COUNTING THE COST

PART 2 ECONOMIC COSTS

The current and future burden of arthritis

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Arthritis Australia
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Arthritis AUSTRALIA

Foreword

About this report:

Counting the Cost: The Current and Future Burden of Arthritis provides up to date estimates of the prevalence and costs of arthritis from 2015 to 2030 under a 'business as usual' scenario. It also models the impact of implementing non-surgical interventions for knee osteoarthritis to illustrate the potential benefits for individuals, governments and the economy from better arthritis care.

Part 1 Healthcare Costs estimates the current and future prevalence of arthritis and the associated costs to the health system. Part 2 Economic Costs considers the economic costs of arthritis, including lost personal income, increased welfare payments, reduced taxation revenue and lost GDP.

Arthritis is one of the most common, costly and disabling chronic conditions in Australia. In its many forms, it affects nearly four million people of all ages, including children.

The personal, social and economic costs of arthritis, as highlighted in this report, are immense but tend to be poorly recognised. These costs amount to many billions of dollars a year and include health care costs, lost personal income and national productivity losses from reduced work capacity due to arthritis and, of course, the immeasurable cost of lost wellbeing.

With arthritis prevalence set to reach 5.4 million people by 2030, associated costs will continue to grow, putting increasing pressure on the sustainability of the health, welfare and aged care systems.

Yet much can be done to alleviate these costs by implementing simple programs to prevent and better manage arthritis. As highlighted in this report, a simple intervention for knee osteoarthritis could achieve savings to the health system of over $170 million a year, as well as helping to keep more people in the work force, yielding additional economic benefits.

The time has come to give programs that provide better care and support for people with arthritis the priority they deserve. With the health and welfare system costs of arthritis set to grow by more than $150 million a year, we simply can't afford not to.

Ainslie Cahill
CEO
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Table of contents

List of tables

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In this project, we used adjusted microsimulation models from Health&WealthMOD and Health&WealthMOD2030 to project the economic costs of arthritis. The development of the Health&WealthMOD was funded by the Australian Research Council (ARC) Linkage Project Grant LP0774919 and awarded to Chief Investigators: Deborah Schofield, Megan Passey, Arul Earnest, Richard Percival and Simon Kelly. Health&WealthMOD2030 was funded by the ARC Linkage Project Grant LP100100158 and awarded to Chief Investigators: Deborah Schofield, Megan Passey, Simon Kelly, Theo Vos, Robert Tanton. Pfizer Australia was a partner to both these grants.

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Executive summary

Arthritis is a common, costly and disabling condition[1]. Due to its impact on physical functioning (and psychological impacts due to pain), it is a condition that impacts substantially on labour force participation (including employment, absenteeism, presenteeism). The indirect costs of arthritis (labour force participation, travel costs, special aids and equipment, carer costs) are recognised as being greater than the direct (healthcare) costs, and these costs are expected to increase over time due to demographic factors (population ageing, more older women in the population who have a greater risk of arthritis)[1-3].

The aims of this study were: (a) To project the economic impacts of arthritis from 2015 to 2030, primarily focussing on the costs of lost productivity; and (b) the potential savings from implementing the main elements of an effective intervention for managing arthritis from the societal perspective. The projected costs of arthritis to the health system under these same scenarios are considered in *Counting the Cost, Part 1 Healthcare Costs.*

In this report, we projected the costs of arthritis through lost labour force participation among Australians aged 15-64 years from the individual and government perspectives. Using our adjusted microsimulation models, we projected 52,000 people to be out of the labour force due to arthritis in 2015, increasing to 59,000 in 2030 – a 13% increase.

By 2030, people not in the labour force due to arthritis were projected to receive AU$1,194.23 (95%CI: $1,260.73; $1,139.16) less in income, $295.53 (95%CI: $291.04; $299.75) more in welfare payments and pay $307.55 (95%CI: $288.92; $328.94) less in taxes per week. They would also have $431,719 (95%CI: $374,393; $493,846) less in total savings and assets than full-time workers without arthritis.

National costs consisted of a loss in annual personal income of $1,753 million (95%CI: $1,631 million; $1,911 million) in 2015, increasing to $2,626 million (95%CI: $2,477 million; $2,808 million) in 2030 – a 50% increase. Extra annual welfare payments increased from $635 million (95%CI: $619 million; $649 million) in 2015 to $784 million (95%CI: $767 million; $801 million) in 2030 – a 23% increase. Lost annual taxation revenue increased from $458 million (95%CI: $422 million; $499 million) in 2015 to $660 million (95%CI: $612 million; $714 million) in 2030 – a 12% increase. A loss of $7.2 billion in GDP was projected for 2015 due to the impact of arthritis on the labour force, increasing to $9.4 billion in 2030 (all figures are expressed in 2015 real Australian dollars).

In this report we also projected the costs of caring for a relative or friend with arthritis through lost labour force participation from 2015 to 2030.

Using our models, we estimated there were 19,000 primary carers (aged 15-64 years) not in the labour force and caring for people with arthritis in 2015. Carers of people with arthritis who were out of the labour force received $293.53 in median weekly income in 2015, which was only 23% of the median weekly income of non-carers who are employed full-time. These primary carers received a median amount of weekly welfare payments of $246.70 and paid a median value of $0 in tax per week, whereas non-carers in full-time employment received a median value of $0 in welfare payments per week, and paid a median value of $256.09 per week in tax in 2015.

By 2030, there are projected to be 22,000 (0.12% of total population) people out of the labour force and caring for someone with arthritis. Primary carers who are not in the labour force and caring for someone with arthritis are projected to receive $313.34 a week in income, $247.78 a week in welfare payments, and pay $0 in income taxes in 2030, expressed in real Australian 2015 dollars.

Published results on the health related quality of life outcomes of a randomised controlled trial *The Arthritis, Diet, and Activity Promotion Trial (ADAPT)*[4,5] were used to estimate the number of people, who would have remained in the labour force if their knee osteoarthritis (OA) had been managed with the ADAPT interventions. It has been estimated that there would be an additional 572 people in the workforce aged 15-64 years as a result of managing their knee OA through a *dietary weight loss plus exercise intervention* from the ADAPT trial in 2015, which would increase to 716 individuals in 2030. The cumulative economic benefit of this increased labour force participation would be an estimated increase of $20.8 million in their annual income in 2015, which would increase to $33.5 million in 2030. There would be an estimated saving of about $7.8 million in welfare payments and an estimated increase of $5.4 million in income tax revenue in 2015. By 2030, the economic benefits for the government would be an estimated reduction of $9.9 million per year in welfare payments, and an estimated increase of $8.4 million in income tax revenue – all attributable to the individuals being able to remain in the labour force as a result of pain reduction by managing their knee OA through a *dietary weight loss plus exercise intervention.* This demonstrates that the interventions to manage knee OA or other chronic conditions have the potential to provide economic benefits to individuals in terms of their increased labour force participation and private income, and to the government in terms of increased income tax revenue and decreased transfer payments, in addition to health benefits.

1 Background

Global Burden of Disease Study Collaborators (2015) estimated there were 537.6 million years lived with disability (YLDs) globally due to acute and chronic diseases and injuries in 1990, increasing to 764.8 million in 2013 (42.3% increase) due to population growth and ageing[6]. Musculoskeletal disorders were a principal category of chronic disease contributing to the increase in YLDs. YLDs for rheumatoid arthritis increased by 56.8% and, for osteoarthritis by 75.4%, from 1990 to 2013. Although these studies provide information about the disease burden of arthritis, governments and international public health/economic organisations (such as WHO, OECD) are equally concerned about the impact of chronic diseases such as arthritis on the productivity of citizens and the capacity of future governments to provide healthcare and other essential services for the ageing population[7-10].

Arthritis is a common condition globally. An estimated 22.7% (52.5 million) of people aged 18 years or older in the United States have doctor-diagnosed arthritis, and 43.2% also reported activity limitations due to arthritis in 2010-2012[11]. Prevalence of arthritis is lower in Europe, mainly due to the lower prevalence of inactivity and obesity in European women (e.g. 13% in the United Kingdom)[12]. Arthritis and musculoskeletal conditions have been a National Health Priority Area (NHPA) in Australia since 2002[13]. These conditions are more prevalent than any other NHPA conditions, affecting around 6.1 million people (26.9% of the population) in 2012[1]. Importantly, more than half of the population with musculoskeletal conditions in Australia (58.4%) is currently aged 25-64 years – the principal working-age population. Prevalence is estimated to increase in the next 17 years due to population ageing, with the number of cases of arthritis and other musculoskeletal conditions projected to increase by 43% to 8.7 million (increase of 2.6 million), affecting 30.2% of the population by 2032[1]. Arthritis also accounts for around 13% of the disability reported in Australia[14].

The direct (healthcare) costs of arthritis are substantial and rising, due mainly to population ageing. In 2003, the total direct costs attributable to arthritis and other rheumatic conditions (AORC) were $80.8 billion in the United States. An estimated 46.1 million people aged 18 years or older reported having AORC, and their average per-person direct costs were $1,752. Ambulatory care accounted for the highest per-person direct costs ($914), followed by emergency department and inpatient services ($352), prescriptions ($338), and other costs ($146)[15].

In Australia, arthritis and other musculoskeletal conditions are the fourth most expensive disease group in terms of health expenditure and the fourth most common reason for seeking GP and specialist services[14]. Healthcare expenditure allocated to these conditions increased from $4.0 billion in 2004-05[16] to $5.7 billion in 2008-09 and it has remained the fourth most expensive disease group, accounting for 8.7% of total healthcare expenditure allocated to disease groups ($65.1 billion) in these years[2]. Around 54% of healthcare expenditure on arthritis and other musculoskeletal conditions was on hospital admitted patient services ($3.1 billion), followed by 30% on out-of-hospital medical expenses ($1.7 billion), and 16% on prescriptions ($922 million)[2]. Recent estimates of the direct costs for treating arthritis and other musculoskeletal conditions are even higher at $9.2 billion in 2012[1].

Counting the Cost Part 1 Healthcare Costs (published separately) estimates that the cost of arthritis alone to the Australian health system was more than $5.5 billion in 2015, and that this would increase to more than $7.6 billion by 2030.

However, the full-range of indirect costs (i.e. lost earnings, lost productivity, lost superannuation, lost taxation revenue, carer costs, extra welfare payments, cost of aids and home modifications, travel costs) are considered to be even greater than the direct costs[1,17]. These costs are mostly attributed to lost productivity, with arthritis affecting an individual's ability to maintain employment (and earnings) due to pain and physical disability[1,18].

In Australia in 2009, the estimated cost of arthritis through lost labour force participation among older workers (45-64 years) consisted of lost income of AU$3,787 million, extra welfare payments of AU$291 million, and lost taxation revenue of AU$394 million[19]. The impact of arthritis on labour force participation among older workers has continued to be significant and enduring in Australia. A recent study has shown that 13.3% of people aged 45-64 years out of the labour force due to ill-health exited because of their arthritis in 2010 (45,000 people) with a similar proportion projected to exit in 2030 (60,000 people).

1 Background

In this and other studies, arthritis is consistently the second most common chronic condition (after back problems) leading to exits from the labour force for this age group[20]. Workforce absences form a significant proportion of the burden of the disease in many countries, including the United Kingdom, Canada, and the United States[3,21].

Arthritis is also the second most common disabling condition among care recipients who have informal carers who are not in the labour force in Australia[22], and thus the disease significantly impacts on the productivity of carers as well.

There are few studies on the costs of arthritis through lost labour force participation that consider the societal perspective[17,20]. Most studies on the indirect costs of arthritis (productivity) focus only on lost earnings to individuals. Ensuing extra welfare payments and reduced income taxation revenue impacting on governments are rarely assessed[19]. Although the authors have estimated some of the economic costs of arthritis through its impact on labour force of older workers (aged 45-64 years) in previous studies[19,23], they are limited to a single year (2009). Additionally, there is limited research on the costs of caring for a relative or friend with arthritis[1].

1.1 Objectives

The objectives of this study are:

(1) to project the economic impacts of arthritis up to year 2030, primarily through lost productivity due to the disease;

(2) to examine the potential economic benefits as a result of increased productivity from implementing key elements of the *ADAPT* interventions[4,5,24].

Projections of the health system costs associated with arthritis to 2030 are considered in *Counting the Cost Part 1 Healthcare Costs.*

The study of the economic impacts consisted of two stages.

Stage 1

The aim for Stage 1 was to project multiple costs of arthritis among Australians aged 15-64 years (lost labour force participation, lost income, extra welfare payments, lost taxes, lost GDP, and carer costs) over a 15 year period (2015-30) using our microsimulation models of the impacts of ill-health on individuals, government and society as a whole.

We developed a microsimulation model for lost productivity due to arthritis and the associated economic impacts. The model was used to project the following economic outcomes, for every five years from 2015 to 2030, using the 'business as usual scenario' to quantify:

- the number of people out of the labour force due to arthritis
- the number of people working full-time and part-time with arthritis
- the loss of income and wealth (including superannuation) for people out of the labour force due to arthritis, relative to those who were able to continue to work full-time without arthritis
- the lost taxation revenue and increased government welfare costs due to arthritis
- the lost GDP due to people being out of employment because of arthritis
- the costs of lost productivity, including loss of income to individuals and loss of taxation revenue and increased welfare payments to the government) of becoming an informal carer for someone with arthritis.

The model captured the impacts of demographic changes including population ageing and changing labour force patterns (such as the increasing number of women and older workers in the labour force and real wages growth) from 2015 to 2030.

Stage 2

Health interventions for people with arthritis can prevent or slow disease progression, reduce pain and immobility caused by arthritis, preserve independence, and improve quality of life[4,25]. Reducing pain and disease progression in people with arthritis potentially enables them to continue in the labour force and contribute to the economy. The *Arthritis, Diet, and Physical Activity Promotion Trial* (ADAPT) – a single-blind, randomised controlled trial (RCT) involving older, obese patients (age>=60 years) with knee osteoarthritis (OA) – assessed strategies for improving quality of life (bodily pain) in

1 Background

people with knee OA[4,5,24]. In this trial, participants were assigned to one of four treatments: exercise only, dietary weight loss only, dietary weight loss plus exercise, or a healthy lifestyle control condition with 18 months of follow-up. The aim of Stage 2 was to estimate the potential productivity benefits associated with implementing *ADAPT* interventions in the Australian population with knee OA. An evaluation of the cost-effectiveness of implementing these interventions in the Australian health system is included in *Counting the Cost Part 1 Healthcare Costs*.

We estimated the potential labour force benefits of managing knee OA by implementing key elements of the ADAPT study, specifically dietary weight loss only, exercise only or dietary weight loss plus exercise programs for people with knee OA[4,5,24]. We also estimated the flow-on economic benefits associated with the potential increase in labour force participation, including increased income to individuals, and increased income taxation revenue and reduced welfare payments to the government.

1.2 Overview of model development

Stage 1

We adjusted our current microsimulation models, Health&WealthMOD and Health&WealthMOD2030[26,27], to develop a model to project the economic impacts of lost labour force participation due to arthritis. Microsimulation is one of the most robust economic applications in Australia. It captures data on a large number of individuals and is used in the development of policy at the Commonwealth Treasury, Department of Human Services and other large social policy departments. Our current models only focus on older workers (aged 45-64 years). For this study, the model was extended to all individuals aged 15-64 years.

Stage 2

For Stage 2, we used the effect size estimates of managing knee OA by implementing the key elements of the *ADAPT* trial[4,5,24] on labour force participation and other economic outcomes from published literature where available.

In the absence of direct measures of the effect on labour force participation in the published literature, we modelled improvements in labour force participation rates by analysing the effects of managing knee OA by implementing the key elements of *ADAPT* strategies on individuals' quality of life/health status (such as the SF-36 bodily pain domain score)[28]. The Household, Income and Labour Dynamics in Australia (HILDA) Survey data[29] was used to model the association between SF-36 and labour force participation. The potential increase in labour force participation rates associated with the improved SF-36 scores of the individuals with knee OA from implementing *ADAPT* interventions were then estimated. We then simulated the national impact on the labour force in terms of the number of people with knee OA who would have remained in the labour force as a result of implementing *ADAPT* interventions, who would otherwise be out of the labour force. We also estimated the economic benefits associated with the potential increase in the labour force.

1.3 Methodology

Our microsimulation models, Health&WealthMOD and Health&WealthMOD2030, were adjusted to project the costs of arthritis through lost labour force participation to individuals, government and society from 2015 to 2030. The development of our latest model, Health&WealthMOD2030, is described in Schofield et al (2014)[27].

The primary data for this project came from the Surveys of Disability, Ageing and Carers (SDAC) 2003, 2009 and 2012[30-32]. The SDACs 2003, 2009 and 2012 are nationally representative (large) Australian household surveys conducted by the Australian Bureau of Statistics (ABS). They provide the most comprehensive data on individuals in terms of their personal characteristics (such as age, sex, family type), socioeconomic status (such as education, income, labour force participation, employment restrictions, reasons for retirement, home ownership, receipt of welfare payments), chronic conditions and disabilities (main chronic condition/disability), and nature of any informal care required as well as information on their carers[30-32].

1 Background

Although the SDACs 2003, 2009 and 2012 are a rich source of information on people with a chronic condition (such as arthritis) and their informal care needs, they are limited in terms of economic data. For more detailed economic information (such as income, welfare payments, income taxes paid and the value of different types of wealth assets e.g. superannuation), the outputs from another microsimulation model, *Static Incomes Model or STINMOD*, developed by the National Centre for Social and Economic Modelling (NATSEM) for the Australian Government[33] were used. STINMOD is Australia's leading static microsimulation model[34] and routinely used by the Commonwealth departments for assessing distributional and revenue implications of tax and cash transfer reforms. The model operates at the micro-level of individuals and families, and is based on the ABS' Income Distribution Survey unit record files[35]. This model simulates the impact of major federal government cash transfers, income tax and the Medicare levy on individuals and families in Australia.

To account for demographic changes in the Australian population from 2015 to 2030 (such as population ageing and trends in labour force participation) we used the population and the labour force projections for this time period provided by the Commonwealth Treasury that were used in the 2015 Intergenerational Report. For socio-economic changes in the population, we used outputs from another microsimulation model, *Australian Population and Policy Simulation Model or APPSIM*, which was also developed by NATSEM in collaboration with 12 Australian Government departments. It is a dynamic population microsimulation model that was developed to provide a snapshot of the socio-economic characteristics of the Australian population annually[36]. The model uses a sample of 188,000 records (1% of the 2001 Australian census population) to simulate the impact of social and fiscal policies on every Australian.

The SDACs 2003, 2009 and 2012 were reweighted separately using the ABS reweighting algorithm GREGWT[37] to account for demographic and other changes in the population occurring between survey years (2003, 2009, 2012) ensuring that, together they represented the Australian population in 2015, and projected to 2020, 2025, and 2030. Commonwealth Treasury provided demographic (ageing and labour force) projections for 2015 to 2030.

The economic data from STINMOD for 2015 were indexed to reflect economic growth projections from 2015 to 2030. Income and taxes paid by individuals were assumed to grow at a rate of 1% per annum in real terms (Treasury, 2015)[38]. Welfare payments were assumed to have no real growth based on the government's policy of increasing welfare payments (except for aged pension) in line with national Consumer Price Index (CPI) growth.

1.4 Structure of the report

Section 2 estimates the economic costs of arthritis through lost productivity for individuals, government and society from 2015 to 2030. It includes a description of the cost items measured and estimated (as per Stage 1), and the projections of these costs. Section 3 examines the costs of arthritis through lost productivity due to informal caregiving from 2015 to 2030. It includes projections of the costs of lost labour force participation due to people (aged 15-64 years) taking on the role of informal carer for someone with arthritis (measured in terms of income, welfare payments, taxes paid and savings differences compared to working non-carers). Section 4 provides discussion and concluding remarks about these costs of arthritis. Section 5 provides estimates of the gains in productivity if people with arthritis could be engaged in the ADAPT trial strategies. Section 6 provides an overall conclusion.

2 The economic costs of arthritis

through lost productivity on individuals, government and society from 2015 to 2030

Using our adjusted models, we estimated the costs of lost labour force participation due to arthritis among Australians aged 15-64 years from 2015 to 2030. The following are the definitions of the key economic outcomes analysed.

2.1 Lost labour force participation due to arthritis

Respondents to the Survey of Disability, Ageing and Carers were asked to nominate their current labour force status. Those who were not in the labour force were also asked to nominate the main reason they were not working or looking for work e.g. 'own ill-health or disability'.

The surveys collected information from all respondents on the type of long term health conditions they have and respondents were also asked to nominate their main long term health condition among the conditions they have. "Arthritis and related disorders" (ICD10 code M00-19) is one of the conditions on the list and respondents who self-reported having this health condition were considered to have 'arthritis'.

Respondents identified as (a) being out of the labour force due to their own ill-health or disability, and (b) having arthritis as their main condition were considered to have *lost labour force participation due to arthritis*.

2.2 The economic costs

The following costs of arthritis through lost labour force participation are projected for every five years from 2015 to 2030:

- the number of people out of the labour force due to arthritis
- the number of people working full-time and part-time with arthritis
- the loss of income and wealth (including cash, assets and superannuation) for people out of the labour force due to arthritis relative to those who are able to work full-time and do not have arthritis and relative to those who are able to work part-time and do not have arthritis
- the lost taxation revenue and increased welfare payments to government due to the lost labour participation because of arthritis
- the GDP loss attributable to arthritis through lost labour force participation among people aged 15-64 years.

2.3 Measurement of economic costs

Personal income consists of labour market earnings, income from other sources generating a return (such as rental properties, investments, interest on cash in a bank), and welfare payments.

Relevant welfare payments for this age group consists of Disability Support Pension, Newstart Allowance (for people looking for work), Youth Allowance, Carer Payment, and Family Tax Benefit; see http://www.humanservices.gov.au/customer/services.

The taxes paid by individuals included personal income tax and the Medicare levy.

Total wealth consists of cash savings, the value of owner occupied home, investment properties, shares, superannuation balance and other investments. Information on wealth variables are only available for income units (e.g. for couples or families) and are the total for an income unit. The value of wealth for an individual, including savings, assets and superannuation, was calculated by dividing the total value of wealth of an income unit by the number of adults (15 years and over) in that income unit and thus, everyone in an income unit was considered to have an equal value of personal wealth.

We calculate the impact of arthritis on national Gross Domestic Product (GDP) using the Commonwealth Treasury's GDP formula:

GDP = (GDP/H) x (H/EMP) x (EMP/LF) x (LF/Pop15+) x Pop15+

where GDP = Gross Domestic Product; H = total hours worked; EMP = total number of persons employed; LF = total labour force; and Pop15+ = population aged 15 years and over[39].

2 The economic costs of arthritis

through lost productivity on individuals, government and society from 2015 to 2030

2.4 Statistical simulation

Descriptive analysis is undertaken to establish patterns in projected lost labour participation due to arthritis and the economic costs listed above in 2015, 2020, 2025, and 2030. We present the mean, standard deviation and median weekly income and savings, welfare payments, and taxes paid by people aged 15-64 years who are out of the labour force due to arthritis or in the labour force (employed full-time with and without arthritis, employed part-time with and without arthritis). All figures are expressed in real 2015 Australian dollars.

The differences in economic outcomes of those not in the labour force due to arthritis compared to those in full-time or part-time employment who do not have arthritis, were estimated using counterfactual simulation with Monte Carlo methods. For each record of those not in the labour force due to arthritis, a counterfactual record was selected at random with replacement from the pool of those in full-time employment who do not have arthritis; records were matched for age group, sex and highest level of education. The mean of the difference in the economic outcomes between the records of those not in the labour force due to arthritis and their counterfactuals were estimated. We ran 1,000 simulations, generating 1000 counterfactual datasets for records of those not in the labour force due to arthritis. The average of the 1000 simulations and the 95% uncertainty interval, estimated using the percentile method, are reported as the result in this report.

The simulation method was repeated with the selection of counterfactual records from the pool of those in part-time employment without arthritis to estimate the differences in economic outcomes of those not in the labour force due to arthritis and those in part-time employment who do not have arthritis.

For the estimation of the economic costs of lost labour force participation due to arthritis at the national level, the counterfactuals were drawn from the pool of those in the labour force (i.e. employed full-time or employed part-time or unemployed) who do not have arthritis.

2.5 Results

Among approximately 15.8 million people aged 15-64 years in 2015, about 52,000 (0.33%) were out of the labour force due to arthritis; about 354,000 (2.25%) were employed full-time with arthritis; about 193,000 (1.23%) were employed part-time with arthritis; about 7.6 million (48.58%) were employed full-time without arthritis; and about 3.3 million (20.88%) were employed part-time without arthritis. Of those working who had arthritis, 35.3% were working part-time compared to 30% of those without arthritis (Table 1).

Those who were out of the labour force due to arthritis received $333.13 in median weekly income in 2015, which is only about one-fourth of the median weekly income of those employed full-time without arthritis ($1,287.81) (Table 1). Those not in the labour force due to arthritis received a median value of weekly welfare payments of $329.50, whereas those in full-time employment received a median value of $0 welfare payments per week and those in part-time employment received a median value of $5.75 welfare payments per week in 2015 (Table 1). Those out of the labour force due to arthritis paid a median value of $0 in tax per week whereas those employed full-time, who do not have arthritis, paid a median of $256.21 per week in tax in 2015.

An estimated median value of total wealth, including savings, assets and superannuation of those not in the labour force due to arthritis was about $156,000. This is about $200,000 less than the wealth of those in full-time employment who do not have arthritis and who had an estimated median value of total wealth of about $345,000. Those who are working part-time and do not have arthritis have a median value of total wealth of about $321,000 in 2015 (Table 1).

Table 1: Mean and median weekly income, welfare payments, taxes and total value of savings and assets of individuals with and without arthritis, Australian population aged 15-64 years (in 2015 Australian dollars)

	N	2015				2020				2025				2030			
Labour force status^	Survey records	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median
Weekly total income (AU$) of individuals																	
Employed full-time without arthritis	53,949	7,644,000 (48.6%)	1,545.53	1,405.97	1,287.81	8,290,000 (49.5%)	1,627.80	1,490.30	1,351.23	8,871,000 (50.6%)	1,729.73	1,598.68	1,421.27	9,381,000 (50.3%)	1,858.54	1,691.18	1,513.72
Employed full-time with arthritis	2,497	354,000 (2.3%)	1,532.98	1,237.24	1,316.40	395,000 (2.4%)	1,598.78	1,317.50	1,375.37	425,000 (2.4%)	1,727.33	1,411.50	1,452.87	452,000 (2.4%)	1,856.19	1,524.46	1,542.24
Employed part-time without arthritis	23,707	3,285,000 (20.9%)	664.61	1,169.21	492.20	3,316,000 (19.8%)	732.36	1,284.09	552.42	3,561,000 (20.3%)	769.76	1,396.89	576.41	3,780,000 (20.3%)	816.19	1,509.69	621.77
Employed part-time with arthritis	1,471	193,000 (1.2%)	697.39	701.93	605.43	214,000 (1.3%)	724.02	752.21	613.97	230,000 (1.3%)	791.96	812.74	671.18	242,000 (1.3%)	859.70	853.52	720.86
Not in labour force due to arthritis	348	52,000 (0.3%)	310.87	205.52	333.13	55,000 (0.3%)	315.22	216.00	334.84	57,000 (0.3%)	329.02	220.39	356.63	59,000 (0.3%)	343.51	227.86	368.93
Weekly welfare income (AU$) received by individuals																	
Employed full-time without arthritis	53,949	7,644,000 (48.6%)	26.52	82.07	0.0-	8,290,000 (49.5%)	26.18	81.11	0.0	8,871,000 (50.6%)	27.36	83.07	0.0	9,381,000 (50.3%)	27.20	83.62	0.0
Employed full-time with arthritis	2,497	354,000 (2.3%)	25.36	79.56	0.0	395,000 (2.4%)	25.41	79.45	0.0	425,000 (2.4%)	25.91	80.38	0.0	452,000 (2.4%)	26.32	81.68	0.0
Employed part-time without arthritis	23,707	3,285,000 (20.9%)	84.31	145.40	5.75	3,316,000 (19.8%)	85.45	145.44	5.75	3,561,000 (20.3%)	85.42	144.57	5.75	3,780,000 (20.3%)	85.31	144.80	5.75
Employed part-time with arthritis	1,471	193,000 (1.2%)	88.80	157.42	5.75	214,000 (1.3%)	86.16	155.00	5.75	230,000 (1.3%)	87.88	156.52	0.0	242,000 (1.3%)	89.67	157.85	0.0
Not in labour force due to arthritis	348	52,000 (0.3%)	281.63	200.25	329.50	55,000 (0.3%)	280.63	198.58	329.50	57,000 (0.3%)	291.12	197.77	329.50	59,000 (0.3%)	299.36	196.91	329.50

Table 1: Mean and median weekly income, welfare payments, taxes and total value of savings and assets of individuals with and without arthritis, Australian population aged 15-64 years (in 2015 Australian dollars) continued

	N	2015				2020				2025				2030			
Labour force status^	Survey records	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median
Weekly tax paid (includes Medicare levy) (AU$) by individuals																	
Employed full-time without arthritis	53,949	7,644,000 (48.6%)	357.72	497.77	256.21	8,290,000 (49.5%)	379.06	538.33	268.91	8,871,000 (50.6%)	406.21	584.84	283.02	9,381,000 (50.3%)	440.57	631.40	302.76
Employed full-time with arthritis	2,497	354,000 (2.3%)	347.83	438.72	254.10	395,000 (2.4%)	363.38	466.62	258.98	425,000 (2.4%)	395.11	504.89	276.16	452,000 (2.4%)	428.11	550.24	299.82
Employed part-time without arthritis	23,707	3,285,000 (20.9%)	77.19	474.51	4.41	3,316,000 (19.8%)	88.80	525.03	10.05	3,561,000 (20.3%)	94.03	578.23	10.07	3,780,000 (20.3%)	100.77	628.95	14.77
Employed part-time with arthritis	1,471	193,000 (1.2%)	75.47	188.98	15.84	214,000 (1.3%)	80.69	203.28	15.12	230,000 (1.3%)	90.00	216.70	19.87	242,000 (1.3%)	99.54	229.92	26.10
Not in labour force due to arthritis	348	52,000 (0.3%)	0.88	22.10	0.0	55,000 (0.3%)	1.80	29.57	0.0	57,000 (0.3%)	2.25	32.73	0.0	59,000 (0.3%)	2.98	37.34	0.0
Total value of savings and assets including superannuation (AU$) of individuals^^																	
Employed full-time without arthritis	53,949	7,644,000 (48.6%)	497,239	695,920	345,317	8,290,000 (49.5%)	579,372	817,885	401,515	8,871,000 (50.6%)	689,349	985,677	478,904	9,381,000 (50.3%)	814,417	1,172,728	563,307
Employed full-time with arthritis	2,497	354,000 (2.3%)	589,323	726,800	423,645	395,000 (2.4%)	697,503	883,014	496,537	425,000 (2.4%)	836,362	1,066,788	591,149	452,000 (2.4%)	999,921	1,294,570	700,649
Employed part-time without arthritis	23,707	3,285,000 (20.9%)	468,691	729,426	321,381	3,316,000 (19.8%)	558,377	826,061	382,767	3,561,000 (20.3%)	651,503	882,114	445,557	3,780,000 (20.3%)	761,746	957,262	519,902
Employed part-time with arthritis	1,471	193,000 (1.2%)	534,189	690,894	344,462	214,000 (1.3%)	626,518	826,826	393,961	230,000 (1.3%)	744,165	993,049	468,943	242,000 (1.3%)	881,321	1,178,348	554,308
Not in labour force due to arthritis	348	52,000 (0.3%)	333,658	618,429	156,231	55,000 (0.3%)	385,820	720,790	180,204	57,000 (0.3%)	437,942	844,626	201,014	59,000 (0.3%)	503,943	991,740	207,377

Note:
^ After excluding respondents living in cared-accommodation, there were 110,119 respondents aged 15-64 years in the concatenated SDAC 2003, 2009 and 2012 data. Of these, 81,972 respondents were identified as being in one of the labour force categories listed in Table 1. A further 25,281 were either unemployed or not in the labour force due to reasons other than ill-health, and 2,866 were not in the labour force due to ill-health with conditions other than arthritis as the main condition. The total number of survey records in three SDACs for 15-64 years age group, was 110,119. After excluding people living in the cared-accommodation, the weighted population for 15-64 years age group was 15,735,000 in 2015; 16,746,000 in 2020; 17,510,000 in 2025; and 18,639,000 in 2030.
^^ Data on total savings and assets are only available for income units. Total value of wealth, including savings, assets and superannuation for an individual was calculated by dividing the total value of wealth of an income unit by the number of adults (15 years and over) in that income unit and thus, everyone in an income unit have equal value of wealth.

2 The economic costs of arthritis

through lost productivity on individuals, government and society from 2015 to 2030

By 2030, the working-age population is projected to be 18.6 million and consist of 59,000 people who were out of the labour force due to arthritis; 452,000 employed full-time with arthritis; 242,000 employed part-time with arthritis; 9.4 million employed full-time without arthritis; and 3.8 million employed part-time without arthritis. Those with lost labour force participation due to arthritis are projected to receive $368.93 a week as their total income, $329.50 a week in welfare payments, and pay $0 in income taxes in 2030, expressed in real 2015 dollars (Table 1, last column).

Compared to those in full-time employment without arthritis, people out of the labour force due to arthritis receive $957.04 (95%CI: $907.32; $1,018.73) less per week in total income after adjusting for age, sex and highest level of education in 2015 (Table 2). They also receive significantly more in welfare payments (an extra AU$280.45 per week, 95%CI: $275.61; $285.16) and pay significantly less in taxation ($252.05 per week, 95% CI: $236.55; $270.37) compared to those working full-time without arthritis. When compared to those in part-time employment without arthritis, those not in the labour force due to arthritis receive $341.38 (95% CI: $303.92; $383.22) less per week in total income and pay $75.80 (95% CI: $65.46; $88.85) less in tax per week but receive an extra $236.51 (95% CI: 228.05; $244.45) per week in welfare payments in 2015. The mean differences in weekly income, welfare payments and taxation between those with lost labour force participation due to arthritis and employed full-time without arthritis and employed part-time without arthritis were also estimated for 2030 (Table 2, last two columns). Lost income as a result of being out of the labour force due to arthritis is projected to increase from $957.04 per week in 2015 (95%CI: $907.32; $1,018.73) to $1,194.23 per week in 2030 (95% CI: $1,139.16; $1,260.73) in real terms (compared to those employed full-time without arthritis). People with lost labour force participation due to arthritis are estimated to pay $252.05 (95% CI: $236.55; $270.37) per week less in income taxes than those employed full-time without arthritis in 2015, with the difference increasing to $307.55 per week (95% CI: $288.92; $328.94) in 2030.

For 2015, the total value of wealth including savings, assets and superannuation of those not in the labour force due to arthritis is about $263,000 (95%CI: $224,000; $309,000) less than those with no arthritis and in full-time employment. This is about $200,000 (95%CI: $158,000; $242,000) less than the total value of wealth of those who do not have arthritis who are in part-time employment. The differences in the total value of wealth between those not in the labour force due to arthritis and those in full-time employment with no arthritis, adjusted for age, sex and highest level of education, is projected to increase to about $432,000 (95%CI: $374,000; $494,000) in 2030. Between those not in the labour force due to arthritis and those in part-time employment with no arthritis, this difference is projected to increase to about $320,000 (95% CI: $263,000; $388,000) in 2030.

The national economic impacts of arthritis through lost labour force participation consists of $1,753 million (95%CI: $1,631; $1,911 million) in lost income in 2015, increasing to $2,626 million (95%CI: $2,477; $2,808 million) in 2030 (i.e. 61% increase over 15 years) mainly due to population growth and ageing (Table 3). Additional welfare payments because of lost labour force participation due to arthritis are projected to increase by about 23% over this period, from $635 million (95%CI: $619; $649 million) in 2015 to $784 million (95%CI: $767; $801 million) in 2030. Finally, lost annual taxation revenue is projected to increase by about 44% in real terms, from $458 million (95%CI: $422; $499 million) in 2015 to $660 million (95%CI: $612; 714 million) in 2030 (Table 3).

As a result of workers aged 15-64 years withdrawing from the labour market because of their arthritis, there are also significant losses in GDP each year. Using the Commonwealth Treasury's GDP formula, we calculated these losses to be $7.2 billion, $7.9 billion, $8.6 billion, and $9.4 billion in lost GDP in 2015, 2020, 2025 and 2030, respectively.

Table 2: Mean differences in weekly income, welfare payments, taxes and total value of savings and assets between people with lost productivity due to arthritis and those employed full-time without arthritis and those employed part-time without arthritis (adjusted for age, sex and highest level of education), Australian population aged 15-64 years (in 2015 Australian dollars)

	2015		2020		2025		2030	
Labour force status	$ difference	95% CI	$ difference	95% CI	$ difference	95% CI	$ difference	95% CI
Weekly total income (AU$) of individuals								
Not in labour force due to arthritis compared to employed full-time without arthritis	-957.04	(-1,018.73; -907.32)	-1,018.11	(-1,085.19; -967.04)	-1,105.64	(-1,162.58; -1,051.26)	-1,194.23	(-1,260.73; -1,139.16)
Not in labour force due to arthritis compared to employed part-time without arthritis	-341.38	(-383.22; -303.92)	-360.38	(-402.32; -322.32)	-409.72	(-456.80; -371.40)	-453.15	(-495.27; -412.50)
Weekly welfare income (AU$) received by individuals								
Not in labour force due to arthritis compared to employed full-time without arthritis	280.45	(275.61; 285.16)	277.51	(273.11; 282.25)	287.28	(282.67; 291.74)	295.53	(291.04; 299.75)
Not in labour force due to arthritis compared to employed part-time without arthritis	236.51	(228.05; 244.45)	234.06	(225.72; 241.94)	243.03	(234.74; 250.89)	250.54	(242.23; 258.08)
Weekly tax paid (includes Medicare levy) (AU$) by individuals								
Not in labour force due to arthritis compared to employed full-time without arthritis	-252.05	(-270.37; -236.55)	-265.55	(-285.10; -248.42)	-286.50	(-305.80; -268.46)	-307.55	(-328.94; -288.92)
Not in labour force due to arthritis compared to employed part-time without arthritis	-75.80	(-88.85; -65.46)	-79.04	(-91.08; -68.42)	-87.17	(-100.22; -76.78)	-92.53	(-104.55; -80.98)
Total value of savings and assets including superannuation (AU$) of individuals^								
Not in labour force due to arthritis compared to employed full-time without arthritis	-263,327	(-309,088; -224,509)	-295,595	(-348,233; -251,908)	-361,331	(-424,036; -306,129)	-431,719	(-493,846; -374,393)
Not in labour force due to arthritis compared to employed part-time without arthritis	-193,919	(-241,842; -158,460)	-217,458	(-273,612; -178,048)	-263,864	(-320,261; -219,697)	-320,147	(-388,378; -263,457)

Note:
^ Data on total savings and assets are only available for income units. Total value of wealth, including savings, assets and superannuation for an individual was calculated by dividing the total value of wealth of an income unit by the number of adults (15 years and over) in that income unit and thus, everyone in an income unit have equal value of wealth.

Table 3: National economic costs of lost labour force participation due to arthritis per year, Australian population aged 15-64 years (in 2015 Australian dollars, in millions)

	2015		2020		2025		2030	
Cost	$ impact	95% CI	$ impact	95% CI	$ impact	95% CI	$ impact	95% CI
Lost income	1,753	(1,631; 1,911)	2,034	(1,900; 2,197)	2,336	(2,190; 2,503)	2,626	(2,477; 2,808)
Extra welfare payments	635	(619; 649)	681	(664; 698)	734	(716; 751)	784	(767; 801)
Lost tax revenue	458	(422; 499)	526	(482; 572)	596	(549; 647)	660	(612; 714)

3 The costs of arthritis

through lost productivity due to informal caregiving from 2015 to 2030

The number of children with a chronic condition or disability and older people needing care is projected to increase substantially in the next 20 years[40-42]. For example, the number of older people with care needs is projected to increase almost threefold from 101 million in 2010 to 277 million in 2050 worldwide[43]. This care can be provided in two ways: (a) formally, by people in paid work in the healthcare sector, and (b) informally, by friends or relative of people needing care[44]. Informal carers normally do not receive an income for their caregiving, but the care provided can impact on their capacity to maintain paid work[45]. In this section, we examine the impact of arthritis in care recipients on the labour force participation of informal caregivers.

Informal carers of people with a chronic condition or disability constituted around 12% of the Australian population (or 2.6 million people) in 2009[46], and this number is expected to increase due to greater demands for such care. In adults, greater demand is largely due to Australia's ageing population[40] and increasing (prevalence) rates of several chronic conditions[47], such as diabetes and dementia[48]. In children, the reasons for greater demand are complex. There has been an increase in the rate of preterm births (babies born less than 37 gestational weeks)[49,50] and an increase in the survival rates of all preterm babies, including extremely preterm babies (born less than 28 gestational weeks), with an associated increase in disability amongst survivors[51]. The substantial number of Australians currently (and projected) providing informal care has serious ramifications for the national workforce, the tax base and welfare costs (and thus the budget balance), and GDP in addition to the individual social, emotional wellbeing, healthcare costs and other financial implications for carers.

Recognising the current (and projected) demand for informal carers worldwide, a number of studies have examined the impact of informal caregiving on labour force participation. These studies have found that the labour force participation rate for carers is lower than for non-carers[45,52-55]. A recent cross-sectional study involving Australians aged 45 and older (n = 265,515) demonstrated that full-time carers are not only more likely to be out of the labour force than non-carers (and part-time carers) but also more likely to have lower household income than non-carers. Just over 40% of non-carers had an annual household income of more than $70,000, whereas only 12.6% of full-time carers had the same level of income[56]. Another study, using one wave of the Household Income and Labour Dynamics in Australia (HILDA) survey data (2008)[57], confirmed the findings of these cross-sectional studies, by reporting that becoming a main carer reduced the probability of being in employment by around 12 percentage points for both males and females regardless of whether or not the carer lived with the care recipient. Longitudinal studies, such as Bittman et al. (2007), who examined the effects of informal caregiving on carers' employment, income and earnings using four waves of HILDA (2001–04)[58], also confirmed that carers are more likely to reduce their hours of work or exit from the labour force and earn less on average than non-carers.

Few studies, however, have examined the impact of specific chronic conditions of care recipients on the labour market behaviour of carers. Schofield et al (2014), using the SDAC 2009, examined the impact of chronic conditions of care recipients on the labour force participation of carers (adjusting for age, sex, education, health of carers), as well as generating a ranking of these conditions in terms of having the greatest impact on the labour force participation of carers using logistic regression analysis[22]. From the SDAC 2009, they identified 1,268 respondents who were primary carers for a care recipient living with them and, of these, 628 (49.5%) were out of the labour force. The most common diseases of care recipients were: back problems (12%); arthritis and related disorders (10%); diseases of the nervous system (such as multiple sclerosis, epilepsy, cerebral palsy) (7.4%); and conditions originating in the perinatal period or congenital malformations, deformations and chromosomal abnormalities (5.1%). Whilst this study provides insight into the importance of arthritis as a common chronic condition of care recipients and affecting the earning capacity of carers, research on the economic costs associated with this is limited. Additionally, there is little on the economic consequences of medical/health interventions that not only improve the health outcomes of people with arthritis but also possibly improve the income of carers and government finances[47]. The aim of Section 3 is to project the costs of lost productivity (loss of incomes to individuals and loss of taxation revenue and increase in welfare payments to the government) of informal carers of people with arthritis.

3 The costs of arthritis

through lost productivity due to informal caregiving from 2015 to 2030

3.1 Methods

The data (and cost measures) described in Section 1.3 was used to model the costs of informal caregiving for arthritis through lost productivity out to 2030.

Lost productivity due to being a carer of someone with arthritis

Several types of informal carers can be identified in the SDACs 2003, 2009 and 2012, such as "primary carers", "non-primary carers" and "non-resident" versus "resident carers". In this report, carers were identified as those who indicated they were:

a) a primary carer of a usual resident (i.e. lives with) care recipient

b) other primary carer of a usual resident care recipient;

c) primary carer of a non-usual resident (i.e. does not live with) care recipient; or

d) other carer.

However, information on both the main care recipient and carer (such as age, sex, education, labour force participation, chronic conditions) required for this project were only available for main usual resident care recipients matched to primary carers. For this reason, the analysis focuses only on primary carers of care recipients who live with them (i.e. categories (a) and (b) above).

This definition is consistent with the common definition of primary carers used by the ABS (2010):

> *A primary carer is a person who provides the most informal assistance, in terms of help or supervision, to a person with one or more disabilities or aged 60 years and over. The assistance has to be ongoing, or likely to be ongoing, for at least six months and be provided for one or more of the core activities (communication, mobility and self-care) (p. 34).*

All SDAC respondents who could be identified as a primary carer (using the definition above) and reported caring for someone who had "arthritis and related disorders" (ICD10 code M00-19) as their main disabling condition were considered to be 'a primary carer caring for care recipients with arthritis' in this project. All primary carers identified as (a) being out of the labour force and (b) caring for a (live with) care recipient with arthritis as their main disabling condition were considered to have lost labour force participation due to caring for someone with arthritis.

3.2 Results

Among approximately 15.8 million people aged 15-64 years, after excluding those living in cared-accommodation, in 2015, approximately 41,000 (0.26%) were primary carers of a care recipient with arthritis (living with them). Of these, 19,000 (46%) were out of the labour force; 14,000 (33%) were working full-time; and 7,800 (19%) were working part-time in 2015.

Primary carers who were out of the labour force and caring for someone with arthritis received $293.53 in median weekly income in 2015, which is only 23% of the median weekly income of non-carers who are employed full-time (Table 4). These primary carers received a median amount of weekly welfare payments of $246.70 and paid a median value of $0 in tax per week, whereas non-carers in full-time employment received a median value of $0 in welfare payments per week, and paid a median value of $256.09 per week in tax in 2015.

By 2030, there are projected to be 22,000 (0.12% of total population) people out of the labour force and caring for someone with arthritis. Primary carers not in the labour force and caring for someone with arthritis are projected to receive $313.34 a week in income (only 21% of the median weekly income of non-carers who are employed full-time), $247.78 a week in welfare payments, and pay $0 in income taxes in 2030, expressed in real 2015 dollars (Table 4, last column). The relatively lower median income of carers compared to the median weekly income of non-carers who are employed full-time is due to wages growth above that of certain government payments and income from the increasing savings of those who are able to keep working.

Table 4: Mean and median weekly income, welfare payments, taxes of primary carers of people with arthritis as main disabling condition, Australian population aged 15-64 years (in 2015 AU$)

	N	2015				2020				2025				2030			
Labour force status^	Survey records	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median	Weighted population (%)	Mean	SD	Median
Weekly total income (AU$) of primary carers																	
Employed full-time, non-carers	51,455	7,362,000 (46.8%)	1,542.60	1,406.99	1,287.47	8,002,000 (47.8%)	1,624.03	1,491.06	1,348.23	8,549,000 (48.8%)	1,726.65	1,599.87	1,420.16	9,028,000 (48.4%)	1,855.15	1,690.27	1,512.77
Employed part-time, non-carers	22,120	3,116,000 (19.8%)	656.36	1,122.63	487.18	3,158,000 (18.9%)	723.89	1,233.91	545.89	3,390,000 (19.4%)	763.00	1,344.87	572.01	3,592,000 (19.3%)	810.79	1,454.28	619.26
Not in labour force, caring for someone with arthritis	140	19,000 (0.12%)	330.64	363.81	293.53	20,000 (0.12%)	349.92	402.96	303.37	21,000 (0.12%)	362.17	414.24	303.37	22,000 (0.12%)	364.90	429.95	313.34
Weekly welfare income (AU$) received by primary carers																	
Employed full-time, non-carers	51,455	7,362,000 (46.8%)	25.90	80.88	0.00	8,002,000 (47.8%)	25.78	80.37	0.00	8,549,000 (48.8%)	26.96	82.40	0.00	9,028,000 (48.4%)	26.78	82.83	0.00
Employed part-time, non-carers	22,120	3,116,000 (19.8%)	81.62	142.44	5.75	3,158,000 (18.9%)	82.99	142.81	5.75	3,390,000 (19.4%)	82.96	141.96	5.75	3,592,000 (19.3%)	82.76	142.04	5.75
Not in labour force, caring for someone with arthritis	120	19,000 (0.12%)	240.78	247.98	246.70	18,000 (0.12%)	239.31	243.71	246.70	21,000 (0.12%)	244.93	244.76	246.70	22,000 (0.12%)	243.12	240.89	247.78
Weekly tax paid (includes Medicare levy) (AU$) by primary carers																	
Employed full-time, non-carers	51,455	7,362,000 (46.8%)	357.03	496.25	256.09	8,002,000 (47.8%)	378.01	536.25	268.14	8,549,000 (48.8%)	405.27	582.46	282.88	9,028,000 (48.4%)	439.55	628.99	302.73
Employed part-time, non-carers	22,120	3,116,000 (19.8%)	75.81	453.67	3.87	3,158,000 (18.9%)	87.24	501.16	9.59	3,390,000 (19.4%)	92.67	551.66	9.60	3,592,000 (19.3%)	99.59	600.02	14.54
Not in labour force, caring for someone with arthritis	120	19,000 (0.12%)	13.08	87.87	0.00	18,000 (0.12%)	18.02	105.34	0.00	21,000 (0.12%)	18.52	108.88	0.00	22,000 (0.12%)	19.66	114.88	0.00

Note:
^ After excluding respondents living in cared-accommodation, there were 110,119 respondents aged 15-64 years in the concatenated SDAC 2003, 2009 and 2012 data. Of these, 73,715 respondents were identified as being in one of the labour force categories listed above. A further 8,049 were either in full-time or part-time employment and were providing caring either as a primary carer or a secondary carer, and 28,355 were either employed or not in the labour force. After excluding people living in the cared-accommodation, the weighted population for 15-64 years age group was 15,735,000 in 2015; 16,746,000 in 2020; 17,510,000 in 2025; and 18,639,000 in 2030.

4 Discussion and concluding remarks

4.1 Costs of arthritis through lost labour force participation

In Section 2, we estimated that 52,000 people aged 15-64 years were out of the labour force due to arthritis in 2015, and projected that this number would grow to 59,000 in 2030 – a 13% increase. People aged 15-64 years who left the labour force due to arthritis had a significantly lower median income and savings than their full-time employed counterparts with no arthritis in 2015, and the gaps are projected to widen by 2030. The lower total income (and wealth) of those who have lost labour force participation due to arthritis has implications for the economic viability of households. The national impact of arthritis through lost labour force participation among people aged 15-64 years is also projected to increase over the next 15 years, with a 50% increase in lost income, a 23 % increase in welfare payments and a 44% increase in lost taxation revenue. Lost income is expected to grow faster than welfare payments as the indexation of welfare payments is expected to be less than wages growth. Importantly, from a societal cost perspective, there was a 31% increase in lost GDP attributable to arthritis through lost productivity. These are the first projections of the costs of arthritis for individuals, government, and the nation out to 2030.

Arthritis has a significant impact on the working capacity of people with the condition and thus their chances of incurring economic losses[1]. In Australia, the costs of arthritis and other musculoskeletal conditions (including back pain and osteoporosis) were estimated to be $11.7 billion in 2012, with $7.4 billion (63.1%) consisting of productivity costs associated with a reduced employment rate ($6.0 billion) as well as significant costs associated with lost superannuation, presenteeism and absenteeism. Deadweight loss associated with transfer payments (taxation forgone and welfare payments) accounted for a further $2.3 billion (19.4%) and carer costs were estimated to be $1.2 billion (10.4%)[1]. The high costs of informal care are indicative of arthritis' deteriorating nature, and the need for individuals with the condition to be assisted and supported; these costs are also expected to increase in the future due to population ageing[20]. Other studies have estimated the indirect costs to be around 80% of the total cost of arthritis[59,60], and mainly attributable to work disability, absenteeism and lost earnings from employment[61,62].

However, most of these studies are based on samples that cannot be considered nationally representative, and focus mainly on lost earnings as opposed to considering other relevant economic measures as well[63]. Conversely, the current study uses a sample from a nationally representative population (SDACs 2003, 2009, 2012) and information on income, savings, welfare payments, taxes and GDP for cost projections. The study makes advancements in methodology through developing microsimulation models that integrate outputs from two long-standing microsimulation models (STINMOD, APPSIM) and reliable demographic and labour force projections from Commonwealth Treasury.

In this study, we only estimated the economic costs associated with people who had left the labour force due to their arthritis. This is an under-estimate of the economic costs of lost productivity due to arthritis. Some of those who have arthritis may have moved from full-time employment to part-time employment because of their arthritis. The economic costs of this reduced employment due to arthritis are not captured in the study because of data limitations. While it is possible to identify individuals in full-time or part-time employment with or without arthritis in our main data source (Surveys of Disability, Ageing and Carers), it is not possible to identify if they are in part-time employment because of their arthritis or some other reason.

Investment in preventive health is recognised as essential to overcoming the detrimental impacts of ill-health on labour force participation[64]. A number of randomised controlled trials have demonstrated that arthritis treatments can increase labour force participation[65]. Studies have also demonstrated that workplace changes can reduce work disability from arthritis[66] and thus help to retain employment of those with arthritis. A supportive work environment such as those permitting adjusted working hours, adjusted job demands, accessibility of workplace and supportive co-workers and employers can reduce withdrawal from the labour force by people with arthritis[67]. Lacaille et al. (2004) also found that modifying work-related factors that increase the risk of work disability in people with arthritis can increase the participation of sufferers[68]. In Australia, self-management interventions to overcome workplace challenges associated with chronic physical pain (such as arthritis) have been shown to be effective. An example is the 'ADAPT' program for work-related pain, which is

4 Discussion and concluding remarks

an intensive cognitive-behavioural pain management program run by the Pain Management and Research Centre (University of Sydney) and Royal North Shore Hospital (http://sydney.edu.au/medicine/pmri/patient-services/resources/index.php). For those who are likely to exit from the labour force due to their arthritis, providing counselling and training, and assisting them to find new jobs which are less physical in nature, where possible, can help them to stay in the labour market[69]. These types of interventions are likely not only to help increase labour force participation and economic growth[39,70] but ensure future governments have sufficient revenue for meeting the healthcare needs of the ageing population[39].

4.2 Costs of arthritis through informal caregiving

We estimated that 41,000 people aged 15-64 years were caring for someone with arthritis and, of these, 19,000 had left the labour force due to their caring responsibilities in 2015. This number is projected to increase to 22,000 in 2030 – a 16% increase. People aged 15-64 years who are not in the labour force and providing care for someone with arthritis had a lower median income than non-carers working full-time or part-time, with income differences widening over time. We are currently developing a microsimulation model to estimate the national costs of lost productivity from caregiving.

Previous governments have focused on increasing labour force participation rates using economic incentives that target particular subgroups of the working-age population. For example, new parents can access the Commonwealth Government's paid parental leave which provides financial support for eligible parents for up to 18 weeks after the birth or adoption of their child. For older workers, the 15% tax on lump sums and pensions from superannuation schemes after the age of 60 years has been removed[71], which encourages continuation in work. There is also the Age Discrimination Act 2004 which provides job protection for all workers in Australia[72]. However, these "broad brush" approaches to help people either return to, or remain in, paid work fail to take into account one of the main reasons people often have to leave their jobs quickly – to take on the caring needs of a relative or friend. Moreover, more needs to be achieved in terms of policy design. There needs to be greater consideration given to the main chronic/disabling conditions associated with most of the lost labour force participation among carers (e.g. back pain, arthritis). Until then, these incentives will not have a major impact on the labour force participation of informal carers.

Conventionally, Australian health policy has focused on the delivery of healthcare to improve the health of citizens for its own sake and employment policy has mainly been conducted in isolation from health policy. Recent health reforms, however, seem to encapsulate the view that "good health policy is part of good economic policy" as suggested in Russell et al. (2008)[64]. This philosophy naturally leads to the necessity of addressing Australia's increasing burden of chronic conditions with the highest care demands.

Overall, the main challenges faced by carers seem to be due to pressures already in the health system and the lack of effective measures for ensuring workplace flexibility for carers. Whilst there are public and private care services for those with a disability, chronic condition, or frail aged (such as residential and aged care facilities) and respite care for carers, available services are insufficient to meet demand, resulting in delayed or constrained access[73]. Moreover, the policies adopted in the last 20 years have seen a substantial move away from institutional forms of care to 'ageing in place' i.e. community-based care (http://ageinplace.com/aging-in-place-basics/what-is-aging-in-place/) which can place greater pressure on informal carers.

Employment policies in relation to working carers having suitable forms of support in their workplaces may also need further attention. Working carers are protected from discrimination when attempting to balance work schedules with family and caring responsibilities. Under the Equal Opportunity Act 2010, employers have a positive responsibility to undertake practical and comparable measures to remove discrimination, sexual harassment and victimisation from their workplace as much as possible. The Act applies to employers (organisations) of all sizes, includes all types of workers, and applies to all stages of employment. Although there are legal protections in place for carers to be in a position to manage their work and caring responsibilities effectively[74], challenges remain in relation to whether (a) workers feel they are able to discuss any difficulties

4 Discussion and concluding remarks

they face with employers when they occur, and (b) employers are feasibly able to provide the type of workplace flexibility (flexible work hours, part-time work or paid carer leave) required to meet the needs of their workers who are also carers.

As demonstrated in this report on arthritis, informal caregiving has negative effects on carers, such as reduced labour force participation and lower income. Previous studies have shown that male and female carers also differ in the way they strive to manage their work and caring duties. Women are more likely to reduce their hours of work or stop working altogether when becoming a carer[75] and thus female carers are more likely to incur additional risks (and costs) in terms of maintaining a good career trajectory and income, compared to male carers[56,58].

With persistent skills shortages and the ageing population needing more healthcare and support in the future, the government will need to adopt a more holistic approach when endeavouring to increase labour force participation in Australia. Addressing some of the challenges effecting working carers and carers wanting to work (http://www.workingcarers.org.au/) may help to improve labour force participation among this growing group.

5 Labour force gains and the associated

economic gains if people with osteoarthritis of the knee could be engaged in the ADAPT trial strategies

The Arthritis, Diet, and Activity Promotion Trial (ADAPT) is one of the best studies available to demonstrate the benefits of interventions including both diet and exercise management for knee osteoarthritis. Consequently this section focuses on people with osteoarthritis of the knee only although they make up a relatively small part of the total arthritis population. We simulated the potential labour force gains and the associated economic gains of managing knee OA, as a case study, to demonstrate that interventions to manage knee OA (or other chronic conditions) have the potential to provide economic benefits both to individuals and the government in addition to health benefits.

Osteoarthritis (OA) of the knee is a chronic condition that is strongly related to obesity[76], is most common among older women[77], and a major source of physical disability with ageing[78,79]. The main symptoms of knee OA are pain in the joints and stiffness[79]. Because there is no known remedy for this condition, much of the focus in public health and medicine is on palliative care i.e. the aim of the treatment is to improve or to preserve quality of life related to health. In recent years, there has been cumulative evidence that physical activity is an effective treatment for the reduction of pain and improves the physical function of older people with knee OA; for example a recent Cochrane review of 32 RCTs involving nearly 3,800 men and women found improvements in self-reported knee pain and function of patients who participated in on-the-ground exercises[81]. The Arthritis, Diet, and Activity Promotion Trial (ADAPT) is one such study that examined the combined impact of weight loss and physical activity on the functioning of overweight and obese older adults with knee OA[4,24]. Adding to this work, the study by Rejeski et al (2002)[5] demonstrates the impact of the interventions in ADAPT on quality of life for older obese people with knee OA. Specifically, Rejeski et al (2002)[5] reported on how dietary weight loss and exercise influence the combined mental and physical health scores of the SF-36 as well as measures of satisfaction with physical function and appearance. (The SF-36 is a generic measure of quality of life related to health, whereas the satisfaction measures assess specific end points that relate theoretically to the intervention and the population under examination.) Secondary analyses were conducted on the eight subscales of the SF-36.

In the Arthritis, Diet, and Activity Promotion Trial (ADAPT)[4,5], a total of 316 older men (28.03%) and women (71.97%) (with mean age = 68.52 years (SD 6.30)) were randomised to one of four 18-month long treatments:

- exercise only
- dietary weight loss only
- dietary weight loss plus exercise
- a healthy lifestyle control condition

It was found that the combined dietary weight loss plus exercise intervention had the most consistent, positive effect on quality of life outcomes compared with the control group; however, the findings were limited to measures of physical health or psychological outcomes related to the physical self (see Table 3 in Rejeski et al (2002)).

In this section, we project the potential labour force benefits of managing knee OA by implementing the ADAPT intervention[5]. Pain reduction among people with knee OA with the use of the three strategies noted above (compared to the control) is reported via the SF-36. The projected benefits are derived for the working-age population (aged 15-64 years) and reflect the probability of being in the labour force associated with severity of pain experienced. Furthermore, as it is known that premature or unplanned exits from the workforce are associated with significant costs to both individuals and governments[19], we also project the follow-on benefits associated with the potentially increased labour force participation to individuals in terms of increased income, and to the government in terms of increased income tax revenue and reduced welfare payments.

Because there is no direct measure of the effect of the intervention on labour force participation in the ADAPT series[5], we model improvement in the labour force participation rates by analysing the effects of managing arthritis by implementing the different arms of the trial on individuals' quality of life (i.e. the SF-36 bodily pain domain score)[28]. The Household, Income and Labour Dynamics in Australia (HILDA) Survey data[29] are then used to model the association between SF-36 bodily pain scores and labour force participation.

5 Labour force gains and the associated

economic gains if people with osteoarthritis of the knee could be engaged in the ADAPT trial strategies

All of this information is then incorporated into our microsimulation models (Health&WealthMOD and Helath&WealthMOD2030) to estimate the potential increase in the labour force associated with the improvement in SF-36 scores of the individuals with knee OA if the ADAPT program is implemented. Using these data, together with the estimated number of Australians aged 15-64 years who left the labour force due to their knee OA, we simulated how many of them would have continued to stay in the labour force if their knee OA was managed using the ADAPT interventions.

5.1 Data and methods

Published results from the ADAPT study (particularly Rejeski et al (2002)[5] and nationally representative Australian household surveys were used to estimate the potential labour force and related economic benefits associated with pain reduction in patients with knee OA via participation in ADAPT. Although the trial collected some information on the socio-economic characteristics of participants at baseline (income, education), labour force participation was not among the characteristics included, as the trial was not designed to analyse the effect of the different management strategies for knee OA on labour force participation.

Since it was not possible to directly estimate the effect of the different management strategies on labour force participation using the RCT data, the effects on labour force participation were estimated based on the association between improvements in quality of life, as a result of taking up one of the strategies, and labour force participation. The SF-36 bodily pain domain score was used as the quality of life measure. The SF-36 bodily pain domain is one of the eight domains of the Medical Outcomes Study Short Form-36 Health Survey (SF-36), with other domains being physical functioning, role limitations-physical, social functioning, general health, role limitations-emotional, mental health and vitality[28]. Each domain score ranges from 0 to 100, with higher scores reflecting better health status. The SF-36 bodily pain domain is used to evaluate overall pain.

5.1.1 Effectiveness of interventions

The effectiveness estimates of the three management strategies (dietary weight loss, exercise, dietary weight loss plus exercise) on improving pain were based on the SF-36 bodily pain domain results of the ADAPT study published by Rejeski et al (2002)[5]. Compared to the control group, improvements in the SF-36 bodily pain score from baseline to follow-up (adjusted for covariates including the pre-randomisation levels of the outcome variable, age, and gender) were significantly greater at the $p<.01$ level for the dietary weight loss plus exercise intervention only. The improvement in SF-36 bodily pain score from baseline to follow up for the dietary weight loss plus exercise group was 4.73 units (i.e. the effect size) greater than for the control group.

5.1.2 Association between SF-36 bodily pain scores and labour force participation

The association between the SF-36 bodily pain score and the probability of being in the labour force were analysed using Wave 10 data of The Household Income and Labour Dynamics in Australia (HILDA) Survey which is a nationally representative Australian household panel survey[29]. Analysis was restricted to the surveyed populations aged 20-64 years and those who had SF-36 bodily pain scores in the range between 0 and 70. This would exclude individuals in the HILDA Survey who had lesser or no pain (i.e. higher SF-36 bodily pain score) and reduce the chance of contaminating the association between the SF-36 bodily pain scores and the probability of being in the labour force.

The association between the SF-36 bodily pain score and labour force participation was estimated as the prevalence ratio (ratio of the probability of being in the labour force) associated with each unit increase in the SF-36 bodily pain score using a modified Poisson regression model with a robust error variance to estimate the prevalence ratios[82]. Analyses were adjusted for the confounding effects of age and highest level of education, and the models were separately fitted for men and women.

5 Labour force gains and the associated economic gains if people with osteoarthritis of the knee could be engaged in the ADAPT trial strategies

5.1.3 Labour force impacts

We estimated the number of persons, who could have continued to stay in the labour force, among those not in the labour force due to their knee OA, as a result of pain reduction if one of the interventions (dietary weight loss only, exercise only, or dietary weight loss plus exercise) were in place for those with knee OA. This was estimated as the potential increase in those who were in the labour force and have knee OA using the equation:

$$\text{AddLF} = \text{Num}_{\text{Int}} * \text{LF}_{\text{kneeOA}} * \text{LF}_{\text{Growth}} \quad (1)$$

where Num_{Int} is the number of people with knee OA participating in the ADAPT intervention[5]; LF_{kneeOA} is the estimated improvement in labour force participation of those with knee OA (a rate); and LF_{Growth} is the estimated growth in the labour force participation rates associated with pain reduction as a result of participating in one of the interventions for individuals with knee OA. This is estimated as

$$\text{LF}_{\text{Growth}} = \exp(^{\text{Effect}*\Delta\text{Pain}}) - 1 \quad (2)$$

where *Effect* is the estimated association between the labour force participation and SF-36 bodily pain domain score for each unit change in SF-36 bodily pain domain score, such that exp^{Effect} is a prevalence ratio of being in the labour force associated with each unit change in SF-36 bodily pain domain score; and $\Delta Pain$ is the estimated improvement in SF-36 bodily pain score for the patients undergoing one of the interventions over the control group.

5.1.4 Economic benefits

The economic benefits of the potential increase in the number of people in the labour force who have knee OA as a result of pain reduction through uptake of one of the interventions in ADAPT were estimated as discussed in Stage 1 (See Section 2.4). The economic benefits were estimated at the national level. For individuals, it was estimated in terms of an increase in their total accumulated income for all additional people in the labour force, and for the government, in terms of savings in welfare (transfer) payments and additional income tax revenue.

This modelling is limited to people already out of the workforce due to their arthritis. It is also likely that the ADAPT interventions, if offered to employed people at risk of leaving the labour force due to their knee osteoarthritis, would help to avoid or delay their exit from the labour force. However, due to data limitations, this scenario could not be modelled. Consequently, estimates of the economic benefits of this intervention are likely to underestimate the benefits.

5.2 Results

5.2.1 Not in the labour force due to knee OA

The prevalence data and the labour force information were not available for those with OA and knee specific OA in our main data sources, the Surveys of Disability, Ageing and Carers, which only have information for those with overall arthritis. Thus, we estimated the labour force information for those with knee specific OA using the projected proportion of OA among overall arthritis and the results from a study which analysed the data on OA related GP presentations from the Bettering the Evaluation and Care of Health (BEACH) program[83]. The study reported the number of GP presentations for knee specific OA and OA overall by age groups allowing us to estimate the age-specific proportion of knee specific OA among those with OA overall. We then further estimated the proportion of knee specific OA among those for arthritis overall using the projected prevalence data on both OA and arthritis overall. Assuming all individual labour force groups would have the same proportion of knee specific OA among those with arthritis, the estimated number of those who were not in the labour force due to their knee OA would be 7,605 in 2015 rising to 8,743 by 2030 (Table 5).

5 Labour force gains and the associated

economic gains if people with osteoarthritis of the knee could be engaged in the ADAPT trial strategies

Table 5: Projected numbers of those not in the labour force due to knee OA, aged 15-64 years

Gender	2015	2020	2025	2030
Male	2,583	2,807	2,910	2,965
Female	5,022	5,370	5,529	5,778
Total	7,605	8,177	8,439	8,743

5.2.2 Association between SF-36 bodily pain scores and labour force participation

For those aged between 20 to 64 years old and with bodily pain domain scores between 0 and 70, the estimated prevalence ratios of being in the labour force associated with each unit increase in SF-36 bodily pain domain score was 1.0112 for men and 1.0103 for women (Table 6). Thus for a 11.86 unit estimated improvement in SF-36 bodily pain score due to *dietary weight loss plus exercise* intervention from baseline to follow-up, there would be an estimated increase of 14% in the labour force participation rate of men and 12.9% for women with knee OA by follow-up (Table 6).

We also estimated the increase in the labour force participation rate due to the dietary weight loss plus exercise intervention versus *healthy lifestyle only* (the control group in the ADAPT Study). There was an estimated improvement of 4.73 units in SF-36 bodily pain domain score from baseline to follow up for the dietary weight loss plus exercise intervention group over the healthy lifestyle control group. Thus, managing of knee OA with dietary weight loss plus exercise intervention would increase the labour force participation rate by approximately 5.4% in men and 4.9% in women compared to managing it with a healthy lifestyle (Table 6).

Table 6: Percentage increase in the labour force participation rates associated with pain reduction due to Diet plus Exercise intervention for the management of knee OA in the ADAPT study

	Male	Female
Prevalence ratios of being in the labour force associated with each unit increase in SF-36 bodily pain score	1.0112	1.0103
Estimated percentage increase in the labour force participation rate from baseline to follow-up with dietary weight loss plus exercise intervention	14%	12.9%
Estimated percentage increase in the labour force participation rate from baseline to follow-up with dietary weight loss plus exercise intervention over healthy lifestyle intervention (control group)	5.4%	4.9%

5 Labour force gains and the associated

economic gains if people with osteoarthritis of the knee could be engaged in the ADAPT trial strategies

5.2.3 Impacts on labour force participation

We simulated the labour force gains and the associated economic benefits of managing knee OA with a dietary weight loss plus exercise intervention compared to not managing at all and compared to managing it with a healthy lifestyle intervention (control group in the ADAPT study).

If those not in the labour force due to their knee OA (Table 5) had taken up the dietary weight loss plus exercise intervention to manage their knee OA, it is estimated that there would be an additional 231 men and 341 women aged 15-64 years in the labour force, who otherwise would be out of the labour force due to their knee OA in 2015 (Table 7). By 2030, the number of men and women who would have avoided being out of the labour force due to their knee OA would have increased to 284 for men and 431 for women.

If knee OA was managed using dietary weight loss plus exercise intervention compared to managing it with a healthy lifestyle intervention, the estimated number of people who would have avoided being out of the labour force due to their knee OA as a result of reduced pain would be 88 for men and 131 for women in 2015 rising to 109 for men and 166 for women in 2030.

Table 7: Estimated number of people who would have avoided being out of the labour force due to their knee OA as a result of dietary weight loss plus exercise intervention for the management of their knee OA, 15-64 years old

Gender	2015	2020	2025	2030
Dietary weight loss plus exercise intervention				
Male	231	259	277	284
Female	341	383	407	431
Dietary weight loss plus exercise intervention versus healthy life style (control group)				
Male	88	99	106	109
Female	131	147	157	166

5.2.4 Economic impacts

The potential increase in the labour force of those with knee OA as a result of reduced pain by managing their knee OA using ADAPT interventions has follow-on economic benefits both to individuals in terms of an increase in their incomes and for the government in terms of savings in welfare payments and additional income tax revenue.

Adopting a dietary weight loss plus exercise intervention as described in the ADAPT trial would result in a total increase of $20.8 million in personal income per year associated with people avoiding being out of the labour force due to their knee OA. (Table 8). Similarly, it is estimated that there would be an associated saving of about $7.6 million per year in welfare payments and an increase of $5.4 million in income tax revenue. By 2030, the economic benefits would have increased to an extra $33.5 million in income per year, a reduction of $9.9 million per year in welfare payments, and an increase of $8.4 million in income tax revenue (Table 8).

5 Labour force gains and the associated

economic gains if people with osteoarthritis of the knee could be engaged in the ADAPT trial strategies

Table 8: Estimated economic benefits from increased labour force associated with reduced pain as a result of managing their knee OA with dietary weight loss plus exercise intervention, 15-64 years old (in thousands, in 2015 AU$)

	2015	2020	2025	2030
Dietary weight loss plus exercise intervention				
Increase in annual incomes	20,770	25,088	29,624	33,488
Increase in annual income tax payment	5,430	6,469	7,515	8,399
Reduction in annual welfare payment	7,578	8,401	9,240	9,909
Dietary weight loss plus exercise intervention versus healthy life style (control group)				
Increase in annual incomes	7,918	9,594	11,392	12,859
Increase in annual income tax payment	2,070	2,473	2,890	3,218
Reduction in annual welfare payment	2,896	3,224	3,549	3,812

If knee OA is managed using a dietary weight loss plus exercise intervention compared to managing it with a healthy lifestyle intervention as described in the ADAPT study, it is estimated that the number of people who would have avoided being out of the labour force due to their knee OA would be 88 for men and 131 for women in 2015 (Table 7). As a result of this increase in the labour force, there would be a total estimated increase of $7.9 million in income per year, an estimated increase of $2.1 million in income tax revenue and a reduction of $2.9 million in welfare payments per year (Table 8). By 2030 this would have increased to a total estimated increase of $12.9 million in income per year, an estimated increase of $3.2 million in income tax revenue and a reduction of $3.8 million in welfare payments per year.

6 Conclusions

Stage 1

In Section 3, we projected that the economic costs of lost productivity due to arthritis in Australians age 15-64 years would increase by 50% in lost income, 23% in additional welfare payments, and 44% in lost taxation revenue from 2015 to 2030. Moreover, these lost workers due to arthritis resulted in a loss of $7.2 billion in GDP in 2015, increasing to $9.4 billion in 2030.

In Section 4, we projected the number of people aged 15-64 years who are out of the labour force due to caring for someone with arthritis to increase from 19,000 in 2015 to 22,000 in 2030. At both time points, carers received less income, more welfare payments, and paid less tax than people employed full-time (or part-time) and who were non-carers. Given the economic challenges facing Australia and other developed countries (such as severe skills shortages, rising healthcare costs, the ageing population), successive governments will need to adopt holistic approaches to reducing the costs of informal care through lost labour force participation.

Stage 2

People with knee OA who experience less pain are more likely to be in the labour force. Effective interventions that reduce bodily pain may thus help patients to remain in the workforce longer. It has been estimated that, among people who had left the labour force due to their knee OA, 572 people aged 15-64 years could have remained in the labour force in 2015 if they had participated in a dietary weight loss plus exercise intervention, based on the ADAPT trial data. The cumulative economic benefit of this increased labour force participation would be an estimated increase of $20.8 million in their annual income in 2015, which would increase to $33.5 million per year in 2030. The benefit of increased labour force participation associated with pain reduction by managing knee OA through the ADAPT intervention extends beyond individuals, and provides economic benefits to government too. We estimated a decrease in the number of people with knee OA receiving welfare payments and an increase in the number of people paying income tax.

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