The Employment and Income Effects of Eight Chronic and Acute Health Conditions

Sylvia Dixon

New Zealand Treasury Working Paper 15/15

December 2015

THE TREASURY
Kaitohutohu Kaupapa Rawa
New Zealand Government

NZ TREASURY WORKING PAPER 15/15

The Employment and Income Effects of Eight Chronic and Acute Health Conditions

MONTH/YEAR

December 2015

AUTHOR/S

Sylvia Dixon
The Treasury
PO Box 3724
Wellington 6008
New Zealand

Email sylvia.dixon@treasury.govt.nz
Telephone 64-4-890 7251

ISBN (ONLINE)

978-0-908337-37-8

URL

Treasury website at December 2015:
http://www.treasury.govt.nz/publications/research-policy/wp/2015/15-15
Persistent URL: http://purl.oclc.org/nzt/p-1811

ACKNOWLEDGEMENTS

The author would like to thank Tony Blakely, Bronwyn Croxson, Michele Morris, Gail Pacheco, Simon Ross, Anton Samoilenko, Talo Talosaga, Kendra Telfer and Martin Tobias for their helpful comments on earlier drafts of this paper. The author takes responsibility for any remaining errors or shortcomings.

NZ TREASURY

New Zealand Treasury
PO Box 3724
Wellington 6008
NEW ZEALAND

Email information@treasury.govt.nz
Telephone 64-4-472 2733
Website www.treasury.govt.nz

DISCLAIMERS

The views, opinions, findings, and conclusions or recommendations expressed in this Working Paper are strictly those of the author(s). They do not necessarily reflect the views of the New Zealand Treasury, Statistics New Zealand, or the New Zealand Government. The New Zealand Treasury, Statistics New Zealand, Ministry of Justice and the New Zealand Government take no responsibility for any errors or omissions in, or for the correctness of, the information contained in this Working Paper. The paper is presented not as policy but with a view to inform and stimulate wider debate.

The results in this report are not official statistics – they have been created for research purposes from the Integrated Data Infrastructure (IDI) managed by Statistics New Zealand. Ongoing work within Statistics New Zealand to develop the IDI means it will not be possible to exactly reproduce the data presented here.

Access to the anonymised data used in this study was provided by Statistics New Zealand in accordance with security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business or organisation. The results in this report have been confidentialised to protect these groups from identification.

Careful consideration has been given to the privacy, security and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the privacy impact assessment for the Integrated Data Infrastructure available from Statistics New Zealand.[1]

The results are based in part on tax data supplied by Inland Revenue to Statistics New Zealand under the Tax Administration Act 1994. These tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form or provided to Inland Revenue for administrative or regulatory purposes.

Any person who has had access to the unit-record data has certified that they have been shown, have read and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes and is not related to the data's ability to support Inland Revenue's core operational requirements.

[1] http://www.stats.govt.nz/browse_for_stats/snapshots-of-nz/integrated-data-infrastructure/privacy-impact-assessment-for-the-idi.aspx

Abstract

This paper examines the impact of eight different health conditions on the employment rates and incomes of working-aged New Zealanders who develop them. The conditions studied are stroke, traumatic brain injury, coronary heart disease, diabetes, chronic obstructive pulmonary disease (COPD), breast cancer, melanoma, and prostate cancer. The paper focuses on 20-59 year olds who were in wage or salaried employment at the time they were first diagnosed with the condition, and survived for at least four years post-diagnosis. Using administrative data from the Integrated Data Infrastructure (IDI), it estimates the impacts that the illness or injury had on their employment, income support, earnings and regular personal incomes, over the following four years. Impacts are estimated by comparing the post-diagnosis employment and incomes of those who developed the condition with those of matched comparison groups.

We find evidence of significant employment rate reductions, income support increases, and income losses in the four years after first diagnosis for six of the eight conditions (stroke, traumatic brain injury, coronary heart disease, diabetes, COPD and breast cancer). After four years, the estimated negative impacts on the proportion who were employed ranged from 2.6 percentage points (for diabetes) to 19 percentage points (for stroke). The estimated negative impacts on monthly personal incomes ranged from 3% (for COPD) to 15% (for stroke). The employment and income impacts of traumatic brain injury, coronary heart disease, diabetes and breast cancer decreased in size during the four years after diagnosis, but remained significant. There was little improvement in the average employment and income effects of stroke during the four-year follow-up period. In the case of COPD, an initially very small impact on employment and incomes grew gradually larger.

JEL CLASSIFICATION I1

KEYWORDS Employment; incomes; cancer; stroke; brain injury; diabetes; chronic obstructive pulmonary disease; coronary heart disease

Executive summary

This paper examines the impact of eight chronic or acute health conditions on the employment rates and incomes of the working-aged New Zealanders who develop them. The conditions studied are stroke, traumatic brain injury, coronary heart disease, diabetes, chronic obstructive pulmonary disease (COPD), breast cancer, melanoma, and prostate cancer. The purpose of the paper is to demonstrate the potential for newly-integrated administrative data to be used in quantifying some of the largest impacts and costs of ill health, focusing on those incurred outside the health system.

The study focuses on 20-59 year olds who were in wage or salaried employment at the time they were first diagnosed with the condition and who survived for at least four years post-diagnosis. Using administrative data from the Integrated Data Infrastructure (IDI), it estimates the impacts that the illness or injury had on their employment, income support, earnings and regular personal incomes, over the following four years.

Health system data were used to identify all New Zealanders who were diagnosed with the conditions of interest for the first time in 2008 or 2009, who were aged 20-59 years at the time. Data on their employment, earnings, and income from benefits and accident compensation before and after the diagnosis were linked at the individual level through IDI. To estimate the impact of each type of injury or illness, the post-diagnosis employment outcomes and incomes of those who developed the condition were compared with those of a matched comparison group, comprising people with very similar measured characteristics in the five years before the diagnosis who did not develop the condition. The matched comparison groups were constructed using a combination of propensity score and exact case matching.

We find evidence of significant employment rate reductions at one year after diagnosis for six of the eight conditions (stroke, traumatic brain injury, coronary heart disease, diabetes, COPD and breast cancer), when we compare the average outcomes of the study populations members with those of their matched comparison groups. The employment reductions were particularly large in the case of people who experienced a stroke or traumatic brain injury (19 percentage points and 9 percentage points respectively). They were smaller in the case of people who developed coronary heart disease, diabetes, COPD or breast cancer (5, 4, 2 and 7 percentage points respectively.

The employment rate reductions following traumatic brain injury, coronary heart disease, diabetes and breast cancer declined during the follow-up period but remained statistically significant after four years. There was little improvement in the employment impact of stroke during the four-year follow-up period. In the case of COPD, an initially very small employment impact grew gradually larger, to 3 percentage points after four years.

We also find evidence of significant earnings losses following diagnoses of stroke, traumatic brain injury, coronary heart disease, diabetes, COPD and breast cancer, during the four years after diagnosis, when we compare the earnings of these study populations with those of their matched comparison groups. In the fourth year after diagnosis, the average monthly earnings of the people with these conditions were between 4% and 22% lower. These medium-term earnings losses were modest in size (4-5%) for people with diabetes, COPD and coronary heart disease but nearly 12% on average for those who had experienced a traumatic brain injury and nearly 22% for those who experienced a stroke. Reductions in the

likelihood of working after diagnosis and reductions in average earnings levels, conditional on being employed, both contributed to the overall earnings decline.

Four years after diagnosis, the proportion of people in the study populations who were receiving government income support was significantly higher than the comparable proportion in the matched comparison group in the case of stroke, traumatic brain injury, coronary heart disease, diabetes and COPD. These impacts ranged in size from a 2 percentage point increase in the income support rate for the diabetes group, to a 13 percentage point increase for the stroke group.

Similar findings are obtained when we estimate the impacts of the eight conditions on average monthly personal incomes, taking both earnings and income support payments into account. There is evidence of significant income losses following diagnoses of stroke, traumatic brain injury, coronary heart disease, diabetes, COPD and breast cancer, during the four years post-diagnosis. The pattern of change in the size of the income impacts was broadly similar to the pattern of change found in the employment impacts. The income impacts were decreasing in size over the four years for people with traumatic brain injury, coronary heart disease, diabetes or breast cancer. They changed relatively little for those who had had a stroke, and increased slightly for those with COPD.

We found no evidence of employment or income losses following a diagnosis of melanoma (for our study population of employed 20–59 year olds who survived the illness). Prostate cancer also did not have significant effects on the employment or incomes of our study population, with the exception of a small and short-term negative effect on earnings, apparent in the first six months only.

The average impacts reported here hide some significant variations in impact size between different individuals. For example, we find that the employment and income losses following stroke and traumatic brain injury were much larger for individuals whose stroke or brain injury was likely to have been more serious than average. Within the stroke group, for example, the estimated negative impact of stroke on the employment rate one year after diagnosis ranged from –5 percentage points for those who had spent 0-1 nights in hospital at the time of their stroke, to –47 percentage points for those who had spent 15 or more nights in hospital. Within the TBI group, the estimated negative impact of traumatic brain injury on the employment rate one year after diagnosis ranged from –2.6 percentage points for those who had spent 0-1 nights in hospital, to –56 percentage points for those who had spent 15 or more nights in hospital. The income impacts were similarly diverse along this dimension.

It should be noted that the results reported in this paper are only valid for the populations studied, namely working-aged adults who were employed in wage or salaried jobs at the time of their diagnosis and who survived the illness or injury for at least four years. Other population groups are likely to experience different impacts.

Table of contents

List of tables

List of figures

The Employment and Income Effects of Eight Chronic and Acute Health Conditions

1 Introduction

This paper examines the impact of eight different health conditions on the employment and incomes of working-aged New Zealanders. The conditions studied are stroke, coronary heart disease (CHD), diabetes, chronic obstructive pulmonary disease (COPD), breast cancer, melanoma, prostate cancer and traumatic brain injury (TBI). The study focuses on 20-59 year old adults who were in paid employment at the time they were first diagnosed with the condition, and estimates the impacts that the illness or injury had on their subsequent employment rates, incomes support rates, earnings and personal incomes, in the four years after the diagnosis.

The purpose of the paper is to demonstrate the potential use of New Zealand's integrated administrative data in understanding and quantifying the indirect impacts of ill health. Understanding the impacts of different illnesses is relevant for decision making in the health sector. Better information on these impacts has the potential to improve resource allocation by showing where increased spending will lead to greatest benefit. The Ministry of Health has undertaken comprehensive studies of the burden of disease and injury on New Zealanders' health, using disability-adjusted life years as the key measure of impact (for example, Ministry of Health, 2013). In addition to the direct impacts of illness on longevity, health and wellbeing, impacts on New Zealanders' capacity to undertake paid work and their earnings and incomes are also important from a welfare and monetary perspective. Administrative data can be used to estimate those latter impacts and costs.

The eight conditions that are studied in this paper are relatively common conditions among working-aged adults. Their treatment is known to generate significant costs within the health system. It has recently been estimated, for example, that the total public cost of treating cancer (all types and for all ages) was $880m in 2011 (Blakely et al, 2015). The choice of the eight conditions was based on practical rather than theoretical considerations: the fact that the data needed to identify these particular illnesses and study their labour supply and income effects became available for the first time, for research purposes, in late 2014.

This study uses several types of administrative data that have been linked together within Statistics New Zealand's Integrated Data Infrastructure (IDI). Data from the health system were used to identify New Zealanders who were diagnosed with the conditions of interest for the first time in 2008 or 2009, were aged 20-59 years at the time of diagnosis, and survived for at least four years post-diagnosis. Data on their employment, earnings, and incomes from benefits, accident compensation and other sources before and after the diagnosis, were obtained from the tax and income support systems, through IDI.

To estimate the impacts of each type of injury or illness, the post-diagnosis employment and incomes of those who developed the condition are compared with the employment and incomes of a matched comparison group, comprising people who had very similar measured characteristics and labour market activity patterns during the five years before the diagnosis but did not develop the condition. The matching is done using a combination of propensity score and exact case matching. This approach gives a more accurate estimate of the marginal impact of an illness or injury than a simple comparison of the groups' employment rates or incomes before and after, or a point-in-time comparison of people with and without the condition.

There are several channels through which serious health conditions can lead to long-term reductions in a person's likelihood of being in paid work or their earnings from paid work. The most direct channel is that persistent physical or mental symptoms restrict their ability to carry out the kinds of tasks they previously performed at work. A second route is through disruptions to the employment relationship. Leaving a job to receive treatment for a disease or to recover from it can lead to low pay through the loss of rewards for job-specific skills and experience. A third channel is through the effect of an illness on preferences regarding working time. A serious illness may cause a person to value their non-working time more highly and to choose to work fewer hours, or perhaps not at all.

A large number of international studies have examined the employment and income effects of particular diseases or types of health events. For example, Carter et al (2013), Jones, Rice and Zantomio (2015), and Trevisan and Zantomio (2015) use longitudinal survey data to study the effects of acute health shocks, pooling data on a range of conditions that normally lead to hospitalisation. Using administrative rather than survey data to measure the employment and income effects of disease is relatively new, however. Examples of recent studies that use administrative data and are methodologically similar to this one are Gracia-Gomez et al (2013), Jeon (2014) and Andersen et al (2015). Because the literature is extensive we do not review it here, but we refer to selected studies about the conditions of interest when discussing the results below.

The paper is structured as follows. Brief descriptions of each condition are given in Appendix 1. The methods used are outlined in Section 2. The results are presented in Section 3, with an overall summary of the findings given in Section 3.8. The findings and their limitations are further assessed in Section 4, the conclusion.

2 Methods

2.1 Data sources

The study uses data from Statistics New Zealand's Integrated Data Infrastructure (IDI), which combines and integrates administrative data from a range of government agencies, including Inland Revenue, the Ministry of Health, and the Ministry of Social Development.[2]

IDI includes longitudinal monthly information on individuals' wage and salary employment, earnings and receipt of income support payments over the period from 1999 to the present, for all taxpayers.

In 2014-15, an extensive set of health data were incorporated into IDI, including data on public hospital admissions and discharges, outpatient and emergency department treatments, pharmaceuticals dispensed, laboratory tests, and enrolments at Primary Health Organisations (PHOs). The data include a series of health condition indicators that were developed by the Ministry of Health to estimate the incidence and distribution of common diseases.

2.2 Study population selection criteria

The eight study populations (one for each illness or injury) comprise 20-59 year-old New Zealanders who were first diagnosed with the condition in 2008 or 2009, and were employed in waged or salaried jobs at the time they were diagnosed.

The full set of selection criteria is listed in Table 1.

Table 1 – Study population selection criteria

	Selection criteria
1	The person has an IRD linkage in IDI, and non-missing gender and birth date variables in the Ministry of Health data.
2	The health condition of interest was first recorded during the period of 1 January 2008 to 31 December 2009.
3	The person was aged 20-59 at the time their condition was first recorded.
4	They were not overseas for more than 1 year in total during the whole of the study period (comprising 5 years before the first diagnosis and 4 years after it).
5	They survived until the end of study period (48 months after the diagnosis/reference date).
6	They received earnings from wage or salary employment in each of the three calendar months immediately before the month when the condition was first recorded.

The study populations exclude people who had a relevant Ministry of Health record but could not be matched by Statistics NZ to the rest of the records in IDI (typically because of problems with the way their name or birth date was recorded).[3]

[2] See http://www.stats.govt.nz/browse_for_stats/snapshots-of-nz/integrated-data-infrastructure.aspx for more information about IDI.

We restrict the study populations to individuals who were first diagnosed between 1 January 2008 and 31 December 2009 for data reasons, to ensure we have sufficient data on the use of health services before the date of the first diagnosis. IDI lacks direct measures of individuals' health risks and existing health conditions, but we use measures of recent health service use (such as the number of prescriptions received or the number of hospital visits) as rough indicators of relatively good or relatively poor health. These are discussed in Section 2.3.3 below.

The minimum age threshold of 20 years was chosen because information on pre-event employment and incomes is required to match each study population member with a comparison group of adults who had similar backgrounds and characteristics (to provide counterfactual outcome scenarios). People below 20 tend to have quite limited employment and income-earning histories, lowering the likely quality of the match.

We restrict the study populations to people who were not overseas for more than 365 days in total during the whole of the study period (comprising 5 years prior to the event and 4 years after it), because employment and incomes can't be observed when a person is out of New Zealand. This criterion excludes temporary residents, permanent residents and citizens who spent significant periods of time away from New Zealand.

We also limit the study populations to people who survived for a standard four-year observation period after diagnosis, so that we can estimate the impacts of the illness up to four years afterwards for everyone. Table 2 shows the proportion of people in the potential study populations who died within the first four years after their diagnosis and were excluded for this reason alone. Death rates were under 6% for most of the conditions, with the exception of stroke (15.2%) and breast cancer (9.2%). Note that these death rates include deaths from all causes, not just the reference condition.

Table 2 – Proportion of people who were excluded from the study population because of mortality

Condition	Died within four years	Four-year survival rate
Stroke	15.2%	84.8%
Traumatic brain injury	3.6%	96.4%
Coronary heart disease	5.2%	94.8%
Diabetes	1.8%	98.2%
COPD	2.8%	97.2%
Breast cancer	9.2%	90.8%
Melanoma	5.8%	94.2%
Prostate cancer	4.2%	95.8%

Note: The death rates include deaths from all causes and not just the reference condition.

[3] About 5 percent of all cases of the eight conditions identified in the Ministry of Health data, for the period 2008-2009 and for people aged 20-59, were not matched to an IRD number in IDI. Because we don't know whether or not these un-matched individuals were employed, we can't tell what proportion would have been selected into our study population if there were no data linking errors.

The study populations were also restricted to people who received earnings from wage or salary employment for each of the three calendar months immediately before the reference month, when the diagnosis was made. This is our operational definition of 'currently employed'.

People who had already been diagnosed with another condition (within the set of common conditions that are currently identified in IDI) were *not* excluded from the study population. Instead, we include information on their prior conditions (those that are known) in the matching process. Statistics on the proportion of people in each study population who had already been diagnosed with one of the other conditions are given in Appendix 2.

The final study populations include around 40-45% of all the 20-59 year olds who were identified by the Ministry of Health as having developed the condition for the first time in 2008-09.

2.3 Variables

2.3.1 Identification of people experiencing the health conditions

To identify the people who developed each condition we use a set of indicators that were developed by the Ministry of Health. These draw on a combination of data sources, including diagnostic codes recorded by hospitals, prescriptions for drugs used to treat the reference condition, and the New Zealand cancer register (NZCR). Table 3 provides a brief overview of the methods used to identify the conditions that are considered in this paper.[4]

Table 3 – Method of identifying new cases of each condition

Condition	Identification method
Stroke	Discharged from a public or private hospital with a primary diagnosis of I60-164 (ICD-10-AM-II). These codes cover subarachnoid haemorrhage, intra-cerebral haemorrhage, other non-traumatic intracranial haemorrhage, cerebral infarction, and stroke not specified as haemorrhage or infarction. The definition does *not* include transient ischemic attacks or TIA (very minor strokes lasting less than 24 hours).
Traumatic brain injury	Discharged from a public hospital with a primary diagnosis of S06 (intracranial injury) (ICD-10-AM-II).
Coronary heart disease	The identification of CHD cases is based on a combination of data sources including relevant diagnostic and procedure codes recorded by hospitals, and prescription records for drugs used in the treatment of CHD.
Diabetes	A Virtual Diabetes Register has been developed by the Ministry of Health to identify diabetes cases, drawing on a combination of data sources including hospital discharges with diabetes as a diagnosis, diabetes education and management clinic attendance, diabetes retinal screening, multiple laboratory tests for HbA1c and prescriptions for insulin or oral hypoglycaemic agents.
Chronic obstructive pulmonary disease	The identification of COPD cases is based on a combination of data sources including diagnostic codes assigned by public and private hospitals for the treatment of inpatients or outpatients for conditions such as bronchitis and emphysema, and prescription records for drugs used in the treatment of COPD.

[4] The methods used by the Ministry of Health to create these condition indicators may change over time as data sources and methods are improved.

Condition	Identification method
Cancer	All cancers that are diagnosed by pathology labs are reported to the New Zealand Cancer Registry. The data recorded in the register include the primary site of the tumour, enabling cancers to be classified by the organ initially affected. Malignant cancers whose primary site was classified as C50 (breast), C43 (melanoma) or C61 (prostate) were selected in this study.

2.3.2 The date when an illness is first identified

In this study, we refer to the date when a condition is first recorded in the national health data sets as the date of the 'first diagnosis', for brevity. However, there are several reasons why it may not in fact be the date of first diagnosis.

First, the person may have first experienced the injury or illness of interest before the time period that is covered by the national health datasets. The coverage of the national datasets varies. The cancer data cover the period from 1948 onwards. Stroke and TBI diagnoses are available from 1988 onwards. The CHD indicator is available from 1985 onwards but is only considered comprehensive from the beginning of 2007. The diabetes and COPD indicators are available from 1999 onwards, but are not considered to be comprehensive until 2005 in the case of diabetes and 2007 in the case of COPD.

Second, some of condition indicators that have been derived by the Ministry of Health to identify conditions that are complex and do not have a simple set of diagnostic codes associated with them, such as CHD, diabetes and COPD, are known to be imperfect because of unavoidable data and methodological limitations.

Third, there may be lags between the date a condition is first diagnosed by a health professional and the time it is first recorded in one of the national health datasets. If a person develops coronary heart disease, diabetes or COPD but the disease is diagnosed by a primary health care professional and is treated without the use of (identifying) pharmaceuticals or lab tests or secondary health care services, it may not be identifiable in the national health data until a later date.

Fourth, for some of the diseases studied (such as COPD), the date the illness is first recorded in the national data sets could lag behind the onset of the condition by a significant period of time, if the first symptoms are fairly minor. Minor symptoms may not be reported to any health professional, or a diagnosis may not be made at that time.

If a person first experienced the condition earlier in their life, or the date the condition is first recorded in the national health data significantly lags the true date of onset, there is a risk that their employment choices and incomes may have already been negatively affected by the condition. By matching them with comparison individuals who also had lower employment rates or incomes (for other reasons), we will tend to underestimate the true size of the disease's impact on their subsequent employment rates or income. We return to this issue in Section 4.

2.3.3 Other health variables

The National Health Index (NHI) is the source of the following demographic and socioeconomic variables used in the study: gender, age, ethnic group, and district health board of residence. An NHI number is a unique identifier that is assigned to every person who uses health and disability support services in New Zealand. Basic demographic

variables such as gender, birth date and ethnicity are recorded for all residents of New Zealand who have a National Health Index number. A meshblock of residence code can also be derived from the address records of those who are either enrolled at a Primary Health Organisation (the vast majority of the resident population) or have recently used secondary health care services.

The health data sets that are currently linked to IDI provide a range of measures of health service use for each individual, such as their number of hospital visits, the time that was spent in hospital, and number and type of prescriptions that were prescribed for them. Unfortunately, they do not provide any direct measures of clinical histories or health risks (such as blood pressure, cholesterol level, smoking or weight). If direct measures of health status were available, data on the known risk factors for particular diseases could be used to more accurately predict individuals' likelihood of developing each disease, and comparison groups could be constructed using the most relevant risk factors.

In the absence of these direct measures, we include frequency measures of health service use in our analysis and interpret them as rough indicators of 'relatively good' or 'relatively poor' health. We make the assumption, for example, that people who had a high number of prescriptions in the year before their reference diagnosis (after controlling for other relevant personal characteristics such as gender and age) probably had an existing health condition and were likely to be less healthy, and more likely to develop a chronic illness, than people with a low number of prescriptions. If we are wrong or the relationships are weak, then the measures of prior health service use simply won't contribute much predictive power to the propensity models that are used to identify relative risks and select comparison group matches.

2.3.4 Employment and income measures

Due to the manner in which tax data are collected, the employment and earnings measures in IDI are available on a calendar month basis only. There are no measures of weekly earnings, hourly earnings, or hours of work.

In this study, a person is classified as 'employed' in a given calendar month if they received any wage and salary earnings in that month (that were reported through the tax system). An 'employment rate' measures the proportion of people in a particular group who received wage and salary earnings in a particular month. Similarly, a person is classified as 'in receipt of a benefit' if they received any income from one of the main income support benefits during the month, and a 'benefit receipt rate' is the proportion of people in a particular group who received benefit income in the specified month. Note that it is possible to be employed *and* receive benefit income in the same month – they are not mutually exclusive states.

Similarly, the accident compensation receipt rates used in the paper represent the proportion of people who received earnings compensation from ACC in a particular calendar month. The 'income support receipt' measures used in this paper combine the benefit and accident compensation measures.

We use two measures of average monthly earnings. One includes people whose earnings were zero, while the other excludes them. The first gives information on changes in the total earnings of the entire study population. The second is used to study changes in individuals' monthly earnings, conditional on being employed. Monthly earnings *levels* can be affected by changes in hours of work or by changes in hourly wage rates.

The study uses the following outcome measures to estimate the impact of each health condition on the outcomes of the study population:

- *The employment rate:* the proportion of the group with any wage or salary earnings in a particular month after the month of the diagnosis.

- *The change on the level of gross monthly earnings (conditional on being in employment)*: The change in the group's average monthly earnings, comparing a specified period after the diagnosis (eg, 13-24 months after) with the 12 months before the diagnosis. Months with no earnings are excluded from the calculation. This measure is intended to capture the effects of the health condition of hours of work and/or pay rates. We use data on each person's average monthly earnings during a 6 or 12 month period rather than a particular month to reduce the effects of earnings volatility, outliers, and measurement error. These individual-level earnings changes are then averaged for the whole of the study population and comparison group.

- *The benefit receipt rate*: the proportion of the group who received income from one of the main income support benefits (paid by the Ministry of Social Development) in a particular month after the diagnosis.

- *The accident compensation rate*: the proportion of the group who received income from earnings-related accident compensation (paid by the Accident Compensation Corporation) in a particular month after the diagnosis. This outcome measure is mainly relevant for traumatic brain injury victims.

- *The income support rate*: the proportion who received income from either one of the main income support benefits or earnings-related accident compensation, in a particular month after the diagnosis.

- *The change in average total gross monthly earnings:* The change in average monthly earnings, comparing a specified period after the diagnosis (eg, 13-24 months after) with the 12 months before the diagnosis. Months with no earnings are included in the calculation. As for the previous measure, we take each person's average earnings during a 6 or 12 month period rather than their earnings in a particular month to reduce the effects of earnings volatility, outliers, and measurement error.

- *The change in regular monthly personal income:* Income from earnings and personal income support payments is summed. We label this 'regular monthly personal income'. The change in each person's average monthly income, comparing a specified period after the diagnosis (eg, 13-24 months afterwards) with the 12 months before the diagnosis, is then calculated.

2.4 Impact estimation methods

The impact of each health condition is estimated by selecting a comparison group of working adults who were as similar as possible to the individuals in the study population, but did not develop the illness. The employment rates and incomes of these comparison group individuals in the follow-up period provide the 'counterfactual' against which the actual outcomes of the study population members are compared. We use a combination of exact case matching and propensity score matching[5] to select the most appropriate

[5] A good overview of the propensity score matching method is given in Caliendo and Kopeinig (2005).

comparison group members for each individual in the study population. Individuals are matched in calendar time as well as on current and prior characteristics.

More specifically, the method used to construct comparison groups has three parts. Firstly, a pool of potential comparison group members was created by selecting all working adults who met all the criteria listed in Table 1, except for the second: they did not experience or develop the reference illness or injury before or during 2008-09. The potential comparison groups (one for each condition) comprised about 1.1 million people.

The characteristics, health histories and employment and income support histories of these working adults can be measured in each calendar month from January 2008 through to December 2009. For each person in the potential comparison group, we generated eight quarterly records corresponding to the eight quarters of 2008 and 2009, and randomly assigned a reference date within the quarter. The characteristics, health histories and employment and income support histories of the individual were then measured as at this reference date. The purpose of creating this large pool of potential control group records (around 9 million) was to ensure we could match each person in the study population with a group of adults whose characteristics were well matched *in the reference quarter* – the quarter when the reference person's health condition was diagnosed.

In the second stage, we took a random sample of 10,000 of the comparison group records, and used them along with the study population records to estimate logistic regression equations modelling the probability of being diagnosed with the condition. The explanatory variables in these models included demographic characteristics (gender, age group, ethnic group, DHB of residence, the New Zealand Deprivation Index score of the area of residence), measures of recent and prior health service use patterns, and measures of employment and income support history. A full list of the explanatory variables included in the regressions is given in Table A4 in Appendix 3.

Predicted probabilities of being diagnosed with the condition were then calculated for all members of the treatment group and potential comparison group (not just the sub-sample of potential comparisons used in the regressions), using the propensity scores from each regression model. These predicted probabilities are referred to as 'propensity scores'.

The third stage of the method was to match each individual in the study population with a group of 'matched comparison' individuals. Matches were only made between people with the same gender, 2-year age group, ethnic group, district health board area, and NZ Deprivation Index score (aggregated into five levels), and whose characteristics and health and economic activity histories were measured in the same quarter of 2008 or 2009. We exact match cases on demographic characteristics and NZ Deprivation Index score because these are some the most significant predictors of being diagnosed with one of the conditions in our propensity score models. We exact match cases by quarter and DHB area to provide some degree of control for the effects of variations in the business cycle and local labour market effects.

Within those exact matching constraints, each study population individual was matched to up to 20 comparison group individuals with the closest values of their propensity score, within a radius of plus or minus 0.03 propensity score points. Fewer than 20 matches were selected if less than 20 people met these criteria. Matching with replacement was used, meaning that each comparison group individual could be matched to more than one study population member.

Each matched comparison individual was assigned a weight based on the number of matches made (eg, 0.05 if the person was one of 20 matches for a particular study

sample member). These weights are applied in the subsequent analysis of impacts, to ensure that the distribution of comparison group characteristics mirrors that of the study population.

We dropped any individuals in the study population who could not be matched with one or more comparisons. The match rates for the eight conditions ranged from 95.8% to 99.3%, and are shown in the upper sections of Tables A2 and A3 in Appendix 2. Members of certain small population subgroups, such as people in the Pacific ethnic group, were less likely to be matched, as were people with higher than average propensity scores (indicating a higher predicted likelihood of having the illness or injury).

The three-stage matching method was designed to balance the average characteristics of the study and matched comparison groups. After matching, there were no remaining statistically significant differences in variable means between the study and comparison groups, for any of the model variables. Although we did not exact match on every variable, the method ensured that the matched samples were very similar in terms of their demographic and regional profiles and prior employment and income support histories (see Tables A2 and A3).

Once the matched comparison groups were constructed, the impacts of the disease could be estimated as the difference between the mean outcome of the study population and the mean outcome of the matched comparison group. Standard errors and confidence intervals for each impact estimate were estimated using bootstrapping methods.

2.5 Propensity score model results

The explanatory variables that were found to be statistically significant in the logistic models estimated to obtain propensity scores for each condition are summarised in Table 4.

According to these regression model estimates, males had a higher likelihood than females of being diagnosed with the first four conditions (stroke, TBI, CHD and diabetes) – after controlling for the effects of the other variables in the regression models. Older adults had a higher likelihood than younger adults of being diagnosed with all of the conditions except traumatic brain injury (for which the likelihood was higher among younger adults). Europeans had a higher likelihood of being diagnosed with melanoma and prostate cancer than members of the other ethnic groups. Māori were more likely than Europeans to be diagnosed with stroke, TBI, CHD, diabetes, and COPD.

Residing in a neighbourhood (meshblock) of low socio-economic status was associated with a higher likelihood of experiencing stroke, TBI, CHD, diabetes and COPD. On the other hand, people residing in high socio-economic areas had a higher likelihood of diagnosis with the three types of cancer studied here. This is consistent with what is already known about the incidence patterns of these diseases.

Having an existing identified disease, such as coronary heart disease, diabetes or COPD, was associated with increased risk for some of the conditions studied here. For example, the model estimates for stroke indicate that people who had already been diagnosed with coronary heart disease were more likely to experience a stroke in 2008-09.

Table 4 – Factors associated with a higher likelihood of being diagnosed with each condition at ages 20-59 in the propensity models

Variable	Stroke	TBI	CHD	Diabetes	COPD	Breast cancer	Mela-noma	Prostate cancer
Male	✓	✓	✓	✓		NA		NA
Younger (eg, aged in '20s)		✓						
Older (eg, aged in '50s)	✓		✓	✓	✓	✓	✓	✓
European							✓	✓
Māori	✓	✓	✓	✓	✓			
Resident in a relatively deprived meshblock (ranked using NZDep2006)	✓	✓	✓	✓	✓			
Resident in a meshblock of low deprivation (ranked using NZDep2006)						✓	✓	✓
Has been diagnosed with coronary heart disease	✓			✓				
Has been diagnosed with diabetes			✓					
Has been diagnosed with COPD						✓		
Has been diagnosed with gout				✓				
Higher number of prescriptions in the prior 12 months	✓		✓	✓	✓			✓
Higher number of prescriptions more than one year ago	✓				✓			
Higher number of lab tests 4-12 months ago*	✓		✓	✓				✓
Higher number of out-patient visits 4-12 months ago*			✓					
Higher number of Emergency Department visits in the prior 12 months	✓	✓	✓	✓	✓			

Notes: NA = not applicable. Gender is not included in the models for breast cancer and prostate cancer because these conditions are gender-specific. *The 3 months before the month of diagnosis were excluded to avoid counting lab tests and outpatient visits that were triggered by the process of diagnosing the reference condition.

There are weaker but statistically significant associations between some of the measures of health service use in the period before diagnosis, and the subsequent diagnosis of several conditions. For example, people who had a relatively high number of prescriptions in the past year were more likely than other adults to be diagnosed with stroke, CHD, diabetes and COPD (after controlling for the effects of the other variables in the regression models). People who had a higher number of Emergency Department visits in the past year were more likely to be diagnosed with stroke, TBI, CHD, diabetes and COPD. The latter association could be driven either by poorer health (leading to more ED visits) *or* the indirect effects of other factors such as income or socio-economic status on both the likelihood of visiting an Emergency Department and the likelihood of developing the condition. Although we control for prior income and socio-economic status, the available measures are imperfect and therefore our ability to control for their effects may be imperfect.

Summary statistics on the demographic and employment profiles of the eight study populations and their corresponding matched comparison groups are given in Tables A2 and A3 in Appendix 2.

3 Impact estimates

3.1 Introduction

This section of the paper presents the main results. It is structured as follows:

- Section 3.2 provides an introduction to the impact estimates, using graphs to illustrate the changes in employment rates and average incomes that followed diagnosis.
- Section 3.3 sets out the main impact estimates and then discuss those results, for each of the eight conditions consecutively.
- Section 3.4 considers the extent to which the main impacts differ by gender, age group and ethnic group.
- Section 3.5 considers whether there are significant differences in impact size by individuals' income level before the diagnosis.
- Section 3.6 discusses the sensitivity of the results to minor variations in study design.
- In section 3.7, we estimate the average monetary value of the employment and income losses associated with the reference condition, for the study populations.
- An overall summary of the findings is provided in Section 3.8.

3.2 Labour market outcomes after developing a health condition

Figures 1–3 provide an introduction to the impact estimates. They plot the monthly employment rates, income support rates, and average monthly incomes of our study and comparison groups in each month before and after their diagnosis. In each figure, we show eight images – one for each of the conditions. The months before diagnosis are shown on the left side of each image and the months after on the right side. Months are labelled by reference to the month of diagnosis.

The employment rate graphs (Figure 1) show that for all of the eight conditions, the pre-diagnosis employment rates of the study and matched comparison groups are closely matched. The pre-diagnosis employment rates rise through time and peak in the three months before the diagnosis date because of our study section criteria: we only selected people who were employed in each month of the three months before the month of diagnosis.

Figure 1 – Employment rates before and after diagnosis

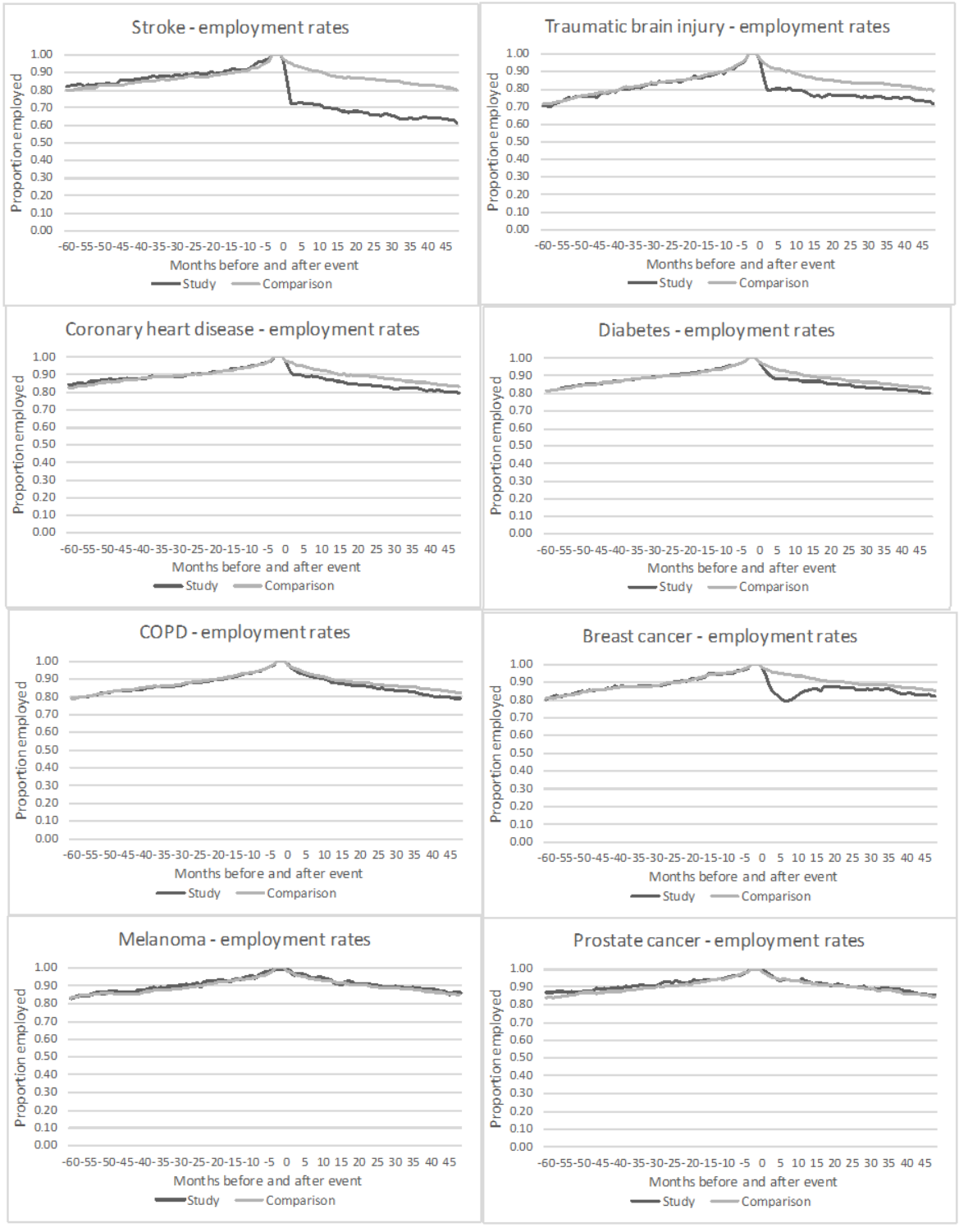
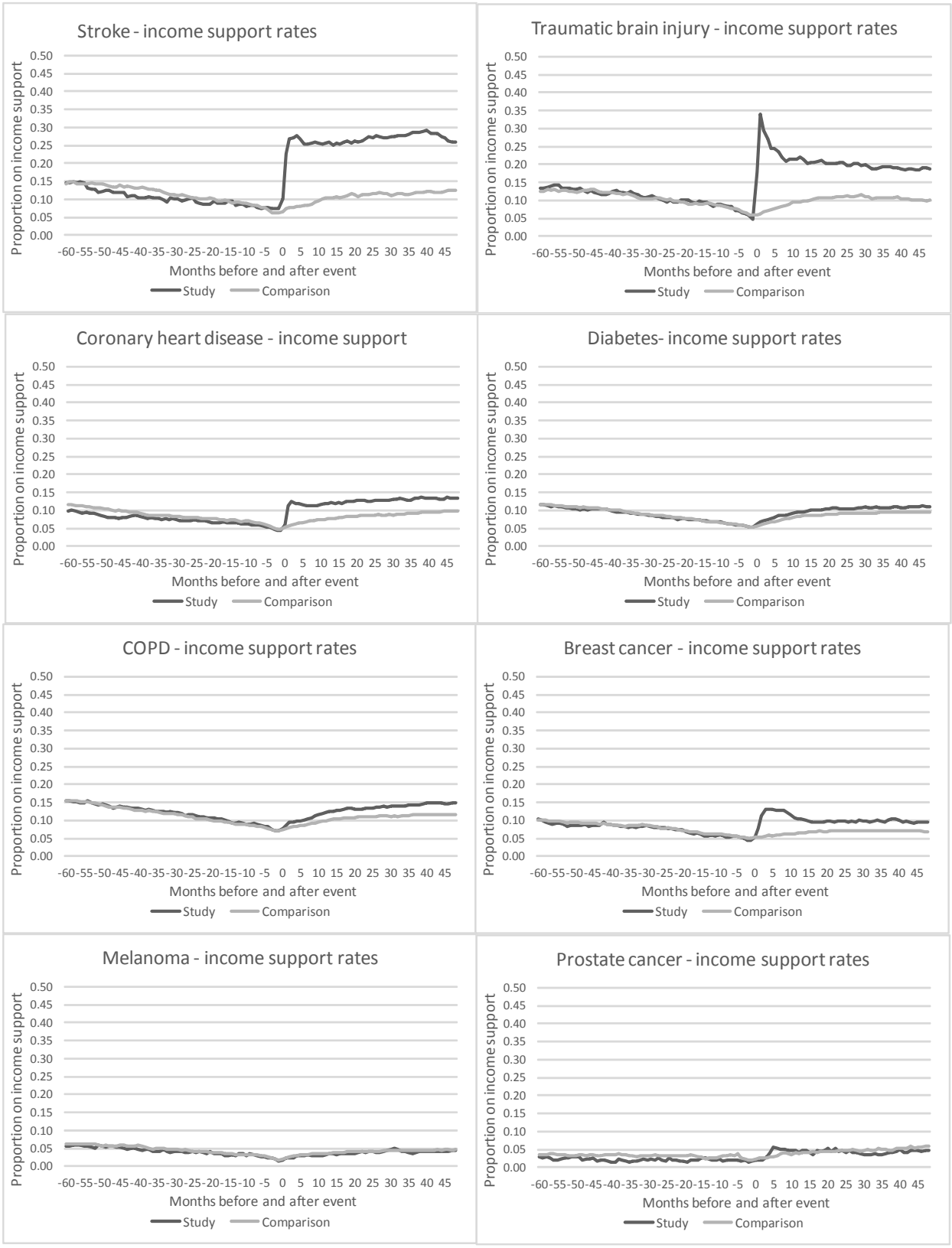
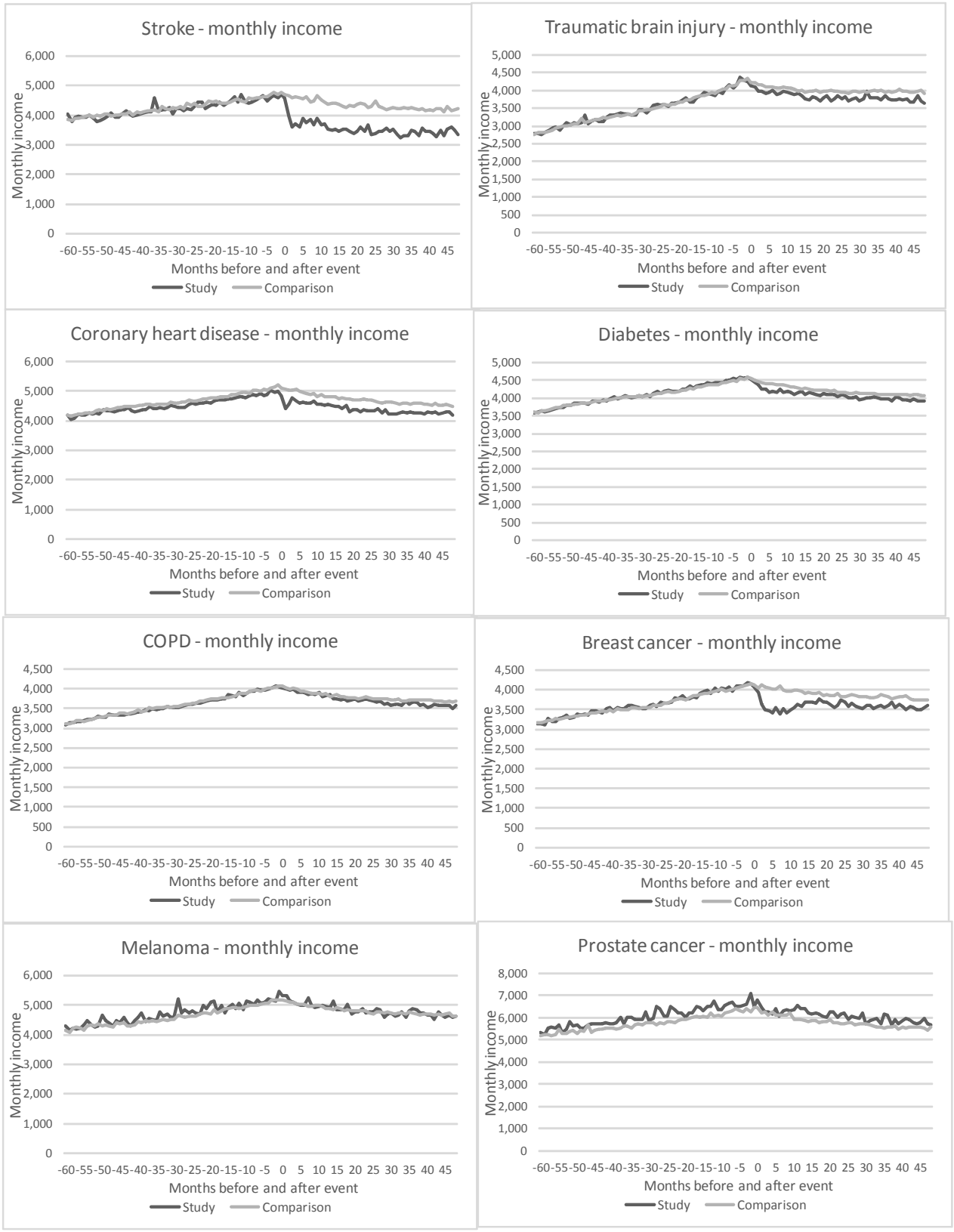


Figure 2 – Income support rates before and after diagnosis



Notes: The measure of income support includes benefits and earnings-related accident compensation.

Figure 3 – Monthly personal incomes before and after diagnosis



Notes: The monthly income measure includes earnings from wage or salaried employment and income support payments from the government.

For some of the conditions, the employment rates of the study population and the comparison group diverge in the months after diagnosis. Large gaps can be seen on the right-hand sides of the graphs for stroke, traumatic brain injury, and breast cancer, for example. This is also the case when we consider the graphs of pre– and post-diagnosis income support rates (Figure 2) and pre– and post-diagnosis average monthly incomes (Figure 3).

These graphs provide a good indication that there were differences in outcomes between the study populations and their matched comparison groups, for at least some of the eight conditions, but they do not show whether the differences were statistically significant. The size and significance of the impacts is assessed through our main results.

3.3 Main impact estimates for each condition

The main impact estimates are summarised in Figure 4 and Tables 5–7. A complete set of results for each condition, showing the mean levels of each variable in each follow-up period, the absolute and relative impact estimates, and their standard errors, is set out the Tables A5–A8 in Appendix 3.

Figure 4 provides a graphical summary, depicting selected results for four outcome measures: the proportion who were employed, mean monthly earnings (conditional upon employment), the proportion receiving income support, and mean monthly personal incomes. The impacts are represented by the height of the bars in each graph. The vertical lines intersecting each bar show the upper and lower bounds of the 95% confidence intervals on each estimate. If the confidence interval crosses '0' on the vertical axis, the impact estimate is not considered to be statistically significant.

Table 5 gives our main estimates of the effects of the eight conditions on: (a) the proportion who were employed at 3, 6, 12, 24, 36 and 48 months after the month of diagnosis, and (b) average monthly earnings conditional on being employed, assessed at 1-6 months, 7-12 months, 13-24 months, 25-36 months and 37-48 months after diagnosis. Each number represents the difference between the employment rate or earnings of the study population and the employment rate or earnings of their matched counterparts who did not experience the condition. Note that the employment figures represent the estimated percentage-point change in the proportion of the study population members who were in wage or salaried employment, while the earnings figures show *relative* impacts (ie, the study population's average earnings loss as a percentage of the average pre-diagnosis earnings of the comparison group), because percentages can be more meaningfully compared across groups than impacts expressed in dollars. See section 2.3.4 for more detail on the outcome measures.

Table 6 focuses on income support receipt rates and gives our estimates of the impacts of the eight conditions on the proportion who were receiving a benefit, receiving earnings-related accident compensation, or receiving either type of government income support, at 3, 6, 12, 24, 36 and 48 months after diagnosis.

Figure 4 – Summary of impacts on employment rates, earnings, income support receipt rates and regular monthly incomes

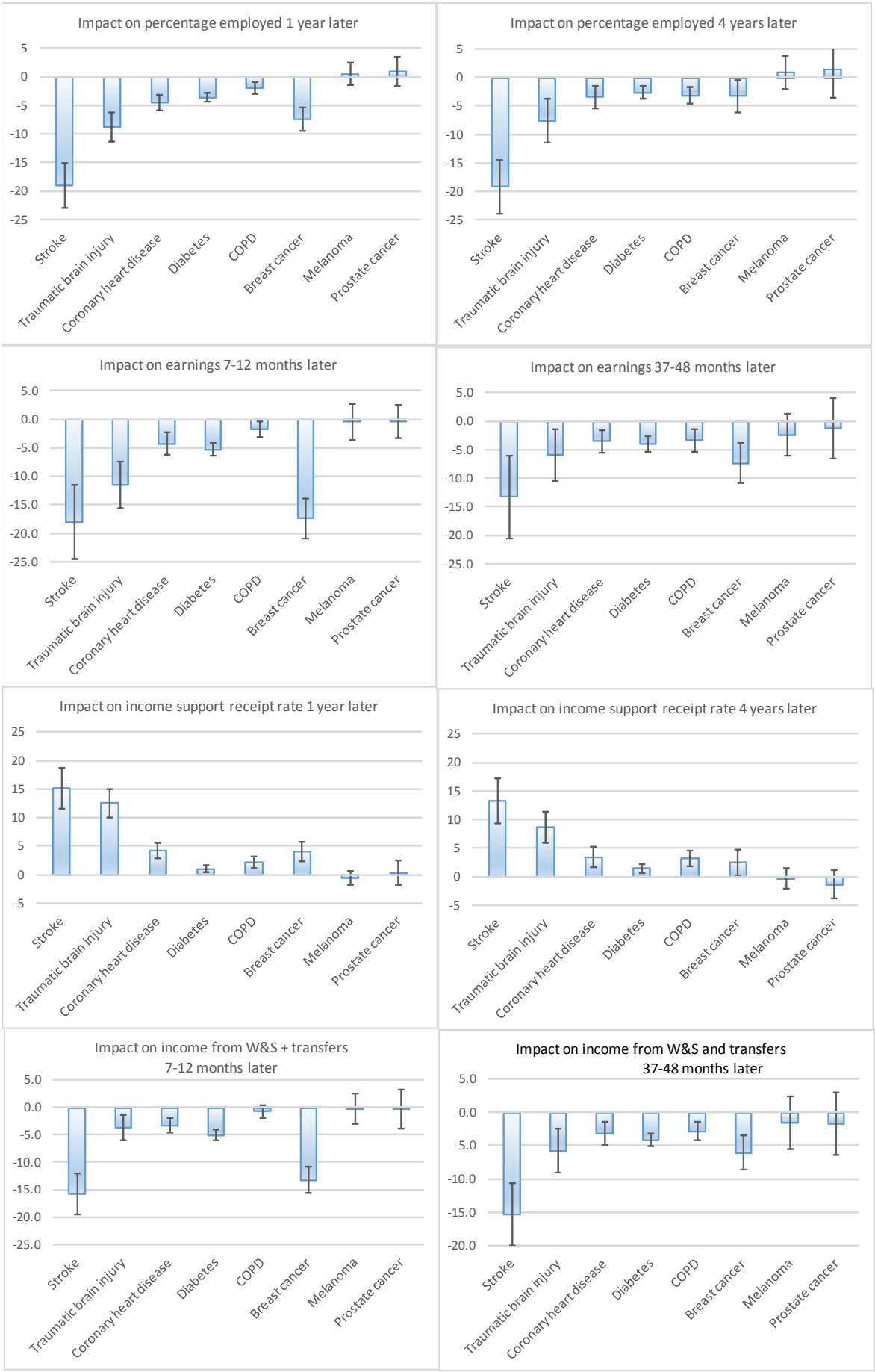


Table 5 – Estimated labour supply impacts of each condition

	3 months after	6 months after	12 months after	24 months after	36 months after	48 months after
			Impact on the employment rate (percentage points)			
Stroke	-21.9	-19.7	-18.9	-19.9	-19.9	-19.1
Traumatic brain injury	-13.3	-10.6	-8.7	-7.0	-7.6	-7.5
Coronary heart disease	-5.4	-5.0	-4.5	-4.6	-3.5	-3.4
Diabetes	-5.2	-4.9	-3.5	-2.4	-2.7	-2.6
COPD	-1.3	-1.1	-1.8	-2.1	-2.6	-3.1
Breast cancer	-10.7	-14.5	-7.3	-2.5	-1.8	-3.2
Melanoma	0.9	0.6	0.5	0.5	0.8	1.0
Prostate cancer	0.7	0.0	1.0	0.8	1.1	1.4
		1-6 months after	7-12 months after	13-24 months after	25-36 months after	37-48 months after
			Impact on log monthly earnings, conditional on working (%)			
Stroke		-28.7	-17.9	-14.4	-19.2	-13.2
Traumatic brain injury		-18.8	-11.4	-7.5	-7.2	-5.8
Coronary heart disease		-11.1	-4.2	-5.6	-5.3	-3.5
Diabetes		-4.6	-5.2	-4.6	-3.9	-4.0
COPD		-2.1	-1.7	-2.7	-3.7	-3.3
Breast cancer		-18.7	-17.3	-9.9	-8.3	-7.3
Melanoma		-0.9	-0.4	-0.8	-0.2	-2.3
Prostate cancer		-4.1	-0.3	-0.2	-2.0	-5.1

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The number of people in each study population is shown in Tables 5 and 6.

Table 7 focuses on personal incomes and gives estimates of the impacts of the conditions on individuals' average monthly earnings and average monthly personal incomes. These impacts are assessed at 1-6 months, 7-12 months, 13-24 months, 25-36 months and 37-48 months after diagnosis. Note that these measures are calculated for everyone in the study population or comparison group, including individuals with zero earnings or incomes. The numbers are percentage impacts (representing the earnings or income loss as a percentage of the average pre-diagnosis earnings/incomes of the comparison group).

Table 8 provides information on the variations in impact size between people with different levels of condition severity.

In each table, estimates that are statistically significant at the 95% confidence level are shown in bold font. Numbers that are not in bold font are not significantly different from zero.

Table 6 – Estimated impacts of each condition on income support rates

	3 months after	6 months after	12 months after	24 months after	36 months after	48 months after
			Impact on the benefit receipt rate (percentage points)			
Stroke	18.2	15.5	14.1	15.7	15.6	12.9
Traumatic brain injury	0.6	1.3	2.3	1.9	2.5	2.8
Coronary heart disease	5.7	4.1	3.5	3.6	3.6	3.2
Diabetes	0.8	1.2	1.0	1.4	1.2	1.5
COPD	1.1	1.1	1.6	1.9	2.3	2.8
Breast cancer	7.5	7.2	4.4	2.6	2.1	2.2
Melanoma	-0.3	-0.2	-0.3	0.1	-0.3	0.3
Prostate cancer	0.2	2.5	0.4	0.6	-0.7	-0.7
			Impact on the accident compensation receipt rate (pp)			
Stroke	1.6	1.4	1.3	0.4	1.2	0.4
Traumatic brain injury	19.4	14.1	10.5	7.6	6.2	6.1
Coronary heart disease	0.2	0.4	0.8	0.4	0.6	0.4
Diabetes	0.1	0.1	0.1	-0.2	0.0	0.0
COPD	0.2	0.4	0.6	0.5	0.6	0.5
Breast cancer	-0.3	-0.2	-0.2	0.1	0.5	0.4
Melanoma	-0.3	-0.2	-0.1	-0.1	-0.4	-0.5
Prostate cancer	-0.1	-0.4	0.0	-0.6	-0.4	-0.6
			Impact on the income support rate (percentage points)			
Stroke	19.5	16.8	15.3	16.0	16.9	13.3
Traumatic brain injury	20.0	15.3	12.6	9.4	8.6	8.8
Coronary heart disease	5.9	4.4	4.3	4.0	4.1	3.5
Diabetes	0.9	1.4	1.1	1.2	1.2	1.5
COPD	1.3	1.4	2.2	2.4	2.8	3.2
Breast cancer	7.2	6.9	4.1	2.6	2.6	2.5
Melanoma	-0.7	-0.4	-0.4	0.1	-0.7	-0.2
Prostate cancer	0.1	2.1	0.4	0.0	-1.1	-1.3

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The number of people in each study population is shown in Tables 5 and 6.

Table 7 – Estimated impacts of each condition on personal monthly income

	1-6 months after	7-12 months after	13-24 months after	25-36 months after	37-48 months after
	Impact on average monthly earnings (%)				
Stroke	-24.5	-22.2	-23.2	-23.9	-21.5
Traumatic brain injury	-17.6	-12.7	-12.0	-10.6	-11.6
Coronary heart disease	-7.3	-4.8	-5.4	-5.2	-4.4
Diabetes	-5.2	-5.6	-4.1	-4.1	-4.8
COPD	-1.1	-1.4	-2.1	-3.2	-4.0
Breast cancer	-15.1	-15.8	-7.8	-8.0	-7.4
Melanoma	-1.1	-0.2	-0.9	-1.6	-1.4
Prostate cancer	-4.5	-0.6	-0.2	-0.6	-1.6
	Impact of average monthly personal income (%)				
Stroke	-17.7	-15.6	-17.2	-17.1	-15.2
Traumatic brain injury	-3.8	-3.7	-4.6	-4.6	-5.7
Coronary heart disease	-5.5	-3.2	-3.9	-3.7	-3.2
Diabetes	-4.7	-5.0	-3.5	-3.6	-4.1
COPD	-0.8	-0.7	-1.3	-2.2	-2.8
Breast cancer	-12.5	-13.2	-6.5	-6.9	-6.0
Melanoma	-1.1	-0.2	-1.0	-1.5	-1.5
Prostate cancer	-4.2	-0.3	0.1	-0.7	-1.6

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The number of people in each study population is shown in Tables 5 and 6.

Table 8 – Variations in estimated impacts by the likely severity of the condition

	N study popn	Empt rate at 1 year pp	Empt rate at 4 years pp	Income support rate at 1 year pp	Income support rate at 4 years pp	Change in avge monthly income at 7-12 months (%)	Change in avge monthly income at 37-48 months (%)
Stroke							
0-1 nights in hospital	96	-5.3	-17.0	-0.5	2.0	-2.5	-18.3
2-7 nights in hospital	285	-8.0	-8.6	8.4	6.7	-7.6	-1.0
8-14 nights in hospital	168	-13.1	-12.8	17.0	11.8	-13.8	-11.3
15+ nights in hospital	189	-47.2	-41.3	31.8	30.1	-36.9	-39.8
Traumatic brain injury							
0-1 nights in hospital	978	-2.6	-4.2	6.1	4.9	-2.8	-5.1
2-7 nights in hospital	180	-8.6	-7.2	14.9	6.8	-2.2	-5.0
8-14 nights in hospital	81	-44.7	-21.1	39.3	20.1	-7.3	-6.5
15+ nights in hospital	66	-55.5	-42.0	70.7	59.3	-15.7	-14.1
Breast cancer							
Localised	732	-4.3	-1.9	2.2	0.9	-10.3	-4.5
Beyond localised	483	-10.7	-4.3	6.3	3.9	-16.6	-5.7
Melanoma							
Localised	738	0.4	0.7	-0.4	0.0	0.1	-1.4
Beyond localised	42	3.3	4.1	-1.1	-0.4	-1.7	-1.3
Coronary heart disease							
No heart attack	1419	-3.8	-2.5	3.6	3.3	-2.8	-4.3
Heart attack	1575	-5.1	-4.1	4.8	3.8	-3.5	-2.2

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The sample size numbers are randomly rounded.

We discuss the results for each illness or injury separately in the remainder of this section. Although we show the estimated impacts at various periods of time from 3 months onwards in our tables, we focus mainly on the longer-term effects from one year onwards in the discussion, because these will have more lasting consequences for people's well-being and incomes.

3.3.1 Stroke

The labour supply and income effects estimated for stroke patients are the largest identified in this paper. The employment rate of the stroke patients fell immediately after diagnosis and was 19–22 percentage points below that of the matched comparison group throughout the four-year follow-up period (see Figure 1 and Table 5). Although the size of the employment impact declined slightly over the follow-up period, there was relatively little improvement, suggesting that the long-term rate of return to work for those who were unable to work in the first six months after the stroke was fairly low.

For those who either continued in work or returned to work, a sharp initial fall in average monthly earnings was followed by a medium-term reduction of 13–19 percent, in the period one to four years after the stroke. This reduction in the stroke patients' average monthly earnings (conditional on being in paid work) could be due to reduced working

hours, job changes leading to lower wages, or a combination of these effects. The data available in IDI do not allow us to distinguish between these different causes.

The proportion of stroke victims who were receiving an income support benefit (Table 6) was 15.5 percentage points higher after six months, and this approximate level of increase was sustained for the rest of the follow-up period. The proportion receiving earnings-related compensation was also very slightly raised, by around 1 percentage point per month, but this small impact was not consistently significant in our estimates.

The income effects associated with stroke were also large (Table 7). We estimate that the stroke patients' total monthly earnings from wages and salaries were on average about 25% lower than those of the matched comparison group during the first six months, as a result of the stroke. This earnings loss declined slightly over time, to 21.5% in the fourth year after the stroke. After summing earnings and income support payments, the estimated loss of regular monthly personal income was somewhat lower, at 17.7% in the first six months, falling to 15.2% in the fourth year after the stroke.

There are no clinical measures of stroke severity in the available data sources, but it is possible to use length of stay in hospital as a rough proxy measure of the likely severity of the stroke. Table 8 shows the variation in employment, income support and income impacts that is associated with variations in the duration of the (initial) period in hospital. People with the shortest hospital stays (0–7 nights, 52% of cases) were not as seriously affected. Most of their employment and income losses were in the 2–8% range. Much larger losses were experienced by those who spent more than two weeks in hospital at the time of their stroke (about 26% of cases). The latter group's employment rate was around 41 percentage points lower after four years, and its average monthly personal income was 40% lower.

3.3.2 Traumatic brain injury

The employment rate of people who experienced a traumatic brain injury fell immediately after diagnosis. It was 8.7 percentage points below that of the matched comparison group after one year, and remained 7–9 percentage points lower throughout the follow-up period.

For those who either continued in employment or returned to work, there is evidence of a substantial and long-term fall in real monthly earnings (of 11.4 percent in the period 7-12 months after the event and 6-8 percent during the following three years). This reduction may have been due to shorter working hours, changes in the wage rates of jobs undertaken or a combination of both.

We find that the proportion of TBI victims who received a benefit was not significantly changed in the first year after the injury, but it increased by 2-3 percentage points in the second to fourth years, increasing gradually though time. The income support received by TBI victims was largely obtained through the ACC scheme. The proportion receiving earnings-related compensation from ACC was around 19 percentage points higher after 3 months, 11 percentage points higher after 12 months and 6 percentage points higher after four years, than that of the matched comparison group. Overall, TBI victims were 13 percentage points more likely to be receiving income support after 12 months and 9 percentage points more likely to be receiving income support after four years.

We estimate that the TBI patient's total monthly earnings from wages and salaries were approximately 18% lower in the first six months as a result of the injury. This earnings loss declined over the following 2–3 years to around 11%. Due to the role of accident-related earnings compensation, however, their loss of regular monthly personal income was much lower, at 4–5% in the first two years, increasing slightly over time to around 6%.

Table 8 shows the variation in employment, income support, and income impacts by the duration of the individual's initial stay in hospital. People with the shortest hospital stays after TBI (0–1 nights, the majority of cases) were least severely affected afterwards, with subsequent employment and income losses in the 3–6% range. Much larger effects were estimated for people who were in hospital for more than two weeks (5% of cases). The latter group's employment rate was 56 percentage points lower than that of its matched comparison group at one year after the event. Its average monthly personal income was around 14–15% lower at both 7–12 months and 37–48 months after the event.

3.3.3 Coronary heart disease

The impact estimates for people with coronary heart disease show a 4–6 percentage point fall in the group's average employment rate in the period from 3 months to 4 years after diagnosis, with some reduction but relatively little change in the size of this impact over time. Conditional on working, average monthly earnings were 11% lower during the first 6 months. Thereafter, the reduction in average monthly earnings was fairly stable at around 5% per month.

The income support rate of this group was 3–5 percentage points higher than that of the matched comparison group from 6 months after diagnosis onwards, largely as a result of higher benefit take-up. The estimated impact of the disease on average monthly personal income was similarly stable through time, with an average reduction of 3–4% during the follow-up period.

As in the case of stroke and TBI, the actual effects of coronary heart disease are likely to be highly variable across individuals, depending on the severity of the disease. About half the CHD patients in our study population experienced a heart attack during the four-year follow-up period. In many cases, the heart attack appears to have been the critical event triggering their diagnosis as a CHD sufferer. We divided the study population between those who experienced a heart attack during the follow-up period and those who did not, and estimated employment and income impacts for each sub-group (see table 8). The impacts were generally larger for the heart attack group than for the rest of the CHD population but the differences were small.

3.3.4 Diabetes

Estimates of the labour supply and income impacts of diabetes show modest short-run effects developing in the 3 months after diagnosis, which weaken slightly during the following four years. At 3 months after diagnosis, people with diabetes were 5.2 percentage points less likely to be employed than their matched counterparts without diabetes. By four years after, the difference had declined to 2.6 percentage points. Average earnings conditional on being employed were 4.6% lower in the first 6 months after diagnosis and 4.0% lower in the fourth year after diagnosis.

Diabetes was associated with a 1 percentage point increase in the proportion receiving a benefit. Both average monthly earnings and average monthly incomes were 3–5% lower for the diabetes sufferers during our four-year follow-up period, than for their matched comparisons. These income effects were slightly lower at the end of the follow-up period than in the first year after diagnosis.

One possible explanation for the pattern of employment impacts is that some individuals with diabetes become better at managing their condition over time, thereby minimising symptoms or side effects that interfere with employment. We do not find evidence of negative impacts increasing with the passage of time, as would be expected if significant numbers of people in the study sample were developing diabetes-related complications. However, the follow-up period may be too short for any such deterioration to be evident. In a US study of the impacts of diabetes, Minor (2013) reports that both the probability of being in paid work and the wage levels of those in paid work are negatively related to years since diagnosis, peaking at 10–16 years after the diagnosis.

3.3.5 Chronic obstructive pulmonary disease (COPD)

The distinguishing pattern found in the labour supply and income impact estimates for COPD is that the impacts are very small initially but grow slightly larger over time. COPD is the only condition considered in this paper that shows evidence of deterioration in outcomes. However, the magnitude of the effects remains modest within our four-year time frame.

At three months after diagnosis, people with COPD were 1.3 percentage points less likely to be employed than their matched counterparts without diabetes. By four years after, the difference had increased to 3.1 percentage points. Average earnings conditional being employed were 2.1% lower in the first 6 months after diagnosis and 3.3% lower in the fourth year after diagnosis. COPD was also associated with a 3.2 percentage point increase in the proportion receiving income support, by four years after diagnosis. Regular monthly personal incomes were not significantly lower for the COPD sufferers immediately after the diagnosis, but they were and 2.8% lower after four years.

Based on the findings of previous research, it is likely that the employment and income effects of COPD vary across individuals according to the severity of the condition and the duration of time they have had the disease. For example, Sin et al (2002) report that for a sample of adults in the United States, mild, moderate and severe COPD was associated with 3.4%, 3.9% and 14.4% reductions in the labour force participation rate, relative to those without COPD.

3.3.6 Breast cancer

Breast cancer was associated with relatively large employment and income losses in the first year after diagnosis. These impacts had become much smaller by around 20 months after the diagnosis, but they did not entirely disappear during the follow-up period.

At 3 months after diagnosis, women with breast cancer were 10.7 percentage points less likely to be employed than their matched counterparts. By two years after, the difference had declined to 2.5 percentage points, after which there was no further consistent improvement. Average monthly earnings conditional being employed were 18.7% lower in the first 6 months after diagnosis and 7.3% lower in the fourth year after diagnosis.

Breast cancer was also associated with a 7.2 percentage point increase in the proportion receiving income support payments 3 months after diagnosis, declining over time to a 2.5 percentage point impact four years later (but the latter is not statistically significant). Average monthly incomes from the combination of employment and income support were 12.5% lower in the first six months and 6.0% lower in the fourth year after diagnosis.

Cancers can be classified by their stage at diagnosis. More advanced cancers may require lengthier or more invasive treatments and are more likely to lead to persistent disabilities after treatment. We compared the employment and income impacts of breast cancer for women whose cancer was classified as localised with those whose cancer was more widely spread. These results are shown in Table 8. As anticipated, the latter group experienced larger reductions in employment rates, larger increases in its income support receipt rates and larger total income losses.

Andersen et al (2015) provides estimates of the effect of breast cancer on personal income three years after diagnosis for Danish women, using data sources and methods that are similar enough to those of the current study to make comparisons valid. They estimate that breast cancer patients generally lost about 2.7% in income compared to the comparable healthy population, measured at three years after diagnosis. They attribute this relatively small average income loss to features of the compensation systems in Denmark, which provide a relatively high level of replacement income for adults whose earning capacity is impaired. They also report a significant difference between metastatic and localised cancers in the size of the impact of breast cancer on women's incomes, with higher impacts for metastatic cancers.

3.3.7 Melanoma

We found no evidence of negative labour supply impacts or income losses following a diagnosis of melanoma, for the adults in our study population of survivors.

3.3.8 Prostate cancer

People who were diagnosed with prostate cancer were no less likely than their matched counterparts (who did not get cancer) to be employed at any time during the follow-up period. On the other hand, we estimate they experienced a 4% reduction in their average monthly earnings and average monthly personal incomes during the first 6 months after diagnosis. We do not find significant earnings or income effects in the longer-term, however.

The labour supply effects of prostate cancer identified here are smaller and shorter-term than those reported by Bradley et al (2005). Using a relatively small sample of men with prostate cancer in the US, the study reports that patients with prostate cancer were 10 percentage points less likely to be employed at six months after diagnosis than similar adults without cancer. After one year there was no significant difference. Syse et al (2008), using population-level data for Norwegian cancer survivors, also reports larger employment rate reductions following prostate cancer than those found here, but did not find significant changes in earnings conditional upon employment.

3.4 Variations in impacts across demographic groups

The main impact estimates reported above are disaggregated by gender, age group and ethnic group in this section. Gender breakdowns are given in Table 9, age group breakdowns in Table 10 and ethnic group breakdowns in Table 11. The analysis is restricted to the first six conditions, due to the lack of robust evidence of labour market or income effects following melanoma and prostate cancer. Results are given for stroke, TBI, CHD, diabetes, COPD and breast cancer subgroups when there were at least 100 people in the subgroup.

The impact estimates for males and females are mostly similar to each other. Diabetes is the only condition in Table 9 with sizeable and statistically significant gender differences in impact size. The employment and income impacts for women with diabetes are consistently larger than those estimated for men.

Table 9 – Variations in impacts by gender

	N study popn	Empt rate at 1 year pp	Empt rate at 4 years pp	Income support rate at 1 year pp	Income support rate at 4 years pp	Change in avg monthly income at 7-12 months (%)	Change in avg monthly income at 37-48 months (%)
Stroke							
Males	417	-19.7	-20.4	16.8	15.8	-14.0	-14.5
Females	321	-17.9	-17.4	13.2	10.0	-18.7	-16.5
Difference		*1.8*	*3.0*	*-3.6*	*-5.9*	*-4.7*	*-2.0*
TBI							
Males	900	-9.6	-8.7	12.4	9.3	-3.4	-7.1
Females	402	-6.5	-4.8	13.0	7.6	-4.4	-1.8
Difference		*3.1*	*3.9*	*0.6*	*-1.7*	*-1.1*	*5.2*
CHD							
Males	2154	-3.7	-2.7	4.1	3.0	-2.8	-2.9
Females	840	-6.5	-4.9	4.8	4.9	-4.8	-4.1
Difference		*-2.8*	*-2.2*	*0.7*	*2.0*	*-2.0*	*-1.2*
Diabetes							
Males	4863	-0.9	-1.0	0.8	1.1	-1.3	-2.3
Females	4749	-6.2	-4.2	1.3	1.9	-10.4	-6.7
Difference		*-5.2*	*-3.2*	*0.5*	*0.8*	*-9.1*	*-4.4*
COPD							
Males	2232	-1.9	-3.1	2.7	3.3	-1.1	-4.2
Females	3660	-1.8	-3.2	1.9	3.2	-0.3	-1.5
Difference		*0.2*	*0.0*	*-0.8*	*0.0*	*0.7*	*2.6*

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The sample size numbers are randomly rounded.

Turning to age group, the differences in impact by broad age group (Table 10) are relatively small or inconsistent in direction for adults with stroke, CHD, COPD and breast cancer. The employment impacts of TBI *do* appear to vary with age and are higher for the oldest age group (50-59) than the youngest age group (20-34) – although these differences are not statistically significant. In contrast, the one-year employment and income impacts of diabetes are much larger for the youngest age group than for the oldest, and significantly so. The reasons for these age variations are not currently known.

Table 10 – Variations in impacts by age group

	N study popn	Empt rate at 1 year pp	Empt rate at 4 years pp	Income support rate at 1 year pp	Income support rate at 4 years pp	Change in avg monthly income at 7-12 months (%)	Change in avg monthly income at 37-48 months (%)
Stroke							
35-49	267	-21.8	-17.2	21.2	16.5	-18.3	-15.6
50-59	423	-18.7	-21.3	12.1	11.9	-14.3	-15.0
Difference 50-59 vs 35-49		*3.1*	*-4.1*	*-9.1*	*-4.6*	*4.0*	*0.7*
TBI							
20-34	657	-7.1	-4.4	13.2	7.8	-4.4	-4.1
35-49	453	-8.8	-9.0	11.8	8.4	-3.2	-6.9
50-59	195	-13.4	-14.4	12.3	13.2	-3.0	-6.9
Difference 20-34 vs 35-49		*-6.2*	*-10.0*	*-0.9*	*5.4*	*1.3*	*-2.8*
CHD							
35-49	1107	-3.4	-2.2	5.1	4.2	-2.4	-3.0
50-59	1830	-5.3	-3.9	3.9	3.1	-3.5	-3.2
Difference 50-59 vs 35-49		*-4.2*	*4.8*	*4.3*	*-2.8*	*5.2*	*3.5*
Diabetes							
20-34	1236	-11.7	-6.1	2.4	2.9	-21.2	-10.1
35-49	4299	-3.4	-2.4	0.9	1.4	-5.1	-4.6
50-59	4074	-1.2	-1.7	0.9	1.2	-1.1	-2.2
Difference 20-34 vs 35-49		*10.5*	*4.3*	*-1.5*	*-1.7*	*20.1*	*7.9*
COPD							
20-34	858	0.7	-0.2	1.3	1.7	1.9	-1.0
35-49	2454	-1.9	-2.4	2.0	2.4	-0.7	-2.6
50-59	2574	-2.6	-4.8	2.7	4.6	-1.4	-3.4
Difference 20-34 vs 35-49		*-3.4*	*-4.7*	*1.4*	*2.9*	*-3.2*	*-2.4*
Breast cancer							
35-49	645	-8.2	-2.0	4.0	3.3	-13.4	-3.5
50-59	594	-6.5	-4.8	3.8	2.1	-12.7	-8.6
Difference 50-59 vs 35-49		*1.7*	*-2.8*	*-0.2*	*-1.2*	*0.7*	*-5.1*

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The sample size numbers are randomly rounded.

Estimates for the main ethnic groups are given in Table 11. These suggest that for stroke, TBI, CHD and perhaps breast cancer, larger impacts on employment rates and income support rates were experienced by Māori and Pacific peoples than by Europeans, on average – but the differences are not statistically significant. In the case of diabetes and COPD, the ethnic group differences are rather small.

Table 11 – Variations in impacts by ethnic group

	N study popn	Empt rate at 1 year pp	Empt rate at 4 years pp	Income support rate at 1 year pp	Income support rate at 4 years pp	Change in avg monthly income at 7-12 months (%)	Change in avg monthly income at 37-48 months (%)
Stroke							
European	471	-16.5	-16.7	11.9	8.7	-14.9	-14.0
Māori	168	-26.6	-25.2	22.4	19.3	-16.0	-17.8
Difference M-E		*-10.1*	*-8.5*	*10.5*	*10.6*	*-1.1*	*-3.8*
TBI							
European	927	-8.2	-6.7	12.2	8.7	-2.9	-5.0
Māori	222	-12.8	-11.5	17.8	11.0	-4.0	-3.8
Pacific ethnicity	108	-5.3	-9.6	6.7	6.8	-9.1	-14.9
Difference M-E		*-4.6*	*-4.9*	*5.6*	*2.3*	*-1.1*	*1.3*
CHD							
European	2205	-3.6	-1.9	3.6	2.6	-2.6	-2.6
Māori	462	-5.9	-7.5	6.3	5.4	-4.3	-2.9
Pacific ethnicity	198	-9.9	-10.6	8.5	9.1	-7.1	-8.1
Difference M-E		*-2.3*	*-5.6*	*2.7*	*2.8*	*-1.7*	*-0.4*
Diabetes							
European	5103	-3.9	-2.4	0.4	1.0	-6.0	-4.7
Māori	1818	-2.7	-3.3	2.3	2.5	-3.5	-4.6
Pacific ethnicity	1497	-2.4	-2.1	2.8	3.3	-3.0	-3.5
Difference M-E		*1.2*	*-0.9*	*1.9*	*1.5*	*2.5*	*0.1*
COPD							
European	4239	-1.7	-3.6	2.0	3.1	-0.7	-2.7
Māori	1110	-3.3	-2.2	2.6	3.7	-0.3	-2.1
Pacific ethnicity	327	0.5	1.5	2.7	5.2	0.1	-2.9
Difference M-E		*-1.5*	*1.4*	*0.5*	*0.5*	*0.4*	*0.6*
Breast cancer							
European	981	-6.1	-1.9	2.6	1.8	-13.3	-6.6
Māori	171	-7.8	-3.7	7.6	5.0	-6.5	1.6
Difference M-E		*-1.7*	*-1.7*	*5.0*	*3.2*	*6.8*	*8.2*

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The sample size numbers are randomly rounded.

Small sample sizes mean that the confidence intervals associated with the impact estimates for Māori and Pacific peoples are particularly large, reducing the likelihood that statistically significant differences in impacts will be found.

3.5 Variations in impacts by income level before diagnosis

In this section we consider whether there are significant variations in the employment and income effects of ill health between people with different levels of wage and salary incomes in the year before their diagnosis.

There are several reasons why such variations might exist. First, the ability of someone with a chronic condition to remain employed or return to work will be affected by the task requirements of their job. Because lower-paid workers are more likely than higher paid workers to be employed in manual jobs, one might expect them to have a lower average rate of employment following diagnosis with any condition that reduces physical fitness.

Second, people who work in more highly skilled and highly paid jobs often have better access to paid sick leave, potentially making it easier for them to retain the jobs they held before diagnosis, and reducing their risks of experiencing earnings and income losses. People who have a serious illness often need time off work for treatment and recovery, and the ability to take sick leave when needed and for as long as needed is likely to be a major asset in these circumstances.

Another reason for income-related variations in impacts is that the income replacement rates provided by benefits will differ, giving people who were previously working in higher paid jobs (who face lower income replacement rates) greater incentives to stay in the labour force than those who were previously working in lower paid or part-time jobs.

Beyond the labour market, there are other factors that could lead to differences in impacts between people with different levels of earnings, if they happen to be correlated with earnings. For example, if workers who had low annual earnings in the year before their diagnosis also tended to develop more serious manifestations of the illness, these differences in severity could lead to variations in impact size that are correlated with income level.[6] We have no evidence, however, that this is the case.

We divided each study population into four quartiles on the basis of individuals' total annual earnings in the year before their diagnosis. Selected employment and income impacts calculated for each quartile group are shown in Table 12. The analysis is restricted to the first six conditions, due to the lack of evidence of labour market or income effects following melanoma and prostate cancer.

[6] Women are more likely than men to be in the lower earnings quartiles, but gender effects will not influence the variations in impacts by income because we exact match females to females and males to males in the comparison group selection process. The same is true of age, ethnic group, and DHB of residence.

Table 12 – Variation in impacts by level of annual earnings in the prior year

	N study popn	Empt rate at 1 year pp	Empt rate at 4 years pp	Income support rate at 1 year pp	Income support rate at 4 years pp	Change in avg monthly income at 7-12 months (%)	Change in avg monthly income at 37-48 months (%)
Stroke							
Lowest quartile	183	-19.8	-18.5	16.8	11.2	-19.0	-16.7
2nd quartile	186	-21.6	-21.5	18.6	16.6	-16.9	-15.5
3rd quartile	183	-19.5	-20.2	16.5	16.5	-20.3	-17.8
Highest quartile	186	-16.0	-17.6	10.9	10.4	-10.9	-12.1
Difference L-H		*3.8*	*0.9*	*-5.9*	*-0.8*	*8.1*	*4.6*
TBI							
Lowest quartile	327	-10.6	-7.0	12.9	9.4	-10.4	-13.0
2nd quartile	327	-10.5	-6.8	14.0	11.0	-4.2	-3.0
3rd quartile	327	-6.7	-4.9	11.5	5.5	-4.5	-4.3
Highest quartile	327	-6.6	-11.0	11.5	9.0	-1.5	-6.2
Difference L-H		*4.0*	*-4.0*	*-1.4*	*-0.3*	*9.0*	*6.8*
CHD							
Lowest quartile	747	-8.8	-7.1	7.9	6.3	-7.4	-7.4
2nd quartile	747	-3.8	-2.7	3.0	3.2	-6.5	-4.8
3rd quartile	747	-2.3	-3.0	3.9	3.1	-3.3	-3.0
Highest quartile	747	-3.0	-0.6	2.2	1.3	-1.0	-2.0
Difference L-H		*5.8*	*6.5*	*-5.7*	*-5.0*	*6.5*	*5.3*
Diabetes							
Lowest quartile	2400	-5.7	-3.8	2.0	2.7	-9.1	-7.6
2nd quartile	2403	-2.7	-2.6	1.6	2.4	-5.7	-3.7
3rd quartile	2403	-3.1	-1.6	0.6	0.7	-3.3	-2.5
Highest quartile	2403	-3.1	-3.0	0.8	1.0	-4.4	-3.9
Difference L-H		*2.6*	*0.8*	*-1.2*	*-1.7*	*4.7*	*3.7*
COPD							
Lowest quartile	1473	-4.5	-6.3	3.3	4.6	-4.3	-7.6
2nd quartile	1473	-1.5	-2.6	3.1	4.1	-1.0	-2.8
3rd quartile	1470	-0.5	-1.9	1.5	2.9	-0.7	-2.5
Highest quartile	1473	-0.3	-1.2	0.3	0.7	0.2	-2.0
Difference L-H		*4.3*	*5.1*	*-3.0*	*-3.9*	*4.5*	*5.7*
Breast cancer							
Lowest quartile	318	-15.6	-5.0	7.0	2.0	-25.3	-9.8
2nd quartile	321	-7.6	-5.1	7.1	4.3	-17.7	-7.4
3rd quartile	318	-3.5	-2.7	1.3	2.9	-12.6	-2.8
Highest quartile	321	-2.9	-0.4	1.7	1.4	-8.6	-6.1
Difference L-H		*12.8*	*4.6*	*-5.3*	*-0.5*	*16.7*	*3.7*

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The sample size numbers are randomly rounded.

For each of these eight conditions, the size of the employment effects appears to be negatively associated with prior annual earnings. In the case of diabetes for example, the reductions in the proportion employed at one year after diagnosis range from –5.7 percentage points for the lowest quartile of earners to –3.1 percentage points for the highest quartile. In the case of breast cancer, the reductions in the proportion employed at one year after diagnosis range from –15.6 percentage points for the lowest quartile of earners to –2.9 percentage points for the highest quartile. This pattern of employment impact differences by earnings quartile is still apparent four years after diagnosis for stroke, coronary heart disease, diabetes, COPD and breast cancer (but not TBI), in weaker form. However, the differences in employment impacts between the lowest and highest quartile groups are only statistically significant in the case of diabetes and breast cancer.

The size of the increases in income support receipt rates at one year after diagnosis also appears to vary by prior earnings level, with larger increases evident for lower-quartile earners. This is true for stroke, coronary heart disease, diabetes, COPD and breast cancer. For example, the increase in the proportion receiving income support at one year after diagnosis was 16.8 percentage points for stroke patients in the lowest income quartile and 10.9% for stroke victims in the highest income quartile. It was 7.9 percentage points for CHD patients in the lowest earnings quartile and 2.2 percentage points for CHD patients in the highest earnings quartile. The same is true for the variations in the size of the impacts on monthly personal incomes, where we see the same general pattern of larger relative income losses for lower-quartile earners than for higher-quartile earners. However, none of these differences are statistically significant.

The patterns in these results suggest that larger employment rate and relative income losses tended to be experienced by adults who had relatively low annual earnings prior to the development of a chronic condition than by those with relatively high annual earnings. However, the study is not able to provide robust evidence that this is in fact the case, due to the relatively small numbers of people in our study samples.

3.6 Sensitivity tests

In this section we consider the sensitivity of the main results to minor variations in the study design. First, we relax the requirement that people had to be employed in each of the three months immediately before the month in which they were diagnosed, and thereby broaden our definition of 'currently employed'. One argument for relaxing the definition is that people who are developing a major condition such as cancer may be unable to work continuously in the months immediately before their official diagnosis.[7] Another argument is that the requirement of three consecutive months of earnings is unnecessarily restrictive: short employment gaps are not uncommon among wage and salary earners.

To test the effects of relaxing this selection criterion, we enlarge the eight study populations to include anyone who was employed for at least two of the four months immediately before the month in which they were diagnosed, who also met the other selection criteria listed in Table 1. We recalculate a selection of the main impact estimates for these larger study populations.

[7] However, they will be classified as employed in a given calendar month if they undertake *any* hours of work that month, due to the structure of the earnings data in IDI.

The results are shown in Table 13. Impact estimates that were previously obtained using the main study populations are given in the top section of the table for comparative purposes. The middle section of the table gives the new results obtained using the broader definition of 'currently employed'. These new study populations are 6-13% larger than previously. Most of the impact estimates are now slightly larger, suggesting that people who were working but not continuously employed before they became ill tended to experience larger employment and income reductions, and larger increases in income support receipt rates, than the original study population members. However, most of the results are not substantively changed. One exception is the income impacts that are estimated for the stroke population, which increase in size from around –15% to around –20%.

Second, we relax the requirement that people had to have survived for at least four years after diagnosis to be included in the study population (but keep the other selection criteria the same as for the main study populations). In the third section of Table 13, we show the *implied* impacts of the illnesses on the employment rates, income support rates and incomes of each study population if we retain the records of the people who died, but set their employment, income support rates and incomes to zero after death. The resulting figures are *implied* group impacts because they include data for people who were deceased and therefore no longer part of the reference group. Note that we are not able to reliably distinguish between deaths caused by the reference condition and deaths caused by other factors, and therefore these adjusted figures including deceased people probably overstate the impact of each condition to some degree.

As would be expected, the results of this thought experiment show larger reductions in employment rates and incomes, and smaller increases in income support rates, than we estimate in the main results. The largest changes in impact size are for the stroke population, which had the highest mortality rate (about 15%). The estimated impact of stroke on the stroke group's employment rate was a 25 percentage point reduction at both one year and four years after diagnosis, when we include the people who died. These new employment impact estimates are 6 percentage points higher than estimated earlier for the main study population. The impact of stroke on the stroke group's income support rates at one year and four years after diagnosis are about 2 percentage points lower than in the main estimates, while the impacts on the stroke group's average monthly incomes are about 10% larger than previously (that is, around –25% rather than –15%). Note that the changes in impact sizes are not as large as 15% (the mortality rate) because only some of the non-survivors would have been employed had they survived.

Including non-survivors also has a material effect on the results for the breast cancer population. For example, the employment impact four years after diagnosis is 7 percentage points larger if non-survivors are included, while the income impact after four years is about 8 percent larger (that is, –14% rather than –6%). Turning to melanoma, we see that two of the six impact estimates (for the employment rate at four years and mean monthly incomes in the fourth year after diagnosis) are now large enough to be statistically significant. For the other five conditions, the effects of including non-survivors are fairly minor (0–2%).

Table 13 – Sensitivity test results

	N study popn	Empt rate at 1 year pp	Empt rate at 4 years pp	Income support rate at 1 year pp	Income support rate at 4 years pp	Change in avg monthly income at 7-12 months (%)	Change in avg monthly income at 37-48 months (%)
Base results – main study population							
Stroke	738	-18.9	-19.1	15.3	13.3	-15.6	-15.2
Traumatic brain injury	1,305	-8.7	-7.5	12.6	8.8	-3.7	-5.7
Coronary heart disease	2,994	-4.5	-3.4	4.3	3.5	-3.2	-3.2
Diabetes	9,612	-3.5	-2.6	1.1	1.5	-5.0	-4.1
COPD	5,889	-1.8	-3.1	2.2	3.2	-0.7	-2.8
Breast cancer	1,278	-7.3	-3.2	4.1	2.5	-13.2	-6.0
Melanoma	813	0.5	1.0	-0.4	-0.2	-0.2	-1.5
Prostate cancer	513	1.0	1.4	0.4	-1.3	-0.3	-1.6
Expanded study population: people with W&S earnings for at least 2/4 months before first diagnosis							
Stroke	789	-21.3	-20.5	17.1	14.6	-20.2	-19.0
Traumatic brain injury	1,476	-9.7	-7.1	13.0	8.3	-4.3	-8.1
Coronary heart disease	3,198	-4.9	-3.8	4.9	3.9	-4.9	-4.4
Diabetes	10,341	-4.3	-2.8	2.0	2.1	-5.0	-4.1
COPD	6,420	-2.1	-3.3	2.4	3.7	-1.6	-3.9
Breast cancer	1,374	-7.8	-2.8	4.9	2.3	-16.2	-7.4
Melanoma	873	0.6	0.9	-1.0	-0.5	-1.5	-2.2
Prostate cancer	540	0.3	-0.2	1.1	0.6	-1.8	-1.7
Main study population plus non-survivors							
Stroke	840	-25.4	-24.7	13.0	11.6	-26.1	-25.2
Traumatic brain injury	1,347	-10.7	-10.7	13.3	9.0	-5.7	-8.4
Coronary heart disease	3,144	-6.6	-6.2	4.4	2.9	-5.9	-6.2
Diabetes	9,801	-4.0	-3.1	1.5	1.5	-5.2	-4.3
COPD	6,078	-3.1	-4.6	2.5	3.0	-2.4	-4.4
Breast cancer	1,404	-10.1	-10.4	5.4	1.5	-17.1	-13.9
Melanoma	861	-1.2	-3.7	-0.8	-0.7	-2.0	-5.8
Prostate cancer	540	-1.2	-2.7	0.6	-0.8	0.3	-2.6

Notes: Estimates that are statistically significant at the 95% confidence level are shown in bold font. The sample size numbers are randomly rounded.

3.7 Monetary value of the employment and income impacts

This paper's estimates of the impacts of the conditions studied have been presented in percentage terms. This captures the *relative* impact and is the best way of comparing impacts across people and population groups that have differing prior employment rates or incomes. However, for some purposes knowing the monetary value of the impacts is more useful. For example, cost of disease studies, which estimate the total cost of a particular disease to a nation, require monetary estimates.

In this section we calculate monetary impact estimates for illustrative purposes – to demonstrate the potential of the IDI as a data source for this type of analysis. Specifically, we calculate the cumulative total losses of income that the members of our study populations experienced during the first four years after their diagnosis. These cost estimates use the current study populations and the outcome data currently available in IDI, without any further assumptions or forecasts.

Results are shown in Table 14. Each figure represents a per-person average impact for the members of the study population, summed over the four follow-up years, and is expressed in June 2013 dollar values. The melanoma and prostate cancer groups are not included in the table, because we did not find evidence of significant employment or income losses for them in the previous analysis.

The cumulative four-year *before-tax* earnings losses for the six study populations range from $4,900 for COPD patients to $49,200 for stroke patients. The cumulative four-year *after-tax* earnings losses range from $3,900 for COPD patients to $39,000 for stroke patients. The cumulative after-tax monthly income losses (summing net earnings and net income support payments) range from around $2,500 for the COPD group to just over $28,000 for the stroke group.

Table 14 – Cumulative personal income losses caused by changes in wage and salary earnings and government income support payments, first four years after diagnosis

	Before tax		After tax	
	W&S earnings	W&S earnings & income support	W&S earnings	W&S earnings & income support
	$	$	$	$
Stroke	-49,233	-36,821	-39,029	-28,063
Traumatic brain injury	-23,070	-8,441	-17,909	-5,985
Coronary heart disease	-11,860	-8,605	-9,609	-6,712
Diabetes	-9,412	-8,435	-7,153	-6,256
COPD	-4,938	-3,333	-3,907	-2,481
Breast cancer	-17,836	-15,152	-13,693	-11,263

Note: Dollars are expressed in June 2013 values. The numbers are per-person averages. The incomes data include all wage and salary payments, income from the main benefits, income from supplementary ('second tier') benefits such as the Accommodation Supplement and the Disability Allowance, earnings-related compensation payments from ACC, and family tax credits provided through the Working for Families scheme.

Stroke was associated with the largest post-tax, post-transfer income losses ($28,000). The estimated net income loss experienced by the average breast cancer patient in our study population was around $11,300, the second highest after stroke. The corresponding figures for TBI, CHD, and diabetes patients are in the range of $6,000 to $7,000.

The variation in average income losses between conditions is influenced by a range of factors including the size of the condition's impact on employment rates and hours worked, the pre-diagnosis average earnings levels of the people in each group, their likelihood of applying for and receiving income support, and whether they were eligible for ACC compensation or benefits. For example, due to their eligibility for earnings-related accident compensation, the average income loss experienced by the TBI patients was not as large as that experienced by the breast cancer and CHD patients.

It's worth noting that the numbers given here represent *personal* income losses. The impacts of these personal income losses may have been mitigated by changes in other sources of household income, particularly the incomes of other family members. For example, spouses or partners may have increased their hours of work in response to the ill health of the reference person.

The numbers given in this section show that the financial costs of illness to individuals and their families can be considerable, particularly for conditions with substantial and long-term effects on employment rates.

3.8 Summary of findings

Employment impacts

Summarising the main results, we found evidence of significant employment rate reductions at one year after diagnosis for six of the eight conditions (stroke, traumatic brain injury, coronary heart disease, diabetes, COPD and breast cancer), when we compared the outcomes of the study populations with those of their matched comparison groups.

The employment reductions were particularly large in the case of people who had had a stroke or traumatic brain injury (19 percentage points and 9 percentage points respectively). They were smaller in the case of people who had developed coronary heart disease, diabetes, COPD or breast cancer (5, 4, 2 and 7 percentage points respectively. The employment outcomes of people who were diagnosed with melanoma or prostate cancer were not significantly changed.

For the six conditions with significant employment impacts, the effects of the condition were still evident four years after diagnosis. For the traumatic brain injury, coronary heart disease, diabetes and breast cancer groups, the employment impacts decreased in size over time during the four-year follow-up period. For the stroke group, there was little change. For the COPD group, an initially very small employment impact grew gradually larger, to 3 percentage points after four years.

Impacts on earnings and incomes

There was evidence of significant earnings losses following diagnoses of stroke, traumatic brain injury, coronary heart disease, diabetes, COPD and breast cancer, during the four years after diagnosis, when we compared the earnings of these groups with those of their matched comparisons. In the fourth year after diagnosis, their average monthly earnings were between 4% and 22% lower. The earnings and incomes of people who were diagnosed with melanoma or prostate cancer were not significantly changed.

These medium-term earnings losses were modest in size (4-5%) for people with diabetes, COPD and coronary heart disease but nearly 12% on average for those who had experienced a traumatic brain injury and nearly 22% on average for those who had experienced a stroke. The earnings losses were the product of both reductions in the likelihood of working after diagnosis and reductions in average levels of earnings, conditional on being employed.

Four years after diagnosis, the proportion receiving government income support was significantly higher than the comparable proportion in the matched comparison group for the stroke, traumatic brain injury, coronary heart disease, diabetes and COPD groups.

These impacts ranged in size from a 2 percentage point increase in the income support rate for the diabetes group, to a 13 percentage point increase for the stroke group.

The pattern of change in the size of the income impacts that was apparent during the four year follow-up period was broadly similar to the pattern of change found in the employment impacts. The income impacts were decreasing in size for people with traumatic brain injury, coronary heart disease, diabetes and breast cancer, changing relatively little for those who had had a stroke, and increasing slightly for those with COPD.

Variations in impacts by severity of the condition and personal characteristics

The average impacts reported here hide significant variations in impact size between individuals, for some of the eight conditions. For example, we found that the employment and income losses following stroke and traumatic brain injury were much larger for the individuals whose stroke or brain injury was likely to have been more serious than average.

Within the stroke group, for example, the estimated negative impact of stroke on the proportion employed at one year after diagnosis ranged from –5 percentage points for those who had spent 0-1 nights in hospital at the time of their stroke, to –47 percentage points for those who had spent 15 or more nights in hospital. Within the TBI group, the estimated negative impact of TBI on the proportion employed one year after diagnosis ranged from –2.6 percentage points for those who had spent 0–1 nights in hospital to –56 percentage points for those who had spent 15 or more nights in hospital. The income impacts estimated for the stroke and TBI populations were similarly diverse along this dimension.

There is some evidence of demographic and socio-economic variations in the magnitude of the employment and income impacts. We find, for example, that the employment and income effects of diabetes were larger for women than for men and larger for adults aged 20–34 then for those aged in their fifties. As a rough generalisation, people with relatively low annual earnings before their diagnosis tended to show larger employment reductions and income support increases than those with relatively high annual earnings. However, most of the demographic and socio-economic variations in impact size estimated in this paper were not statistically significant. It is likely that a greater number of significant differences would be identified in a study using data for larger study populations.

Sensitivity tests

The sensitivity of the results to a change in the study population selection criteria that enlarged and broadened the set of people classified as ‘currently employed’ was assessed. The effect of varying this definition was small and not large enough to materially alter the paper’s main findings.

We also explored the consequences of retaining non-survivors in the study populations. Our alternative impact estimates that included non-survivors set their employment rates, income support rates and incomes to zero after their death. We found that this variation made a material difference to some of the results, stroke, breast cancer and melanoma. For example, if non-survivors are included, the new employment impact estimates for the stroke population are 6 percentage points larger than those estimated previously, the income support rate impacts are about 2 percentage points smaller than previously, and the monthly income impacts are about 10% larger than previously.

4 Conclusion

This paper has examined the impact of eight common health conditions (stroke, traumatic brain injuries, coronary heart disease, diabetes, COPD, breast cancer, melanoma, and prostate cancer) on the employment rates and incomes of working-aged New Zealanders. The study focused on 20–59 year olds who were in paid employment at the time they were first diagnosed with the condition, who were first diagnosed in 2008 or 2009, and who survived for at least four years afterwards. It estimated the impacts the illness or injury had on their subsequent employment rates, income support receipt rates, earnings and regular personal income.

Administrative data collected within the health system were used to identify all New Zealanders who were diagnosed with the conditions of interest in 2008 or 2009. Data on their employment, earnings, and income from government transfers before and after the diagnosis were sourced from the tax and income support systems, through IDI. To estimate the impact of each type of injury or illness, the post-diagnosis employment and incomes of the individuals who developed it were compared with those of a matched comparison group (matched at the individual level) comprising people with similar measured characteristics and economic activity patterns in the five years before the diagnosis.

A particular strength of the study is the use of relatively accurate pre-event labour market and incomes data covering a five year period. This means that the matched comparison groups are likely to be well matched to the study population members in terms of their past employment propensities and earnings potential. It should lead to more accurate estimates of the employment and income effects of illness than could be obtained using survey data.

Across the eight conditions, the findings show a diverse set of short and medium-term impacts on employment rates and incomes, ranging from 15–20% losses for people who experienced a stroke, to 'nothing significant' for melanoma and prostate cancer. The time pattern of the impacts provides valuable information on medium-term recovery patterns. There is little evidence of improvement in the employment and incomes losses experienced by the people in the stroke group, which remain large during the follow-up period. On the other hand, there are reductions over time in the size of the employment and income losses estimated for the TBI, CHD, diabetes and breast cancer groups.

Given that the employment and income losses associated with stroke, traumatic brain injuries, coronary heart disease, diabetes, COPD, and breast cancer remained significant after four years, we cannot assume that the burden of these diseases is temporary in nature. Even if the average impact is relatively small, the cumulative income losses could be substantial if the effects of the disease are long-lasting or permanent.

The findings also show very large within-group variations in the size of the impacts associated with stroke and TBI, suggesting that for these conditions (and possibly others), reporting a range of impacts according to the severity or progression of the illness is likely to be more useful and illuminating than reporting an average effect for everyone.

Turning to the study's limitations, it should be noted that the employment and income effects reported in this paper are only valid for the study populations, comprising 20–59-year-old wage and salary earners. Adults who are not working in wage or salaried jobs at the time of their diagnosis may respond differently and experience different patterns of employment and income losses.

Data limitations affecting our ability to accurately identify the onset of some of the health conditions may mean that the impact estimates given in this paper are either upwardly or downwardly biased. The first diagnosis date that is recorded in IDI may not always capture the first episode of the condition, or may lag behind the development of the symptoms of the disease, for some people in the groups studied. If some of the people in our study populations either had an earlier episode of the condition or experienced symptoms of the disease well before their recorded diagnosis date, this could have caused them to work less and earn less. In that situation, our study design may lead us to underestimate the effect of the disease on a person's subsequent employment and incomes (in counting only the outcome changes that emerged after the recorded first diagnosis date).

Another limitation of the study arises from the limited range of controls for the effects of variations in health status or existing co-morbidity. If the members of our study populations were on average less healthy or at higher health risk than the people who were selected as comparisons (for example, because they had other existing health conditions), they may have been more likely to develop an illness of some kind during the follow-up period. If they were more likely to become ill than the comparison group members, the comparison group's employment rates and income trajectories will not provide the correct 'counterfactual' and we could be systematically over-estimating the difference in employment rates, earnings and incomes that is due to the reference condition.

Indicators of a number of common health conditions that can be identified in IDI through the Ministry of Health data were included as control variables in the propensity score models. In addition, we may have partially mitigated the problem of differences in prior health status by controlling on prior employment, earnings and benefit histories, using data for five years. If unobserved factors such as other diseases, smoking and obesity affect labour market outcomes post diagnosis, they will also be affecting the same outcomes during the five years before the diagnosis. Therefore controlling on prior employment, earnings and benefit histories should reduce the effects of these pre-existing illnesses and health risks on our estimates. However, it is impossible to fully eliminate the potential for bias without access to a wider range of health data or the use of an experimental research design.

Despite the possibility of estimation biases, this study has shown that employment and income impact estimates for health conditions can be readily obtained using the employment and income data held in IDI (provided the people who have experienced the health condition of interest can be identified sufficiently accurately). Due to IDI's full population coverage, estimates of employment and income impacts can also be obtained for a variety of sub-populations. The information thus obtained has the potential to be used in cost-benefit assessments of particular treatments or in studies of the aggregate social and economic costs of illnesses to New Zealand as a whole.

5 References

ACC (2006) 'Traumatic brain injury: Diagnosis, acute management and rehabilitation. Evidence-based best practice guideline.' Wellington, Accident Compensation Corporation.

Andersen, Ingelise et al (2015) 'The effect of breast cancer on personal income three years after diagnosis by cancer stage and education: a register-based cohort study among Danish females'. *BioMed Central Public Health*, 15:50.

Blakely, Tony, et al (2015) 'Patterns of cancer care costs in a country with detailed individual data'. *Medical Care*, 53(4), pp.302-309.

Bradley, Cathy et al (2005) 'Employment outcomes of men treated for prostate cancer'. *Journal of the National Cancer Institute*, 97(13), pp.958-965.

Caliendo, Marco and Sabine Kopeinig (2005) 'Some practical guidance for the implementation of propensity score matching.' IZA DP No. 1588.

Carter, Kristie et al (2013) 'The impact of a health shock on participation in the labour force in a working age population: A repeated measures analysis.' *Australian and New Zealand Journal of Public Health*, 37(3), pp.257-63.

Garcia-Gomez, Pilar et al (2013) 'Long-term and spillover effects of health shocks on employment and income'. *Journal of Human Resources* 48(4), pp. 873-909.

Jeon, Sung-Hee (2014) 'The effects of cancer on the employment and earnings of cancer survivors'. Statistics Canada, Analytical Studies Branch Research Paper Series.

Jones, Andrew, Nigel Rice and Francesca Zantomio (2015) 'Acute health shocks and labour market exits'. University of York, Department of Economics Working Paper.

Ministry of Health (2009) *Report on New Zealand cost-of-illness studies on long-term conditions.* Wellington: Ministry of Health.

Ministry of Health (2013) *Health Loss in New Zealand: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study 2006–2016*. Wellington: Ministry of Health.

Ministry of Health and Accident Compensation Corporation. (2013) *Injury-related Health Loss: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study 2006–2016.* Wellington: Ministry of Health.

Minor, Travis (2013) 'An investigation into the effect of type I and type II diabetes duration on employment and wages'. *Economics and Human Biology*, 11, pp.534-544.

Sin, Don et al (2002) 'The impact of chronic obstructive pulmonary disease on work loss in the United States'. *American Journal of Respiratory and Critical Care Medicine*, 165, pp.704-707.

Syse, Astri, Steinar Tretli and Oystein Kravdal (2008) 'Cancer's impact on employment and earnings – A population-based study from Norway'. *Journal of Cancer Survival*. 2, pp.149-158.

Tobias, M, Cheung J, Carter K, Anderson C, Feigin V. (2007) “Stroke surveillance: Population-based estimates and projections for New Zealand.” *Australian and New Zealand Journal of Public Health* 2007; 31(6), pp.520-525.

Trevisan, Elisabetta and Francesca Zantomio (2015) ‘The impact of acute health shocks on the labour supply of older workers: evidence from sixteen European countries’. Ca’Foscari University of Venice, Department of Economics Working Paper No.27.

Appendix 1: Background information on the eight conditions and their health impacts

Stroke

A stroke is the sudden death of brain cells in a localized area due to inadequate blood flow. A stroke occurs when blood flow is interrupted to part of the brain. Depending on the area and region of the brain that is affected, a stroke may cause paralysis, speech impairment, loss of memory and reasoning ability, coma, or death. Many stroke survivors have persistent disabilities afterwards, ranging from minor to severe.

In this study, strokes are identified by the primary diagnostic codes recorded at the time of admission to a hospital. The definition excludes transient ischemic attacks or TIA (very minor strokes lasting less than 24 hours).

Tobias et al (2007) states that approximately one-quarter of all people in New Zealand who experience a first stroke are aged under 65 years.

The Ministry of Health (2013) has estimated that strokes affecting people in the working-age population led to 238 deaths and a loss of 10,214 disability-adjusted life years in 2006 (see Table A1).

Table A1– New Zealand Burden of Disease Study estimates of the mortality and morbidity impacts of the eight health conditions in 2006, for 15-64 year olds

Condition	Deaths	Disability-adjusted life years lost
Stroke	238	10,214
Traumatic brain injury	282	17,035
Coronary heart disease	858	31,614
Diabetes (all types)	204	14,278
COPD	149	12,287
Breast cancer	1006	30,476
Melanoma	411	11,826
Prostate cancer	671	12,148

Source: Ministry of Health (2013).

Traumatic brain injury (TBI)

Traumatic brain injury (TBI) is an acute brain injury resulting from mechanical energy to the head from external physical forces. TBI is identified by confusion or disorientation, loss of consciousness, post-traumatic amnesia and other neurological abnormalities (ACC, 2006, p21). TBI cases can be mild, moderate or severe, with mild cases being the most common.

The effects of severe TBI can include physical deficits, including motor and sensory impairment; cognitive deficits, including impairment of memory attention, and judgement; behavioural deficits, including emotional and mood problems, and inappropriate

behaviour; and communicative deficits, including language expression and comprehension. People who have had a clinically significant TBI may have impairment in their ability to live independently, return to work, education and leisure activities, and maintain relationships (ACC, 2006).

The Ministry of Health and Accident Compensation Corporation (2013) have estimated that TBIs led to 282 deaths and a loss of 17,035 disability-adjusted life years within the working-age population in 2006. Transport injuries were the predominant external cause of health loss from traumatic brain injury, and were responsible for 62% of health loss from TBI (ibid, p17). Common causes of the other TBI cases included falls (16%), interpersonal violence (9%) and self-inflicted injury (8%) (ibid, p17).

Coronary heart disease

Coronary heart disease is caused by the build up of plaque in the arteries that supply blood to the heart. People with coronary heart disease may experience chest pain, fatigue, shortness of breath, or they may have a heart attack.

The Ministry of Health (2013) has estimated that coronary heart disease led to 858 deaths in the working-age population and a loss of 31,614 disability-adjusted life years in 2006. Nearly all of the impact on working-aged adults was experienced by people aged 40–64.

Diabetes

Diabetes mellitus is a group of metabolic diseases that cause high blood sugar levels over a prolonged period. While diabetes does not necessarily have any side effects that interfere with a person's ability to work, poorly managed diabetes can lead to more serious health conditions. Direct complications of diabetes include diabetic kidney disease, diabetic retinopathy and diabetic neuropathy (which can lead to lower limb amputation). Diabetes is also a risk factor for coronary heart disease, stroke and dementia.

Diabetes affecting working-aged New Zealanders is estimated to have caused 204 deaths and a loss of 14,278 disability-adjusted life years in 2006.

Chronic obstructive pulmonary disease

COPD is characterised by irreversible airway obstruction. The symptoms include breathlessness and chronic coughing. Smoking is one of the most important causes of COPD in New Zealand.

The Ministry of Health estimates that COPD was the cause of 149 deaths and 12,287 disability-adjusted life years lost among 15-64 year olds in 2006.

Cancer

The cancers studied in this paper are malignant growths or tumours that were reported to the Cancer Register. Breast cancers, melanomas and prostate cancers were identified using the recorded primary site.

The Ministry of Health's burden of disease estimates show that lung cancer, breast cancer and colon cancer (in that order) have the largest mortality and morbidity impacts, among all types of cancer, for working-aged New Zealanders. However, breast cancer, melanoma and prostate cancer were selected for study in this paper because they had a greater number of cases within our intended study population of people in wage or salaried employment who survived the disease for at least four years.

Appendix 2: Profiles of the study populations and matched comparison groups

Tables A2 and A3 summarise the characteristics of the eight study populations and their corresponding matched comparison groups. The purpose of the tables is to provide some basic descriptive information on the populations studied, and in addition to demonstrate the quality of the case matching.

The tables show, for example, that the mean ages of our eight study populations range from 46.1 years (diabetes) to 54.6 years (prostate cancer), indicating that they tend to affect older adults within the working-age population. The traumatic brain injury population is the only exception, with a mean age of 35.5 years and a high proportion of people who were aged in their 20s and 30s. Men outnumber women in the stroke, TBI and CHD study populations, while the opposite is true of the COPD and melanoma study populations.

Comparing the numbers in each pair of columns, it is clear that the demographic profiles, recent health service use profiles and recent employment histories of the matched comparison groups are very similar to those of the study populations they are designed to provide counterfactual outcome data for. Although not shown in the tables, the comparison group members were also exact-matched to the study population members by their DHB area of residence.

The largest differences apparent in the tables are in mean monthly earnings in the 12 months before the diagnosis. For most of the eight conditions, there is a difference of around 1% between the mean earnings of the study group and those of the comparison group (which are either higher or lower). The comparison group for prostate cancer is the least well matched, with mean earnings that were about 5% higher in the 12 months before the diagnosis than those of the study population it was matched to.

These differences in average earnings levels before the diagnosis will not affect the main impact estimates, however, because we calculate the *change* in each person's mean earnings or mean income from the year before diagnosis to a specified period after their diagnosis, and report the differences in average income changes experienced by the study and comparison groups. Through this calculation, the effect of any pre-existing difference between the study population and comparison group in the base level of earnings or incomes is removed.

Table A2 – Profile of the study populations and matched comparison groups, Part A

	Stroke		TBI		Coronary HD		Diabetes	
	S	C	S	C	S	C	S	C
Number observations in the study population	777		1359		3117		9879	
Number of observations that were matched	738	9,264	1,305	16,962	2,994	35,937	9,612	113,172
Match rate for study population (%)	95.0		96.0		96.1		97.3	
Demographics								
Mean age	49.1	49.0	35.5	35.5	50.4	50.4	46.1	46.1
				Percentages				
Male	56.5	56.5	69.2	69.2	72.0	72.0	50.6	50.6
Female	43.9	43.5	31.0	30.8	28.0	28.1	49.4	49.4
20-29	3.3	3.3	38.4	38.6	0.5	0.5	6.3	6.2
30-39	10.6	10.6	22.8	22.5	6.0	5.8	16.5	16.5
40-49	29.3	28.9	23.9	23.7	32.4	32.5	34.8	34.8
50-59	57.3	57.3	14.9	14.9	61.1	61.2	42.4	42.5
European	63.8	63.8	71.0	71.0	73.7	73.7	53.1	53.1
Māori	23.2	22.8	17.0	17.0	15.4	15.4	18.9	18.9
Pacific	8.5	8.5	8.0	8.3	6.6	6.6	15.6	15.6
Asian	4.9	4.5	3.2	3.2	3.7	3.7	11.2	11.1
NZ Deprivation Index (2006) for meshblock of residence								
1-2	16.7	16.7	17.0	17.0	17.8	17.8	13.5	13.5
3-4	15.4	15.4	17.2	17.2	18.1	18.1	15.2	15.2
5-6	19.9	19.5	18.2	18.2	17.8	17.8	17.7	17.7
7-8	20.7	20.7	22.1	22.1	19.3	19.3	21.3	21.3
9-10	25.2	24.8	21.8	21.8	23.1	23.1	27.0	27.0
Address not available	2.4	2.4	3.9	3.9	3.7	3.7	5.2	5.2
Percentages with a previously identified health condition								
Stroke	NA	NA	0.7	S	0.7	0.7	0.6	0.6
Traumatic brain injury	2.4	2.0	NA	NA	2.0	2.2	1.5	1.3
Coronary heart disease	8.5	6.5	1.6	1.6	NA	NA	4.8	4.1
Diabetes	10.6	9.3	3.2	3.2	11.0	10.5	NA	NA
COPD	3.7	4.5	1.1	1.8	4.8	4.3	3.6	3.7
Cancer	2.4	2.8	1.1	1.4	2.2	2.3	2.0	1.7
Heart attack	4.5	2.8	S	0.9	S	S	2.2	1.8
Gout	5.7	5.7	1.4	1.8	6.8	5.3	7.9	6.2

	Stroke		TBI		Coronary HD		Diabetes	
	S	C	S	C	S	C	S	C
Health service use, previous year								
Mean no. of quarters with PHO consultations (0-4)	1.7	1.7	1.2	1.2	1.7	1.7	1.8	1.8
Mean no. pharms dispensings	12.5	13.1	6.4	6.5	14.4	12.9	12.2	10.8
Mean no. lab tests	7.4	7.5	4.4	4.2	7.9	7.2	8.6	7.8
Mean no. hospital admissions	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2
Mean no. hospital nights	0.8	0.4	0.3	0.2	0.4	0.5	0.4	0.3
Mean no. emergency department visits	0.7	0.6	0.3	0.3	0.7	0.7	0.4	0.5
Mean no. outpatient events	0.4	0.3	0.4	0.4	0.3	0.3	0.2	0.2
Employment and income support, previous year								
Percentage in employment, monthly average	95.9	94.8	93.9	94.3	96.8	96.6	96.8	96.6
Percentage with benefit income, month average	6.4	6.7	6.0	6.4	4.0	4.9	5.3	5.3
Percentage receiving income support, monthly average	7.9	7.8	7.4	7.6	5.5	6.2	6.1	6.1
Mean monthly earnings in months with paid work ($ June 2013)	4532	4614	4109	4107	4885	5045	4470	4434
Mean monthly earnings, all months ($ June 2013)	4427	4474	3949	3961	4791	4930	4385	4343

Notes: In column headings S = study population and C = comparison group. NA=not applicable. In table cells S = suppressed for confidentiality reasons. The sample size numbers in the first two rows are randomly rounded.

Table A3 – Profiles of the study populations and matched comparison groups, Part B

	COPD		Breast cancer		Melanoma		Prostate cancer	
	S	C	S	C	S	C	S	C
Number observations in the study population	6078		1299		819		528	
Number of observations that were matched	5889	69642	1278	20937	813	14463	513	6729
Match rate for study population (%)	96.8		98.4		99.3		97.2	
Demographics								
Mean age	45.8	45.8	48.6	48.6	47.5	47.5	54.6	54.3
				Percentages				
Male	37.9	37.9	0.0	0.0	42.4	42.8	100.0	100.0
Female	62.2	62.1	100.0	100.0	57.6	57.6	0.0	0.0
20-29	9.3	9.3	0.5	1.2	4.4	4.4	S	1.8
30-39	15.2	15.2	9.4	8.9	14.0	14.0	S	1.2
40-49	31.7	31.6	43.7	43.4	34.7	34.7	12.3	9.4
50-59	43.7	43.9	46.5	46.5	47.2	47.2	88.3	87.7
European	72.0	72.0	76.8	76.8	96.3	96.3	91.8	91.8
Māori	18.9	18.8	13.4	13.4	3.0	3.0	4.7	4.7
Pacific	5.6	5.5	4.9	4.9	0.7	0.7	1.8	2.3
Asian	3.2	3.1	4.9	4.9	S	S	1.2	1.2

	COPD		Breast cancer		Melanoma		Prostate cancer	
	S	C	S	C	S	C	S	C
NZ Deprivation Index (2006) for meshblock of residence								
1-2	13.8	13.9	25.1	25.1	29.9	30.3	26.3	26.3
3-4	16.0	15.9	21.8	21.8	24.0	23.6	25.1	25.1
5-6	19.2	19.1	19.0	18.8	16.2	16.2	18.1	18.1
7-8	23.0	23.0	17.4	17.4	15.5	15.5	13.5	14.0
9-10	23.3	23.3	12.9	13.1	9.2	9.2	12.3	12.3
Address not available	4.7	4.7	3.8	3.8	5.5	5.5	4.1	4.7
Percentages with a previously identified health condition								
Stroke	0.6	0.5	S	S	S	S	S	S
Traumatic brain injury	2.5	2.6	0.9	0.7	1.1	1.8	1.2	1.2
Coronary heart disease	4.2	3.5	1.4	1.2	2.6	2.2	7.0	7.0
Diabetes	6.8	6.9	3.8	3.5	4.1	3.3	5.8	5.8
COPD	NA	NA	4.0	3.5	0.7	2.2	1.8	1.8
Cancer	2.4	2.2	NA	NA	NA	NA	NA	NA
Heart attack	1.5	1.4	S	S	1.5	1.1	2.9	2.9
Gout	3.3	3.3	0.7	0.7	2.6	2.2	5.8	5.8
Health service use, previous year								
Mean no. of quarters with PHO consultations (0-4)	1.9	1.9	1.6	1.6	1.4	1.4	1.8	1.7
Mean no. pharms dispensings	15.5	13.7	8.9	8.9	7.2	6.9	9.4	10.7
Mean no. lab tests	7.1	7.1	6.4	6.5	5.5	5.4	8.8	8.4
Mean no. hospital admissions	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2
Mean no. hospital nights	0.5	0.4	0.2	0.2	0.2	0.2	0.2	0.3
Mean no. emergency department visits	0.5	0.5	0.4	0.4	0.3	0.3	0.5	0.4
Mean no. outpatient events	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Employment and income support, previous year								
Percentage in employment, monthly average	96.1	96.2	96.8	97.0	97.1	96.6	97.3	97.1
Percentage with benefit income, month average	7.2	7.1	4.7	5.1	1.9	2.3	1.2	1.6
Percentage receiving income support, monthly average	8.5	8.2	5.4	5.8	2.8	2.9	2.0	2.9
Mean monthly earnings in months with paid work ($ June 2013)	3903	3917	4021	3988	5166	5082	6672	6317
Mean monthly earnings, all months ($ June 2013)	3809	3826	3943	3919	5066	4970	6561	6212

Notes: In column headings S = study population and C = comparison group. NA=not applicable. In table cells S = suppressed for confidentiality reasons. The sample size numbers in the first two rows are randomly rounded.

Appendix 3: Supplementary tables

Table A4 – List of variables included in the propensity score models

Variable	Categories
Personal characteristics and local labour market area	
Gender	Male, female
Age group	2-year age groups from 20-21 to 58-59
Ethnicity	European, Maori, Pacific, Asian, Other or missing
District health board of residence	21 DHBs + area missing. Derived from PHO enrolment records.
Deprivation index (2006) of neighbourhood lived in	1-2, 3-4, 5-6, 7-8, 9-10, missing. Derived from PHO enrolment records.
Existing health conditions	
Coronary heart disease	1,0 indicators
Diabetes	1,0 indicators
COPD	1,0 indicators
Gout	1,0 indicators
Prior health service use	
Number of quarters with at least one PHO consultation in prior year	3 categories (0,1-2,3-4)
Number prescriptions, prior year	5 categories (0, 1-2, 3-7, 8-49, 50+)
Number prescriptions, previous year	5 categories (0, 1-2, 3-7, 8-49, 50+)
Number lab tests, prior year	5 categories (0, 1-2, 3-7, 8-49, 50+)
Number hospital admissions, prior year	3 categories (0,1-2,3+)
Number hospital admissions, previous 4 years	3 categories (0,1-2,3+)
Number nights in hospital, prior year	3 categories (0,1-2,3+)
Number nights in hospital, previous 4 years	3 categories (0,1-2,3+)
Number Emergency Department visits, prior year	3 categories (0,1-2,3+)
Number outpatient visits, prior year	3 categories (0,1-2,3+)
Economic cycle	
Quarter in which the health event occurred	8 quarters from March 2008 to December 2009
Employment and income support history	
Months employed in previous 3 months	2 categories (2,3)
Months employed in previous 4-12 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months employed in previous 13-24 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months employed in previous 25-36 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months employed in previous 37-48 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months employed in previous 49-60 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months received income support in previous 3 months	2 categories (0,1-3)
Months received income support in previous 4-12 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months received income support in previous 13-24 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months received income support in previous 25-36 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months received income support in previous 37-48 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)
Months received income support in previous 49-60 months	5 categories (0, 1-3, 4-6, 7-9, 10-12)

Variable	Categories
Average monthly W&S earnings in previous 3 months	15 categories
Average monthly W&S earnings in previous 4-12 months	16 categories
Average monthly W&S earnings in previous 13-24 months	16 categories
Average monthly W&S earnings in previous 25-36 months	16 categories
Average monthly W&S earnings in previous 37-48 months	16 categories
Average monthly W&S earnings in previous 49-60 months	16 categories
Average monthly income support payments in previous 3 months	5 categories based on income support quartiles
Average monthly income support payments in previous 4-12 months	5 categories based on income support quartiles
Average monthly income support payments in previous 13-24 months	5 categories based on income support quartiles
Average monthly income support payments in previous 25-36 months	5 categories based on income support quartiles
Average monthly income support payments in previous 37-48 months	5 categories based on income support quartiles
Average monthly income support payments in previous 49-60 months	5 categories based on income support quartiles

Table A5 – Main impact estimates for stroke and traumatic brain injury

	Stroke					Traumatic brain injury				
	Comparison mean	Study mean	Impact	Std Error	Rel. impact	Comparison mean	Study mean	Impact	Std Error	Rel. impact
Employment rate										
3 months	0.943	0.724	-0.219	0.018 *	-23.2	0.926	0.793	-0.133	0.013 *	-14.4
6 months	0.922	0.725	-0.197	0.018 *	-21.4	0.910	0.804	-0.106	0.014 *	-11.6
12 months	0.890	0.701	-0.189	0.020 *	-21.3	0.877	0.790	-0.087	0.013 *	-9.9
24 months	0.863	0.664	-0.199	0.019 *	-23.1	0.838	0.768	-0.070	0.014 *	-8.3
36 months	0.834	0.634	-0.199	0.019 *	-23.9	0.825	0.749	-0.076	0.015 *	-9.2
48 months	0.803	0.612	-0.191	0.024 *	-23.8	0.792	0.716	-0.075	0.019 *	-9.5
Benefit rate										
3 months	0.063	0.245	0.182	0.017 *	287.5	0.060	0.067	0.006	0.007	10.6
6 months	0.069	0.224	0.155	0.016 *	224.8	0.071	0.084	0.013	0.009	18.6
12 months	0.088	0.229	0.141	0.015 *	161.6	0.083	0.107	0.023	0.009 *	27.7
24 months	0.098	0.255	0.157	0.018 *	159.4	0.102	0.121	0.019	0.010	18.5
36 months	0.103	0.259	0.156	0.017 *	152.2	0.097	0.123	0.025	0.010 *	26.2
48 months	0.110	0.238	0.129	0.019 *	117.2	0.091	0.120	0.028	0.013 *	31.0
ACC rate										
3 months	0.014	0.030	0.016	0.008	109.9	0.011	0.205	0.194	0.011 *	1719.0
6 months	0.016	0.030	0.014	0.008	83.3	0.012	0.152	0.141	0.010 *	1226.0
12 months	0.017	0.030	0.013	0.007 *	80.2	0.013	0.118	0.105	0.010 *	801.5
24 months	0.016	0.020	0.004	0.006	27.1	0.010	0.086	0.076	0.008 *	787.9
36 months	0.015	0.027	0.012	0.006 *	82.0	0.011	0.073	0.062	0.008 *	574.6
48 months	0.016	0.020	0.004	0.007	25.9	0.010	0.071	0.061	0.008 *	598.1
Income support rate										
3 months	0.077	0.272	0.195	0.019 *	253.0	0.071	0.271	0.200	0.012 *	281.1
6 months	0.085	0.253	0.168	0.018 *	198.5	0.081	0.234	0.153	0.013 *	188.0
12 months	0.104	0.256	0.153	0.018 *	147.2	0.096	0.222	0.126	0.013 *	130.5
24 months	0.114	0.274	0.160	0.019 *	140.3	0.112	0.205	0.094	0.012 *	83.8
36 months	0.117	0.286	0.169	0.018 *	143.8	0.108	0.194	0.086	0.012 *	79.9
48 months	0.126	0.259	0.133	0.020 *	105.6	0.101	0.189	0.088	0.014 *	86.9
Change in log monthly earnings (conditional on employment)										
1-6 months	-0.006	-0.345	-0.339	0.029 *	-28.7	0.020	-0.189	-0.209	0.018 *	-18.8
7-12 months	-0.007	-0.204	-0.197	0.033 *	-17.9	0.015	-0.107	-0.121	0.021 *	-11.4
13-24 months	-0.035	-0.190	-0.155	0.033 *	-14.4	-0.001	-0.079	-0.078	0.020 *	-7.5
25-36 months	-0.037	-0.251	-0.214	0.033 *	-19.2	0.009	-0.066	-0.074	0.022 *	-7.2
36-48 months	-0.035	-0.176	-0.141	0.037 *	-13.2	0.042	-0.018	-0.060	0.023 *	-5.8
Change in mean monthly earnings ($)										
1-6 months	14	-1078	-1092	85 *	-24.5	90	-599	-690	56 *	-17.6
7-12 months	-134	-1121	-986	100 *	-22.2	-5	-502	-497	57 *	-12.7
13-24 months	-302	-1333	-1031	116 *	-23.2	-108	-576	-468	64 *	-12.0
25-36 months	-385	-1450	-1065	115 *	-23.9	-127	-544	-417	73 *	-10.6
36-48 months	-468	-1425	-957	117 *	-21.5	-120	-574	-454	76 *	-11.6
Change in mean monthly income support ($)										
1-6 months	5	285	280	35 *	192.6	-4	532	537	36 *	406.7
7-12 months	27	296	269	37 *	185.0	21	370	349	34 *	264.6
13-24 months	46	288	242	34 *	166.2	37	320	283	32 *	214.5
25-36 months	48	325	278	37 *	190.9	40	273	233	30 *	176.3
36-48 months	59	317	258	33 *	177.7	37	261	224	30 *	169.6
Change in mean monthly personal income ($)										
1-6 months	19	-793	-812	75 *	-17.7	86	-67	-153	44 *	-3.8
7-12 months	-107	-825	-717	89 *	-15.6	16	-132	-148	49 *	-3.7
13-24 months	-256	-1045	-789	106 *	-17.2	-71	-257	-185	58 *	-4.6
25-36 months	-337	-1124	-788	104 *	-17.1	-87	-271	-184	67 *	-4.6
36-48 months	-409	-1108	-699	108 *	-15.2	-83	-313	-230	70 *	-5.7

Table A6 – Main impact estimates for coronary heart disease and diabetes

	Coronary heart disease					Diabetes				
	Comparison mean	Study mean	Impact	Std Error	Rel. impact	Comparison mean	Study mean	Impact	Std Error	Rel. impact
Employment rate										
3 months	0.956	0.901	-0.054	0.007 *	-5.7	0.949	0.897	-0.052	0.003 *	-5.5
6 months	0.939	0.889	-0.050	0.006 *	-5.3	0.931	0.883	-0.049	0.004 *	-5.2
12 months	0.916	0.871	-0.045	0.007 *	-4.9	0.905	0.870	-0.035	0.004 *	-3.9
24 months	0.886	0.841	-0.046	0.009 *	-5.2	0.874	0.850	-0.024	0.004 *	-2.7
36 months	0.858	0.823	-0.035	0.008 *	-4.1	0.853	0.826	-0.027	0.004 *	-3.2
48 months	0.830	0.797	-0.034	0.010 *	-4.0	0.827	0.801	-0.026	0.005 *	-3.1
Benefit rate										
3 months	0.049	0.107	0.057	0.007 *	116.2	0.055	0.064	0.008	0.003 *	15.1
6 months	0.057	0.098	0.041	0.007 *	72.2	0.062	0.074	0.012	0.003 *	19.6
12 months	0.064	0.098	0.035	0.007 *	54.6	0.074	0.084	0.010	0.003 *	13.8
24 months	0.075	0.111	0.036	0.007 *	47.4	0.082	0.096	0.014	0.003 *	17.0
36 months	0.081	0.117	0.036	0.007 *	43.8	0.085	0.098	0.012	0.004 *	14.5
48 months	0.086	0.118	0.032	0.009 *	36.9	0.087	0.102	0.015	0.004 *	17.2
ACC rate										
3 months	0.013	0.015	0.002	0.003	18.0	0.010	0.011	0.001	0.001	5.1
6 months	0.013	0.018	0.004	0.003	33.1	0.010	0.012	0.001	0.001	13.5
12 months	0.013	0.021	0.008	0.003 *	61.2	0.010	0.011	0.001	0.001	6.8
24 months	0.012	0.016	0.004	0.003	37.7	0.010	0.008	-0.002	0.001	-16.0
36 months	0.012	0.018	0.006	0.003 *	54.7	0.009	0.009	0.000	0.001	1.4
48 months	0.013	0.018	0.004	0.003	32.4	0.009	0.009	0.000	0.001	3.6
Income support rate										
3 months	0.062	0.121	0.059	0.007 *	94.9	0.065	0.075	0.009	0.003 *	14.0
6 months	0.070	0.114	0.044	0.007 *	63.1	0.072	0.085	0.014	0.003 *	19.1
12 months	0.076	0.119	0.043	0.007 *	55.9	0.084	0.094	0.011	0.003 *	12.8
24 months	0.086	0.126	0.040	0.007 *	45.8	0.091	0.104	0.012	0.004 *	13.5
36 months	0.093	0.134	0.041	0.007 *	44.6	0.094	0.107	0.012	0.004 *	13.1
48 months	0.099	0.135	0.035	0.009 *	35.5	0.096	0.111	0.015	0.004 *	15.6
Change in log monthly earnings (conditional on employment)										
1-6 months	-0.002	-0.120	-0.118	0.010 *	-11.1	0.004	-0.044	-0.047	0.005 *	-4.6
7-12 months	-0.022	-0.065	-0.043	0.010 *	-4.2	-0.009	-0.062	-0.053	0.006 *	-5.2
13-24 months	-0.042	-0.100	-0.058	0.010 *	-5.6	-0.026	-0.073	-0.047	0.006 *	-4.6
25-36 months	-0.058	-0.113	-0.054	0.011 *	-5.3	-0.041	-0.080	-0.040	0.006 *	-3.9
36-48 months	-0.056	-0.091	-0.035	0.010 *	-3.5	-0.031	-0.072	-0.040	0.007 *	-4.0
Change in mean monthly earnings ($)										
1-6 months	13	-344	-356	34 *	-7.3	2	-221	-223	20 *	-5.2
7-12 months	-145	-380	-235	35 *	-4.8	-111	-352	-241	22 *	-5.6
13-24 months	-287	-554	-267	42 *	-5.4	-238	-415	-177	20 *	-4.1
25-36 months	-423	-676	-253	41 *	-5.2	-341	-520	-179	21 *	-4.1
36-48 months	-504	-721	-217	46 *	-4.4	-381	-589	-208	23 *	-4.8
Change in mean monthly income support ($)										
1-6 months	0	80	80	10 *	76.8	5	21	16	4 *	13.7
7-12 months	16	91	75	11 *	71.6	25	44	19	5 *	16.5
13-24 months	25	96	70	11 *	67.4	36	56	20	5 *	18.0
25-36 months	31	100	69	10 *	66.3	42	62	21	5 *	18.1
36-48 months	44	103	59	10 *	56.4	43	69	27	6 *	23.4
Change in mean monthly personal income ($)										
1-6 months	13	-264	-277	32 *	-5.5	7	-201	-208	19 *	-4.7
7-12 months	-128	-289	-160	34 *	-3.2	-86	-308	-223	20 *	-5.0
13-24 months	-262	-458	-196	40 *	-3.9	-202	-359	-157	18 *	-3.5
25-36 months	-392	-576	-184	40 *	-3.7	-299	-457	-159	20 *	-3.6
36-48 months	-460	-618	-158	44 *	-3.2	-338	-519	-181	22 *	-4.1

Table A7 – Main impact estimates for COPD and breast cancer

	COPD					Breast cancer				
	Comparison mean	Study mean	Impact	Std Error	Rel. impact	Comparison mean	Study mean	Impact	Std Error	Rel. impact
Employment rate										
3 months	0.950	0.937	-0.013	0.003 *	-1.3	0.953	0.846	-0.107	0.011 *	-11.3
6 months	0.928	0.917	-0.011	0.004 *	-1.2	0.944	0.799	-0.145	0.011 *	-15.3
12 months	0.901	0.882	-0.018	0.005 *	-2.0	0.926	0.853	-0.073	0.011 *	-7.9
24 months	0.871	0.850	-0.021	0.006 *	-2.4	0.896	0.871	-0.025	0.010 *	-2.8
36 months	0.848	0.822	-0.026	0.006 *	-3.1	0.878	0.859	-0.018	0.011	-2.1
48 months	0.820	0.788	-0.031	0.007 *	-3.8	0.852	0.820	-0.032	0.014 *	-3.8
Benefit rate										
3 months	0.071	0.082	0.011	0.004 *	15.2	0.051	0.126	0.075	0.010 *	147.4
6 months	0.076	0.087	0.011	0.004 *	13.8	0.053	0.124	0.072	0.010 *	135.7
12 months	0.088	0.105	0.016	0.004 *	18.6	0.058	0.102	0.044	0.008 *	76.9
24 months	0.099	0.118	0.019	0.005 *	18.7	0.065	0.091	0.026	0.009 *	39.9
36 months	0.105	0.128	0.023	0.005 *	22.2	0.065	0.086	0.021	0.009 *	32.3
48 months	0.104	0.133	0.028	0.007 *	27.2	0.064	0.086	0.022	0.011	35.2
ACC rate										
3 months	0.012	0.014	0.002	0.002	17.6	0.007	0.005	-0.003	0.003	-37.2
6 months	0.012	0.015	0.004	0.002	30.2	0.006	0.005	-0.002	0.002	-25.3
12 months	0.012	0.018	0.006	0.002 *	51.2	0.007	0.005	-0.002	0.002	-30.8
24 months	0.011	0.017	0.005	0.002 *	49.0	0.007	0.008	0.001	0.003	15.6
36 months	0.010	0.016	0.006	0.002 *	54.9	0.005	0.010	0.005	0.004	87.6
48 months	0.011	0.016	0.005	0.002	41.4	0.006	0.009	0.004	0.004	63.9
Income support rate										
3 months	0.083	0.096	0.013	0.005 *	15.2	0.058	0.130	0.072	0.010 *	123.8
6 months	0.087	0.101	0.014	0.004 *	15.5	0.059	0.128	0.069	0.010 *	117.5
12 months	0.100	0.122	0.022	0.005 *	22.4	0.064	0.106	0.041	0.009 *	64.5
24 months	0.110	0.134	0.024	0.006 *	21.7	0.072	0.098	0.026	0.009 *	36.7
36 months	0.115	0.143	0.028	0.005 *	24.6	0.070	0.096	0.026	0.010 *	36.6
48 months	0.116	0.148	0.032	0.007 *	28.1	0.069	0.095	0.025	0.012	36.7
Change in log monthly earnings (conditional on employment)										
1-6 months	0.010	-0.011	-0.021	0.005 *	-2.1	0.014	-0.194	-0.207	0.015 *	-18.7
7-12 months	-0.003	-0.021	-0.018	0.007 *	-1.7	0.009	-0.181	-0.190	0.018 *	-17.3
13-24 months	-0.021	-0.048	-0.027	0.008 *	-2.7	-0.010	-0.115	-0.105	0.015 *	-9.9
25-36 months	-0.025	-0.063	-0.038	0.009 *	-3.7	-0.013	-0.100	-0.087	0.015 *	-8.3
36-48 months	-0.014	-0.048	-0.033	0.010 *	-3.3	-0.017	-0.092	-0.076	0.018 *	-7.3
Change in mean monthly earnings ($)										
1-6 months	33	-9	-42	20 *	-1.1	49	-539	-588	51 *	-15.1
7-12 months	-79	-134	-55	23 *	-1.4	-6	-620	-614	51 *	-15.8
13-24 months	-190	-271	-82	23 *	-2.1	-120	-425	-305	47 *	-7.8
25-36 months	-258	-378	-120	27 *	-3.2	-185	-498	-313	55 *	-8.0
36-48 months	-298	-452	-154	27 *	-4.0	-238	-528	-289	59 *	-7.4
Change in mean monthly income support ($)										
1-6 months	1	11	11	6 *	7.5	-7	81	88	13 *	77.3
7-12 months	15	44	28	7 *	19.9	1	87	86	14 *	75.9
13-24 months	31	62	31	7 *	22.1	7	50	42	15 *	37.4
25-36 months	36	71	35	7 *	24.4	8	44	36	15 *	31.8
36-48 months	44	89	45	9 *	31.5	8	57	50	17 *	43.8
Change in mean monthly personal income ($)										
1-6 months	34	3	-31	20	-0.8	42	-458	-501	47 *	-12.5
7-12 months	-64	-91	-27	24 *	-0.7	-5	-533	-528	47 *	-13.2
13-24 months	-159	-209	-50	22 *	-1.3	-113	-376	-263	45 *	-6.5
25-36 months	-222	-307	-85	27 *	-2.2	-177	-454	-277	51 *	-6.9
36-48 months	-254	-363	-109	26 *	-2.8	-231	-470	-240	53 *	-6.0

Table A8 – Main impact estimates for melanoma and prostate cancer

	Melanoma					Prostate cancer				
	Comparison mean	Study mean	Impact	Std Error	Rel. impact	Comparison mean	Study mean	Impact	Std Error	Rel. impact
Employment rate										
3 months	0.960	0.968	0.009	0.008	0.9	0.954	0.961	0.007	0.010	0.8
6 months	0.943	0.948	0.006	0.009	0.6	0.944	0.943	0.000	0.011	0.0
12 months	0.926	0.931	0.005	0.010	0.6	0.924	0.934	0.010	0.013	1.0
24 months	0.895	0.900	0.005	0.012	0.6	0.898	0.906	0.008	0.015	0.9
36 months	0.876	0.883	0.008	0.012	0.9	0.878	0.889	0.011	0.018	1.2
48 months	0.849	0.859	0.010	0.015	1.1	0.843	0.858	0.014	0.025	1.7
Benefit rate										
3 months	0.022	0.018	-0.003	0.005	-15.3	0.019	0.021	0.002	0.006	12.3
6 months	0.025	0.023	-0.002	0.006	-8.2	0.024	0.049	0.025	0.010 *	102.4
12 months	0.029	0.026	-0.003	0.006	-11.0	0.031	0.035	0.004	0.009	14.2
24 months	0.035	0.037	0.001	0.007	4.1	0.037	0.043	0.006	0.010	16.6
36 months	0.037	0.033	-0.003	0.007	-9.3	0.040	0.033	-0.007	0.009	-16.9
48 months	0.039	0.042	0.003	0.009	7.2	0.048	0.041	-0.007	0.013	-14.8
ACC rate										
3 months	0.008	0.005	-0.003	0.003	-41.4	0.009	0.008	-0.001	0.006	-13.9
6 months	0.007	0.005	-0.002	0.003	-32.8	0.010	0.006	-0.004	0.005	-39.0
12 months	0.007	0.006	-0.001	0.003	-15.4	0.008	0.008	0.000	0.005	-5.8
24 months	0.007	0.006	-0.001	0.003	-8.8	0.012	0.006	-0.006	0.005	-50.5
36 months	0.007	0.004	-0.004	0.003	-50.3	0.010	0.006	-0.004	0.005	-42.1
48 months	0.008	0.002	-0.005	0.002 *	-68.4	0.011	0.006	-0.006	0.006	-48.8
Income support rate										
3 months	0.030	0.023	-0.007	0.006	-22.6	0.028	0.029	0.001	0.007	3.9
6 months	0.033	0.028	-0.004	0.007	-13.7	0.034	0.055	0.021	0.012	62.1
12 months	0.036	0.032	-0.004	0.006	-11.9	0.039	0.043	0.004	0.011	10.5
24 months	0.042	0.043	0.001	0.008	2.2	0.048	0.049	0.000	0.011	0.6
36 months	0.044	0.037	-0.007	0.007	-16.2	0.050	0.039	-0.011	0.010	-21.8
48 months	0.047	0.044	-0.002	0.009	-5.3	0.059	0.047	-0.013	0.013	-21.1
Change in log monthly earnings (conditional on employment)										
1-6 months	0.012	0.002	-0.010	0.012	-0.9	-0.002	-0.044	-0.042	0.014 *	-4.1
7-12 months	-0.001	-0.005	-0.004	0.016	-0.4	-0.027	-0.030	-0.003	0.015	-0.3
13-24 months	-0.015	-0.023	-0.008	0.017	-0.8	-0.042	-0.044	-0.002	0.018	-0.2
25-36 months	-0.025	-0.027	-0.002	0.018	-0.2	-0.052	-0.072	-0.020	0.026	-2.0
36-48 months	-0.016	-0.039	-0.024	0.019	-2.3	-0.053	-0.106	-0.052	0.027	-5.1
Change in mean monthly earnings ($)										
1-6 months	66	11	-55	62	-1.1	-58	-337	-279	102 *	-4.5
7-12 months	-56	-66	-10	73	-0.2	-217	-252	-34	115	-0.6
13-24 months	-188	-234	-47	91	-0.9	-439	-448	-9	122	-0.2
25-36 months	-284	-364	-80	102	-1.6	-599	-637	-37	163	-0.6
36-48 months	-349	-417	-68	101	-1.4	-714	-811	-97	149	-1.6
Change in mean monthly income support ($)										
1-6 months	-1	-4	-2	10	-3.5	-3	16	20	15	36.8
7-12 months	7	5	-2	11	-2.5	11	27	16	17	30.3
13-24 months	14	12	-2	11	-3.3	19	33	14	17	26.6
25-36 months	16	21	5	11	7.7	24	16	-8	19	-15.7
36-48 months	19	15	-5	11	-7.3	32	26	-5	18	-10.0
Change in mean monthly personal income ($)										
1-6 months	65	8	-57	61	-1.1	-61	-321	-260	104 *	-4.2
7-12 months	-49	-60	-11	72	-0.2	-207	-224	-18	115	-0.3
13-24 months	-174	-223	-49	89	-1.0	-420	-415	5	121	0.1
25-36 months	-268	-343	-75	100	-1.5	-575	-621	-46	161	-0.7
36-48 months	-330	-403	-73	101	-1.5	-682	-785	-103	149	-1.6