	844	0.5
25-34	11,610	1.7	9,860	2.8	1,750	0.5
35-44	9,352	1.6	7,840	2.8	1,512	0.5
45-54	36,474	5.7	29,537	9.7	6,937	2.1
55-64	33,726	5.8	27,383	9.7	6,343	2.1
65-74	51,506	11.9	35,250	16.8	16,256	7.3
75+	36,203	11.5	23,305	16.8	12,898	7.3
Total	**184,998**	**5.1**	**138,459**	**7.9**	**46,540**	**2.5**

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

Table 3.5 Prevalence by age, gender and type of arthritis in New Zealand, 2040

	Persons	%	Males	%	Females	%
Arthritis (all types)						
15-24	6,412	0.9	2,289	0.6	4,123	1.2
25-34	23,735	3.3	14,367	3.9	9,367	2.7
35-44	47,498	6.5	29,764	7.8	17,734	5.0
45-54	122,890	15.7	60,780	15.4	62,110	16.0
55-64	158,430	26.8	72,210	25.4	86,219	28.1
65-74	256,815	42.8	107,500	37.8	149,316	47.2
75+	378,700	51.5	147,403	44.7	231,297	56.9
Total	**994,480**	**20.5**	**434,313**	**18.0**	**560,167**	**22.9**
Osteoarthritis						
15-24	1,445	0.2	442	0.1	1003	0.3
25-34	6,517	0.9	3,318	0.9	3199	0.9
35-44	16,990	2.3	9,896	2.6	7094	2.0
45-54	58,488	7.5	24,068	6.1	34420	8.9
55-64	93,573	15.8	33,741	11.9	59832	19.5
65-74	173,380	28.9	61,841	21.8	111538	35.2
75+	266,375	36.2	88,297	26.8	178077	43.8
Total	**616,766**	**12.7**	**221,604**	**9.2**	**395162**	**16.1**
Rheumatoid arthritis						
15-24	1,453	0.2	110	0.0	1342	0.4
25-34	2,846	0.4	948	0.3	1898	0.6
35-44	7,386	1.0	3,259	0.9	4127	1.2
45-54	14,881	1.9	5,691	1.4	9190	2.4
55-64	22,826	3.9	9,539	3.4	13287	4.3
65-74	34,102	5.7	13,187	4.6	20915	6.6
75+	62,752	8.5	23,213	7.0	39539	9.7
Total	**146,246**	**3.0**	**55,947**	**2.3**	**90298**	**3.7**
Gout arthritis						
20-24	5,868	1.7	5,047	2.8	821	0.5
25-34	12,118	1.7	10,404	2.8	1714	0.5
35-44	12,413	1.7	10,639	2.8	1773	0.5
45-54	46,518	5.9	38,366	9.7	8152	2.1
55-64	33,984	5.8	27,540	9.7	6443	2.1
65-74	70,845	11.8	47,736	16.8	23110	7.3
75+	85,057	11.6	55,400	16.8	29657	7.3
Total	**266,802**	**5.9**	**195,132**	**8.8**	**71670**	**3.1**

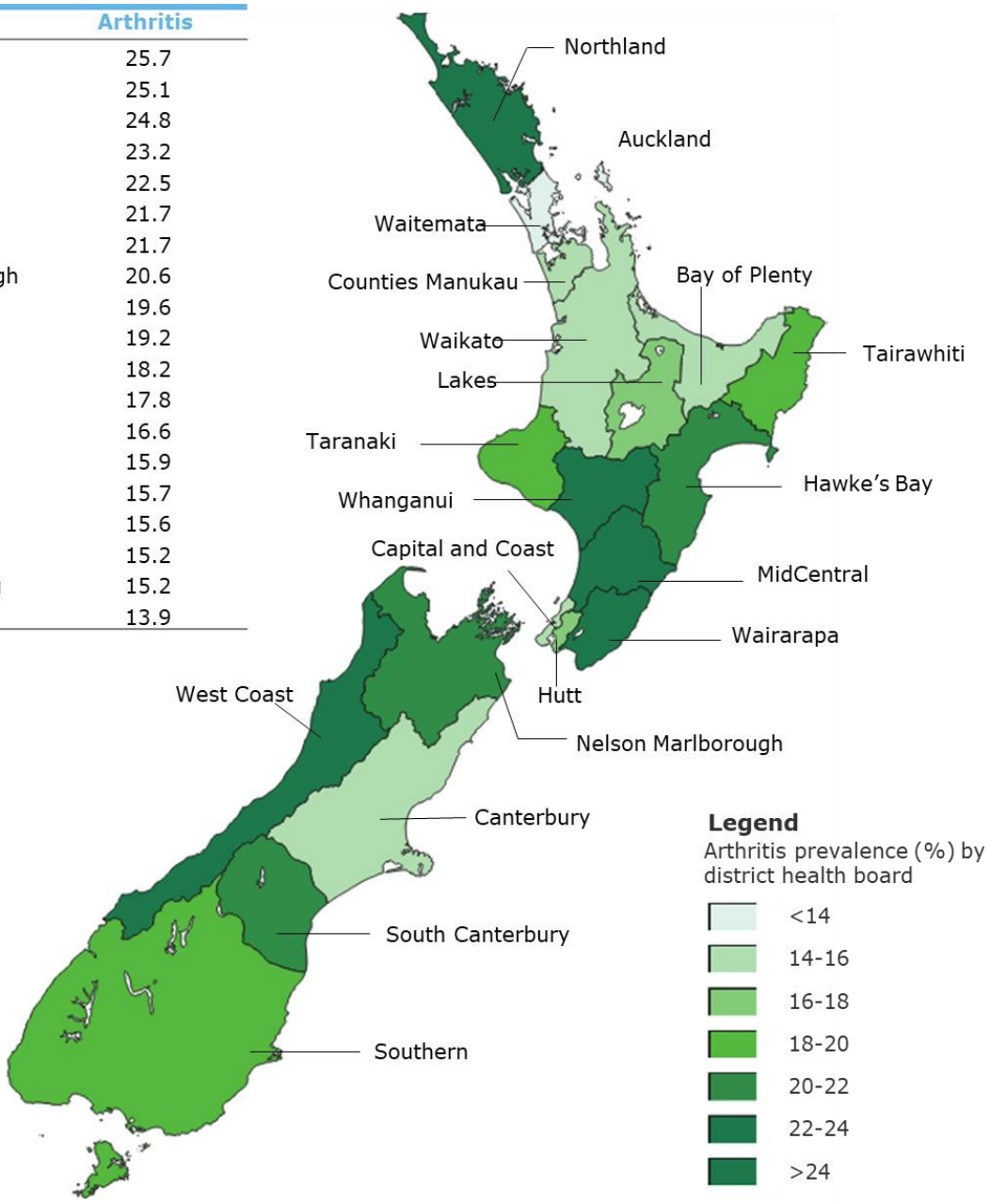
Source: Deloitte Access Economics calculations. Note: components may not add to totals due to rounding.

3.3 Prevalence by region

The NZHS and the HQSC also provide prevalence data by district health board (DHB). Prevalence rates of arthritis, osteoarthritis, rheumatoid arthritis and gout arthritis are summarised in Figure 3.1 to Figure 3.4. As illustrated in Figure 3.1, arthritis prevalence varies across district health boards, ranging from, at its lowest around 12% in Auckland to 26% in the Wairarapa DHB.

Figure 3.1 Arthritis prevalence by DHB, New Zealand, 2014-17 (% DHB population)

DHB	Arthritis
Wairarapa	25.7
Whanganui	25.1
West Coast	24.8
Northland	23.2
MidCentral	22.5
Hawke's Bay	21.7
South Canterbury	21.7
Nelson Marlborough	20.6
Tairawhiti	19.6
Taranaki	19.2
Southern	18.2
Hutt Valley	17.8
Lakes	16.6
Bay of Plenty	15.9
Capital & Coast	15.7
Waikato	15.6
Canterbury	15.2
Counties Manukau	15.2
Waitemata	13.9



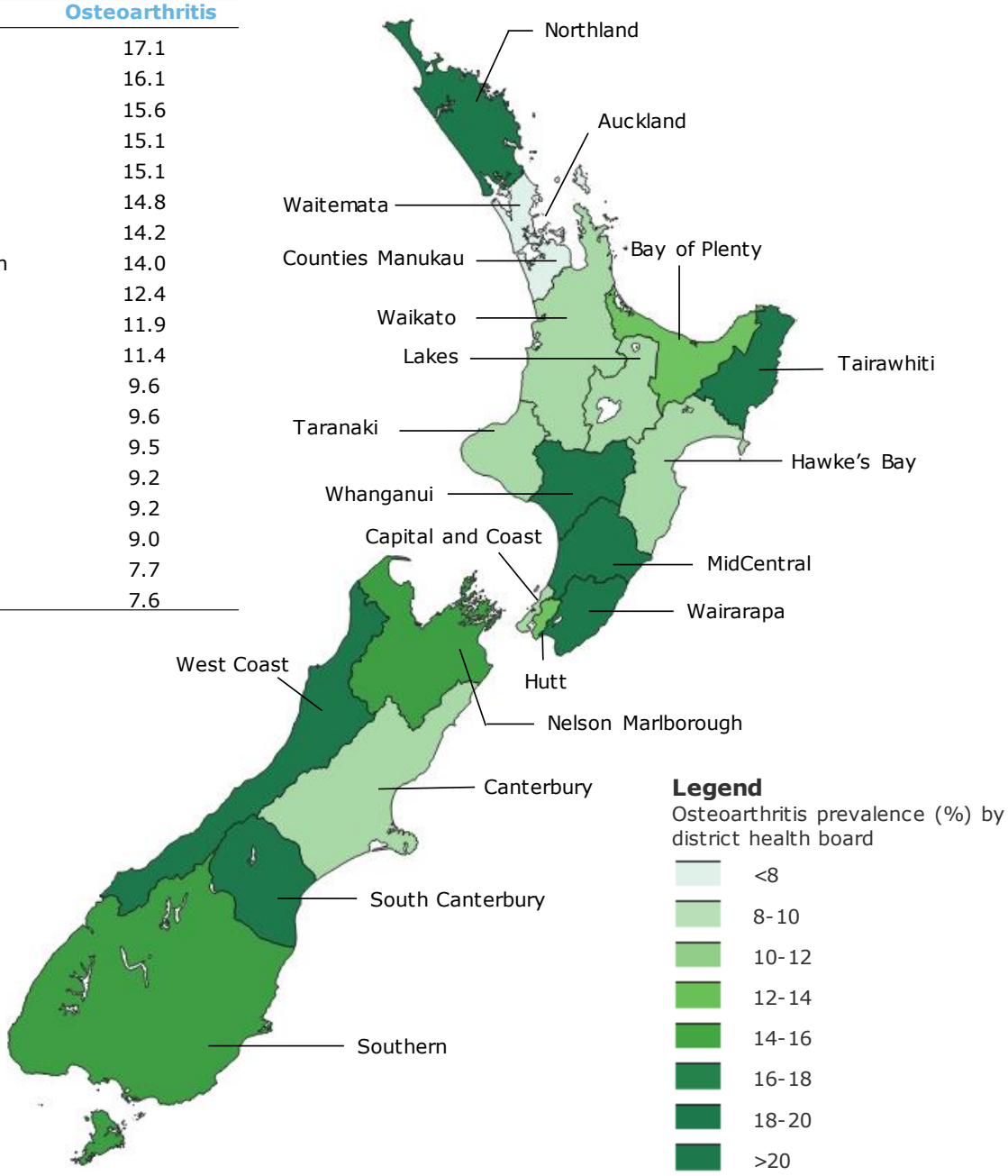
Source: Deloitte Access Economics analysis based on Ministry of Health (2018a). Note: due to small sample sizes the average prevalence between 2014 and 2017 was used.

Osteoarthritis is more prevalent in MidCentral and South Canterbury (Figure 3.2). In contrast, rheumatoid arthritis prevalence also varies across DHBs with Taranaki, Whanganui and West Coast having the highest prevalence rates (Figure 3.3). Gout arthritis prevalence ranges from 3.2% for Canterbury to 8.1% in

Tairawhiti DHB (Figure 3.4). Variations observed between DHBs likely reflect different ethnicity and age structures between DHBs.

Figure 3.2 Osteoarthritis prevalence rate by DHB, New Zealand 2014-17 (% DHB population)

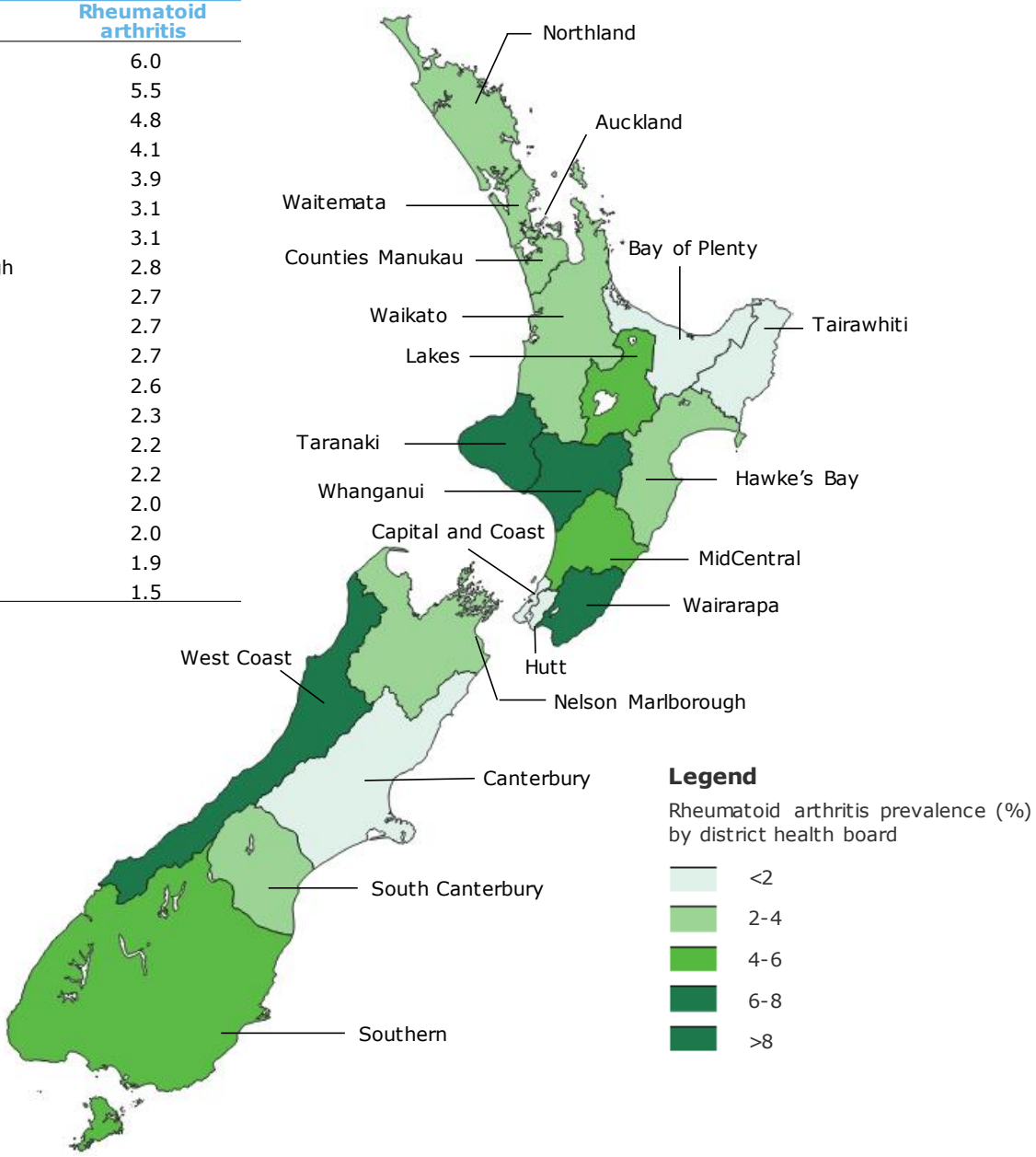
DHB	Osteoarthritis
MidCentral	17.1
Northland	16.1
South Canterbury	15.6
Wairarapa	15.1
West Coast	15.1
Tairawhiti	14.8
Whanganui	14.2
Nelson Marlborough	14.0
Southern	12.4
Hutt Valley	11.9
Bay of Plenty	11.4
Canterbury	9.6
Lakes	9.6
Hawke's Bay	9.5
Taranaki	9.2
Waikato	9.2
Capital & Coast	9.0
Waitemata	7.7
Counties Manukau	7.6



Source: Deloitte Access Economics analysis based on Ministry of Health (2018a). Note: due to small sample sizes the average prevalence between 2014 and 2017 was used.

Figure 3.3 Rheumatoid arthritis prevalence rate by DHB, New Zealand 2014-17 (% DHB population)

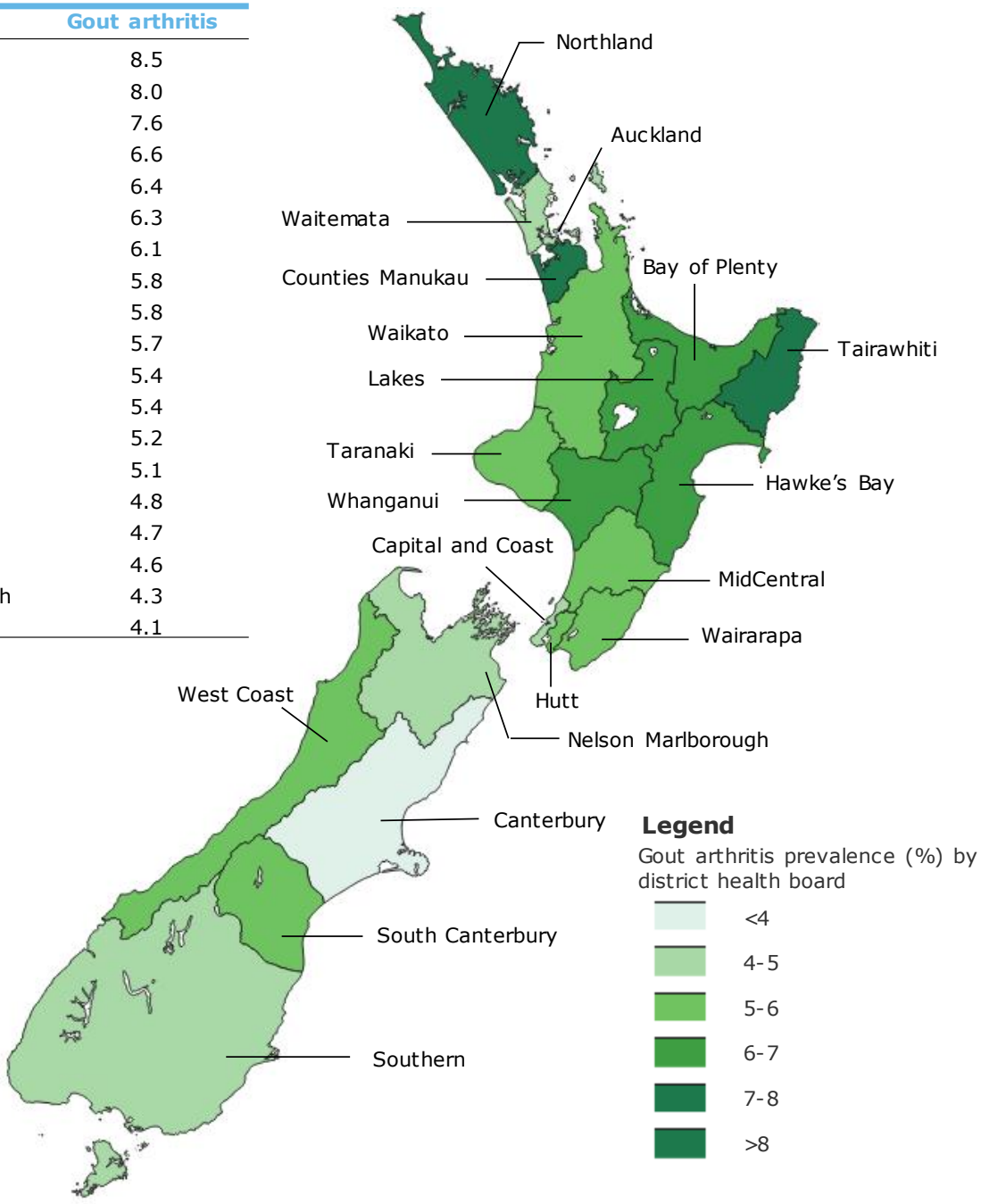
DHB	Rheumatoid arthritis
Whanganui	6.0
West Coast	5.5
Taranaki	4.8
Wairarapa	4.1
Lakes	3.9
MidCentral	3.1
Southern	3.1
Nelson Marlborough	2.8
Hawke's Bay	2.7
Northland	2.7
Waikato	2.7
Counties Manukau	2.6
Auckland	2.3
South Canterbury	2.2
Waitemata	2.2
Capital & Coast	2.0
Hutt Valley	2.0
Canterbury	1.9
Bay of Plenty	1.5



Source: Deloitte Access Economics analysis based on Ministry of Health (2018a). Note: due to small sample sizes the average prevalence between 2014 and 2017 was used.

Figure 3.4 Gout arthritis prevalence rate by DHB, New Zealand 2016 (% DHB population)

DHB	Gout arthritis
Tairawhiti	8.5
Northland	8.0
Counties Manukau	7.6
Hawke's Bay	6.6
Bay of Plenty	6.4
Lakes	6.3
Whanganui	6.1
South Canterbury	5.8
Wairarapa	5.8
Waikato	5.7
MidCentral	5.4
West Coast	5.4
Hutt Valley	5.2
Taranaki	5.1
Southern	4.8
Waitemata	4.7
Auckland	4.6
Nelson Marlborough	4.3
Capital & Coast	4.1



Source: Deloitte Access Economics analysis based on HQSC 2016.

3.4 Prevalence in children

The term juvenile arthritis refers to arthritis in children. There are different types of juvenile arthritis and the most common one, which we will focus on, is juvenile idiopathic arthritis (JIA). The word 'idiopathic' means that the causes of this condition are unknown. While some patients go into remissions, JIA often persists into adulthood if left untreated and the inflammatory damage can lead to physical disability (Beukelman et al, 2011).

In New Zealand, specific data on the number of children with JIA is not collected by the Ministry of Health and a detailed understanding of the prevalence is not currently available. As such, a literature scan of international studies was conducted to assess the prevalence nature of arthritis in children. An extensive review of studies on prevalence of JIA by Manners and Bower (2002) found a large variation in reported prevalence rates. The reported prevalence was *from 0.07 to 4.01 per 1000 children*. The discrepancy was likely due to varying study characteristics such as differing case ascertainment and diagnostic criteria. Manners and Bower (2002) found that community-based studies tend to report a higher prevalence, whereas clinical-based studies seem to report lower prevalence. Among the 34 included studies, the highest rates of JIA was reported in an Australian study conducted by Manners and Diepeveen (1996). From a community-based screening program of 12-year-old children in a West Australian school, Manners and Diepeveen (1996) found the prevalence rate of 4.01 per 1000 children with seven of 9 cases being previously undiagnosed.

Manners and Bower (2002) also noted different classifications of juvenile arthritis used in their review. The first criteria were from the American College for Rheumatology, developed in 1972 for juvenile rheumatoid arthritis. The second set was developed in 1977 by the European League Against Rheumatism for juvenile chronic arthritis. These two sets of criteria differ in symptom duration and some sub-classification of the condition). The most recent classification was the International League of Associations for Rheumatology (ILAR) for juvenile idiopathic arthritis (JIA), developed in 1997 and revised in 2001. More recent studies tend to use JIA as a generic term for all three classifications (Thierry et al, 2013; Harrold et al, 2013). In their recent study of the population in Northern California, Harrold et al (2013) used computerised clinical data collected between 1996 and 2006 on patients aged 15 years or below to estimate the JIA prevalence rate. The authors estimated that the prevalence of JIA, standardised to the 2000 Census, was 0.45 per 1000 children.

Given differences in culture, ethnicity and background between New Zealand and other countries, it is inappropriate to apply these rates to the New Zealand population. As such, this report is limited to arthritis in the 15 years or over population, which was also the approach taken in the two previous reports on the cost of arthritis in New Zealand. Moreover, the three classifications employed in current literature define juvenile arthritis as arthritis that happens prior to the 16th birthday, further restricting the transferability of reported results to the New Zealand setting (Manners and Bower, 2002).

4 Loss of wellbeing

Key findings:

- In 2018, the economic value of lost wellbeing due to arthritis was estimated to be $7.9 billion.
- Overall, people with arthritis experienced 44,930 DALYs, or 0.067 DALYs per person with arthritis in 2018.

Loss of wellbeing or burden of disease refers to the impact of pain, suffering, disability and premature death resulting from a condition. Musculoskeletal disorders, which include arthritis, are the leading cause of disability, particularly in high-income countries. Globally, musculoskeletal disorders result in the greatest loss of productive life years in the workforce relative to other non-communicable diseases (Briggs et al, 2018). According to the *Global Burden of Disease Study 2016,* musculoskeletal disorders were found to contribute to 18.5% of all YLDs in 2015. The World Health Organization found that osteoarthritis and rheumatoid arthritis are amongst the most disabling musculoskeletal conditions and pose major threats to healthy ageing by limiting physical and mental capacities and functional ability. In 2016:

- Rheumatoid arthritis was found to affect around 21.3 million people globally and accounted for around 5 million years of healthy life lost due to disability. This is a 28.8%[15] increase from 2006.
- Osteoarthritis was found to affect around 301.6 million people globally and account for 16.3 million years of healthy life lost due to disability. This is a 31.5% increase from 2006.
- Gout arthritis was found to affect about 34 million people globally and account for around 1.1 million years of healthy life lost due to disability, representing a 26.2% increase from 2006.

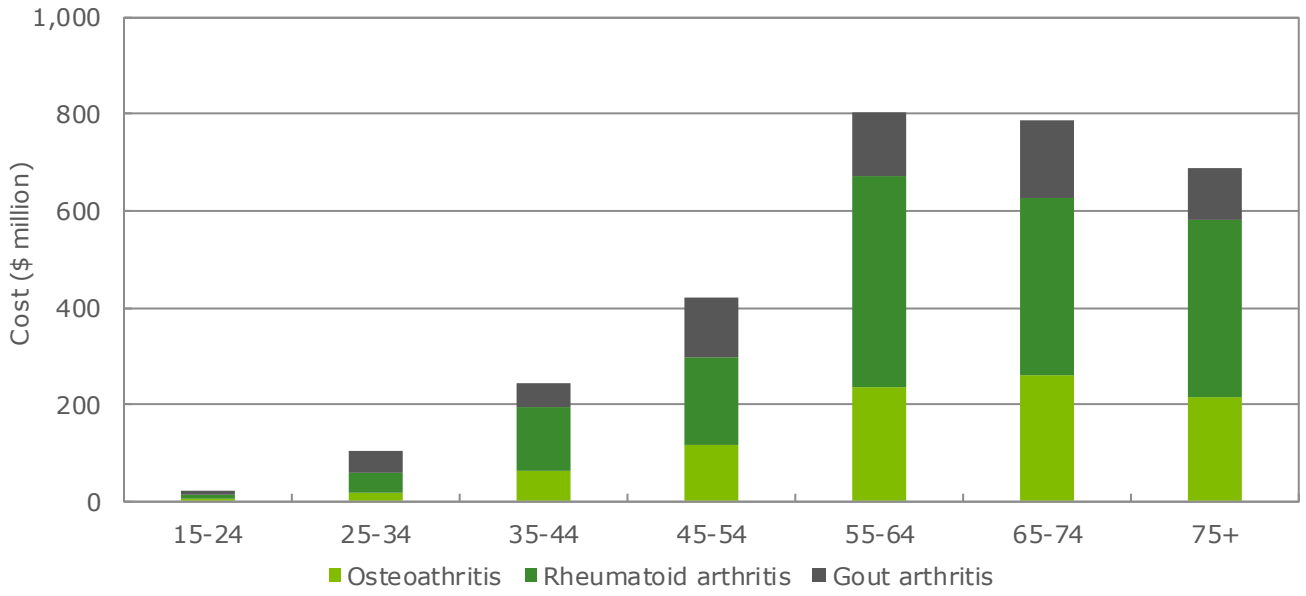
4.1 Summary of loss of wellbeing

The economic value of lost wellbeing due to arthritis in New Zealand is estimated to be $7.9 billion in 2018, comprising of $3.1 billion for males and $4.8 billion for females. The loss of wellbeing is shown in Chart 4.1 and Chart 4.2 for males and females, respectively.

- Loss of wellbeing tends to increase with age for both males and females, reflecting increasing prevalence with age.
- The loss of wellbeing starts to decline in older age groups due to a smaller underlying population.
- Loss of wellbeing is higher in rheumatoid arthritis for both males and females.
- The cost of gout arthritis is higher for males, reflecting higher prevalence of the condition in males.

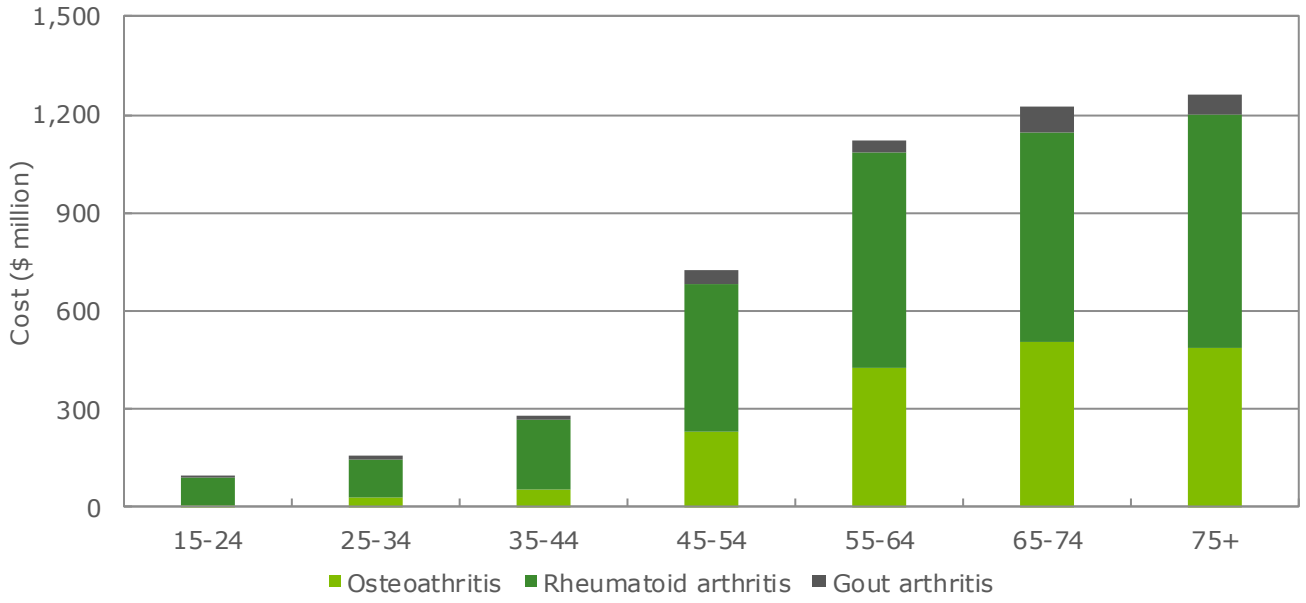
[15] This is percentage change in counts of YLDs between 2006 and 2016.

Chart 4.1 Loss of wellbeing by age and type, males



Source: Deloitte Access Economics calculations.

Chart 4.2 Loss of wellbeing by age and type, females



Source: Deloitte Access Economics calculations.

4.1.1 Methodology

Our approach adopts the 'loss of wellbeing' methodology in order to quantify the impact of arthritis on wellbeing. This methodology is used to calculate non-financial costs and instead assesses reduction in health quality in terms of *disability adjusted life years* (DALYs).

Life and health can be measured in terms of DALYs, which are based on disability weights where a weight of 0 represents a year of perfect health and a weight of 1 represents death. The DALY approach has been adopted and applied in New Zealand by the Ministry of Health. The Ministry of Health (2013) separately identifies the premature mortality (years of life lost due to premature death – YLLs) and morbidity (years of healthy life lost due to disability – YLDs) associated with disability due to a condition:

$$DALYs = YLLs + YLDs$$

In any year, the disability weight of a health condition reflects a relative health state. For example, the disability weight for a broken wrist is 0.18, which represents losing 18% of a year of healthy life because of the injury, for the duration of the condition.

The loss of wellbeing as measured in DALYs can be converted into a dollar figure using the concept of the value of a statistical life (VSL)**.** The VSL is an estimate of the value society places on an anonymous life. As DALYs are enumerated in years of life rather than in whole lives it is necessary to calculate the value of a statistical life year (VSLY) based on the VSL. This is done using the formula[16]:

$$VSLY = \frac{VSL}{\sum_{i=0}^{n-1}(1+r)^n}$$

Where: n = years of remaining life, and
r = discount rate

The Ministry of Transport (2017) estimated that the VSL was $4.21 million in 2017 dollars, which was estimated to be $4.38 million in 2018 when accounting for average growth in AWE. The average person living in New Zealand has around 45.4 years of expected life remaining (Statistics NZ, 2015), so the VLSY was estimated to be $176,480 in 2018 dollars.

4.1.2 Loss of wellbeing from arthritis

Defining a disability weight for arthritis was necessary to estimate the burden of disease due to arthritis in New Zealand. No New Zealand specific data on health or disability weights of arthritis was available. While the latest global burden of disease (2016) publications do not provide disability weights for overall arthritis, disability weights are available for osteoarthritis, rheumatoid arthritis and gout arthritis separately. These weights and severity levels are summarised in Table 4.1.

Table 4.1 Disability weights by types of arthritis by types of arthritis

	Severity	Disability weight	Proportions[17]
Rheumatoid arthritis	Mild	0.117	0.488
	Moderate	0.317	0.376
	Severe	0.581	0.122
Osteoarthritis	Mild	0.023	0.743
	Moderate	0.079	0.243
	Severe	0.165	0.011
Gout arthritis	All severities	0.295	1.000

Source: Abajobir et al (2017).

The weighted average disability weights were derived by summing the products of disability weight and the associated proportion for each level of severity. The weighted average disability weights for rheumatoid

[16] The formula is derived from the definition:
$VSL = \Sigma VSLY_i/(1+r)^i$
$where\ i = 0,1,2 \ldots . n;\ and\ \text{VSLY}\ is\ assumed\ to\ be\ constant\ (i.e.\ no\ variation\ with\ age)$

[17] As the Global Burden of Disease (GBD) estimates each proportion separately using meta-regression, the raw values do not necessarily add up to 100%. Where possible, the GBD ensure proportions are scaled to 100%.

arthritis and osteoarthritis were 0.251 and 0.038, respectively. As severity splits were not reported for gout arthritis, disability weight was adjusted using duration, which was reported at 0.094 per year. Thus, the adjusted disability weights for gout arthritis was estimated to be 0.028.

DALYs comprise only YLDs as mortality is not considered in this report. DALYs were estimated by multiplying the prevalence of osteoarthritis, rheumatoid arthritis and gout arthritis by the respective disability weights. Where necessary, prevalence rates were adjusted so that the total of the individual groups did not exceed the prevalence of overall arthritis. The adjustment is necessary to account for comorbidities across the subtypes of arthritis. For example, in the over 75-year-old group, the estimated number of people with arthritis was 162,598, whereas the number of people estimated in the three categories add up to 181,340, suggesting the presence of comorbidities (see Table 4.2). To account for this issue, the proportions of each type relative to their sum were estimated and prevalence was adjusted by multiplying prevalence of each type with the relevant proportions.

Table 4.2 Adjusted prevalence to account for comorbidities in adults 75 years and over

	Prevalence (2018)	Proportion (%)	Adjusted prevalence (2018)
Osteoarthritis	115,160	64	103,258
Rheumatoid arthritis	27,203	15	24,392
Gout arthritis	38,977	21	34,948
Total	**181,340**	**100**	**162,598**

Source: Deloitte Access Economics calculations.

Table 4.3 shows the total DALYs by type of arthritis, age and gender. Females have higher loss of wellbeing compared to males, which is mostly the result of higher prevalence in females. *Overall, people with arthritis experienced 44,930 DALYs, or 0.067 per person with arthritis*.

Table 4.3 DALYs due to arthritis in New Zealand in 2018 by type of arthritis, age and gender

Age/gender	Osteoarthritis	Rheumatoid arthritis	Gout arthritis	Arthritis	DALYs ($m)
Male					
15-24	33	54	31	119	21
25-34	115	215	270	601	106
35-44	352	760	269	1,380	244
45-54	665	1,032	701	2,397	423
55-64	1,338	2,481	746	4,564	806
65-74	1,483	2,075	895	4,454	786
75+	1,212	2,091	608	3,912	690
Male total	**5,199**	**8,708**	**3,521**	**17,428**	**3,076**
Female					
15-24	50	453	24	526	93
25-34	174	646	68	888	157
35-44	315	1,212	57	1,583	279
45-54	1,319	2,544	227	4,090	722
55-64	2,414	3,735	189	6,338	1,119
65-74	2,867	3,629	431	6,927	1,222
75+	2,766	4,050	334	7,150	1,262
Female total	**9,905**	**16,269**	**1,329**	**27,502**	**4,854**
Persons total	**15,103**	**24,977**	**4,850**	**44,930**	**7,929**

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

5 Health sector costs

Key findings:

- Health sector costs related to arthritis were estimated to be $992.5 million in 2018, equivalent to 23% of total financial costs.
- Of this, an estimated one third is attributable to hospital inpatient costs ($321.0 million). Public inpatient costs were estimated to be $244.0 million, and private inpatient costs were estimated to be significantly lower, at $77.0 million.
- Residential aged cared costs related to arthritis were estimated to be $97.9 million, while arthritis-related pathology and diagnostic imaging costs were estimated to be $96.4 million, and pharmaceuticals costs were estimated to be $69.5 million.

There are two main methods for estimating direct health system costs:

- 'Top-down' disease cost data can be derived from central data collection agencies.
- 'Bottom-up' cost estimates use surveys, diaries and other cross-sectional or data-gathering tools to accumulate information from either a single study or multiple sources.

The advantage of the top-down methodology is that cost estimates for various diseases will be consistent, enhancing comparisons and ensuring that the sum of the parts (health system costs of each disease) does not exceed the whole (total expenditures on health care in New Zealand). The advantage of the bottom-up methodology is that it can provide greater detail in relation to specific cost elements and the same study can be extended to capture information about indirect cost elements as well as direct cost elements.

A lack of comprehensive data of either type limited this analysis. In New Zealand, there is not the extensive collection of top-down disease cost data that are compiled, for example, in Australia by the Australian Institute of Health and Welfare (AIHW). Additionally, it is currently also not possible to source an existing comprehensive bottom-up study of cost elements associated with arthritis in New Zealand, although a variety of different sources exist in relation to some elements. Therefore, a collation of available information from various sources on arthritis in New Zealand was used to estimate the 2018 health sector costs.

5.1 Summary of health sector expenditure

Total health sector costs related to arthritis were estimated to be $992.5 million in 2018, which is equivalent to 23% of total financial costs. The total cost is broken down by cost component in Table 5.1.

Table 5.1 Health sector costs for arthritis, 2018

Health Sectors	Total expenditure ($ million)	Percentage of total
Hospital inpatient costs	321.0	32%
Hospital outpatient costs	102.7	10%
GP visits	34.9	4%
Medical specialists	40.4	4%
Allied health	169.6	17%
Aged Care	97.9	10%
Research	6.6	1%
Pharmaceuticals	69.5	7%
Pathology	21.4	2%
Diagnostic imaging	75.0	8%
Other costs	53.5	5%
Total	**992.5**	**100%**

Source: Deloitte Access Economics.

5.2 Hospital costs

Arthritis symptoms can severely affect an individual's wellbeing, and surgical treatment is often undergone to repair or replace damaged joints. These surgeries results in hospital costs, which can be apportioned into inpatient costs (comprising patients who stay overnight following treatment), and outpatient costs (comprising patients who are treated without staying overnight).

Access Economics (2005) and (2010) consulted three specialists' expert rheumatologists (two from New Zealand and one from Australia), and the Ministry of Health to determine the surgical cost categories relevant to arthritis treatment. In New Zealand, International Classification of Disease Tenth Revision (ICD-10) codes, are used to categorise hospital admissions by disease and injury. From these specialist consultations, a list of ICD-10 codes related to arthritis was compiled, and has been used for this study.

The approach taken to estimate total hospital costs related to arthritis is outlined below. In summary, *hospital costs due to arthritis were estimated to be $423.7 million in 2018, comprised of $244.0 million for public inpatients, $77.0 million for private inpatients and $102.7 million for outpatients.*

5.2.1 Public inpatient data

Public inpatients encompass all individuals treated in the public hospital system who are admitted overnight. To estimate public inpatient costs related to arthritis, public inpatient hospital admission data[18] for the arthritis-related ICD-10 codes was collated for the most recent year available (2016-17). These data included, for each primary arthritis diagnosis type (categorised by ICD-10 codes):

- the number of patients undergoing hospital treatment;
- the average length of stay;
- the average cost per stay for the financial year; and
- the total cost of inpatients.

Total estimated arthritis-related public inpatient costs for 2016-2017 was calculated as the summation of total inpatient costs for each ICD-10 code. This total cost figure was adjusted based on estimated changes in the number of people with arthritis in New Zealand between 2016-17 and 2017-18 (see Table 5.2). Appendix D contains the data set and calculations.

[18] Provided by the Ministry of Health.

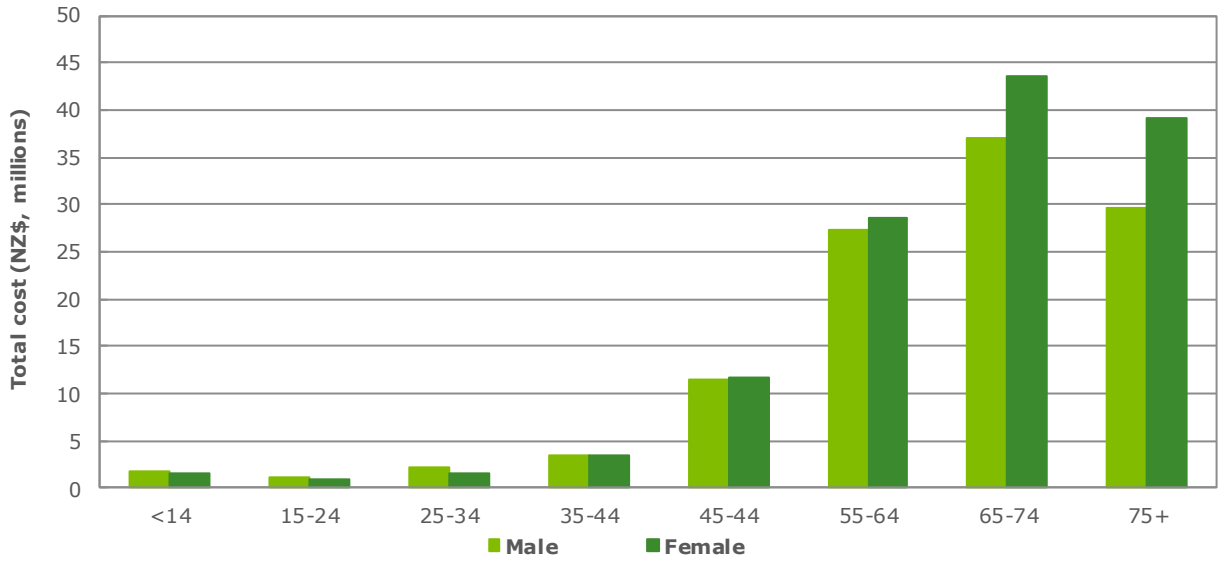
Table 5.2 Estimated number of people with arthritis in New Zealand by year

	2014-2015	2015-2016	2016-2017	2017-2018
Total number with arthritis ('000)	618	635	653	670
Extrapolated factor		1.028	1.028	1.026

Source: Deloitte Access Economics.

This approach resulted in the *number of arthritis inpatient cases estimated to be 23,800, and costing $244.0 million in 2018*. Arthrosis of the knee and arthrosis of the hip were the most common types of arthritis, accounting for 45% of the total number of public inpatient cases, and 69% of the total cost.

Chart 5.1 Arthritis public inpatient costs by age and gender, 2017-18



Source: Deloitte Access Economics based on Ministry of Health data.

5.2.2 Private inpatient data

Private inpatients encompass all individuals treated in the private hospital system who are admitted overnight. To estimate private inpatient costs related to arthritis, private inpatient hospital admission data[19] for the arthritis-related ICD-10 codes was collated for the most recent year available (2014-15). Unlike public inpatient data, only the number of patients admitted for treatment, and the average length of stay was available, but no cost data were included.

The number of treated patients from 2014-15 was adjusted to 2017-18 using the estimated increase in the number of people with arthritis. To estimate the average cost per discharge for each ICD-10 code, the public hospital inpatient data were used to derive the estimated average cost per day of stay, which was applied to the number of treated patients, and the average length of stay to get a total cost figure. This approach resulted in the *number of arthritis private hospital inpatients estimated to be 6,000, and costing $77.0 million in 2018*. The detailed data set is presented in Appendix D.

Arthrosis of the knee and hip accounted for 88% of private inpatient cases, and 96% of the total cost.

5.2.3 Outpatient costs

Outpatients encompass all individuals treated in the public or private hospital system, who are treated without staying overnight, and are therefore not admitted.

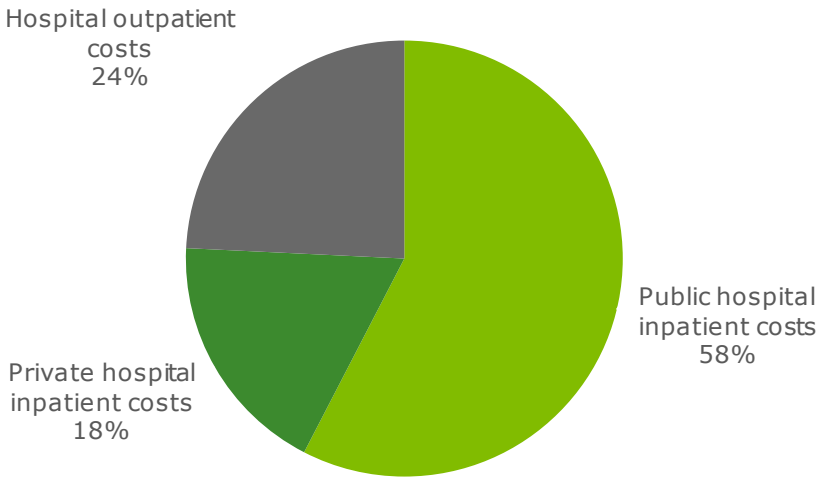
[19] Provided by the Ministry of Health.

Currently, there is a gap in the data for estimating outpatient costs. DHBs do not code by disease within non-admitted patient systems, and so have no way of separating patients with arthritis from those without, even though patients with arthritis do use these services.

Greater confidence in an outpatient cost estimate was deemed to be derived by using the ratio of outpatient to inpatient costs from Australian Institute of Health and Welfare (AIHW) data, as these costs are collated in Australia, and clinical practice at the tertiary care level is quite similar to New Zealand. Outpatient costs were thus estimated as 32.0% of inpatient costs. With total inpatient costs estimated to be $321.0 million, *arthritis outpatient costs were estimated to be $102.7 million in 2018.*

Overall, hospital costs for arthritis were thus estimated to be $423.7 million in 2018.

Chart 5.2 Hospital costs related to arthritis in New Zealand by category, 2018



Source: Deloitte Access Economics.

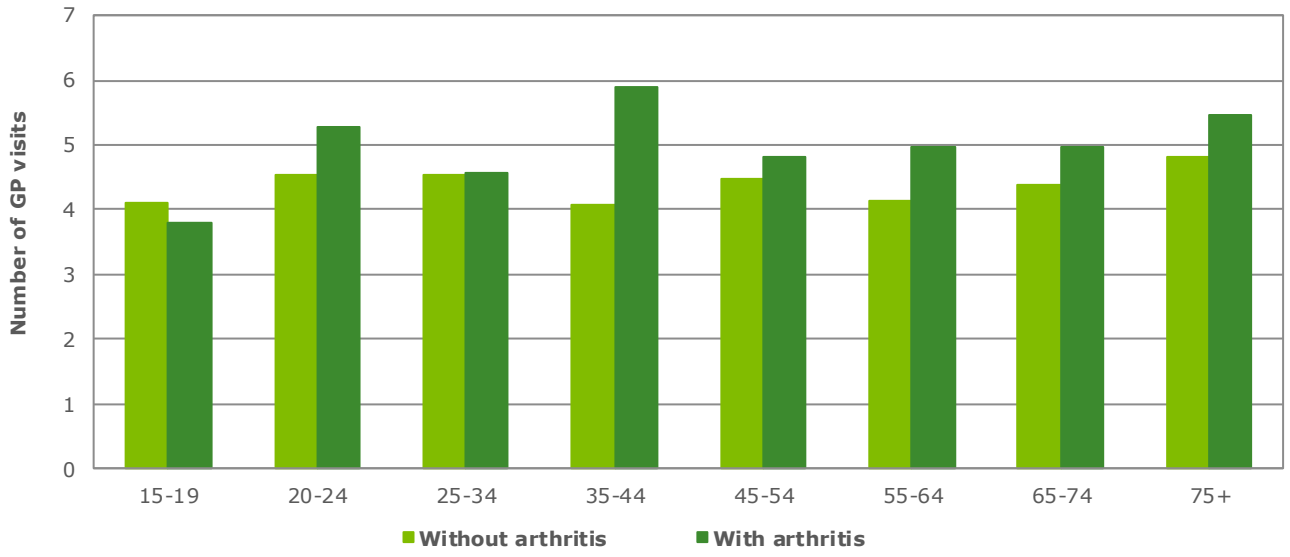
5.3 General practice costs

People with arthritis are likely to frequent a General Practitioner (GP) for appointments related to the condition. To estimate the total cost of GP visits related to arthritis, data on the number of GP visits in the last twelve months for a cohort with arthritis, and a cohort without arthritis,[20] shown in Chart 5.3, was used.

Controlling for age, on average, the cohort with arthritis reported 0.67 more GP visits over the last twelve months than the cohort without arthritis. This analysis, therefore, applied the assumption that 0.67 GP visits per year for people with arthritis can be attributed to the condition.

[20] 2016-17 New Zealand Health Survey

Chart 5.3 Number of GP visits in the last twelve months, with arthritis cohort vs without arthritis cohort



Source: Deloitte Access Economics.

Applying this rate to the estimated number of people with arthritis, and using an average cost of a GP visit in 2016 of $75 per consultation, or $77.70 inflated using the New Zealand Casemix Framework for Publicly Funded Hospitals to 2018 dollars, *the GP costs related to arthritis were estimated to be $34.9 million in 2018.*

5.4 Medical specialists costs

To determine whether a person with arthritis needs surgical treatment, a medical specialist is often consulted. For the treatment of arthritis conditions, rheumatologists (specialists who diagnose and treat rheumatic diseases) and orthopaedic surgeons (specialists in the diagnosis and treatment of diseases and injuries of the musculoskeletal system) are most frequently consulted.

To estimate the medical specialists costs related to arthritis, the estimated number of annual arthritis-related hours worked, and hourly cost, for each specialist was used from Access Economics (2005), and applied to the estimated number of each specialist currently operating in New Zealand.

There are currently approximately 44 full time equivalent registered rheumatologists in New Zealand. Access Economics surveyed ten rheumatologists and ten orthopaedic surgeons to infer annual arthritis-related hours worked in the non-hospital sector (to avoid double counting with outpatient costs), and costs per hour. These hours were adjusted for the estimated change in the number of people with arthritis. Hourly cost estimates were inflated using Statistics New Zealand's health inflation to 2018 dollars.

Seven of the ten rheumatologists surveyed responded to the questionnaire. Due to the small sample size, for confidentiality reasons these data have not been included in the report. Using the above approach, the *non-hospital rheumatology costs related to arthritis are estimated to be $4.6 million in 2018.*

There are an estimated 264 orthopaedic surgeons with an Annual Practicing Certificate at Consultant Level in New Zealand in 2017 (New Zealand Orthopaedic Association, 2017b). In 2005, five of the ten orthopaedic surgeons surveyed responded to the questionnaire. As with rheumatologists, due to the small sample size, for confidentiality reasons these data have not been included in the report. Using the above approach, the *non-hospital orthopaedic surgeon costs related to arthritis are estimated to be $35.8 million in 2018.*

While other specialists may treat people with arthritis outside of the hospital system, these costs are likely to be very small and were difficult to ascertain, and thus were excluded. *The medical specialist costs for people with arthritis are thus estimated to be $40.4 million in 2018.*

5.5 Allied health costs

Allied health is defined in New Zealand as 'an area of health, such as pharmacy, physiotherapy and occupational therapy, most often based in the community that does not include doctors and nurses' (Health Workforce Advisory Committee, 2003). Physiotherapists and occupational therapists frequently treat people with arthritis for issues relating to the condition. Other allied health workers who may work with people with arthritis are social workers and psychologists. An estimated 20% of people with arthritis in New Zealand visited a physiotherapist, 2% visited an occupational therapist, 2% visited a social worker, and 3% visited a psychologist over 2016-2017.[21]

To estimate the allied health costs related to arthritis, the number of annual arthritis-related hours worked for each specialist was used from Access Economics (2005). The estimated costs per hour for each allied health services from Work Safe were used for social worker fees, and the current average market fees were used for an occupational therapist, physiotherapist and psychologist across New Zealand. The estimated annual arthritis-related non-hospital hours worked and hourly costs were applied to the estimated number of each professional currently operating in New Zealand.

There are an estimated 6,650 registered physiotherapists, 2,450 occupational therapists, 4,950 social workers and 2,750 registered psychologists in New Zealand. Access Economics surveyed physiotherapists and occupational therapists to infer annual arthritis-related hours worked in the non-hospital sector (to avoid double counting with outpatient costs), and costs per hour. These hours were adjusted for the estimated increase in the number of people with arthritis. As social workers and psychologists are less likely to work with people with arthritis, average annual arthritis-related hours were deflated for these professions.

Using this approach, the cost of allied health services for people with arthritis in New Zealand was estimated to be $169.6 million in 2018.

Table 5.3 Allied health costs related to arthritis, 2017-18

Allied Health	Registered practitioners	Cost per hour (2018 prices, $)	Estimated annual arthritis-related cost ($ millions)
Physiotherapist	6,650[22]	150	112.7
Occupational Therapist	2,450[23]	109	30.0
Social Worker	4,950[24]	48	8.9
Psychologist	2,750[25]	175	18.0
Total			**169.6**

Source: Deloitte Access Economics based on NZHS 2016-17.

5.6 Residential aged care costs

5.6.1 Arthritis patients in residential and home care

Admission to residential aged care is a potential outcome associated with arthritis. InterRai provided aged care data for both residential care and community care, including medical diagnoses, for the most recent year available (2017). This section focuses solely on residential aged care costs, as community aged care is considered for its financial costs in chapter 6 (Other Financial Costs) of this report.

Table 5.4 provides the estimated number of people with arthritis within the aged care population by arthritis condition and type of care provided. The long-term care facility and palliative care in hospice are the aged care residences considered in this analysis. The data identified 31% of the aged care population having arthritis,

[21] 2016-17 New Zealand Health Survey
[22] https://www.physioboard.org.nz/annual-reports
[23] https://www.otboard.org.nz/documents/annual-reports-newsletters/
[24] http://swrb.govt.nz/for-social-workers/maintain-registration/annual-practising-certificate/
[25] http://www.psychologistsboard.org.nz/cms_show_download.php?id=525

and shows upward trends in the number of people with each arthritis condition during the period of 2015 to 2017.

Table 5.4 Estimated number of people with arthritis in residential and community aged care, 2017-18

Assessment	Osteoarthritis	Rheumatoid	Other	Total
Long-term Care Facility (LTCF)	9,950	750	1,450	**12,150**
Palliative Care in Hospice (PCH)	0	0	1	**1**
Other (Home care)	12,950	1,150	2,600	**16,700**
Total	**22,900**	**1,900**	**4,050**	**28,850**

Source: Deloitte Access Economics, based from information received from InterRAI New Zealand.

5.6.2 Residential aged care cost

A literature review was conducted to estimate residential aged care admission numbers as a result of arthritis. Giles, Glonek, Luszcz & Andrews (2007) identified rates of admission for both those with and without arthritis. This is identified as an odds ratio, which measures the potential for an outcome to occur. The odds ratio measures the likelihood of residents admitted into aged care facilities due to their arthritis condition.

This odds ratio was converted to a relative risk estimate using the methodology outlined in Appendix E, so that it could be used to estimate the proportion of admissions to residential aged care that were due to arthritis. Table 5.5 details the inputs used for this methodology and the assumptions used to derive an appropriate population estimate.

Table 5.5 Key inputs for the population attributable fraction

Source	Input	Assumption
Deloitte Access Economics analysis based on Ministry of Health (2017a)	45%	Probability of people aged 70 years+ who have arthritis based on arthritis prevalence estimates.
InterRAI (2018); New Zealand Statistics (2016)	7.4%	Probability of people aged 70 years+ who are in long-term aged care facilities based on the number of people in long-term age care and New Zealand statistics population estimates.
Giles, Glonek, Luszcz & Andrews (2007)	1.5	Odds ratio of admission to care due to arthritis based on admissions to an age care facility due to a mobility or non-mobility disability as a proxy for arthritis for the population of 70 years+

Source: Deloitte Access Economics, based from information received from InterRAI New Zealand, New Zealand Statistics (2016), and Giles et al (2007).

These inputs into the population attributable fractions calculation provides a population attributable fraction (PAF) of 17%. The PAF was applied to the number of people with arthritis residential in aged care, to determine the number in aged care due to their arthritis condition.

The 2017 aged care population was adjusted by the estimated change in the number of people with arthritis and multiplied by the PAF. Therefore, the number of residential aged care admissions attributable to arthritis in 2018 is estimated to be 2,100.

The average aged care cost per day ($126.46)[26] was applied to the estimated number of admissions to residential aged care attributable to arthritis in 2018. *The residential aged care costs due to arthritis were thus estimated to be $97.9 million in 2018.*

5.7 Research costs

Research costs related to arthritis encompass research around the diagnosis, treatment and prevention of the condition. To estimate the costs associated with this research, relevant projects were collated,[27] resulting in the total value of research undertaken in 2016-17 specifically for arthritis.

The total costs by project are presented in Table 5.6. The seventeen research projects approved totalled $4.65 million, or $4.8 million inflated using Statistics New Zealand's health inflation to 2018 dollars. Arthritis New Zealand also provided research grants and expenditure on services and programs of $1.8 million (Arthritis New Zealand, 2017). *The total expenditure of research related to arthritis is thus estimated to be $6.6 million in 2018.* Table 5.6 itemises the funding provided for the seventeen research projects.

Table 5.6 Research funding allocation for arthritis based research, 2016-2017

Approved Arthritis Research Projects	2016-17 ($ thousands)
Safety and efficacy of high dose allopurinol in the management of gout: a randomised interventional study	28.7
Predicting response to anti-TNF therapy based on serum cytokine and gene profile	159.4
A randomised controlled trial of nortriptyline in knee osteoarthritis	343.0
A role for p53 isoforms in inflammatory disease	277.1
Urate and gout: genetic control, environmental and medicine interactions	1,035.9
International Relationship Fund: EU-NZ collaboration	25.3
The impact and management of rising osteoarthritis burden	385.1
Effects of tart cherry concentrate on gout arthritis flares and serum urate	80.5
Neutrophil oxidants in infection and inflammation	1,000.9
Growth Factors Delivery System for Bone Regeneration and Vascularisation	50.4
Mechanisms and Management of Musculoskeletal Disease	1,034.0
Discovering novel pathways for gout arthritis via functional genetics	55.5
Osteoarthritis: a case of cellular mismanagement?	129.5
Naturally biased? Exploring neuropeptide signal pathway bias in pain	11.5
Genetics in iwi health: A journey to understanding	32.2
Total	**4,651.0**

Source: Data request from the Health Research Council.

Note: total may not add due to rounding.

5.8 Pharmaceutical costs

5.8.1 Prescription medicines

Arthritis symptoms are frequently treated with prescription medicines. To estimate prescription medicine costs related to arthritis, data for prescription medicines usage and cost was collated.[28] The most commonly prescribed medicines used to treat arthritis or its symptoms are summarised in Table 5.7.[29] These data were

[26] New Zealand Aged Care Association
[27] Health Research Council
[28] Sourced from PHARMAC and the Ministry of Health, and supplemented by data available in the public domain
[29] These data only includes medicines funded by PHARMAC

provided by the Ministry of Health, and while total dispensing figures were provided, the indication for referral is not available, and so assumptions around dispensing proportions related to arthritis were made.

Table 5.7 Number of units and costs of pharmaceuticals dispensed to arthritis patients

Medicine	Total dispensed (thousands)	Estimated total related to arthritis (thousands)	Average cost ($)	Total cost ($ thousands)
Adalimumab (Humira)	43.1	21.5	1,600	34,465.5
Allopurinol (Zyloprim)	640.4	8.1	38	308.2
Diclofenac sodium (Voltaren*)	157.4	6.3	8	53.7
Etanercept (Enbrel)	15.3	12.2	1,579	19,273.8
Hydroxychloroquine (Plaquenil)	50.9	14.6	8	116.2
Ibuprofen (Brufen*)	1,111.8	33.9	9	311.3
Ketoprofen (Oruvail)	2.4	0.3	12	3.1
Leflunomide (Arava*)	35.4	28.4	3	82.2
Naproxen (Naprosyn*)	254.1	12.7	15	195.4
Penicillamine (D-Penamine)	0.5	0.1	104	5.5
Sodium aurothiomalate (Myocrisin)	0.5	0.4	212	82.1
Sulindac (Daclin)	1.2	0.1	13	1.9
Tenoxicam (Tilcotil)	25.2	2.4	11	26.0

Source: Deloitte Access Economics based on PHARMAC via Ministry of Health.

Using Access Economics' 2005 data containing arthritis-related against non-arthritis-related prescriptions in 2005 for the list of medicines, the estimated proportion of dispenses related to arthritis was calculated. For the listed medicines not included in this data set, and those that were included but the sample size was insufficient to provide a robust estimate, an assumption was made around the per cent of the prescriptions related to arthritis based on the uses of the medicine.

The list of pharmaceuticals include both pain-relief and treatment medicines for arthritis conditions. Medicines shaded in the table are used predominantly for arthritis (etanercept, leflunomide, and sodium aurothiomalate). An estimate of 80% of dispenses being related to arthritis was used for these medicines, as these data were unavailable or insufficient in the 2005 dataset. As adalimumab is commonly used to treat the symptoms of rheumatoid arthritis, psoriatic arthritis and ankylosing spondylitis, but it is also used for the treatment of Crohn's disease of the intestine,[30] an estimate of 50% of dispenses being related to arthritis was used. As we have found no evidence for a higher estimate to be used for adalimumab, a lower, conservative assumption was made, which may be an underestimate of the true arthritis-related number of dispenses. An estimate of 10% of dispenses being related to arthritis was used for penicillamine due to the declining use of it for arthritis treatment with changing practice.

Infused pharmaceuticals, while often used for the treatment of arthritis, were not included in the Ministry of Health dataset, and have therefore not been included. The total estimated pharmaceutical costs related to arthritis are therefore likely an underestimate.

30 https://www.medicinenet.com/adalimumab/article.htm#what_is_adalimumab,_and_how_does_it_work_(mechanism_of_action)?

The estimated arthritis usage was applied to the total cost of each medicine inflated using Statistics New Zealand's health inflation to 2018 dollars, and adjusted for estimated changes in the number of people with arthritis.

The summation of all medicines resulted in the *cost of pharmaceuticals related to arthritis estimated to be $55.0 million in 2018*. This cost may be overestimated due to confidential rebates from the pharmaceutical manufacturers.

5.8.2 Additional medicines

For the remaining non-prescription medicines, data from Access Economics (2010) on the estimated cost of non-prescription medicines for arthritis-related purposes were used.[31] The costs for each medicine were inflated using Statistics New Zealand's health inflation to 2018 dollars, and adjusted for estimated changes in the number of people with arthritis. The summation of medicines resulted in the *cost for additional medicine related to arthritis is thus estimated to be $14.5 million in 2018*.[32]

Table 5.8 Costs of additional pharmaceuticals dispensed to arthritis patients, 2010 and 2018

Additional medicines	2010 costs ($ million)	2018 costs, adjusted for the change in the number of people with arthritis ($ million)
NSAIDs	2.2	3.1
Cyclooxygenase 2 (COX-2s)	3.7	5.1
Biologics	1.6	2.2
Other prescribed agents	1.3	1.8
Over-the-counter (OTC)	1.7	2.3
Total	**10.5**	**14.5**

Source: Access Economics (2010) and Deloitte Access Economics.

5.9 Pathology costs

For the diagnosis of arthritis, laboratory tests are conducted to prove or disprove a diagnosis. To estimate pathology costs related to arthritis, laboratory tests conducted during the diagnosis of arthritis, including the test costs, was collated.[33] However, the data did not include the reason for each test being ordered.

Proportions of arthritis tests vs non-arthritis tests from Access Economics (2005) was adjusted for the estimated change in the number of people with arthritis. This was applied to the estimated number of laboratory tests for each test in 2016-17. There were a number of tests that appeared in the 2016-17 data that were not observed in 2005. In these instances, an average estimated proportion of arthritis tests of 14%, which is equivalent to the proportion of arthritis tests in the all of the test samples observed in 2005, was used as a proxy.

Laboratory costs figures from 2016-17 were inflated using Statistics New Zealand's health inflation to 2018 dollars, and applied to the total estimated 2018 arthritis-related test numbers for each test. The summation of each test's estimated arthritis-related number and costs resulted in an *estimated 2.1 million laboratory tests related to arthritis, with a total cost of $21.4 million in 2018*.

[31] Data available to estimate the cost of over the counter medicines, such as paracetamol and aspirin, may underestimate the value of medicines sold directly from manufacturers to supermarkets or online sales, due to limitations on sources and collection methods.
[32] As these medicines costs are sourced from Deloitte Access Economics (2010), the data does not consider additional medicines introduced or medicines removed from the market.
[33] Provided by the Ministry of Health.

Table 5.9 provides the top 10 laboratory tests with the highest estimated number of tests related to arthritis (covering 92% of total estimated arthritis-related pathology costs). Appendix D provides results for all 65 different laboratory tests for which arthritis patients were referred.

Table 5.9 Laboratory test numbers and costs, top 10 laboratory referrals by number of arthritis tests, 2017-18 estimates

Laboratory Test name	Number of tests (thousands)	Estimated number of arthritis tests (thousands)	Estimated % of tests related to arthritis (prevalence adjusted)	Estimated value of arthritis-related claims ($ thousands)
Glycosylated haemoglobin	1,741.9	1,142.1	66%	12,392.1
Fasting lipid group test	1,324.7	179.1	14%	1,465.1
Liver function group	1,550.8	137.3	9%	2,756.3
Asparate amino transferase, serum – AST	72.8	68.7	94%	231.8
Ferritin, serum	1,198.5	81.6	7%	523.1
C-reactive protein test	957.9	71.2	7%	449.1
Erythrocyte sedimentation rate (ESR)	101.6	56.8	56%	414.6
Gamma glutamyl transferase, serum (GGT)	57.2	54.8	96%	194.2
Folate plus Vitamin B12, serum	657.2	56.4	9%	468.1
Urine culture	667.1	48.3	7%	813.6

Source: Deloitte Access Economics based on Ministry of Health, Laboratory Tests 2016-17.

The dataset provided by the Ministry of Health includes the autoantibodies test, a common test for arthritis. However, they were not in the top 10 laboratory referrals by number of arthritis tests. There were an estimated 213,000 autoantibodies tests related to arthritis in 2017-18, for a total estimated cost of $357,000. This is included in the total laboratory costs related to arthritis estimate, and in the extended table in Appendix D. The provided dataset did not, however, include any data on serologies referrals, another common test for arthritis. As this is an expensive test, and estimates for this test have not been included, the total laboratory cost related to arthritis is likely to be an underestimate.

5.10 Diagnostic imaging costs

Diagnostic imaging is often used to confirm an arthritis diagnosis, and to ascertain the severity of the condition. To estimate the diagnostic imaging costs related to arthritis, the number of visits and costs associated with arthritis patients' diagnostic imaging was estimated through academic literature. In particular, two small-scale studies conducted in Otago looked at the impact of osteoarthritis interventions on health expenditure. The research included a control group of around 50 people who could provide information on current health services use, including imaging. Table 5.10 provides the relationships found in these studies.

Table 5.10 Academic literature on the number of radiology visits with people with arthritis

Author	Year	Country	Relationship found
Pinto, D., Robertson, M. C., Hansen, P., & Abbot, J. H.	2011	New Zealand	Estimates the number of radiology visits for people with osteoarthritis is 0.35 per person annually
Pinto, D., Robertson, M. C., Hansen, P., Abbot, J. H., & Campbell, A. J.	2013	New Zealand	Estimates between 29% and 35% of people with osteoarthritis had an arthritis-specific radiology visit

Source: Deloitte Access Economics

Both of these studies provide similar results on the number of radiology visits annually for people with arthritis, 0.35 per person. This analysis applied the assumption that 0.35 radiology visits annually related to arthritis for people with any arthritis conditions. This rate was applied to the estimated total number of people with arthritis. Using this approach, the number of imaging tests related to arthritis is estimated to be 234,400 in 2018.

To apportion costs by imaging type, the results from a questionnaire by Otago University to patients with inflammatory arthritis who had had a recent imaging test in 2016 was used. The responses showed that 44% of respondents had an x-ray, 23% an ultrasound, 20% an MRI, and 13% a CT scan. These proportions were used as the assumption around imaging type proportions for the total population with arthritis, to allocate total imaging costs by type.

To determine the cost of these services, information on the cost per scan for MRIs,[34] and the average cost of x-rays, ultrasounds and CT scans, from two of the larger providers of diagnostic imaging services[35] in New Zealand was used.

Using this approach, the total diagnostic imaging costs related to arthritis were estimated to be $75.0 million in 2018.

Table 5.11 Diagnostic imaging costs related to arthritis, 2018

Imaging type	Average cost ($)	Estimated proportion of each imagining type for arthritis population	Population with arthritis (thousands)	Total cost ($ millions)
X-ray	130	44%	103.1	13.4
Ultrasound	236	23%	53.9	12.7
MRI	733	20%	46.9	34.4
CT	475	13%	30.5	14.5
Total			**234.4**	**75.0**

Source: Deloitte Access Economics based on ACC, Schedule for high tech imaging service 2018

5.11 Capital expenditure related to arthritis

Within New Zealand's overall health expenditure there is a significant component which is capital investment, some of which can or should be attributed to the treatment of arthritis. To estimate this cost, Deloitte Access Economics made an estimate for New Zealand's capital expenditure related to arthritis.

OECD (2017) reports that the average spend on health-related capital expenditure is 0.5% of GDP across the OECD, with New Zealand reported to spend close to the average. Currently, New Zealand's total health expenditure is 9.2% of GDP. Therefore, it is estimated that approximately 5.4% (0.5%/9.2%) of total health expenditure can be attributed to capital expenditure. Applying this proportion to total health expenditure related to arthritis in New Zealand, as calculated above, we can estimate the total health-related capital expenditure related to arthritis.

Using this approach, the total cost of capital expenditure related arthritis was estimated to be $53.5 million in 2018.

[34] Provided by ACC.
[35] Based on the following pricing lists: https://www.pacificradiology.com/#/referrers/referrer-pricing-guides and https://broadwayradiology.co.nz/our-services/pricing

6 Other financial costs

Key findings:

- In 2018, total other financial costs of arthritis are estimated to be $3.3 billion as shown in Table 6.1 and Chart 6.1.
- The productivity loss in individuals with arthritis is $1.2 billion in 2018, or $1,858 per person with arthritis. Employers ($451.6 million) and individuals ($410.2 million) bear most of these costs. The productivity cost is largely due to losses from reduced employment ($648.9 million).
- The productivity loss due to informal care was $1.5 billion in 2018, or $2,311 per person with arthritis. Each informal carer is estimated to provide, on average, 11.7 hours of care per week to people with arthritis. In addition, it is estimated that $29.4 million is spent on formal care services.
- Expenditure on aids, equipment and modifications was estimated to be $40.3 million, while the overall deadweight losses associated with transfers was estimated to be $8.1 million.

6.1 Summary of other financial costs

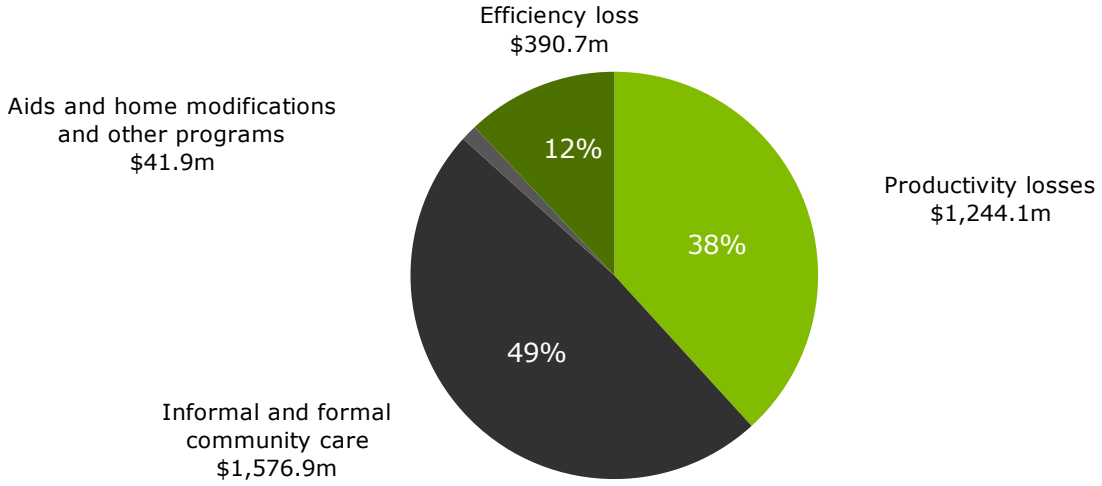
In 2018, total other financial costs of arthritis are estimated to be $3.3 billion as shown in Table 6.1 and Chart 6.1.

Table 6.1 Other financial costs of arthritis, 2018

Category	Total expenditure ($ million)
Productivity losses	1,244.1
Informal and formal community care	1,576.9
Aids and home modifications	40.3
Other programs	1.6
Efficiency loss	390.7
Total	**3,253.6**

Source: Deloitte Access Economics calculations.

Chart 6.1 Other financial costs of arthritis, 2018



Source: Deloitte Access Economics calculations.

6.2 Productivity losses

Arthritis can have a substantial impact on an individual's ability to work. This may include a reduced chance of participating in employment, a greater number of sick leave days than average due to the condition, and/or a diminished capacity to be productive at work. As such, arthritis may incur a range of productivity costs not only to the individual but also to employers, government (through reduced taxation revenue) and the economy in general.

This section provides an analysis of productivity costs associated with arthritis, in particular the costs associated with reduced employment, absenteeism, and reduced productivity at work known as presenteeism. We adopt a human capital approach to the estimation of productivity losses. This involves the calculation of the difference in employment between people with arthritis and that of the general population, multiplied by average weekly earnings (AWE). Furthermore, costs incurred through absenteeism and/or presenteeism are derived by multiplying AWE by the average number of weeks, as converted from the number of days and hours respectively lost.

6.2.1 Reduced employment

Arthritis may have a considerable impact on an individual's chances of employment, resulting in reduced employment either through disadvantages in job-seeking or self-selection out of the labour force. This can lead to significant productivity losses, in the form of wages lost from employment that would otherwise have been gained, in addition to other costs to the individual, such as diminished social engagement.

A special request was submitted to the Ministry of Health for data on the employment outcomes of people with arthritis collected for the 2016-17 NZHS. Of the working age population with arthritis, it was estimated that 72.25% males and 61.53% females were employed. In the absence of arthritis, the expected employment for these groups would have been 76.91% and 63.49% for males and females, respectively. This reflects a decrease in the likelihood of employment, due to arthritis, of 4.66% for males and 1.97% for females. Gaps in employment outcomes are summarised in Table 6.2.

Table 6.2 Employment gap (%) by gender and working age population (15-64)

	Male (%)	Female (%)
Working age population (15-64)	4.66	1.97
65 years and over	0.72	2.66

Source: Deloitte Access Economics analysis.

Applying the estimated employment gaps, it is estimated that there are 12,401 people not employed due to arthritis in New Zealand in 2018, of whom 61% are male. Applying this to the New Zealand general employment rates and AWE by age and gender (Statistics NZ, 2018; Statistics NZ, 2017a), *the total cost associated with reduced employment is estimated to be $648.9 million – or $969 per person with arthritis*.

6.2.2 Absenteeism

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

A literature scan was conducted to find relevant data regarding the relationship between arthritis and absenteeism. While there are a variety of studies on the impacts of rheumatoid arthritis and osteoarthritis, far fewer were identified on the impacts of overall arthritis in particular. Two studies were found regarding the relationship between arthritis and absenteeism. In a study situated in Canada, Li et al (2006) conducted a prospective study of 383 employed individuals with arthritis to assess the cost attributable to lost productivity from arthritis. Participants were interviewed using structured questionnaires, covering demographic, self-reported disease, employment-related, workplace activity limitations and psychosocial characteristics, at two time points. Lost productivity from arthritis was looked at from three different perspectives: reduced work hours, absenteeism and presenteeism. It was estimated that 29% of participants reported missing workdays, 49% reported reduced performance, 10% reported reduced work hours and 11% reported stopping working or changing jobs. It was followed that total lost productivity associated with arthritis was $CAN11,553 (in 2000 dollars), of which 10% was the result of absenteeism.

A more recent study by Vuong et al (2015) looked at the relationship between seven chronic conditions including arthritis/rheumatism and absenteeism in full-time workers in the United States of America[36]. The study used data in the 2011-2013 National Health Interview Survey from which only full-time employed individuals aged 18 to 64 years were included. Participants were asked to indicate the number of lost workdays due to a chronic condition in the past year. Using the total sample of 39,230 full-time workers, the study found a significant association between workdays lost and functional limitation attributed to chronic condition. In particular, individual with limitations due to arthritis were found to have on average 6.65 workdays lost per year. The estimated average workday lost per year for individuals without functional limitation attributed to the seven chronic conditions was three. This represents an annual estimate of excess workdays lost of 3.65 days for individuals with arthritis.

Given the lack of ability to translate the results from Li et al (2006) into a measure of time, the study from Vuong et al (2015) was used in this report to estimate the cost associated with absenteeism. It was estimated that an individual with arthritis is absent from work 3.65 days per year due to the condition.

Applying the sick leave amount to those who are employed, it was estimated that there were approximately one million workdays were lost in 2018 due to arthritis in New Zealand.

Applying this to the New Zealand general population employment rates and average weekly earnings by age and gender (Statistics NZ, 2018; Statistics NZ, 2017a), *the total cost associated with absenteeism was estimated to be $332.6 million – or $497 per person with arthritis on average*.

[36] There is no difference between rheumatism and arthritis and rheumatism is no longer the preferred term used by medical professionals. Source: https://www.medicalnewstoday.com/articles/7625.php.

6.2.3 Presenteeism

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. As presenteeism is not as readily apparent as absenteeism, its prevalence and effects may not be as easily discerned. However, presenteesim can have the potential to convey costs to employers by reducing the quality of work produced by employees or the efficiency with which it is performed.

A literature scan was conducted to find relevant data on the impact of arthritis on presenteeism. Due to the relative infancy of this area of study in academia, limited data on presenteeism were available. In a Canadian study, Zhang et al (2010) conducted a survey of 212 employed individuals aged between 18 and 65 years who had been diagnosed with osteoarthritis or rheumatoid arthritis to estimate the associated lost productivity. The study used four different instruments in estimation – the Health and Labor Questionnaire (HLQ), the Work Limitations Questionnaire (WLQ), the World Health Organization's Health and Work Performance Questionnaire (HPQ), and the Work Productivity and Activity Impairment Questionnaire (WPAI). The average number of lost hours per two weeks attributed to presenteeism using HLQ, WLQ, HPQ and WPAI were estimated at 1.6, 4.0, 13.5 and 14.2, respectively. The significant variations in lost-hour estimates highlighted the underlying conceptual differences in the way presenteeism is defined in the current literature.

In another study by Burton et al (2006), a survey of employees from a large financial services company in the United States was used to estimate work productivity lost associated with arthritis. A modified version – an eight-item brief version – of the WLQ[37] was used to assess the impact of chronic conditions such as arthritis on work productivity. Employees were asked to rate any impairment as "None of the time (0%), Some of the time, Half of the time (50%), Most of the time, All of the time (100%)" and scores of 0,1,2,3 and 4 were assigned to these responses, respectively. An overall WLQ score was calculated by averaging the subscale scores. Since each score of one is equivalent to 25% loss of self-reported productivity, the percentage of productivity loss was estimated by multiplying the WLQ score by 25%. Employees who reported having been told by doctor they had arthritis were further divided into those who did and did not receive medical treatment. The analysis was adjusted for relevant confounding factors, including demographics, health risks and other health conditions. With a total sample of 16,651 respondents, productivity losses were estimated to be 15.7%, 16.3%, and 18.2% for employees with no arthritis, arthritis without treatment and arthritis with treatment, respectively. Thus, the overall excess productivity loss due to arthritis was 1.4%.

People with more severe arthritis are more likely to be receiving treatment, which is why they have a larger productivity loss relative to people with arthritis and not receiving treatment.

In order to identify an estimate for the impact of arthritis on presenteeism, the results of the study by Burton et al (2006) were used as it was the largest and well-constructed study[38]. It should be noted that given the lack of agreement between different instruments used in the literature (Zhang et al, 2010), further research is warranted to provide a more accurate quantification of any adverse impact of arthritis on work performance.

Based on Burton et al (2006), it was estimated that *arthritis leads to an increase in presenteeism, resulting on average in a 1.4%[39] decrease in productivity* relative to that of an employee without arthritis.

Applying the relative reduction in productivity to those who are employed, it was estimated that approximately 5,933 productive days would be lost in 2018 as a result of presenteeism linked to arthritis.

Applying this to the New Zealand general population employment rates and average weekly earnings by age and gender (Statistics NZ, 2018; Statistics NZ, 2017a), *the total cost associated with presenteeism was estimated to be $262.6 million – or $392 per person with arthritis*.

[37] The WLQ is a 25-item questionnaire, originally developed to measure the effect of chronic diseases and treatment on work performance where respondents report the frequency of difficulty in the past 2 weeks over four domains: time management, physical work, mental/interpersonal, and overall output.

[38] Using the WLQ result from Zhang et al (2010), the percentage of productivity loss for people with arthritis was around 5.7% (=4.0/70). However, in contrast to Burton et al (2006), Zhang et al (2010) only included patients with osteoarthritis and rheumatoid arthritis rather than arthritis. The sample size employed in Burton et al (2006) was also significantly larger. On these bases, Burton et al (2006) estimates were used in this report.

[39] The 1.4% was calculated using a weighted average as follows: (18.2-15.7)*(986/2,469)+(16.3-15.7)*(1,483/2,469)

6.2.4 Summary of productivity costs

Productivity costs are summarised in Table 6.3. The total productivity costs in people with arthritis are estimated to be $1,244.1 million annually. This is equivalent to $1,858 per person with arthritis. It should be noted that the total productivity costs associated with arthritis were estimated at $1.5 billion in Access Economics (2010). In light of new studies and more up-to-date data available for arthritis, $1,244.1 million is a more accurate estimate for productivity costs in 2018.

The vast majority of productivity costs are associated with reduced employment opportunities for people with arthritis ($648.9 million), followed by absenteeism ($332.6 million) and reduced productivity while at work ($262.6 million). This does not include the substantial carer costs associated with informal care (discussed further in section 6.3 – although this is also a productivity loss).

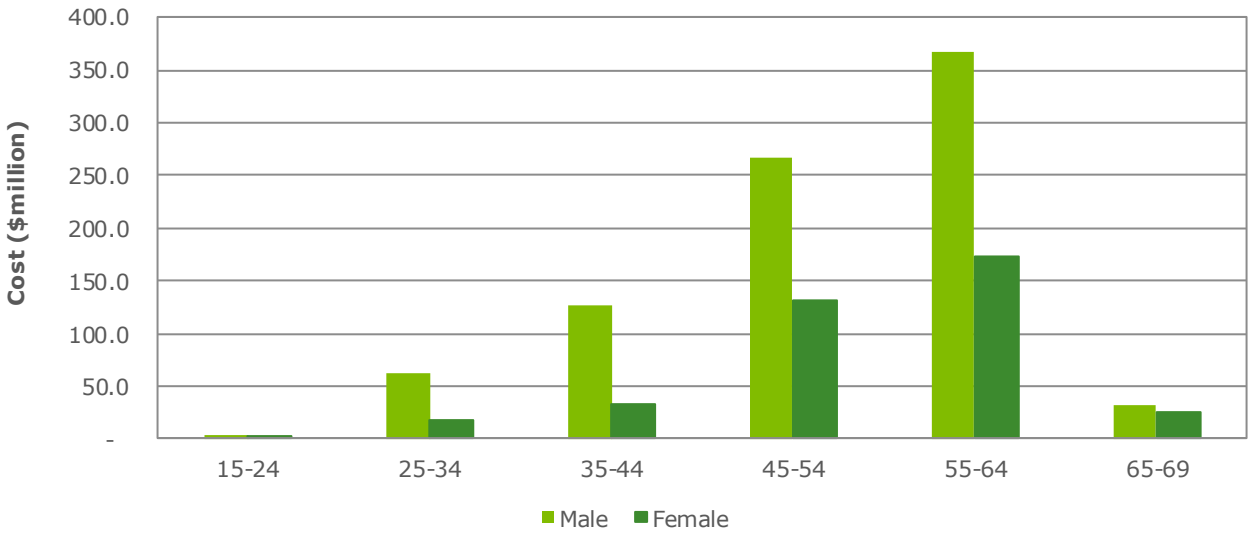
Table 6.3 Summary of productivity costs for people with arthritis

Source of productivity loss	2018 ($m)	Per person ($)
Reduced employment	648.9	969
Presenteeism (reduced productivity at work)	262.6	392
Temporary absenteeism from work (including management time)	332.6	497
Total	**1,244.1**	**1,858**

Source: Deloitte Access Economics calculations.

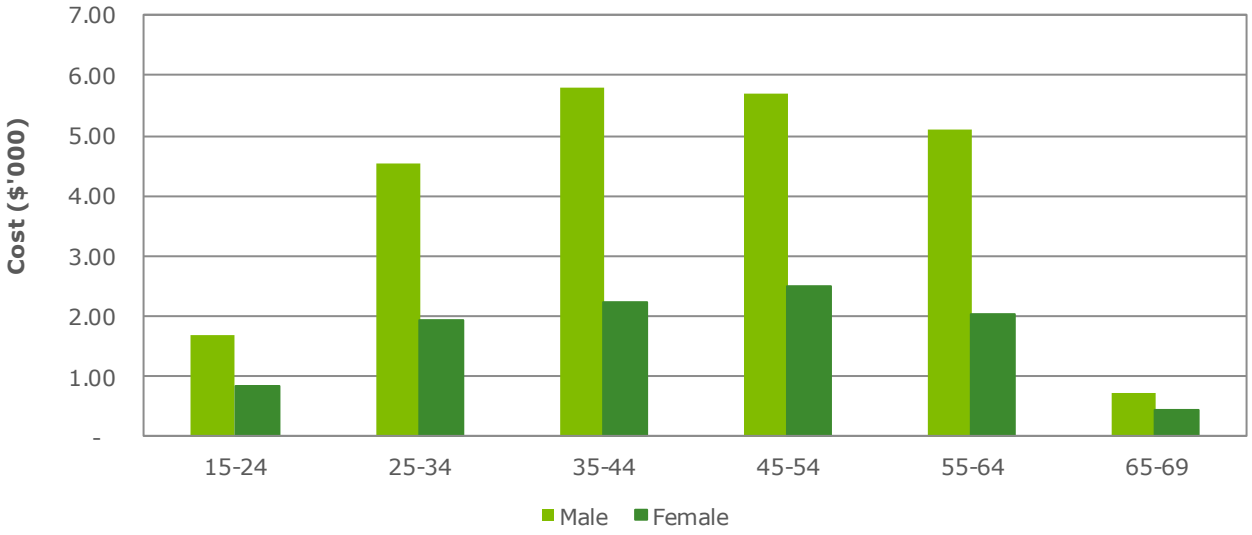
As shown in Chart 6.2 and Chart 6.3, the overall costs and the average productivity cost per person with arthritis differ by age and gender, with males having higher associated productivity cost, reflecting higher earnings.

Chart 6.2 Productivity costs by age and gender, 2018



Source: Deloitte Access Economics calculations.

Chart 6.3 Productivity cost per person by age and gender, 2018



Source: Deloitte Access Economics calculations.

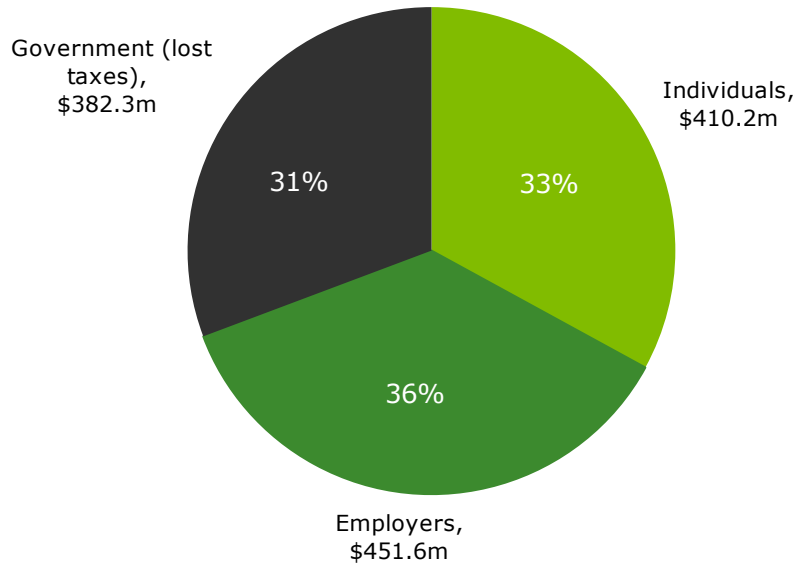
The average productivity cost per person primarily related to reduced employment. This means that costs are higher in the 45-64 age groups as the lost earnings for these groups are higher.

The productivity costs are shared between workers, employers and government (through a reduction in taxable income). Post-tax, the shares of productivity losses are:

- **Workers:** the productivity cost of arthritis borne by workers is $410.2 million in 2018 – this largely consists of lost earnings as a result of reduced employment.
- **Employers:** the productivity cost of arthritis borne by employers is $451.6 million in 2018 – this largely consists of reduced productivity while at work (presenteeism) and additional paid days off work (absenteeism).
- **Government:** the productivity cost of arthritis borne by government is $382.3 million, which again is largely the result of reduced employment for people with arthritis – resulting in lower taxation revenue.

The share of total productivity cost borne by each payer are shown in Chart 6.4. Employer bore the largest shares of costs (36%), followed by employees (33%) and government (31%).

Chart 6.4 Productivity costs for people with arthritis by who bears the cost, 2018



Source: Deloitte Access Economics calculations.

6.3 Informal and formal community care costs

This section describes the approach that was used to estimate the costs of informal care for people with arthritis in New Zealand. Carers are people who provide care to others in need of assistance or support, such as assistance with everyday activities of daily living. An informal carer provides this service free of charge and does so outside the formal care sector. An informal carer will typically be a family member or friend of the person receiving care, and usually lives in the same household as the recipient of care. As such, many people receive informal care from more than one person. The person who provides the majority of informal care is known as the primary carer.

While informal carers are not paid to provide this care, informal care is not free in an economic sense. Time spent on caring involves forfeiting time that could have been spent on paid work or undertaking leisure activities. As such, informal care can be valued as the opportunity cost associated with the loss of economic resources (labour) and the loss in leisure time valued by the carer. To estimate the dollar value of informal care, an opportunity cost approach was used.[40]

To determine the amount of, and costs associated with, informal care given by carers of people with arthritis, a literature scan was undertaken to determine how many people with arthritis receive care, the number of hours each carer provides on average, and who generally provides this care (i.e. a family member). Who provides this care is important to ascertain, as to correctly value the carers' opportunity cost of time, which is calculated based on AWE for age and gender groups and the chance of being employed (Statistics NZ, 2017a).

6.3.1 Recipients of care

The NZHS asked people whether they had reduced time spent, or had difficulty with regular daily activities as the result of their physical health. Daily activities could include work, housekeeping and looking after a child or other person. A special request was submitted to the Ministry of Health to obtain information on the effect of arthritis on the activities of daily living. Responses of people with arthritis are summarised in Table 6.4.

[40] It is also possible to use the replacement valuation or the self-valuation methods. The replacement cost method measures the cost of 'buying' an equivalent amount of care from the formal sector if the informal care was not supplied. The self-valuation method measures how much carers themselves feel they should be paid for undertaking their responsibilities. However, these options were not explored further in this report as they are less suitable for cost of illness analysis than the opportunity cost approach.

Table 6.4 Impact of arthritis on daily activities, New Zealand 2003

Type of arthritis	Had difficulty performing activities (%)
Rheumatoid arthritis	46.5
Osteoarthritis	44.9
Gout arthritis	27.9
Other arthritis	37.9
Arthritis (all types)	41.3

Source: Special data request from the Ministry of Health 2003 NZHS.

A literature scan was conducted to find relevant data regarding informal care on arthritis. No New Zealand specific studies examined the burden of informal caregivers to patients with arthritis. While there are a variety of studies on informal care provided to patients with rheumatoid arthritis, no study was identified for the case of overall arthritis. Results from these studies are varied. Riemsa et al (1998), in their survey of outpatients in the United States, found approximately 11.4% of patients receiving informal care, whereas a Dutch study of rheumatoid arthritis patients by Brouwer et al (2004) found approximately 51% of patients received informal care from their partner. In another Dutch study conducted by Jacobi et al (2003), approximately 37.2% of patients reported receiving informal care from their partner. Using the relative need for assistance reported in Table 6.4 above, the percentage of care recipients with arthritis can be computed as shown in Table 6.5[41].

Table 6.5 Percentage of people with arthritis receiving informal care

Studies	Care recipients (%)
Riemsa et al (1998)	10.1
Jacobi et al (2003)	33.0
Brouwer et al (2004)	45.5

Source: Deloitte Access Economics analysis.

The best available data on arthritis were from the Australian Survey of Disability, Ageing and Carers in Australia (SDAC), conducted in 2015. The SDAC shows that approximately 33.9% of people with arthritis receive informal assistance with activities. This figure falls well within the range and appears to agree with Jacobi et al's (2003) estimate reported above. In the absence of New Zealand specific data, 33.9% was used in computing the costs of informal care.

No studies specifically identified the relationship between carers and care recipients. According to *Disability and Informal Care in New Zealand in 2006,* spouses or partners were found to be the most common informal carers for adult, while disabled children received informal care mostly from their parents or guardians. This means that the age distribution of carers is similar to the age distribution of people with arthritis.

After adjusting for people with arthritis in long-term care facilities which was estimated at 28,868 persons as set out in section 5.3, *it was estimated that there are 217,261 people with arthritis received informal care in New Zealand in 2018*.

[41] Assuming patients had difficulty performing activities and will require assistance for that, Table 6.4 can be used to estimate the proportion of patients with arthritis receiving care for their activities. For example, since Brouwer et al (2004) found 51% of patients with rheumatoid arthritis receiving care from their partner, multiplying this by the relative need ratio between arthritis and rheumatoid arthritis (=41.3/46.5) gives the estimated percentage of people with arthritis receiving informal care of 45.5%.

6.3.2 Hours of informal care provided

In New Zealand, as in other countries, there are few robust data on the need and use of carers by people with arthritis. No recent literature was found specifically for New Zealand that identified the hours of informal care provided to people with arthritis. The best available data were the 2015 SDAC. For people with arthritis as a main condition, an average of 27.9 hours of care were received each week, while for people with no main condition, 16.2 hours of care received each week on average. *This represents an additional 11.7 hours of informal care each week for those with arthritis*.

6.3.3 Cost of informal care

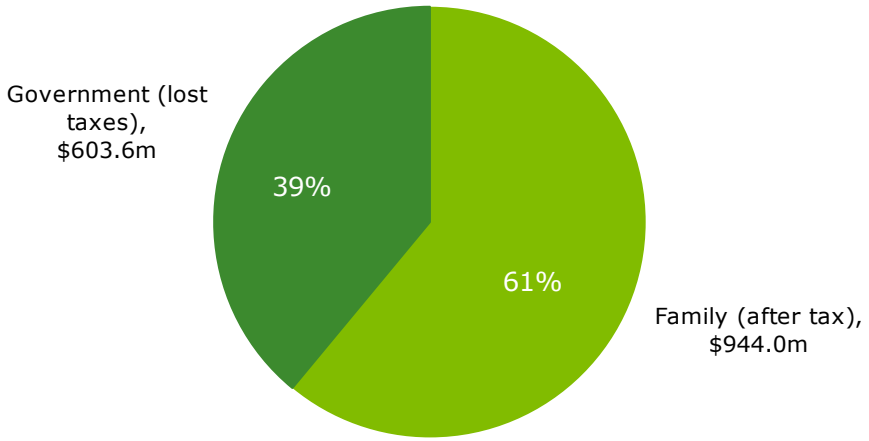
To estimate the carer costs, estimates of the number of people requiring care were multiplied by the annual hours of care provided (11.7 hours on average per week x 52.1 weeks), and the *opportunity cost* of carers' time[42]. The total hours of care per year per person (609.6 hours) was multiplied by the total number of people receiving care – which was estimated to be 217,261 people with arthritis. *This represents approximately 132.2 million hours of care to people with arthritis in New Zealand during 2018*.

Multiplying these hours by AWE (by age and gender) for the carers leads to an estimate of *the cost of informal care provided to people with arthritis of around $1,547.6 million in New Zealand in 2018*. This represents $11.71 per hour of informal care based on an opportunity cost approach. Of the total cost:

- carers (post-tax) bear around $944.0 million (61%) in the form of lost income; and
- government bears around $603.6 million (39%) in the form of lost taxes.

The distribution of informal care costs by the respective payer is shown in Chart 6.5.

Chart 6.5 Informal care costs by who bears the cost, 2018



Source: Deloitte Access Economics calculations.

6.3.4 Formal care

Formal care can include help with childcare, housekeeping, gardening, shopping, personal care and home-based nursing that is not covered by private health insurance or the government health budget (and thus included already in health system costs). The services are generally provided by nursing aides or other paid carers. These costs are generally out-of-pocket expenses borne by individuals and their families, although some government community funding is provided through home assistance and similar programs.

[42] As the age profile of carers was assumed to be the same as for the population with arthritis, this implicitly excludes informal carer costs of care provided to children.

No specific data and studies could be located for New Zealand regarding formal care for patients with arthritis. In addition to informal care above, Brouwer et al (2004) identified around 13% of all patients received formal assistance with household tasks and 2.0% of all patients received assistance with their activities of daily living (ADL). On average, the study reported 4.5 hours per week were spent on household activities and 2.5 hours on ADL. To be conservative, the estimate of average time spent on formal care was limited to hours spent providing personal care (i.e. not household activities). Applying this finding and relative assistance requirement for patients with arthritis, it was estimated that *1.5 million hours of formal care are provided to people with arthritis* in New Zealand in 2018[43].

The average cost of formal care was estimated based on the minimum hourly wage rates available from the *Care and Support Workers (Pay Equity) Settlement Act 2017.* From 1 July 2018 to 30 June 2019, the minimum hourly wage for a care and support worker varies from $19.80 to $24.50 depending on length of service and qualification. To be conservative, the estimated average cost of formal care was based on the lowest rate, which is $19.80. Applying this rate to the hours of formal care, *it is estimated that $29.4 million is spent on formal care services for people with arthritis in New Zealand in 2018*.

6.4 Aids and home modifications

People with arthritis may require aids and/or housing modifications in order to continue living at home. The Ministry of Health provides support for aids and modifications through the Equipment and Modifications Service. Through the service, people with a disability are able to access advice on the best equipment or modifications to meet their needs; equipment on long-term loan; and financial support for all or part of the costs of modifications to their home or vehicle (Ministry of Health, 2017b).

Data on the proportion of people with arthritis using aids and modifications was taken from the 2015 SDAC.[44] It was considered reasonable to base these estimates on Australian data, since the average level of support required is estimated based on the impact of the condition, which is unlikely to vary substantially between the two countries.

Cost estimates for the various products are based on prices from New Zealand providers of self-care and mobility aids for people with a disability. The cost of home modifications was taken from annual data on home modifications from Enable New Zealand – an organisation that provides home modifications funded by the Ministry of Health – and used the average cost of home modifications provided in 2016-17 inflated using CPI to 2018 dollars. The home modifications expenditure only covers government expenditure and is likely to underestimate the cost. However, with private home modifications it can be complicated to determine the amount of expenditure that is purely due to the requirement of the disease, and that which is cosmetic.

While some equipment and modifications require large outlays but are amortised over a number of years, other devices need to be replaced more regularly. It was assumed that devices in heavy use (eating, dressing and orthotics) need to be replaced on an annual basis, while most other devices –showering and toileting aids and most mobility aids such as canes, crutches, walking sticks and frames – have a lifespan of three years, and larger expenses such as wheelchairs and mobility scooters were depreciated over five years. Home modifications tend to be one-off investments, so their lifespan was assumed to be 20 years (Table 6.6).

[43] Using the relative assistance need reported in Table 6.4, it was estimated that around 1.8% of patients required assistance with their activities of daily living.

[44] Data on aids and modifications were not readily available. The Ministry of Health noted that they did not have information for aids and modifications that could be attributed by diagnosis code and therefore could not provide an estimate of expenditure on aids and modifications attributable to arthritis.

Table 6.6 Cost of aids and home modifications, estimated product life and total costs, 2018

Device	Base price ($)	Product life (years)	Unit cost ($ per annum)	Number of devices	Total cost ($m per annum)
Self care					
Eating aids	109	1	109	6,226	0.7
Meal preparation	70	1	70	12,062	0.8
Showering or bathing aids	146	3	49	47,029	2.3
Dressing aids	67	1	67	12,559	0.8
Toileting aids	352	3	117	28,773	3.4
Mobility aids					
Walking stick	31	3	10	42,005	0.4
Walking frame	220	3	73	38,392	2.8
Seating or bedding aid(s)	200	3	67	25,015	1.7
Manual wheelchair	1,183	5	237	13,065	3.1
Cane	31	3	10	8,750	0.1
Electric operated lounge chairs and/or specialised seating	1,625	5	325	8,159	2.7
Orthoses/orthotics	441	1	441	7,115	3.1
Mobility scooter	4,756	5	951	4,871	4.6
Crutches	98	3	33	4,304	0.1
Electric wheelchair	4,615	5	923	898	0.8
Modified car or car aid(s)	198	3	66	453	0.0
Home modifications					
Home modifications (including structural changes, ramps, bath modifications, doors widened, handrails, etc.)	4,179	20	209	60,942	12.7
Total aids and home modifications					**40.3**

Sources: https://enablenz.vendecommerce.com; https://www.disabilityfunding.co.nz/equipment/ and https://www.mobilitycentre.co.nz/
Note: People may use more than one device. Totals may not add due to rounding.

From the analysis presented in Table 6.6, *it is estimated that $40.3 million was spent on aids and modifications for people with arthritis in New Zealand in 2018*.

This estimate is lower than presented in the 2010 report, which estimated that the total cost of aids, modifications and travel was $65.6 million. This was based on the Australian ratio of formal care costs to the cost of aids, modifications and travel. We consider that estimating the cost from the need and using New Zealand prices is a more robust method. We have also not included travel costs in this section, as the cost of travel will be captured in the community care costs (i.e. time spent by carers driving people with arthritis to appointments, etc.) and we did not want to double count this cost.

6.5 Other expenditure on support for people with arthritis

Arthritis New Zealand also directly provides services and programs to support people with arthritis, including the provision of arthritis information services, public awareness campaigns and newsletters. *The cost of this support is estimated to be $1.6 million in 2018* (Arthritis New Zealand, 2017).

6.6 Deadweight losses

Transfer payments represent a shift of resources from one economic entity to another, such as raising taxes from the entire population to provide welfare payments to people with arthritis. The act of taxation and redistribution creates distortions and inefficiencies in the economy, so transfers also involve real net costs to the economy, referred to as efficiency losses.

Transfer costs are important when adopting a whole-of-government approach to policy formulation and budgeting. Transfer costs also allow us to examine the distribution of the costs of arthritis across different parts of society.

6.6.1 Income support for people with arthritis

The main source of income support for people in New Zealand aged less than 65 years who are unable to work due to a health condition or another reason comes from the Supported Living Payment (SLP). The SLP is also a payment for people who have, or are caring for someone with a health condition, injury or disability (Ministry of Social Development, 2018a).

It is estimated that in 2018 there are approximately 10,559 people under 65 years of age who are not working due to arthritis, this was calculated in section 6.2.1. This number represents the maximum number of people who would be eligible to receive an SLP payment due to having arthritis.

To determine the total SLP payments made to people with arthritis, the number of people receiving the SLP payment was multiplied by the average yearly payment per person. Average per person yearly payments were calculated as total expenditure for SLP in 2017-18, divided by the total number of people receiving the payment and increased by AWE to 2018 dollars (Ministry of Social Development 2017; 2018b).

Taking the average number of people receiving payments in any one quarter, there were approximately 93,107 people receiving SLP during 2016-17. Total expenditure was $1.5 billion for SLP during this period. After adjusting for inflation, the estimated average payment in 2018 terms is $17,000. Multiplying the average annual payment by the number of people with arthritis receiving the SLP payment, it was estimated that approximately $179.3 million was paid in SLP payment to people with arthritis in 2018.

All people aged over 65 years receive superannuation payments (New Zealand Super) regardless of health status, and the payment is not means tested. Thus, we have not included New Zealand Super payments in this report, as it is universal there is no additional cost attributable to arthritis (Ministry of Social Development, 2018c).

6.6.2 Taxation revenue forgone

People with arthritis who work less or retire early not only forgo income, but also contribute less tax revenue to the government through reduction in personal income tax. Moreover, there will also be a fall in indirect (consumption) tax, as those with lower incomes consume a smaller set of goods and services.

Personal income tax forgone is estimated as a product of the average personal income tax rate and the forgone earnings. As presented in relevant sections throughout this report:

- people with arthritis missed out on $672.4 million in wage income largely due to reduced employment;
- carers lost $1,547.6 million in wage income due to caring for a person with arthritis; and
- employers lost $571.7 million in productivity on account of presenteeism and paid absenteeism resulting from arthritis.

Consistent with Deloitte Access Economics' standard methodology, in terms of allocating these losses to either personal income or company income, only the employer losses were included as lost company revenue, with the remainder allocated as lost personal income in one form or another. The average personal income tax rates in 2016 was 24% according to New Zealand Treasury, 2016[45]. The indirect tax forgone is estimated as a product of the forgone consumption and the average indirect tax rate. In 2018**,** the average indirect tax rate was modelled as 15% using the current Goods and Services Tax in New Zealand (Inland Revenue, 2016).

[45] The latest update available was made in October 2016. We assume the tax rate holds for 2018 as there has been no changes made to individual income tax rates in New Zealand since 2016.

Corporates and companies are taxed at a flat rate of 28% in New Zealand. An average company tax rate of 21% was used in our estimate to account for the proportion of the economy (25%) comprised by the public sector (NZ Statistics, 2017). In New Zealand, the headline company rate and the effective rate paid by companies are closely aligned and thus we assumed the average company tax rate is 28%, equal to the headline rate (Wong, J. & Wong, N., 2017).

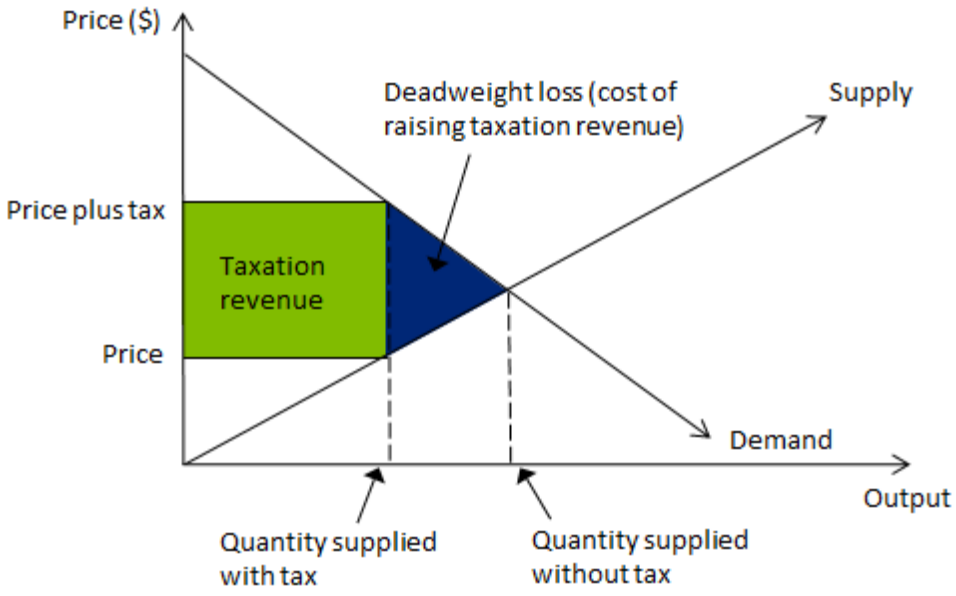
By applying the total lost wage income or business output to the relevant tax rates, *the total loss of tax revenue was estimated to be $985.8 million in 2018*. This represents taxation revenue that must be collected from other parts of the economy (e.g. those that remain in the workforce) given a "no change in expenditure" assumption. That is, small tax changes are unlikely to change the level of demand for expenditure.

6.6.3 Efficiency loss 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 the act of 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.

As 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

The rate of efficiency loss used in this report is *20 cents per $1 tax revenue* raised (New Zealand Treasury, 2015). The efficiency loss rate is applied to:

- lost tax revenue from forgone earnings of people with arthritis, their carers and employers (which must be raised from another source); and

- government services provided (for example, the public health system, grants and programs), since in a budget neutral setting, government expenditures require taxation to be raised and thus also have associated distortionary impacts.

6.6.4 Summary of deadweight losses

Using the rate of efficiency losses (20%), the expected total efficiency loss associated with arthritis was estimated to be $390.7 million in 2018, or $583 per person with arthritis. The components of efficiency loss and the overall cost are summarised in Table 6.7.

Table 6.7 Components of efficiency loss, 2018

Component of efficiency loss	2018 ($m)
Health system costs borne by government	788.2
Lost taxes	985.8
Other costs borne by government	179.3
Total transfers	**1,953.3**
Rate of efficiency loss	20%
Resulting efficiency loss	**390.7**

Source: Deloitte Access Economics calculations. Note: The proportion of health system, and aids and modification costs borne by government was assumed to be 80% based on the proportion of total health costs funded by the government (OECD, 2017).

7 Total cost of arthritis

Key findings:

- The total cost of arthritis in New Zealand was estimated to be $12.2 billion in 2018, comprising approximately $4.2 billion in financial costs and $7.9 billion in loss of wellbeing costs. This equates to approximately $18,179 per person in total (both components).

The total financial costs of arthritis were estimated to be $4.2 billion in New Zealand in 2018, while including the loss of wellbeing increases that total to $12.2 billion. The cost for each component are shown in Table 7.1.

Table 7.1 Total cost of arthritis, 2018

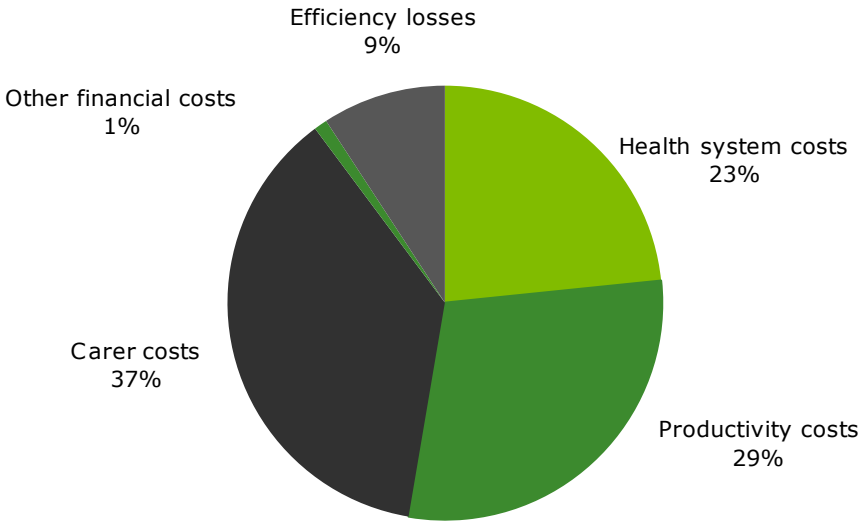
Component	Value ($m)	Per person ($)
Health system costs		
Hospital costs	423.7	633
GP visits	34.9	52
Medical specialists	40.4	60
Allied health	169.6	253
Aged Care	97.9	146
Research	6.6	10
Pharmaceuticals	69.5	104
Pathology	21.4	32
Diagnostic imaging	75.0	112
Other costs	53.5	80
Total health costs	*992.5*	*1,482*
Indirect financial costs		
Productivity costs		
Reduced employment	648.9	969
Presenteeism	262.6	392
Absenteeism	332.6	497
Total productivity costs	1,244.1	1,858
Carer costs	1,576.9	2,354
Other financial costs	41.9	63
Efficiency losses	390.7	583
Total indirect financial costs	*3,253.6*	*4,858*
Total financial costs	***4,246.1***	***6,340***
Total loss of wellbeing costs	***7,929.2***	***11,839***
Total costs	**12,175.3**	**18,179**

Source: Deloitte Access Economics calculations.

Note: Totals may not add due to rounding.

Chart 7.1 illustrates the financial costs associated with arthritis in New Zealand for 2018. Overall, the majority of costs were associated with caring for people with arthritis (37%), followed by productivity costs (29%) and health system expenditure (23%).

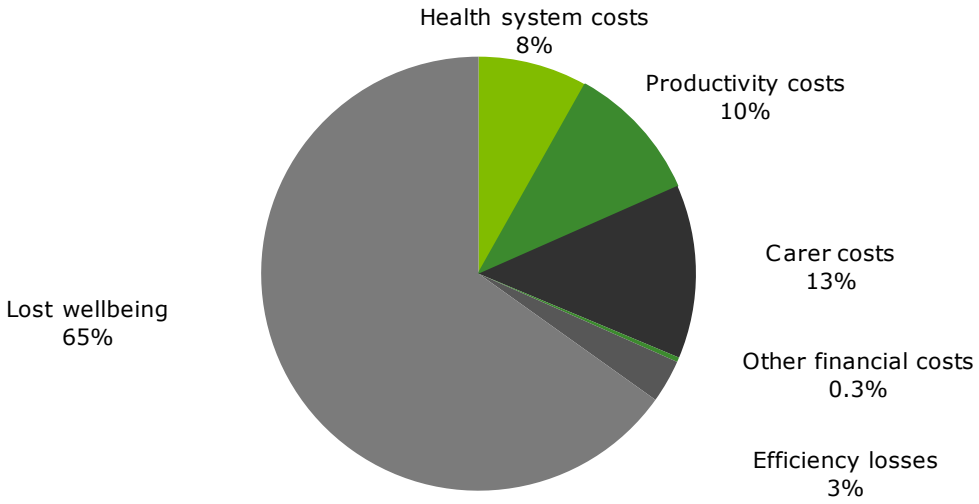
Chart 7.1 Financial costs associated with arthritis in New Zealand, 2018



Source: Deloitte Access Economics calculations.
Note: Totals may not add due to rounding.

Total economic costs reflect financial and wellbeing costs, as depicted in Chart 7.2. As a whole, loss of wellbeing accounted for 65% of the total costs of arthritis in 2018.

Chart 7.2 Total costs associated with arthritis in New Zealand, 2018



Source: Deloitte Access Economics calculations.
Note: Totals may not add due to rounding.

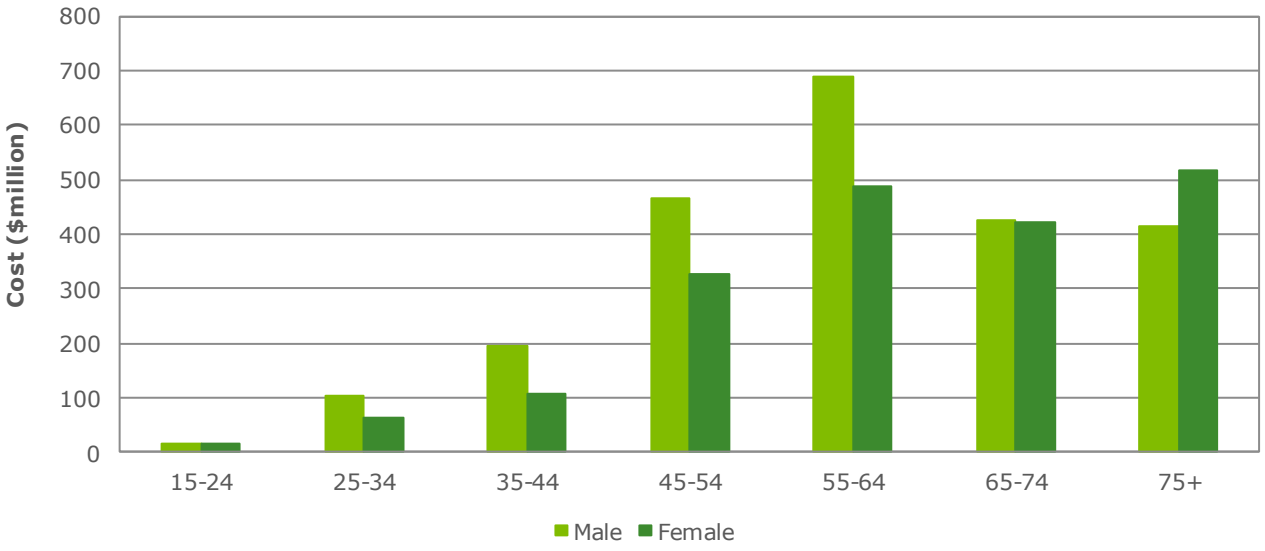
Table 7.2 depicts total economic costs and total costs by age and gender. Economic costs tend to increase with age, in line with the increasing prevalence of arthritis, before declining again due to the smaller number of people in the very old age groups. These trends are illustrated in Chart 7.3 and Chart 7.4.

Table 7.2 Total costs associated with arthritis by age and gender

Age/gender	Health system costs ($m)	Other financial costs ($m)	DALYs ($m)
Male			
15-24	3	14	21
25-34	12	93	106
35-44	19	177	244
45-54	43	421	423
55-64	75	612	806
65-74	97	329	786
75+	138	275	690
Male total	**387**	**1,923**	**3,076**
Female			
15-24	4	11	93
25-34	8	57	157
35-44	14	95	279
45-54	49	276	722
55-64	89	399	1,119
65-74	139	281	1,222
75+	303	212	1,262
Female total	**606**	**1,331**	**4,854**
Persons total	**993**	**3,254**	**7,929**

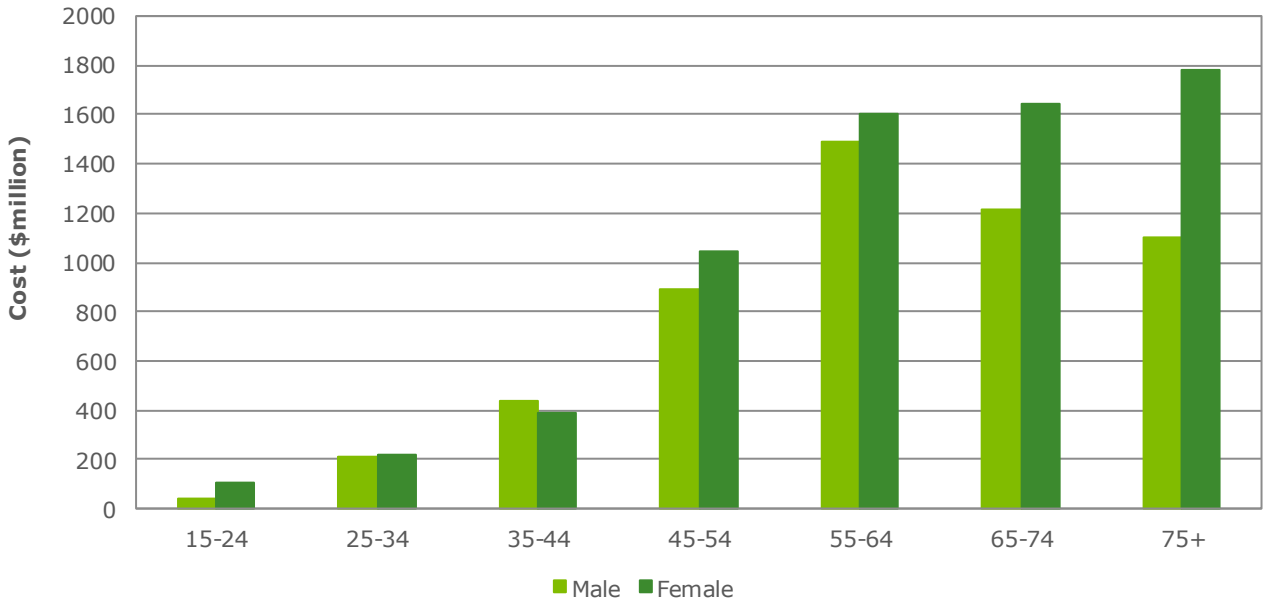
Source: Deloitte Access Economics calculations. Note: For costs where the age and gender specific cost was unknown the per person cost was assumed to be constant. This does not include a small cost associated with people aged under 15 in hospitals. Components may not exactly sum to total due to rounding.

Chart 7.3 Total economic costs associated with arthritis by age and gender, 2018



Source: Deloitte Access Economics calculations.

Chart 7.4 Total cost associated with arthritis by age and gender, 2018



Source: Deloitte Access Economics calculations.

8 Conclusion and recommendations

Arthritis is a highly prevalent condition that affects around 17% of people in New Zealand aged over 15 years. As prevalence increases with age – for people aged over 65 years more than 45% of people have some form of arthritis – it is estimated that 1 million New Zealanders will have arthritis by 2040. For the Māori population, the prevalence of arthritis is almost 25% higher than the non-Māori population, with Māori men almost 50% more likely than non-Māori men to have arthritis. For gout arthritis, compared to the non-Māori non-Pacific population, the Māori prevalence is almost twice as high, while for the Pacific population the prevalence is over three times as high.

Arthritis has a large cost to the New Zealand economy. The total economic and wellbeing costs are estimated to be $12.2 billion in 2018, which is an increase of $5.7 billion from 2010 estimate of the total cost of arthritis of $7.0 billion (Access Economics, 2010). Of these costs, over $1.2 billion are reductions in New Zealand's gross domestic product, and a further $1 billion is spent on healthcare. Almost $8 billion is lost through reduced quality of life from disability and premature mortality.

In undertaking this analysis, we have found that there is a need for better data to be reported on arthritis by the Government in New Zealand. In particular, we could not locate any publicly available data on the prevalence of juvenile arthritis and on elements of health expenditure, notably diagnostic imaging and medical services provided outside of hospitals. This makes it very difficult to understand the full cost of arthritis to the economy and to assess whether people with arthritis are receiving appropriate services, or to identify the best targets for preventative health expenditure. For example, diagnostic imaging may not be required in the diagnosis of osteoarthritis based on recommendations from the European League Against Rheumatism (Sakellarious et al, 2017). Without data on the use of diagnostic imaging for the diagnosis of osteoarthritis in New Zealand it is not possible to assess the extent to which diagnostic imaging is or is not being over used.

Given the prevalence and cost of arthritis, a focus on cost-effective interventions for arthritis such as those targeted at reducing obesity, continued investment in research and development, and self-management education, are important to minimise costs. One initiative is the Ministry of Health funded MAP, which is piloting programs that fund evidence-based early intervention programs. These may inform development of a model of care (Baldwin et al, 2017).

A nationally consistent model of arthritis care focussed on all three of the most prevalent forms of arthritis and modelled on the lines of the Australian policy and its associated eight recommendations may also deliver benefits. This model of care would need to be developed in partnership with Māori providers to ensure the model is culturally appropriate to address the needs of young Māori populations. However, policy support is needed to scale up successful programs and deliver best practice osteoarthritis management nationwide. This would entail recognition of osteoarthritis as a national priority area for intervention.

While age is the strongest risk factor for the progression of many forms of arthritis, there are other risks factors such as obesity and other dietary factors. Studies by Jiang et al (2011; 2012) have found that the risk of developing hip and knee osteoarthritis increase by 11% and 35%, respectively, for each 5-unit increase in BMI. The *Health Loss in New Zealand 2006-2016* publication identified that osteoarthritis contributes over 2% of the total DALYs in New Zealand, and that a high BMI accounts for approximately 60% of this burden. Baldwin et al (2017) has argued that an osteoarthritis model of care should be a national priority for New Zealand.

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Appendix A Forms of arthritis

A.1. Osteoarthritis

Osteoarthritis is the most common form of arthritis. Osteoarthritis is characterised by degradation, destruction and eventual loss of articular cartilage. A healthy cartilage acts as a shock absorber and provides a smooth surface for bones to glide over one another. In osteoarthritis, the cartilage in joints becomes thin and rough, and starts to break down and wear away. Degradation of cartilage can be associated with underlying bone damage, thickening and bone-on-bone friction. Osteoarthritis has been traditionally considered as 'wear and tear' condition of the joint, although recent research has recognised the contribution of inflammation to the breakdown of cartilage (Cicuttini and Wluka, 2014). The development of osteoarthritis can also be the result of hereditary genes, joint injury, infection in the bone or joint or excess weight for a long period (Health Navigator Editorial Team, 2018).

Osteoarthritis can affect any joint in the body, but more commonly occurs in the major weight-bearing joints such as hips, knees or lower spine. Neck and hands are also being frequently affected sites. Symptoms that are consistently associated with osteoarthritis include joint pain, stiffness, swelling and limitation of joint functions. Bone growths and cartilage loss can lead to deformity, affecting ability to carry out physical activity. According to the Global Burden of Disease study, osteoarthritis is the 12th highest contributor to disability globally, and the 16th highest in New Zealand (Abajobir et al, 2017).

A.2. Rheumatoid arthritis

Rheumatoid arthritis is an autoimmune disease, characterised by inflammation of the joints. Inflammation normally occurs as part of the body's mechanism to fight off viruses and bacteria in response to injuries. In rheumatoid arthritis, inflammation occurs for no obvious reason. The body's immune system mistakenly attacks the synovial membrane (the tissue lining the joint producing fluid that lubricate joint tissues) causing inflammation and synovial thickening (Arthritis New Zealand, 2014).

Common symptoms include swelling, pain and stiffness in the joints (usually in the morning). If rheumatoid arthritis is left untreated, joint damage may become irreversible, leading to significant deformity and disability. In addition to joint pain, patients with rheumatoid arthritis may also experience symptoms such as fatigue, depression, irritability and flu-like symptoms. Rheumatoid arthritis can also be symmetrical, with the same joints on both sides of the body being affected. Other less common symptoms include weight loss, rheumatoid nodules and inflammation of other body parts such as eyes, lungs and blood vessels (Banderas et al, 2017).

A.3. Gout arthritis

Gout arthritis occurs when uric acid levels build up in the blood causing excess urate to crystallise in one or more joints. These sharp and needle-shaped crystals result in inflammation, intense pain and swelling (Khanna *et al,* 2012; as cited in Dalbeth et al, 2016). Gout arthritis can affect any joint, but most commonly the big toe. It is also not uncommon to have gout arthritis attack in knees, elbows, ankles or wrists.

Gout arthritis is characterised by sudden attacks of severe pain, swelling, redness, heat and stiffness in the affected joints. Although an attack usually lasts about one week, if gout arthritis is not managed well, attacks can become more frequent and more severe. In some cases, gout arthritis can progress into a chronic condition causing constant mild pain, tophi (lumps) and kidney stones (Arthritis New Zealand, 2018b).

Appendix B Literature review

B.1. Data sources used in prevalence estimation

The best method of measuring community prevalence is through well-designed clinical studies of populations, preferably longitudinal and prospective. This is recommended, as such studies are very useful to inform policy makers on risk factors, impacts and the cost-effectiveness of interventions and preventive activities. However, there do not appear to be such studies in relation to arthritis in New Zealand. Despite being a common condition around the world, there were a limited amount of sources that discuss the prevalence of arthritis specifically in New Zealand. The primary source of data for New Zealand contains a measure of self-reported arthritis.

In the absence of detailed New Zealand epidemiological studies, the best estimate of community arthritis prevalence obtainable is from well-designed self-reported surveys, as these tend to capture some undiagnosed arthritis as well as almost all diagnosed arthritis. Self-reported data have been criticised due to concerns that people:

- do not have sufficient information to know whether or not they have a particular condition;
- may have recall problems; and
- may be 'led' in the survey or due to other incentives to misrepresent or misclassify their condition.

While this may be true in some cases, anonymous non-coercive self-reported data for current long term conditions (except mental health illnesses) have tended to support prevalence estimates based on clinical studies, with no significant bias towards reporting found (Benitez et al, 2004). Moreover, more recent survey verification techniques are utilised (such as cross-checks with other household members or aged care facility staff, detailed questioning regarding the condition etc.) in order to minimise any potential bias.

Appendix C provides the questions from the NZHS on arthritis. A key point to note is that the estimate is of diagnosed arthritis as adults (aged 15 years or older) are defined as having arthritis if they had ever been told by a doctor that they have arthritis. This definition is likely to underestimate true arthritis prevalence as some people may be in the early stages of disease and have yet been diagnosed. The follow-up question differentiates the type of arthritis, including rheumatoid arthritis, osteoarthritis, gout arthritis, other known type (specified) and 'Other'. As an example, adults are defined as having osteoarthritis if they had ever been told by a doctor that they have arthritis, and one of the types of arthritis they have is osteoarthritis. It should be noted that as multiple responses are allowed, the sum of the number of people with each type of arthritis will be greater than the 'total' number of people with any (or multiple) forms of arthritis.

This report estimates arthritis (overall, osteoarthritis and rheumatoid arthritis) prevalence based on the 2016-17 NZHS. Although the NZHS also provides gout arthritis prevalence, a richer data set is available from the New Zealand Health Quality and Safety Commission (HQSC) and these data were used for the prevalence of gout arthritis for this report. As shown in Table B.1, the rates reported are lower, particularly for the Māori and Pacific populations, compared to the HQSC.

Table B.1 Prevalence rate of gout arthritis, 2014 by ethnicity

	HQSC (2014)	NZHS (2011-14)
Māori	7.6	3.4
Pacific	12.7	4.5
All*	4.9	2.1

Source: Regional results of 2011-14 NZHS and 2014 HQSC. * All means all ethnic groups, including Māori, Pacific, European/Other, Asian and Other.

It should be noted that of the surveyed participants, only 19% were Māori and 5% were of Pacific origin. Since Māori and Pacific populations are found to be more prone to gout arthritis development (Gibson et al, 1984;

Klemp et al, 1997, as cited in Access Economics, 2010), the NZHS data are likely to underestimate prevalence of gout arthritis. The HQSC estimates prevalence of gout arthritis using a similar approach to Winnard et al (2012), utilising both public hospital admissions and medicine claims[46]. The HQSC provides the number and percent of the New Zealanders (aged 20 years and older) identified with gout arthritis up to 31 December 2016.

As noted in Access Economics (2010), surveys of prevalence within the primary care system (such as the use of General Practitioners (GP) consultations) only identify those people with arthritis who also seek medical attention for their condition within a certain period. In case of gout arthritis, as attacks can reoccur and get worse if left untreated, patients with gout arthritis are likely to seek medical assistance. Thus, primary care data can be used to estimate prevalence of gout arthritis. The HQSC data, which were based on service utilisation, also cover an extensive period from 1988 to 2016, which helps mitigate the recall problem posed by self-reported surveys.

Prevalence from the NZHS and the HQSC was evaluated to assess consistency with findings from international studies, particularly from countries with similar demographic profiles to that of New Zealand. The prevalence estimates from these studies are provided in Table B.3. As evident in the table, the prevalence rates derived from the NZHS and the HQSC are similar to prevalence rates available from these studies, albeit slightly higher for rheumatoid arthritis.

Table B.2 Summary of prevalence rates from literature research

Condition	Range of prevalence rates from literature	Prevalence rates from New Zealand data[47]
Arthritis (all types)	15.3[48] – 21.6%	16.9%
Rheumatoid arthritis	0.3 - 2%	2.5%
Osteoarthritis	9.0 - 14.8%	10.2%
Gout arthritis	1.4 - 5.2%	5.1%

Sources: Detailed information on the references for the prevalence rates from literature are presented in Appendix B.2.

[46] Adults (≥ 20 years old) are identified with gout arthritis if they have either been in public hospital with a diagnosis of gout arthritis (ICD 9 274, ICD 10 M10) from 1 January 1988 to 31 December 2016, or have been prescribed with allopurinol or colchicine from a community pharmacy between 2001 and 2016. Patients with leukaemia or lymphoma are excluded. Source: https://www.hqsc.govt.nz/assets/Health-Quality-Evaluation/Atlas/gout arthritisSF14Jan/atlas.html

[47] Estimates of prevalence rates for arthritis, rheumatoid arthritis and osteoarthritis were obtained from the 2016-17 NZHS. Deloitte Access Economics estimated the prevalence rate of gout arthritis for 2017 based on the HQSC 2016 data.

[48] This estimate was obtained from the Australian Bureau of Statistics (ABS) National Health Survey 2014-15.

B.2. Literature research on prevalence of arthritis

Table B.3 Overview of literature research

Condition	Study	Brief description
Gout arthritis	Winnard et al (2012), Aotearoa New Zealand	The authors investigated th**e prevalence of gout arthritis** in the entire Aotearoa New Zealand population. The study used hospitalisation and medicine dispensing claims from the Aotearoa New Zealand Health Tracker (ANZHT) to estimate the prevalence of gout arthritis in 2009. **Estimates of prevalence were 2.69% and 3.75% for all-ages and ≥20 years old populations, respectively.** The study also cross-checked the results using the HealthStat database which contains primary care records from a sample of 103 New Zealand general practices. Of 555 313 patients recorded, 16 956 had been diagnosed with gout arthritis, giving an estimated all-ages raw prevalence of 3.05% and standardised prevalence of 2.89%. Estimates of prevalence for ≥20 years old in the HealthStat sample was 4.52% (raw) or 4.06% (standardised).
Rheumatoid arthritis Arthritis	Helmick et al (2008), United States of America (US)	The study reports on the prevalence of self-reported doctor-diagnosed arthritis in the US. Using the 2003-05 National Health Interview Survey, **the estimated prevalence of overall arthritis among adults aged 18 years or older was 21.6%.** The authors also estimated the **rheumatoid arthritis (RA) prevalence rate to be 0.6%** among American adults by applying the 1995 rheumatoid arthritis prevalence in Rochester, Minnesota to the corresponding 2005 population estimates.
Rheumatoid arthritis	Guillemin et al (2005), France	The authors assessed the prevalence of **rheumatoid arthritis** in France in the year 2001. A national multistage (including case detection and case confirmation stages) sample survey was conducted in 20 counties across various regions. Using responses from 9395 adults ≥18 years old, the study gives **an estimated overall standardised (for age and gender) prevalence of 0.31%, 0.51% for women and 0.09% for men**. Estimates of prevalence also varied across regions, ranging from 0.16 to 0.62%.
Osteoarthritis	Plotnifoff et al (2015), Canada	The study examined the prevalence of self-reported knee and hip osteoarthritis (OA) in Alberta, Canada. Adults ≥18 years were randomly selected from four communities. A total sample of 4 733 was telephone interviewed, of which, 1808 agreed to take part in a clinical-based survey. **The overall prevalence of self-reported (knee or hip) OA in the total sample was 14.8%**. For knee OA, the prevalence was 6.3% for males and 8.9% for females using self-reported data (4.4% for males and 6.7% for females using robust values). For hip OA, the prevalence was 4.4% for males and 7.6% for females (2.9% for males and 4.1% for females using robust values).
Osteoarthritis	Grotle et al (2008), Norway	The study assessed the prevalence of knee, hip and hand OA in Norway. The target cohort, to which postal questionnaire were sent in 2004, included people born in 1928-30, 1938-40, 1948-50, 1958-60, 1968-70, and 1978-80. **From a total of 3266 respondents, the overall prevalence of OA was estimated to be 12.8%**. The prevalence of hip, knee and hand OA was 5.5%, 7.1% and 4.3%, respectively.
Gout arthritis	Kuo et al (2013), UK	The study investigated trends in the prevalence of gout arthritis in the UK from 1997 to 2012. From the Clinical Practice Research Datalink (one of the largest databases of longitudinal medical records from primary care in

Condition	Study	Brief description
		the world), the prevalence of gout arthritis for each calendar year was estimated. Of 4,634,974 participants, 115,608 prevalence cases of gout arthritis were identified, giving **a prevalence of 2.49% in 2012** (significantly higher than in 1997 with a prevalence of 1.52%).
Gout arthritis	Zhu et al (2011), US	The authors assessed the prevalence of gout arthritis in the US using the National health and Nutrition Examination Survey (NHANES) 2007-2008. Gout arthritis cases were identified by asking participants their history of health professional-diagnosed gout arthritis. **The prevalence of gout arthritis among adults in 2007-2008 was 3.9%,** 5.9% among men and 2.0% among women.
Gout arthritis	Ting et al (2016), Australia	The study looked at the prevalence and associations of gout arthritis and hyperuricemia in South Australia using the North West Adelaide Health Study (a representative longitudinal study of adults ≥18 years old, consisting of three stages). In Stage 3 (2008-2010), participants were asked if a doctor had ever diagnosed them with gout arthritis. Participants were defined as having gout arthritis if they had self-reported medically diagnosed gout arthritis or were taking any gout arthritis-specific medication. From the 2389 participants who provided a response to self-reported medically diagnosed gout arthritis, **the overall prevalence of gout arthritis was estimated to be 5.2%.** Males were found to be significantly more likely to have gout arthritis than females (8.5% vs 2.1%).
Gout arthritis	Annemans et al (2007), UK and Germany	The authors conducted a retrospective analysis of patients with gout arthritis, using a longitudinal database containing patient records from general practitioners. Patients (≥18 years old) included in the analysis if they had had a consultation with a diagnosis of gout arthritis between Jan 2000 and Jun 2005. **The prevalence of gout arthritis was estimated to be 1.4% in both countries.**
Gout arthritis	Robinson et al (2015), Australia	The study examined the prevalence of gout arthritis using data from general practice point-of-care electronic records over a 5-year period from Dec 2008 to Nov 2013. The study cohort included adults aged 20 years or older. A validated method for population-wide epidemiological studies of gout arthritis was used to identify patients with gout arthritis. **The raw prevalence of gout arthritis in the general practice population was 1.54%**.

Appendix C NZHS Questions

Figure C.1 Arthritis-related questions

Arthritis

A1.18 Have you ever been told by a doctor that you have arthritis? Please include gout arthritis, lupus and psoriatic arthritis.

1 Yes
2 No [go to mental health conditions intro before A1.23]
.K Don't know [go to intro before A1.23]
.R Refused [go to intro before A1.23]

[Showcard]
A1.19 What kind of arthritis was that?
[Multiple responses possible]

1 Rheumatoid
2 Osteoarthritis
3 Gout arthritis
4 Psoriatic
5 Systemic lupus erythematosus (SLE)
77 Other **[Specify]** _____
.K Don't know [go to treatments A1.21]
.R Refused [go to A1.21]

ⓘ Ask A1.20 if respondent has more than one kind of arthritis in A1.19.

A1.20 Which kind of arthritis affects you most?

1 Rheumatoid
2 Osteoarthritis
3 Gout arthritis
4 Psoriatic
5 Systemic lupus erythematosus (SLE)
77 Other **[Specify]** _____
.K Don't know
.R Refused

[Showcard]
A1.21 What treatments do you <u>now</u> have for arthritis?
[Multiple responses possible]

1 No treatment
2 Medicines, tablets, or pills
3 Exercise or physiotherapy
4 Injections
5 Diet
77 Other **[Specify]** _____
.K Don't know
.R Refused

A1.22 Have you ever had an operation or surgery because of your arthritis?

1 Yes
2 No
.K Don't know
.R Refused

[Showcard]

A1.22a Are you now limited in any way in your usual activities because of arthritis symptoms?

1 Yes, limited a lot
2 Yes, limited a little
3 No, not limited at all
.K Don't know
.R Refused

Source: Ministry of Health 2017a.

Appendix D Data sets

Table D.1 Arthritis public inpatient costs by ICD-10 code, 2017-18

Code	ICD-10 Descriptor	Number	Average length of stay	Total ($ millions)	% Total cost
M17	Gonarthrosis [arthrosis of knee]	5,511	3.2	84.0	35.2%
M16	Coxarthrosis [arthrosis of hip]	5,351	3.3	80.8	33.9%
M48.0	Spinal stenosis	1,407	5.8	21.0	8.8%
M19	Other arthrosis	1,057	2.1	11.8	4.9%
M00	Pyogenic arthritis	762	9.4	9.8	4.1%
M10	Gout	1,713	3.0	5.5	2.3%
M06	Other rheumatoid arthritis	1,327	1.8	4.5	1.9%
M65	Synovitis and tenosynovitis	1,003	1.8	3.4	1.4%
M46	Other inflammatory spondylopathies	303	10.4	3.2	1.3%
M13	Other arthritis	492	2.2	2.7	1.1%
M47	Spondylosis	390	3.1	2.6	1.1%
M05	Seropositive rheumatoid arthritis	1,185	1.2	2.2	0.9%
M31	Other necrotizing vasculopathies	453	3.9	1.9	0.8%
M11	Other crystal arthropathies	347	2.9	1.3	0.6%
M08	Juvenile arthritis	444	1.0	1.3	0.5%
M32	Systemic lupus erythematosus	289	3.1	1.2	0.5%
M30	Polyarteritis nodosa and related conditions	205	4.3	1.0	0.4%
M45	Ankylosing spondylitis	340	0.8	1.0	0.4%
M18	Arthrosis of first carpometacarpal joint	186	0.6	0.8	0.3%
M35.3	Polymyalgia rheumatica	145	2.1	0.7	0.3%
M07	Psoriatic and enteropathic arthropathies	141	1.8	0.5	0.2%
M76	Enthesopathies, lower limb, excluding foot	106	1.6	0.5	0.2%
M34	Systemic sclerosis	126	2.8	0.5	0.2%
M02	Reactive arthropathies	177	1.9	0.5	0.2%
M12	Other specific arthropathies	54	1.6	0.4	0.1%
M49	Spondylopathies in diseases classified elsewhere	31	6.1	0.3	0.1%

Code	ICD-10 Descriptor	Number	Average length of stay	Total ($ millions)	% Total cost
M14	Arthropathies in other diseases classified elsewhere	25	10.3	0.3	0.1%
M75.0	Adhesive capsulitis of shoulder	64	1.0	0.2	0.1%
M71.2	Synovial cyst of popliteal space [Baker]	67	0.9	0.2	0.1%
M15	Polyarthrosis	32	1.1	0.1	0.1%
M35.0	Sicca syndrome [Sjögren]	40	1.2	0.1	0.1%
M77.5	Other enthesopathy of foot	14	0.6	0.06	0.0%
M09	Juvenile arthritis in diseases classified elsewhere	9	1.0	0.04	0.0%
M77.3	Calcaneal spur	9	0.4	0.04	0.0%
M77.9	Enthesopathy, unspecified	11	0.9	0.04	0.0%
M01	Direct infections of joint in infectious and parasitic diseases classified elsewhere	6	3.5	0.02	0.0%
M48.1	Ankylosing hyperostosis [Forestier]	4	3.3	0.02	0.0%
M35.1	Other overlap syndromes	4	4.3	0.02	0.0%
M70.0	Crepitant synovitis (acute) (chronic) of hand and wrist	2	2.0	0.008	0.0%
M03	Postinfective and reactive arthropathies in diseases classified elsewhere	2	2.0	0.003	0.0%
M68	Disorders of synovium and tendon in diseases classified elsewhere	-	-	-	0.0%
M77.8	Other enthesopathies, not elsewhere classified	-	-	-	0.0%
Total		**23,835**		**244.0**	**100%**

Source: Data request from the Ministry of Health.

Table D.2 Arthritis public inpatient costs by age and gender, 2017-18

	$ millions			% of total		
Age groups	**Female**	**Male**	**Total**	**Female**	**Male**	**Total**
0 to 14	1.7	1.8	3.5	0.7%	0.7%	1.4%
15 to 24	0.98	1.15	2.12	0.4%	0.5%	0.9%
25 to 34	1.46	2.16	3.62	0.6%	0.9%	1.5%
35-44	3.56	3.36	6.93	1.5%	1.4%	2.8%
45-54	11.78	11.42	23.19	4.8%	4.7%	9.5%
55-64	28.59	27.27	55.87	11.7%	11.2%	22.8%
65-74	43.51	36.98	80.50	17.8%	15.1%	32.9%
75+	39.23	29.60	68.84	16.0%	12.1%	28.2%
Total	**130.8**	**113.7**	**244.5**	**53.5%**	**46.5%**	**100.0%**

Source: Deloitte Access Economics analysis based on data from the Ministry of Health.

Table D.3 Arthritis private inpatient costs by ICD-10 code, 2017-18

Code	ICD-10 Descriptor	Number	Average length of stay	Total ($ millions)	% Total cost
M17	Gonarthrosis [arthrosis of knee]	2,498	4.4	35.3	46.0%
M16	Coxarthrosis [arthrosis of hip]	2,775	4.2	38.4	50.1%
M48.0	Spinal stenosis	254	3.2	1.1	1.4%
M19	Other arthrosis	113	2.5	1.1	1.4%
M00	Pyogenic arthritis	2	14.0	0.04	0.1%
M10	Gout	6	0.6	0.006	0.0%
M06	Other rheumatoid arthritis	15	2.8	0.1	0.1%
M65	Synovitis and tenosynovitis	207	0.0	0.0009	0.0%
M46	Other inflammatory spondylopathies	5	4.4	0.1	0.2%
M13	Other arthritis	5	2.0	0.03	0.0%
M47	Spondylosis	12	3.1	0.4	0.5%
M05	Seropositive rheumatoid arthritis	1	1.0	0.003	0.0%
M31	Other necrotizing vasculopathies	2	-	-	0.0%
M11	Other crystal arthropathies	-	1.0	-	0.0%
M08	Juvenile arthritis	-	-	-	0.0%
M32	Systemic lupus erythematosus	1	-	-	0.0%

Code	ICD-10 Descriptor	Number	Average length of stay	Total ($ millions)	% Total cost
M30	Polyarteritis nodosa and related conditions	1	4.0	0.007	0.0%
M45	Ankylosing spondylitis	-	-	-	0.0%
M18	Arthrosis of first carpometacarpal joint	1	-	-	0.0%
M35.3	Polymyalgia rheumatic	-	-	-	0.0%
M07	Psoriatic and enteropathic arthropathies	-	-	-	0.0%
M76	Enthesopathies, lower limb, excluding foot	13	0.9	0.02	0.0%
M34	Systemic sclerosis	-	1.0	-	0.0%
M02	Reactive arthropathies	2	2.0	0.006	0.0%
M12	Other specific arthropathies	3	1.7	0.02	0.0%
M49	Spondylopathies in diseases classified elsewhere	-	-	-	0.0%
M14	Arthropathies in other diseases classified elsewhere	9	3.5	0.04	0.1%
M75.0	Adhesive capsulitis of shoulder	10	1.0	-	0.0%
M71.2	Synovial cyst of popliteal space [Baker]	1	1.0	0.001	0.0%
M15	Polyarthrosis	-	1.0	-	0.0%
M35.0	Sicca syndrome [Sjögren]	1	1.2	0.004	0.0%
M77.5	Other enthesopathy of foot	8	0.3	0.01	0.0%
M09	Juvenile arthritis in diseases classified elsewhere	-	-	-	0.0%
M77.3	Calcaneal spur	10	0.2	0.009	0.0%
M77.9	Enthesopathy, unspecified	8	0.1	0.005	0.0%
M01	Direct infections of joint in infectious and parasitic diseases classified elsewhere	-	1.0	-	0.0%
M48.1	Ankylosing hyperostosis [Forestier]	-	-	-	0.0%
M35.1	Other overlap syndromes	-	-	-	0.0%
M70.0	Crepitant synovitis (acute) (chronic) of hand and wrist	-	-	-	0.0%
M03	Postinfective and reactive arthropathies in diseases classified elsewhere	-	1.0	-	0.0%
M68	Disorders of synovium and tendon in diseases classified elsewhere	-	-	-	0.0%
M77.8	Other enthesopathies, not elsewhere classified	-	1.0	-	0.0%
Total		**5,964**		**$77.0**	

Source: Deloitte Access Economics based on Ministry of Health data.

Table D.4 Laboratory test numbers and costs, 2018 estimates

Laboratory Test name	Number of tests (thousands)	Estimated number of arthritis tests (thousands)	Estimated % of tests related to arthritis	Estimated value of arthritis-related claims ($ thousands)
Albumin, serum	224.5	6.4	3%	21.6
Alkaline phosphatase, serum	115.1	3.3	3%	11.7
Alpha-feto protein	1.9	0.2	10%	2.2
Amylase	62.9	1.3	2%	4.4
Anti human globulin test including Coombs test	2.3	0.3	14%	2.5
Asparate amino transferase, serum – AST	72.8	68.7	94%	231.8
Autoantibodies, other	213.2	28.8	14%	357.1
Blood Grouping - ABO/ Rhesus group	6.3	0.9	14%	6.3
Blood grouping - Rhesus - phenotyping	0.05	0.007	14%	0.1
Blood grouping - Rhesus – titre	0.4	0.05	14%	0.7
Blood Grouping ABO group	0.01	0.001	14%	0.005
Bone marrow aspirate - (per site, not per slide)	0.2	0.02	14%	6.0
Brucella antibodies	0.1	0.01	12%	0.01
Calcium, serum	360.4	12.0	3%	41.0
Chlamydia direct antigen test	240.0	3.2	1%	73.3
Cholesterol total, serum	28.9	0.6	2%	2.1
Coagulation factors individual assays	22.9	3.1	14%	98.4
Coagulation profile	1.3	0.2	14%	5.4
Coagulation profile (Group H06 - H07 - S01)	31.9	4.3	14%	113.1
C-reactive protein test	957.9	71.2	7%	449.1
Creatinine, serum	2,370.1	67.0	3%	221.5
Digoxin	10.5	0.8	7%	5.9
Epstein-Barr virus IgG antibody	34.0	0.5	1%	10.6
Epstein-Barr virus IgM antibody	17.6	0.2	1%	4.8
Erythrocyte sedimentation rate (ESR)	101.6	56.8	56%	414.6
Faecal occult blood, human haemoglobin specific	43.6	0.6	1%	4.2
Fasting lipid group test	1,324.7	179.1	14%	1,465.1
Ferritin, serum	1,198.5	81.6	7%	523.1

Laboratory Test name	Number of tests (thousands)	Estimated number of arthritis tests (thousands)	Estimated % of tests related to arthritis	Estimated value of arthritis-related claims ($ thousands)
Fibrinogen (qualitative)	0.04	0.002	14%	0.03
Fibrinogen (quantitative)	30.8	4.2	14%	39.8
Folate plus Vitamin B12, serum	657.2	56.4	9%	468.1
Folate, red cell	12.6	1.1	9%	8.8
Follicle stimulating hormone (FSH)	80.0	1.0	1%	9.7
Gamma glutamyl transferase, serum (GGT)	57.2	54.8	96%	194.2
Glucose Tolerance Test post-polycose	30.5	0.5	2%	2.8
Glucose Tolerance Test standard	19.8	0.3	2%	5.8
Glycosylated haemoglobin	1,741.9	1,142.1	66%	12,392.1
Hepatitis B - (HBsAg) surface antigen	91.1	2.0	2%	14.9
Hepatitis C antibody	71.5	1.6	2%	22.3
Immunoglobulins (IgA, IgE, IgG, or IgM)	178.8	8.5	5%	58.3
Iron, serum	319.0	7.2	2%	25.6
Ketones	0.002	-	4%	0.001
Liver function group	1,550.8	137.3	9%	2,756.3
Lupus erythematosis cells (LE cells)	0.3	0.05	14%	2.1
Luteinising hormone (LH)	86.1	1.7	2%	12.6
Magnesium, serum	74.8	1.8	2%	7.1
Magnesium, urine	0.05	0.001	2%	0.009
Oestradiol, serum	75.8	2.0	3%	26,495
Paul-Bunnell (or equivalent)	2.7	0.06	2%	0.2
Phosphate, serum	281.7	6.5	2%	21.9
Potassium, 24 hr. urine	0.04	0.001	3%	0.007
Potassium, serum	57.1	1.6	3%	5.5
Progesterone, serum	63.1	1.5	2%	13.4
Prolactin, serum	39.0	0.8	2%	9.8
Prostate Specific Antigen	386.7	11.1	3%	127.1
Prostate Specific Antigen	0.1	0.004	3%	0.06
Red blood cell inclusion bodies	15.7	2.1	14%	22.1
Rheumatoid factor - Rose Waaler test	59.0	10.4	18%	68.8

Laboratory Test name	Number of tests (thousands)	Estimated number of arthritis tests (thousands)	Estimated % of tests related to arthritis	Estimated value of arthritis-related claims ($ thousands)
Sodium, serum	53.0	1.5	3%	5.1
Thyroid stimulating hormone, serum (TSH)	1,209.7	27.9	2%	165.0
Toxoplasma antibodies IgG	5.0	0.3	6%	4.8
Toxoplasma antibodies IgM	5.0	0.3	6%	3.7
Transferrin, serum	155.7	3.3	2%	14.7
Urea, serum	308.7	11.3	4%	34.7
Urine culture	667.7	48.3	7%	813.6
Totals	**15,831.7**	**2,140.7**		**21,434.3**

Source: Deloitte Access Economics based on Ministry of Health, Laboratory Tests 2016-17.

Appendix E Supplementary methods

Methodology to calculate population attributable fractions

Where evidence from studies of a causal relationship between arthritis residential aged care placement was provided in terms of odds ratios, population attributable fractions were calculated using the following method based on Eide and Heuch (2001). First, the following two equations were solved simultaneously:

$$q1 * s1 + q2 * p1 \quad (1)$$

$$\frac{q1}{1-q1} * \frac{1-q2}{q} = OR \quad (2)$$

where:

- $q1$ = probability of residential aged care placement given that an individual had arthritis;
- $q2$ = probability of residential aged care placement given that an individual did not have arthritis;
- $s1$ = probability of having arthritis;
- $s2$ = probability of not having arthritis;
- $p1$ = probability of residential aged care placement; and
- OR = odds ratio for admission to residential aged care given arthritis.

After solving these equations for $q1$ and $q2$, the following equation is derived:

$$PAF = \frac{(q1-q2) * s1}{p1} \quad (3)$$

Equation (3) was used to determine the population attributable fraction for each condition due to delirium. Where studies reported relationships in terms of a hazard ratio, the hazard ratios were assumed to be roughly equivalent to relative risk ratios.[49] The population attributable fraction was calculated using the following equation, taken from Eide and Heuch (2001).

$$PAF = \frac{s1 * (RR-1)}{s1 * (RR-1) + 1} \quad (4)$$

where:

- $s1$ = probability of having arthritis; and
- RR = relative risk ratio.

[49] Choi et al (2010) show that where the risk of an event is rare, relative risk ratios are numerically quite similar to hazard ratios.

Limitation of our work

General use restriction

This report is prepared solely for the use of Arthritis New Zealand. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of providing an estimate on the economic cost of arthritis in New Zealand in 2018. You should not refer to or use our name or the advice for any other purpose.

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