Hidden costs

The employment and income impacts of later prostate cancer diagnosis in New Zealand men

NZIER report to the Prostate Cancer Foundation of New Zealand

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Key points

Prostate cancer impacts on men's ability to work – an issue of fundamental importance to men and their whānau

Research demonstrates conclusively that prostate cancer outcomes largely depend on the stage and grade of the cancer at the time of diagnosis. The earlier prostate cancer can be diagnosed, the more options are available to men for treatment and the better the prognosis for their subsequent survival and quality of life. For men of working age, an early diagnosis also means a greater ability to continue supporting their families, saving for retirement, and being productive members of society.

"Prostate cancer diagnosis can occur at a time when men's work and careers are central to their masculine identity, sense of purpose, and family life" (Yu Ko et al. 2018). Men's roles as providers and their professional identities can be an important source of self-worth, so the ability to regain their status at work and as income earners should not be underestimated. Unemployment and low income have previously been found to be associated with suicidal ideation in men diagnosed with prostate cancer. Indeed, men with prostate cancer are two to four times more likely to die by suicide compared with men who have never had prostate cancer.

Private economic impacts of late diagnosis can be accurately identified using Statistics NZ's Integrated Data Infrastructure

Statistics NZ's Integrated Data Infrastructure (IDI) presents an opportunity that is virtually unique in the world to explore what the private economic impacts of prostate cancer diagnosis are. The IDI allows information about the health of individuals to be linked to information about their employment status, earnings, and dependence on social welfare payments. It also allows a wide range of other individual characteristics to be identified to support individual case matching and propensity score matching techniques that provide robust results with high confidence in causality.

Men with a later diagnosis experience negative impacts on employment earnings not experienced by men with an early diagnosis

After controlling for age, ethnicity, income, health status, deprivation status, and a wide range of other variables through exact case matching and propensity score matching, our IDI research identified that, on average, men with a later prostate cancer detection experienced an earnings loss of approximately $12,000 compared with matched controls. In contrast, men with an early diagnosis of prostate cancer experienced earnings that were no different from their matched controls. This figure translates into each annual lost earnings of over $28 million due to a diagnosis that could potentially have happened earlier.

Context is important to understanding the human and equity issues

While some of the impacts presented here may not appear substantial, these earnings losses and other impacts must be considered in a broader context.

- Māori men with a late diagnosis of prostate cancer:
  - Experience nearly $7,000 in lost earnings, as well as increased unemployment and increased welfare dependency, coming from a position of being less financially resilient and being set up by these impacts to experience institutional racism within both the health sector and the social services sector
  - Experience significant private economic impacts of later prostate cancer detection alongside significant barriers to making adjustments to employment arrangements (as noted by Oranga Tū) and often having to travel greater distances to receive treatment that is not organised in a way that respects their cultural needs or financial realities
- Men aged 60 to 64 with a late diagnosis of prostate cancer face being forced earlier than they would have chosen to reduce their hours worked or change their type of employment, experience significant earnings loss of up to $18,000 in a period of their lives when they may have been hoping to work for just a few more years to generate much-needed retirement savings and have little opportunity to make compensating changes to earnings.
- Younger men with a late diagnosis of prostate cancer experience an increase in welfare dependency and reduced earnings of up to $9,300 potentially while still paying a mortgage and with dependents who rely on them financially.
- Many working-age men with a late diagnosis of prostate cancer withstand earnings losses of up to $12,000 (the average loss for men of all ages and ethnicities) while also funding their treatment through private health services due to concerns about the quality of publicly funded cancer care in New Zealand and wanting the best possible chance of survival and the ability to continue supporting their family and whānau through and post-treatment.

Older men experience the greatest financial impacts

The group that was most affected compared with their matched counterparts were men aged 60 to 64. On average, men aged 60 to 64 with a later diagnosis of prostate cancer experienced up to a 14 percent reduction in earnings – equivalent to around $18,000 over four years. While these men were older, they, like the other study groups, were compared with their matched counterparts for this analysis, so the loss of earnings is related to diagnosis, not age. Further analysis of their employment status and welfare dependency indicated that the loss in earnings was not related to withdrawal from the workforce but to other factors, which may include reduced hours worked or a change in role.

We recommend that decisions on prostate cancer screening, diagnosis and treatment take this new information into account

The health and disability system is shifting from an activity-focused or, at best, patient-focused system to one that places the person and whānau at the centre. In light of our findings, we recommend that:

- The Ministry of Health, Te Whatu Ora and the Te Aka Whai Ora explore the new evidence on the costs and benefits of prostate cancer screening in New Zealand from a societal rather than health system perspective.

- The Ministry of Health funds further research to better understand the other hidden costs of prostate cancer, and later prostate cancer diagnosis in particular.
- The Ministry of Health funds further research to better understand the impacts of late prostate cancer diagnosis on men's families and whānau.

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1   Background

1.1   Prostate cancer is the most common cancer in New Zealand

Approximately 4,000 men are diagnosed with prostate cancer every year in New Zealand, representing nearly 21 percent of all cancer diagnoses in men (International Agency for Research on Cancer 2020).

Figure 1 Cancer diagnoses in New Zealand men
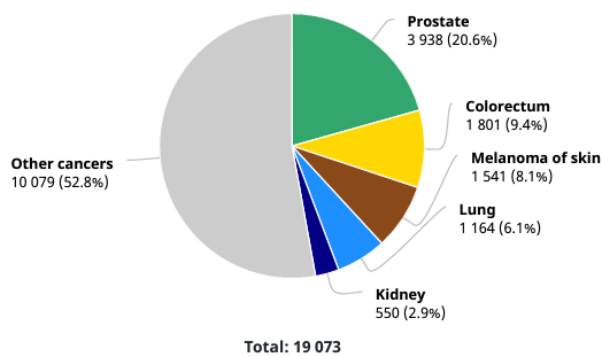
Source: International Agency for Research on Cancer (2020)

Prostate cancer is not just the most common cancer in New Zealand men, it is the most common cancer overall at 11 percent of all cancers – slightly higher than breast cancer.

Figure 2 Cancer diagnoses in the New Zealand population, both sexes
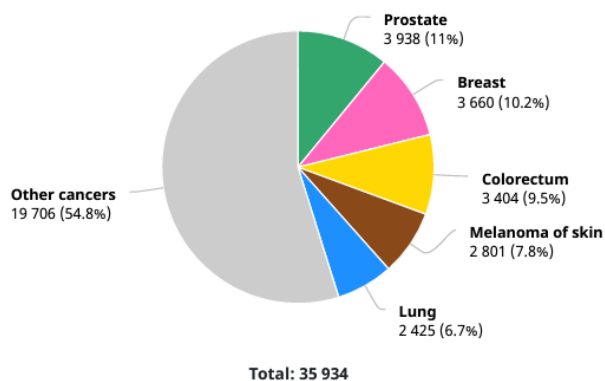
Source: International Agency for Research on Cancer (2020)

1.2   While the health impacts of prostate cancer are well understood, comparatively little is known about socioeconomic and equity impacts

The published literature offers a great deal of detail on the health outcomes for men with prostate cancer, including mortality and quality of life impacts. These, in addition to costs of diagnosis and treatment, are the impacts that are of concern from a purely health system perspective. A societal perspective, which provides for a better determination of the value

of interventions, would also consider the private impacts of prostate cancer – the costs that prostate cancer imposes on men and their families and whānau and, by extension, on the broader economy.

1.3 But health outcomes indicate significant potential for hidden private impacts

A New Zealand study (Lawrenson et al. 2014) of the physical and psychological impacts of prostate cancer treatment found that:

- 25 percent of men experienced problems with mobility

- 7 percent of men experienced problems with self-care

- 31 percent of men experienced problems undertaking their usual activities

- 35 percent of men experienced pain or discomfort

- 21 percent of men experienced anxiety or depression.

The same study also found that 35 percent of men experienced pain or discomfort described as moderate or extreme, and 21 percent of men experienced depression or anxiety described as moderate or extreme. Evidence from the study also indicates worse outcomes for Māori men with:

- 50 percent of the Māori men involved in the study reported pain or discomfort that was described as moderate or extreme compared with 31 percent of the non-Māori men.

- 35 percent of the Māori men involved in the study reported depression or anxiety that was described as moderate or extreme compared with 17 percent of the non-Māori men (Lawrenson et al. 2014).reported

The stage at diagnosis has an important impact on these outcomes and, therefore, on how these outcomes impact on men's ability to work. Early, low-grade prostate cancer causes no symptoms. It is often not until the cancer is locally advanced that men will develop urinary problems. Men with advanced prostate cancer, where the cancer has spread beyond the prostate gland to other parts of the body, may present with weight loss, fatigue and bone pain.

The stage of diagnosis also has a direct impact on treatment choices. According to a UK study, late stage at diagnosis and greater comorbidity were the strongest predictors of movement to unemployment for men treated for prostate cancer. Other significant predictors included having symptoms at diagnosis, having bowel or urinary problems, and living in areas of greater deprivation (Bennett et al. 2018). Men living in the most deprived areas had over twice the odds of becoming unemployed after prostate cancer treatment. The same study also identified part-time work, advanced stage of disease at diagnosis, and carer responsibilities as significant predictors of early retirement (retirement at age 60 or below).

The association between living in areas of high deprivation and becoming unemployed post-treatment may be explained by a higher proportion of employed men in high deprivation areas being in physically demanding or manual work. Other studies have confirmed that cancer survivors in physically demanding jobs experience greater challenges to maintaining employment (de Jong et al. 2017; Taskila et al. 2007). Those studies also

found that cancer survivors who had had chemotherapy reported greater impacts on their work ability. Chemotherapy is most commonly used in the treatment of advanced prostate cancer.

Although prostate cancer is predominantly a disease affecting men over the age of 65, approximately 30 percent of prostate cancer survivors are of "working age" (Maddams, Utley, and Møller 2012), and men are increasingly continuing to maintain paid employment beyond this age.

1.4   Employment and earnings are important to New Zealand men

Prostate cancer often comes at a time when a man's work and career form a critical dimension of their masculine identity, their sense of purpose, and their family life. Population ageing and many men increasingly choosing to maintain their employment to an older age mean that increasing numbers of men are being diagnosed with prostate cancer during their working lives.

The importance of work and the ability to provide for whānau is one reason many Māori men delay seeing a doctor about symptoms. The Oranga Tū study (J Kidd et al. 2020) found that Māori men prioritise their whānau and work over their own health, delaying visiting a doctor until symptoms or whānau forced them to (Jacquie Kidd et al. 2013).

1.5   This report offers new insights from IDI research

New Zealand's unique resource, Statistics NZ's IDI, offers an opportunity to better understand the employment and income impacts of prostate cancer for New Zealand men. Previous research (Dixon 2015a) used IDI data and a robust methodology based on exact case matching and propensity score matching techniques to identify employment, earnings and welfare dependency impacts of eight chronic conditions in the New Zealand population. That research included prostate cancer but did not differentiate between early and late diagnosis. It found that, on average, across all prostate cancer diagnoses, men diagnosed with prostate cancer:

- were no less likely than their matched counterparts to be employed at any time during the follow-up period

- experienced a 4 percent reduction in their average monthly earnings and average monthly personal incomes during the first six months after diagnosis, only

- did not appear to have significant earnings or income effects in the longer term.

A key shortcoming of the Dixon (2015) study was the lack of a policy-relevant question for prostate cancer which these results would inform. As there is no currently known way of preventing prostate cancer, the key concern is not about the difference between diagnosis and non-diagnosis but rather about early versus late diagnosis. In other words, if we can't prevent prostate cancer, are there hidden costs to late diagnosis of prostate cancer that should be factored into a decision to improve early detection?

2 Our approach

2.1 Key research questions

In this research study, we addressed two key questions:

1 What are the employment, earnings and welfare dependency impacts of a later diagnosis of prostate cancer?

2 What are the employment, earnings and welfare dependency impacts of prostate cancer, and particularly a later diagnosis of prostate cancer for Māori men?

While these were the key questions of our research, we also explored the impacts of early diagnosis, impacts by age group, and impacts on Pacific men.

2.2 Overall approach

We followed the methodology used by Dixon (2015), which estimated the employment and income effects of eight chronic health conditions, including prostate cancer. Dixon (2015) used the following steps:

- Identified people who developed the health condition

- Established selection criteria of the study population who developed the health condition while in employment and with sufficient data records

- Applied exact case matching and propensity score matching to construct a control group who did not develop a health condition but had a similar probability of developing the health condition

- Compared outcomes for those who did and did not receive a diagnosis using appropriate econometric techniques.

The main way our methodology differed from Dixon (2015) was by studying one disease with two different diagnosis categories. We labelled our two study groups 'early diagnosis' and 'late diagnosis'. We also stratified our results by age group and ethnicity. Below, we detail our research process.

2.3 Data sources

We used data from the IDI, a linked administrative dataset maintained by Statistics NZ. The IDI links individual-level data from across government agencies. For this study, we combined data from:

- the New Zealand Cancer Registry, which includes cancer registration information

- the Ministry of Health, which includes critical data for matching, including primary health organisation (PHO) enrolment, primary care and hospital service use, diagnosis of long-term conditions, laboratory tests and pharmaceuticals

- Inland Revenue, which includes income from employment, employment status, and benefit receipt at the monthly level.

Figure 3 The Integrated Data Infrastructure
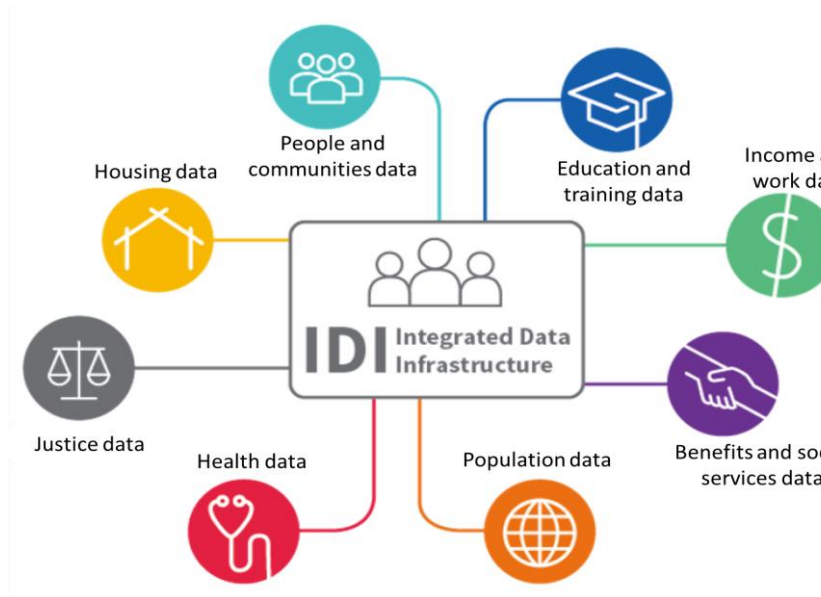
Source: Statistics NZ

2.3.1 Health variables

Prostate cancer

All cancers diagnosed by pathology labs are reported to the New Zealand Cancer Registry, a population-based register of all primary malignant diseases diagnosed in New Zealand. The data records the diagnosis date and site of origin of the tumour. We identified people diagnosed with prostate cancer as those where the primary tumour site was classified as prostate.

Early and later diagnosis

To compare outcomes for early and later diagnosis, we used the grade of tumour code. This code specifies the extent to which the tumour resembles the normal tissue where it arose, where well-differentiated cells look more like normal cells and tend to spread more slowly than poorly differentiated cells. We classify people with 'well differentiated' or 'moderately differentiated' as 'early diagnosis', and 'poorly differentiated' or 'undifferentiated' as 'later diagnosis'. It is important to note that this definition of 'later diagnosis' is likely to be different than what is considered to be a clinically late diagnosis. Our 'later diagnosis' group includes many men whose prostate cancer is of a lower risk than those whose cancer is considered to be diagnosed clinically late.

Diagnosis date

We used the date when the condition was recorded in the Cancer Registry as the date of diagnosis. However, this is a proxy measure and may not be the date a person learned of their condition in practice. More importantly, we do not know when a person first experienced symptoms. Since we look at outcome variables in the months pre- and post-diagnosis date, we can observe effects in the pre-diagnosis months, and these are possible for men with a later diagnosis.

Other health variables

We included measures of health service use as contributors to our propensity score model to ensure the treatment and control groups were as similar as possible prior to the diagnosis. We captured prior PHO consultations, number of prescriptions, number of lab tests, number of hospital admissions, nights in a hospital, emergency department visits, and outpatient visits. We also included indicators for diabetes and gout, using the chronic conditions data available. This information helped to ensure that the matched controls closely resembled the men in the study group.

2.3.2 Demographic data

Demographic data, includes age, sex, ethnicity, area deprivation and DHB of domicile were captured to define our study groups as well as to support the creation of matched control groups as individual demographics as well as local labour markets are expected to influence employment outcomes.

2.3.3 Economic data

The outcomes of interest for our study were all captured from Inland Revenue data on the men who were included in our study and control groups. These included employment earnings, employment status and receipt of social welfare payments.

2.4 Study population selection criteria

To be able to follow a cohort long enough to detect longer-term impacts of disease and disease treatment, it is necessary to start with a cohort for whom sufficient years of follow-up can be identified in the data. At the same time, it is important not to go back too far and analyse outcomes for people diagnosed and treated many years ago, as treatment may have changed substantially, resulting in any impacts being less relevant to today's decisions.

Like Dixon (2015), we identified that a cohort of men diagnosed with prostate cancer in 2015 or 2016 would allow for four complete years of data follow-up in the IDI and that this duration of follow-up should be sufficient to indicate where long-term impacts may occur.

Starting with a population of men with a prostate cancer diagnosis between the beginning of January 2015 and the end of 2016, we applied the selection criteria outlined in Table 1.

Table 1 Selection criteria for sample

	Selection criteria
1	Prostate cancer diagnosis first recorded 2015–2016
2	The person has an IRD link in IDI, is classified as male, and has a birth date recorded in Ministry of Health data
3	The person was aged 20-64 at the time of their prostate cancer diagnosis
4	The person was not overseas for more than 365 days during the whole study period
5	The person survived until the end of the study period
6	The person received earnings from wage or salary employment in each of the three months immediately before the month where the condition was first recorded

Source: NZIER
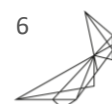
The selection criteria reduced the population of interest from 6,258 to a study population of 1,014. The main population loss for the study occurred due to most prostate cancer diagnoses being in men aged 65 or older at the time of diagnosis. This is shown in Figure 4 below.

Figure 4 Application of selection criteria to create a study population
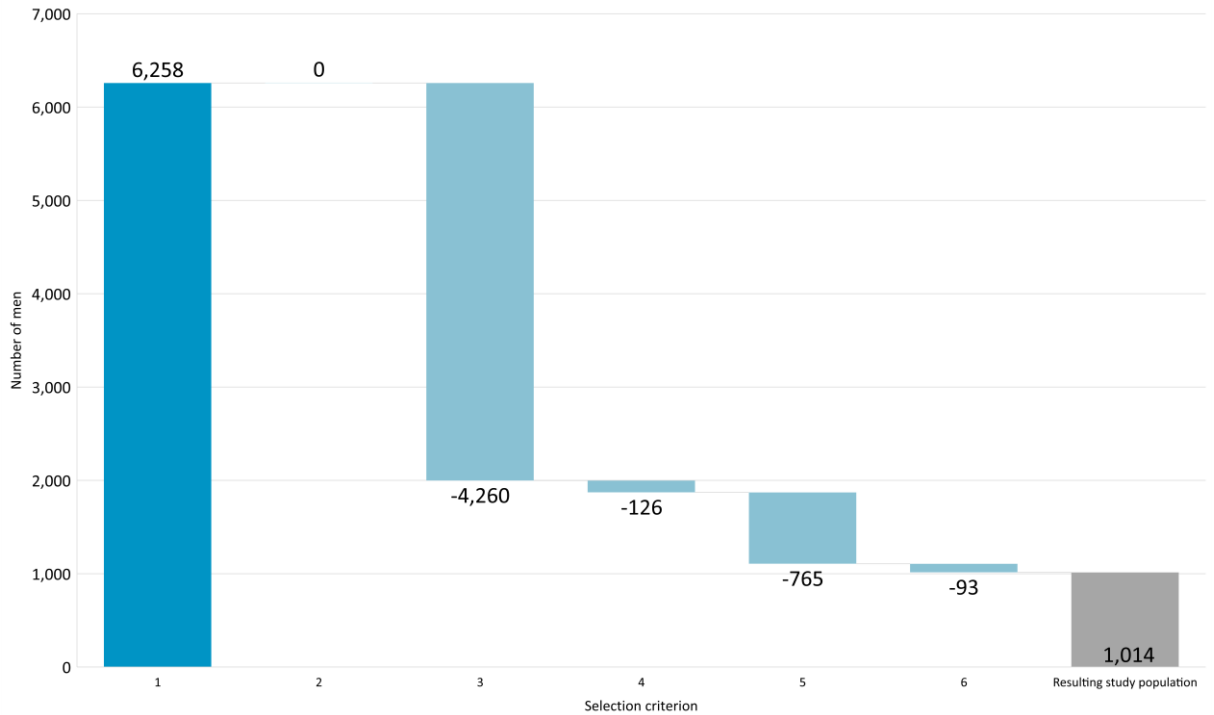
Source: NZIER

We only included men aged between 20-64 because:

- men under 20 have limited employment and income data before and after a diagnosis

- men aged over 65 or older at the time of diagnosis would be 69 and older at the end of the study period, with a substantial reduction in employment and income data due to retirement, leaving very few individuals and reducing the likelihood of statistically significant results. However, unlike Dixon, we do include men in their early sixties as even though they will be aged 64–68 by the end of the study period, many men do continue to work during these years, and any retirement-related loss of income would be controlled for through the analysis which includes robust matching with men in same age group.

Men who were overseas 365 days before the diagnostic date are not included because their employment information can't be recorded when they are overseas. Only men who survived four years after the diagnostic date are included in this study because we want to estimate the impact of the illness up to four years for the entire sample population. Lastly, condition 6, which ensured the person received income in the three months before diagnosis, was applied to ensure that each person was employed prior to diagnosis.

2.5 Constructing a comparison group

To estimate the impact of prostate cancer, we continued to follow the estimation method employed by Dixon (2015) to select a comparison group. We used a combination of exact case matching and propensity score matching to identify the closest match on observable characteristics for each person in the sample diagnosed with prostate cancer. A general introduction to the propensity score matching method is available by Caliendo and Kopeinig (2008).

These matches then provide the 'counterfactual' for what would have happened to each person if they weren't diagnosed with prostate cancer.

We used the following steps, which were originally described by Dixon (2015):

3   We identified a pool of potential comparison group members by selecting everyone who meets the criteria in Table 1, except for receiving a prostate cancer diagnosis. To get a reference date for earnings and employment histories, we generated eight quarterly records corresponding to the eight quarters of 2015 and 2016 and randomly assigned a date within that quarter. This process essentially created up to eight 'versions' of each person, with differing employment and earnings histories depending on the reference date.

4   We randomly selected one quarter per person, and of these selected a random 10,000 records. We combined these with the study population and ran a logit model to model the probability of each individual being diagnosed with prostate cancer. The explanatory variables in these logistic models included demographic characteristics (age group, ethnicity, DHB of residence, the New Zealand Deprivation Index score of the area of residence), existing health conditions, measures of recent and prior health service use patterns, and measures of employment and income support history. We estimated predicted probabilities of being diagnosed with early or late prostate cancer for all members of the treatment group and potential comparison group using the propensity scores from each regression. We test out a full list of explanatory variables to use in the propensity score model and then select the significantly correlated variables with a prostate cancer diagnosis. The full list of explanatory variables we used, and the variables selected for the propensity score models can be found in Table 2 of this report.

5   We apply the derived propensity score model from step 2 to the entire New Zealand population that meets the criteria in Table 1 and estimate a propensity score for each person.

6   We matched each person in the study population with a group of up to 20 matched comparison people. We used a combination of exact matching and propensity score matching:

   −   We exact match on ethnicity, age, New Zealand Deprivation score, and DHB of residence. To take into account the more important predictors of being diagnosed with prostate cancer, and control for local labour market effects.

   −   Within the exact matching constraints, we match people diagnosed with prostate cancer with comparison group individuals with the closest value of their propensity score within a radius of 0.03 propensity score points.

Each person was matched with replacement so that individuals in the study population could be matched to multiple people. Then each match was assigned a weight based on the number of matches made, taking the value of 0.05 if 20 matches were found for a member of the study population, and the value of 1 if only 1 match was found.

We carried out this process three times, for the full sample of prostate cancer cases and then separately for early and late diagnoses. Table 2 below shows the variables associated with a higher likelihood of being diagnosed with each stage of prostate cancer diagnosis that we identified in the logit models.

Table 2 Variables selected in the logit models to estimate propensity score

Variable	Definition	Full sample	Early diagnosis	Late diagnosis
Personal characteristics and local labour market area				
Age group	5-year age groups from 20 to 65	✓	✓	✓
Ethnicity	European, Māori, Pacific, Asian, Other or missing	✓	✓	✓
District Health Board of residence	DHBs derived from PHO enrolment records	✓	✓	✓
New Zealand deprivation score	Deprivation score based on PHO enrolment records	✓		✓
Existing health conditions				
Diabetes	Have been diagnosed with diabetes			
Gout	Have been diagnosed with gout			
Prior health service use				
Previous PHO consultations	Number of quarters with at least one PHO consultation in the prior year	✓		✓
Prescriptions	Number of prescriptions before diagnosis	✓	✓	✓
Lab tests	Number of lab tests before diagnosis	✓	✓	✓
Hospital admissions	Number of hospital admissions before diagnosis	✓		
Nights in the hospital	Number of nights in the hospital before diagnosis	✓		✓
Emergency department visits	Number of emergency department visits before diagnosis	✓	✓	✓
Outpatient visits	Number of outpatient visits before diagnosis	✓	✓	✓
Economic cycle				
Diagnosis quarter	Quarter in which the health event occurred	✓		
Employment and income support history				
Previous employment	Employment information before the diagnosis	✓	✓	
Income support history	Income support information before the diagnosis	✓	✓	✓
Average monthly earnings	Average monthly earnings before the diagnosis	✓	✓	✓
Average monthly income support	Average monthly income support before the diagnosis			

Source: NZIER, Statistics NZ

Whilst one randomly selected quarter per person in the very large potential comparison pool for non-Māori, non-Pacific men was sufficient to achieve a high-quality match, we elected to boost the potential comparison pool to all eight quarters per person to achieve a high-quality match for Māori and Pacific men. This was because Dixon (2015) noted that members of smaller population subgroups were less likely to be matched.

We did not include any individuals diagnosed with prostate cancer who could not be matched with any comparison group members. Before the matching, there were 1,014 individuals in our study group, and high-quality matches were achieved for 969 men.

We followed Dixon (2015) in applying this matching method to balance the sample characteristics of the study group and the matched comparison groups. Our control group contained 11,568 records.

Once the matching is complete, the impact of prostate cancer diagnosis is estimated as the difference between the mean outcomes of each study group and its matched comparison group. Similar to Dixon (2015), we estimate the standard errors and confidence intervals for each impact by using the bootstrapping method.

In other words, all results are presented as differences between what each study group experienced and what would have been expected for them if they had not had cancer – the outcomes experienced by men to whom they were matched based on a wide range of characteristics.

Figure 5 Assessment of outcomes as a comparison with matched controls

All men with prostate cancer diagnosis	Men with early prostate cancer diagnosis	Men with late prostate cancer diagnosis
↕	↕	↕
Matched controls	Matched controls	Matched controls
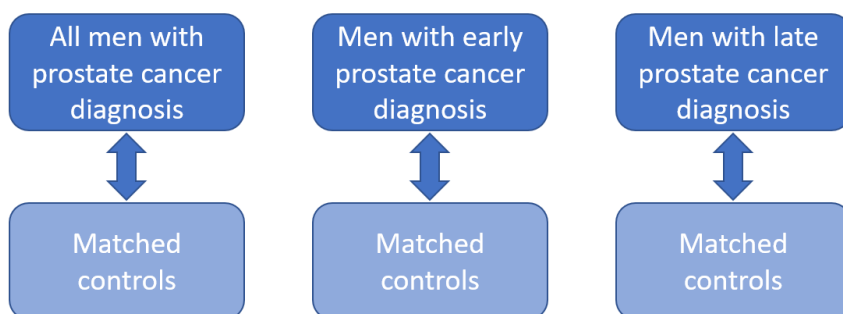
Source: NZIER

2.6 Outcome measures

We were interested in the impact of early and late diagnosis on employment, earnings, and benefit receipt. We measure these using the following:

- **Employed**: whether a person has any wage or salary earnings in a given month.

- **Earnings conditional on employment**: the difference in pre- and post-diagnosis average monthly earnings excluding months with no earnings

- **Earnings not conditional on employment**: the difference in pre- and post-diagnosis average monthly earnings, including months with no earnings

- **Benefit receipt**: whether a person received income from one of the main income support benefits in a given month. These benefits include unemployment benefit, domestic purposes benefit, sickness benefit, invalid's benefit, widow's benefit, and emergency benefit.

Both earnings conditional on employment and not conditional on employment are included in this report to study the changes in total earnings for the entire study population and the effect of a prostate cancer diagnosis on individuals' monthly earnings conditional on employment.

We estimate the difference between the mean outcome of the study population and the matched comparison group using a difference in difference regression model.

2.7 Evaluating differences in employment and income outcomes

We adopt the difference in difference (DiD) estimator to evaluate the impact of prostate cancer between the study group and the comparison group. The DiD regression is a quasi-experimental approach that establishes a causal effect by comparing the study group with a comparison group using longitudinal data while controlling for the difference in sample outcome before the prostate cancer diagnosis (Roth et al. 2022) .

The DiD regression model is usually implemented by incorporating interaction terms between time and study group dummy variables in a regression model:

$$Y = \beta_0 + \beta_1 Time + \beta_2 Study\ group + \beta_3 Time * Study\ group + \varepsilon$$

Where:

Y is the outcome measure.

$Time$ is the study period after the prostate cancer diagnosis.

$Study\ group$ is a dummy variable that takes the value of 1 for the study group and a value of 0 for the comparison group.

The coefficient in the above equation captures the following:

β_0 is the constant term.

β_1 is the group-specific effect which captures the difference between the treatment and control before the prostate cancer diagnosis

β_2 is the time trend common to both the study and the comparison group

β_3 is the true effect of prostate cancer

We adopt the above difference in difference regression methodology to all the outcome measures listed in section 1.4 of this report to establish the causality of a prostate cancer diagnosis on people's employment and income. We will detail our estimates in the results section of this report.
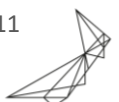
3 Characteristics of the study sample

In this section, we describe our study sample of men with a prostate cancer diagnosis, including the subgroups of early and later diagnoses.

3.1 Early and late diagnosis

As described in section 2.3.1, to compare outcomes for early and later diagnosis, we used the grade of tumour code which is the only available stage of diagnosis-related measure in the IDI. We created the following diagnosis groups:

- men with 'well differentiated' or 'moderately differentiated' prostate cancer at the time of diagnosis are considered men with an 'early diagnosis'
- men with 'poorly differentiated' or 'undifferentiated' prostate cancer at the time of diagnosis are considered men with a 'later diagnosis'.

As explained in section 2.3.1, it is important to note that this definition of 'late diagnosis' is likely to be different from what is considere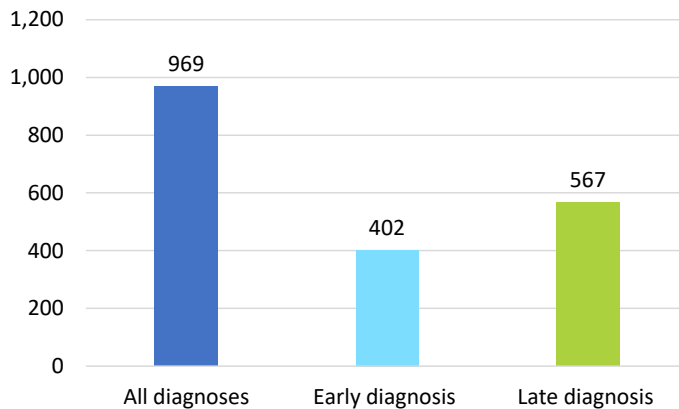d clinically late diagnosis. Our 'late diagnosis' group includes many men whose prostate cancer is of a lower risk than those whose cancer is considered to be diagnosed clinically late. In fact, in our working age study sample, most men (567) had a late diagnosis by the definition used for this study.

Figure 6 Number of men in the study sample by diagnosis group

Source: NZIER

3.2 Age and ethnicity of men with a prostate cancer diagnosis

The average age of men in our study was 58. This was true for the overall sample and for both the early and late diagnosis groups.

The number of men who were aged 20 to 29 or 30 to 39 at the time of diagnosis was under 6, the threshold below which Statistics NZ does not allow reporting. The proportion of men in the 40-to-49-year age group, the 50-to-59-year age group and the 60-to-64-year age group was similar across all three groupings, with only a slightly higher proportion of men aged 40 to 49 in the early diagnosis group and a slightly higher proportion of men aged 50 to 59 in the late diagnosis group.

Figure 7 Proportion of men in each age group, by diagnosis group
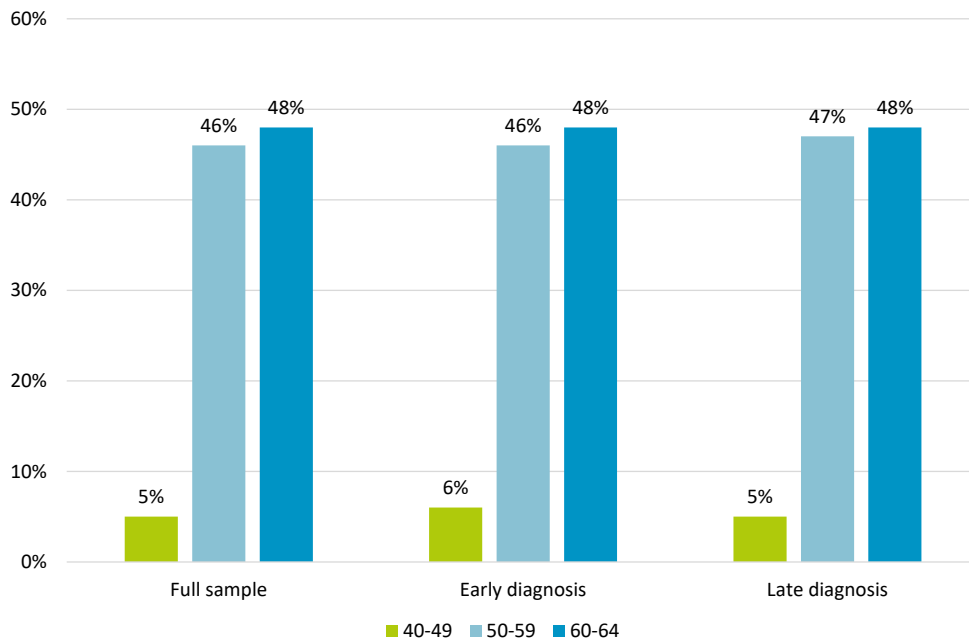
Source: NZIER, Statistics NZ

Regarding ethnicity, 82 percent of the overall sample were identified as European, 11 percent were identified as Māori, 3 were identified as Pacific, and 2 percent were identified as Asian. These proportions are somewhat different when accounting for the stage at diagnosis, with a slightly higher proportion of European men in the early diagnosis group and a slightly higher proportion of Māori and Asian men in the later diagnosis group.

Figure 8 Proportion of men of each ethnicity by diagnosis group
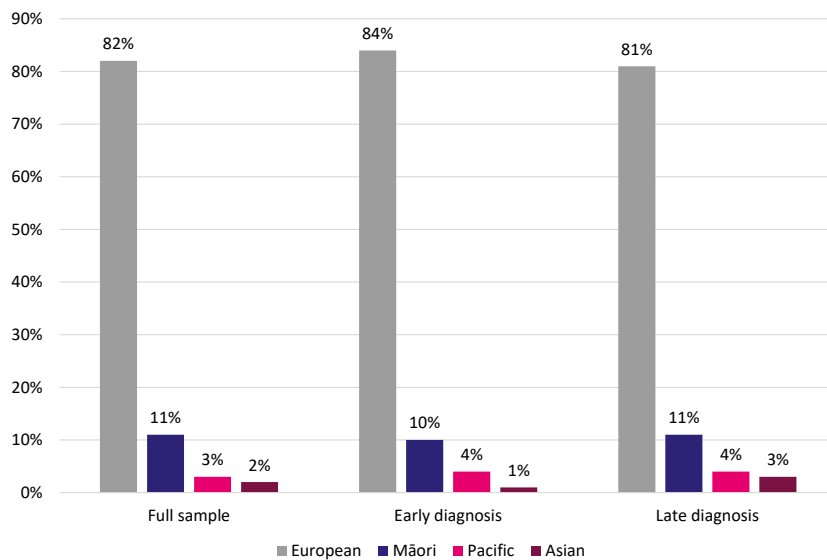
Source: NZIER, Statistics NZ

Overall, the Asian ethnicity group was too small to provide any statistically significant results, so three ethnicity groups were analysed:

- Maori men

- Pacific men

- Non-Maori, non-Pacific men (European and Asian men combined).

Table 3 below summarises the demographic characteristics of the study groups and the comparison groups obtained through the matching methodology described in section 2.5.

Table 3 Summary of demographic characteristics for the study and comparison groups
Results of matching methodology

Variable	Full sample	Comparison group for Full sample	Early diagnosis	Comparison group for early diagnosis	Late diagnosis	Comparison group for late diagnosis
Number of people that were matched	969	11568	402	5,469	567	6960
Demographics						
Average age	58	58	58	58	58	58
20-29	S	S	S	S	S	S
30-39	S	1%	S	1%	S	0%
40-49	5%	6%	6%	6%	5%	6%
50-59	46%	51%	46%	50%	47%	53%
60-64	48%	42%	48%	42%	48%	41%
European	82%	88%	84%	90%	81%	88%
Māori	11%	7%	10%	6%	11%	7%
Pacific	3%	3%	4%	3%	4%	2%
Asian	2%	2%	1%	1%	3%	2%

Note: S indicates the number was below 6, Statistics NZ's threshold for reporting. Consequently, these figures are suppressed (S).

Source: NZIER, Statistics NZ

3.3 Deprivation status of men with a prostate cancer diagnosis

The deprivation status of men in the study group was identified by the NZDep18 decile recorded for the meshblock (the smallest geographical units defined by Statistics NZ, containing between 100 and 200 people) identified as their domicile at the time of diagnosis. The NZDep2018 index of deprivation ordinal scale ranges from 1 to 10, where 1 represents the areas with the least deprived scores and 10 the areas with the most deprived scores.

There is little difference between the overall sample and the early and later diagnosis groups for most deprivation groups. However, the late diagnosis group includes a higher

proportion of men from areas with a high level of deprivation (NZDep18 level 9 or 10) – 17 percent of the group, compared with only 13 percent of the early diagnosis group.

Figure 9 Proportion of men by deprivation status and diagnosis group
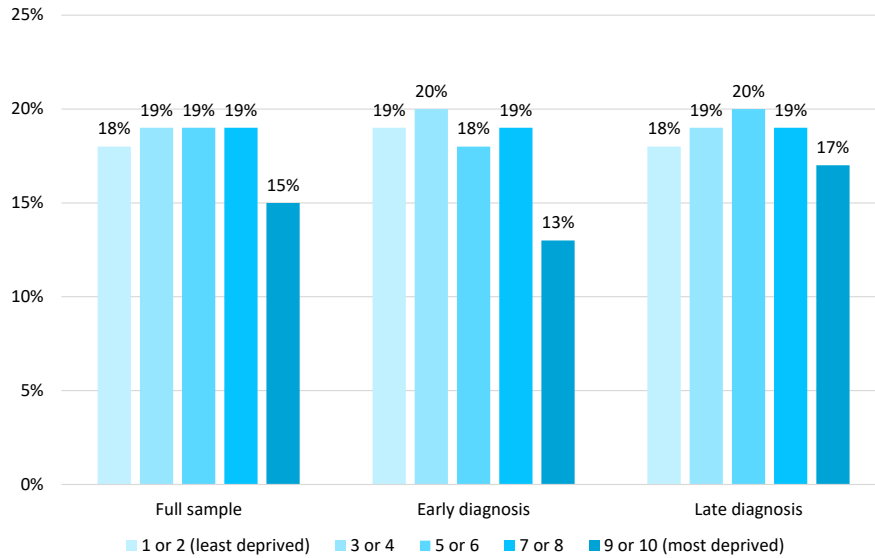
Source: NZIER, Statistics NZ

Table 4 below summarises the deprivation status of the study groups and the comparison groups obtained through the matching methodology described in section 2.5.

Table 4 Summary of deprivation status for the study and comparison groups
Results of matching methodology

NZDep18	Full sample	Comparison group for Full sample	Early diagnosis	Comparison group for Early diagnosis	Late diagnosis	Comparison group for late diagnosis
1 or 2	18%	20%	19%	20%	18%	22%
3 or 4	19%	20%	20%	19%	19%	20%
5 or 6	19%	19%	18%	18%	20%	18%
7 or 8	19%	18%	19%	19%	19%	18%
9 or 10	15%	13%	13%	12%	17%	14%

Source: NZIER, Statistics NZ

4 Employment, earnings and welfare dependency impacts

All analyses of employment, earnings, and welfare dependency involved a comparison of the study groups (all diagnoses, early diagnosis, and late diagnosis) with matched control groups, as described in section 2.5. We also present the results of the sub-group analysis, including:

- Māori men
- Non-Māori, non-Pacific men
- Older men (aged 60-64 at the time of diagnosis)
- Younger men (aged 40-59 at the time of diagnosis).

We do not present results on the analysis of outcomes for Pacific men. Although we attempted to explore outcomes for Pacific men, the study group was too small to generate any statistically significant results. This group requires further research.

4.1 Employment impacts

We analysed this impact by calculating the probability of being in paid employment in each post-diagnosis period compared with matched controls for each study group, across all men, by ethnicity, and by age group.

Our analysis showed that for men with prostate cancer, a change in employment status from employed to out of employment is not common, regardless of whether the diagnosis is early or later.

There was, however, one statistically significant result: Māori men with a late prostate cancer diagnosis experienced a 7 percentage point decrease in the probability of being in employment six months after diagnosis compared with matched controls.

4.2 Welfare dependency impacts

We analysed this impact by calculating the probability of receiving social welfare benefits in each period post diagnosis compared with matched controls for each study group, across all men, by ethnicity, and by age group.

Our analysis showed that for men with prostate cancer, a change in status concerning welfare dependency is not common, regardless of whether a diagnosis is early or later.

There were, however, two statistically significant results:

- Māori men with a late prostate cancer diagnosis experienced a 4 percentage point increase in the probability of social welfare dependency 48 months after diagnosis compared with matched controls
- younger men (aged under 60 at the time of diagnosis) experienced a 3 percentage point increase in the probability of social welfare dependency 6 months post-diagnosis.

4.3 Employment earnings impacts

Given the lack of widespread statistically significant results for employment impacts and welfare dependency impacts, it appears that most men with prostate cancer manage to remain in employment post-diagnosis. However, health conditions and their treatment may nevertheless impact a person's ability to maintain the same level or type of employment, and this can be because:

- physical symptoms of the disease make some types of work or working full-time challenging

- the after-effects of treatment make some types of work or working full-time challenging

- the need to attend multiple medical appointments to receive treatment over a period of time can make working full-time challenging

- the need to travel to other centres if cancer care is not available locally can make full-time work challenging.

We analysed employment earnings in two ways. First, we analysed employment earnings unconditional on employment. That is, we did not remove months in which employment earnings were zero (a phenomenon that was observed in the study groups as well as the control groups). Then, we removed those months when employment earnings were zero and analysed the earnings in months with non-zero earnings (when people were clearly employed). This was to avoid conflating the analysis of employment impacts with the analysis of employment earnings impacts.

For Māori men, the analysis of conditional earnings produced unexpected results that were so highly positive that they were not credible as impacts of a prostate cancer diagnosis. On further investigation, it was found that the restriction to conditional earnings reduced the size of the group to the point where statistically significant results were still achievable, but the results were highly susceptible to extreme values. Further investigation revealed some extreme values and a high degree of volatility in the data. For this reason, we present the results for Māori men based on unconditional earnings, which allowed for a larger group and reduced the impact of extreme values and volatility somewhat.

For Pacific men, there were no statistically significant results, so no results are presented in this report for this group.

4.3.1 Lost employment earnings – all men, unconditional on employment

In our analysis of earnings unconditional on employment (including any months with a zero income, indicating a potential period of unemployment) we found that, on average, men with a prostate cancer diagnosis experience no statistically significant reduced earnings compared with matched controls for the four years post-diagnosis. Similarly, men with an early prostate cancer diagnosis experienced no statistically significant loss of earnings compared with their matched controls. However, men with a late prostate cancer diagnosis experience:

- statistically significant reduced earnings of 4.4 percent over the first six months post-diagnosis

- statistically insignificant earnings impacts over the six months to 2 years post-diagnosis period

- statistically significant reduced earnings of 3.6 percent in the third and fourth years post-diagnosis.

These results are shown in Figure 10 below.

Figure 10 Percentage reduction in earnings – all men, unconditional on employment
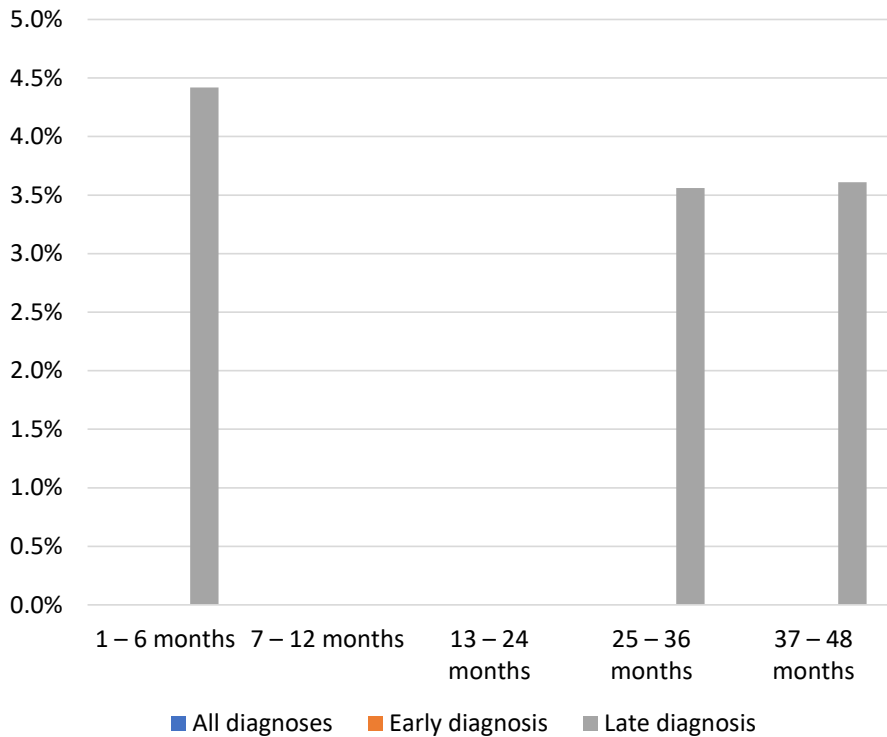
Source: NZIER

To better understand the value of these lost earnings, we calculated the dollar amount based on the average monthly earnings of men in our study. These figures indicate that over the four years post-diagnosis:

- men with any prostate cancer diagnosis or an early prostate cancer diagnosis have no statistically significant loss of earnings
- men with a late prostate cancer diagnosis miss out on nearly $7,000 in addition to any months in which they did not earn an employment income.

These results are shown in Figure 11 below.

Figure 11 Value of lost earnings – all men, unconditional on employment

Source: NZIER

4.3.2 Lost employment earnings – all men, conditional on employment

In our analysis of earnings conditional on employment (discarding any months with a zero income to consider only losses in the months when some employment income was recorded), we found that:

- on average, men with a prostate cancer diagnosis experienced reduced earnings of around three to four percent compared with matched controls for the first 12 months post-diagnosis (this result is similar to Dixon (2015))

- men with an early diagnosis of prostate cancer experienced no statistically significant loss of income at any stage compared with their matched controls

- men with a late prostate cancer diagnosis experienced reduced earnings of between three and six percent over a period of three years post-diagnosis compared with their matched controls.

These results are shown in Figure 12 below.

Figure 12 Percentage reduction in earnings – all men, conditional on employment
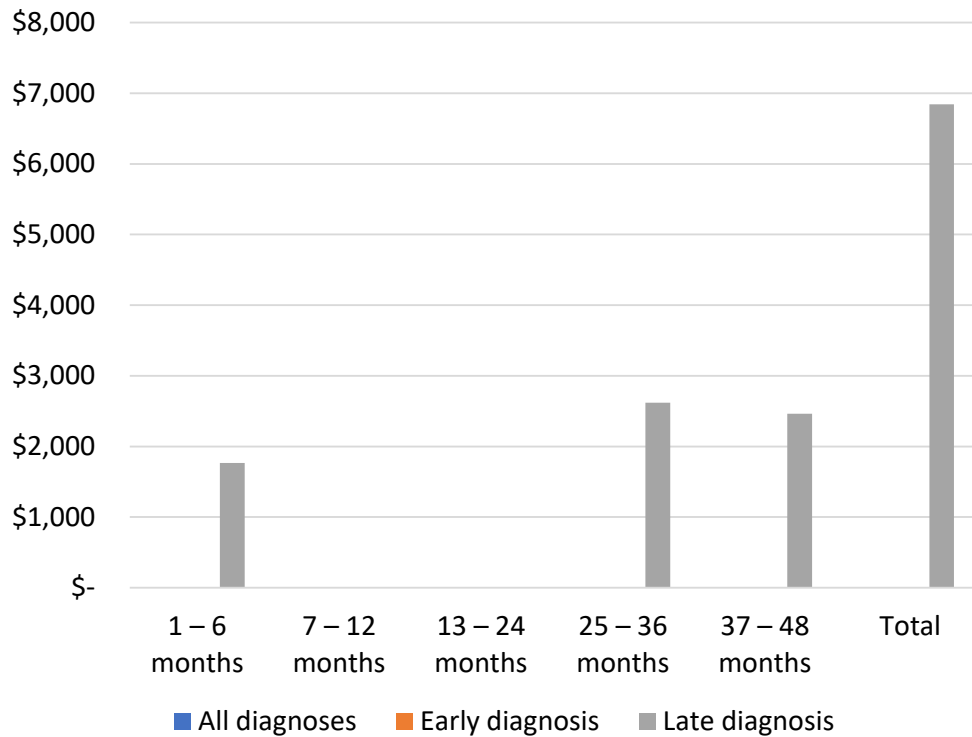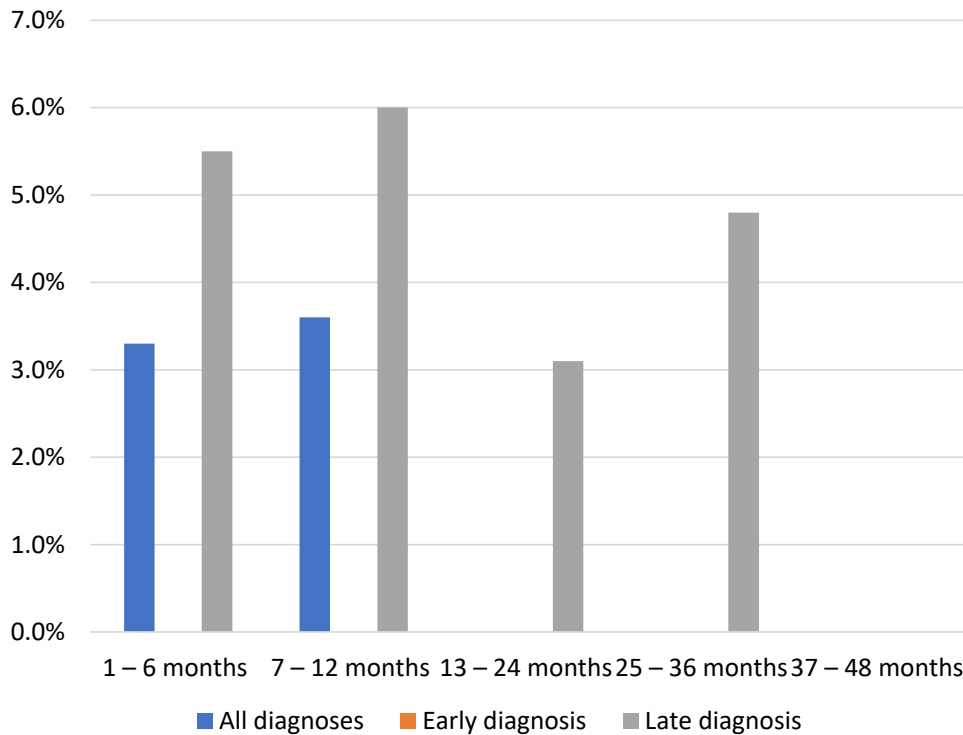

Source: NZIER

To better understand the value of these lost earnings, we calculated the dollar amount based on the average monthly earnings of men in our study. These figures indicate that over the four years post-diagnosis:

- men with any prostate cancer diagnosis miss out on just under $3,000 compared with their matched controls

- men with an early prostate cancer diagnosis have earnings that are not statistically significantly different from that of their matched controls

- men with a late prostate cancer diagnosis miss out on nearly $12,000 compared with their matched controls.

These results are shown in Figure 13 below.

Figure 13 Value of lost earnings – all men, conditional on employment

Bar chart showing value of lost earnings across time periods (1–6 months, 7–12 months, 13–24 months, 25–36 months, 37–48 months, Total) for All diagnoses (blue), Early diagnosis (orange), and Late diagnosis (grey). The Total Late diagnosis bar reaches approximately $11,500.
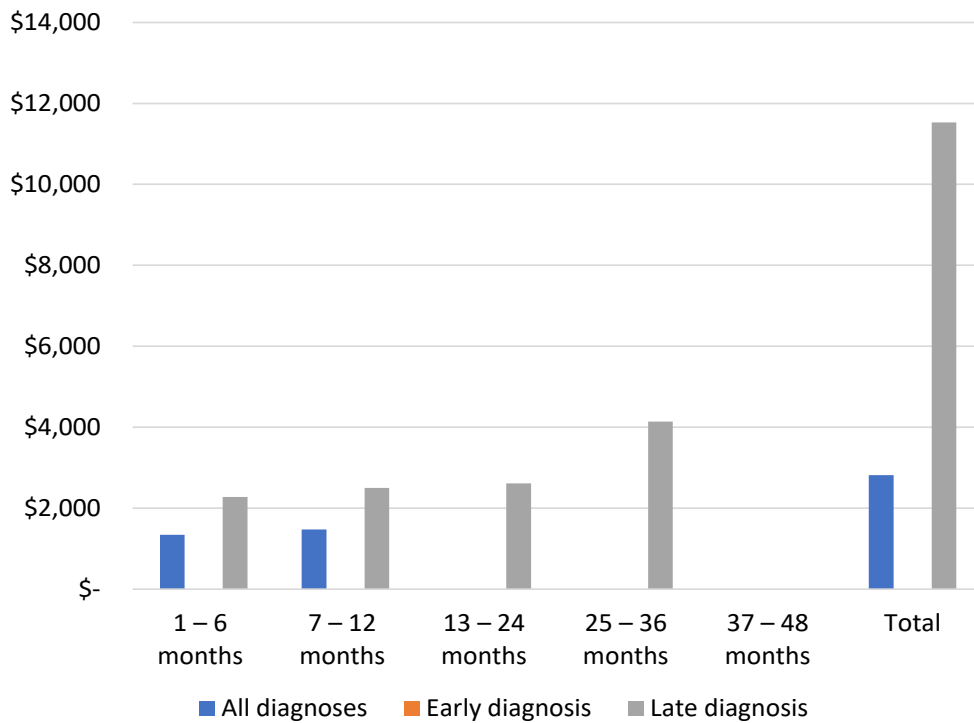
Source: NZIER

4.3.3 Lost employment earnings – Māori men

Māori men are less likely to be diagnosed with prostate cancer; when they are diagnosed, they are more likely to be diagnosed later. Māori men also experience a high prostate cancer mortality rate. The equity impacts of prostate cancer diagnosis are real, not only in the statistics that suggest inequitable access to diagnosis but in the stories, particularly as captured by the Oranga Tū study (J Kidd et al. 2020). This study revealed the experience of prostate cancer and prostate cancer treatment for Māori men is particularly challenging due to a lack of culturally safe services and institutional racism.

On the private economic dimension, Māori men are already disadvantaged, earning lower incomes on average than non-Māori, non-Pacific men. Lower-income employment is also more likely to be physical work and work with less flexibility to accommodate medical appointments, remote working, or other adjustments that may be needed to support a return to work with the after-effects of prostate cancer and its treatment. The Oranga Tū study found that Māori men face barriers to taking time off work to travel to and attend services (ibid, 12). In addition, a lifetime of lower income puts a man in a financial position that is less able to withstand a loss of income or employment, even for short periods.

Our analysis of employment earnings for Māori men reveals that the earnings of Māori men (unconditional on employment) demonstrate:

- reduced earnings compared with matched controls for one-year post-diagnosis, regardless of the stage at diagnosis
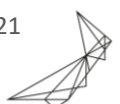
- greater losses of earnings in the first year post-diagnosis for Māori men with a late diagnosis (up to 9 percent) compared with their matched controls than for Māori men with an early diagnosis (up to 6 percent) compared with their matched controls

- evidence of attempts to compensate for lost earnings by earning more than their matched controls in the third and fourth years post-diagnosis, driven by the early diagnosis group, while the late diagnosis groups experience no such effect.

These results are shown in Figure 14 below.

Figure 14 Percentage reduction in earnings – Māori men, unconditional on employment
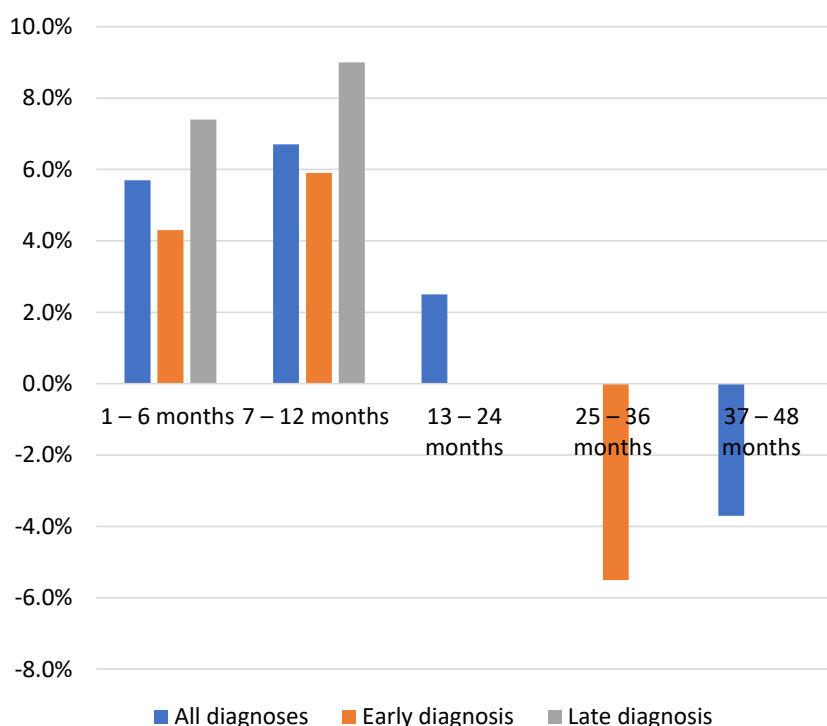
Note: This chart provides an example of where statistical significance can lead to counter-intuitive results. In the 37 to 48 months post diagnosis, some recovery of earnings is identified for the "all diagnoses" group, but nothing is identified for the early or late diagnosis groups. This is due to the latter groups being smaller subsets of the overall group and results for the sub-groups in this period being statistically insignificant.

Source: NZIER

The results contrast with those of non-Maori, non-Pacific men for whom:

- when all diagnoses are considered together, there are no statistically significant earnings losses compared with their matched controls

- there were no statistically significant earnings losses for those with an early diagnosis, compared with their matched controls, and just one period with a small gain in earnings

- all statistically significant earnings losses were in for the late diagnosis group, which lost 4 to 4.7 percent compared with matched controls.

These results are shown in Figure 15 below.

Figure 15 Percentage reduction in earnings – non-Māori, non-Pacific men, unconditional on employment
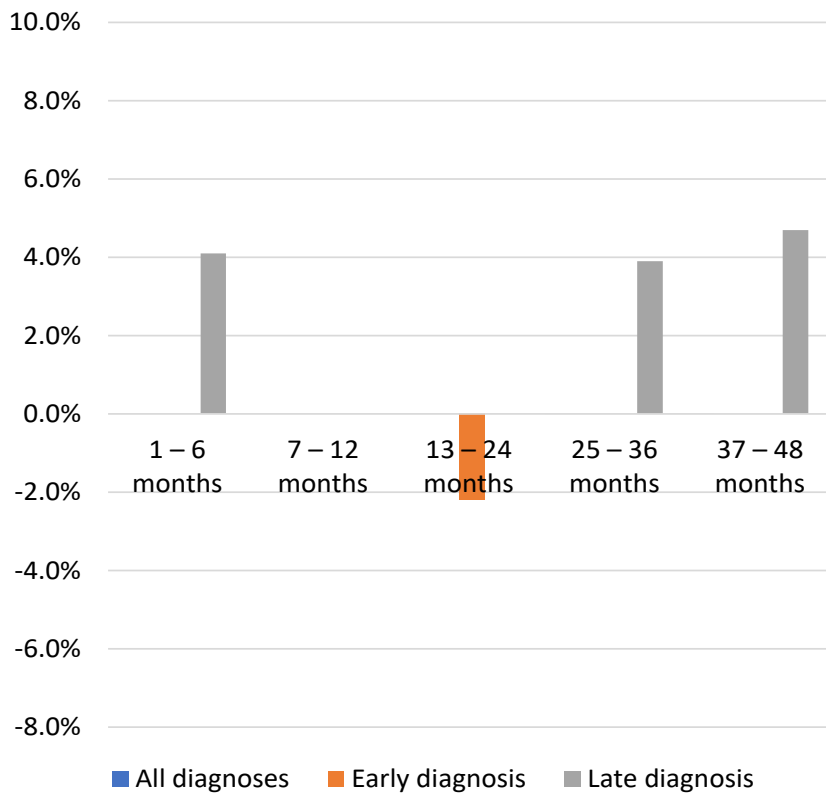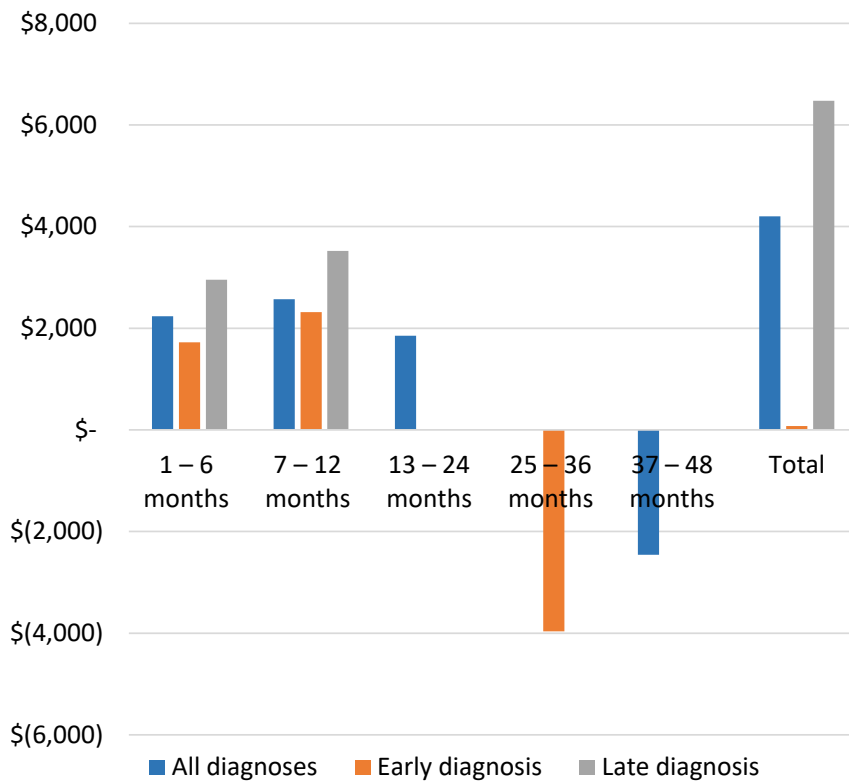

Source: NZIER

To better understand the value of lost earnings for Māori men, we calculated the dollar amount based on the average monthly earnings of all men in our study. This was to avoid undervaluing the loss to Māori by perpetuating disadvantage. These 'equity-adjusted' figures indicate that over the four years post-diagnosis:

- Māori men with any prostate cancer diagnosis miss out on over $4,000 compared with their matched controls

- Maori men with an early prostate cancer diagnosis are able to fully compensate for any early loss in earnings by increasing their earnings in the later periods post-diagnosis, compared with their matched controls

- Maori men with a late prostate cancer diagnosis miss out on nearly $6,500 compared with their matched controls.

These results are shown in Figure 16 below.

Figure 16 Value of lost earnings – Māori men, unconditional on employment

Source: NZIER

Interestingly, compared with non- Māori, non-Pacific men, the value of losses to Māori men with a late diagnosis is less due to the absence of earnings loss in the third and fourth years post-diagnosis for Māori men. At the same time, the average loss based on all diagnoses is significantly greater for Māori due to Māori men with an early diagnosis experiencing worse earnings outcomes than Non-Māori, non-Pacific men.

Non-Māori, non-Pacific men:

- experience nearly $8,000 in lost earnings if they have a late prostate cancer diagnosis, compared with matched controls
- experience a small gain in earnings (nearly $1,700) compared with matched controls after an early diagnosis of prostate cancer.

These results are shown in Figure 17 below.

Figure 17 Value of lost earnings – non-Māori, non-Pacific men, unconditional on employment
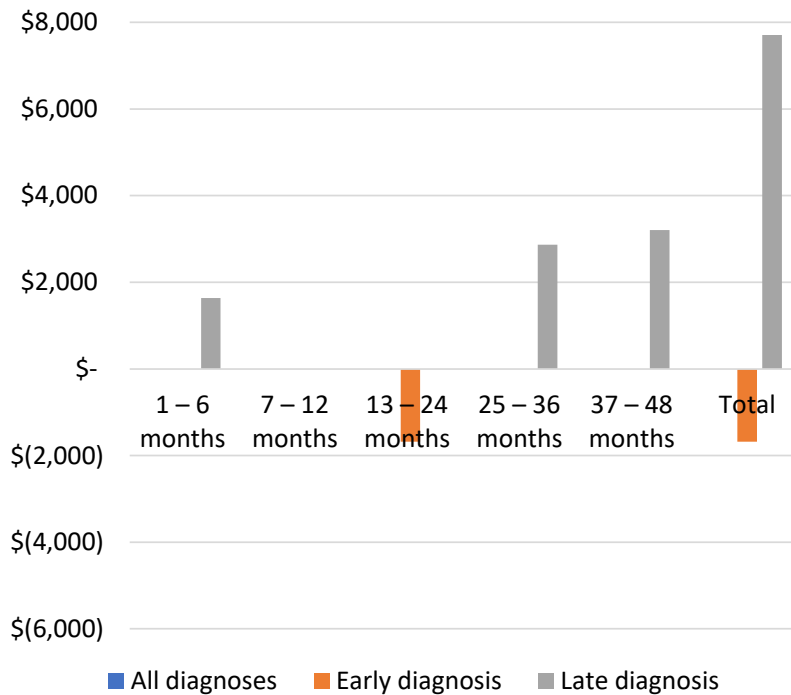
Source: NZIER

4.3.4 Lost employment earnings – by age group

Because most men diagnosed with prostate cancer are diagnosed at an older age, in our study, even with an age cut-off of 64 years, a large proportion of men were in the 60-64 age group. So our age-related subgroups were 'younger men', aged under 60 at the time of diagnosis, to 'older men', aged 60-64 at the time of diagnosis. Both of these groups' lost earnings were calculated in comparison to their respective matched controls so that to the extent that older men may generally expect to reduce their working hours as they move through their mid-sixties, this effect is controlled for. Any remaining impact on older men's earnings is more likely to be related to prostate cancer.

Lost employment earnings – by age group, unconditional on employment

In our analysis of earnings unconditional on employment (including any months with a zero income) and splitting the overall group into the two age-related subgroups, 60-64 years and 40-59 years, we found that:

- on average, younger men with a prostate cancer diagnosis experienced no statistically significant reduced earnings post-diagnosis compared with matched controls

- younger men with an early diagnosis of prostate cancer experienced no statistically significant loss of income at any stage compared with their matched controls

- younger men with a late prostate cancer diagnosis experienced reduced earnings in the first six months post-diagnosis compared with their matched controls.

The results are shown in Figure 18 below.

Figure 18 Percentage reduction in earnings – younger men, unconditional on employment
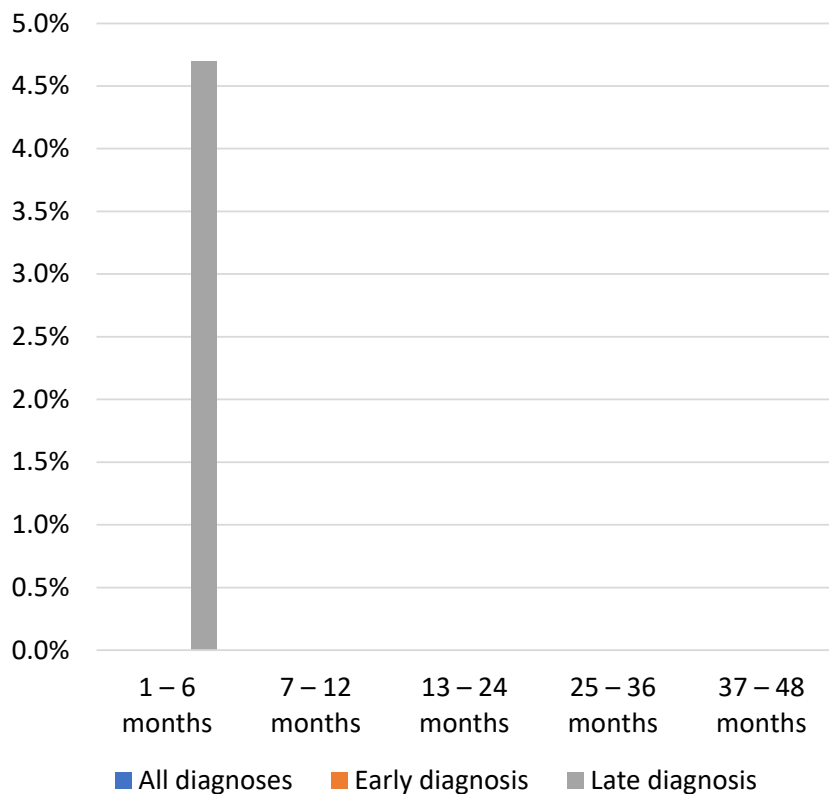
Source: NZIER

Older men in our study – those aged 60-64 at the time of diagnosis – experienced similar short-term earnings losses to the younger men in the short term but saw earnings losses increase over time:

- older men with either a late diagnosis or an early diagnosis lost up to 4.3 percent of earnings in the first 12 months after diagnosis compared with matched controls

- earnings losses grew to 10 percent in the third-year post-diagnosis for older men with a later diagnosis

- earnings losses in the fourth year post-diagnosis were greatest for older men with a later diagnosis (14 percent) but also significant for older men with an early diagnosis (11 percent).

These results are shown in Figure 19 below.

Figure 19 Percentage reduction in earnings – older men, unconditional on employment
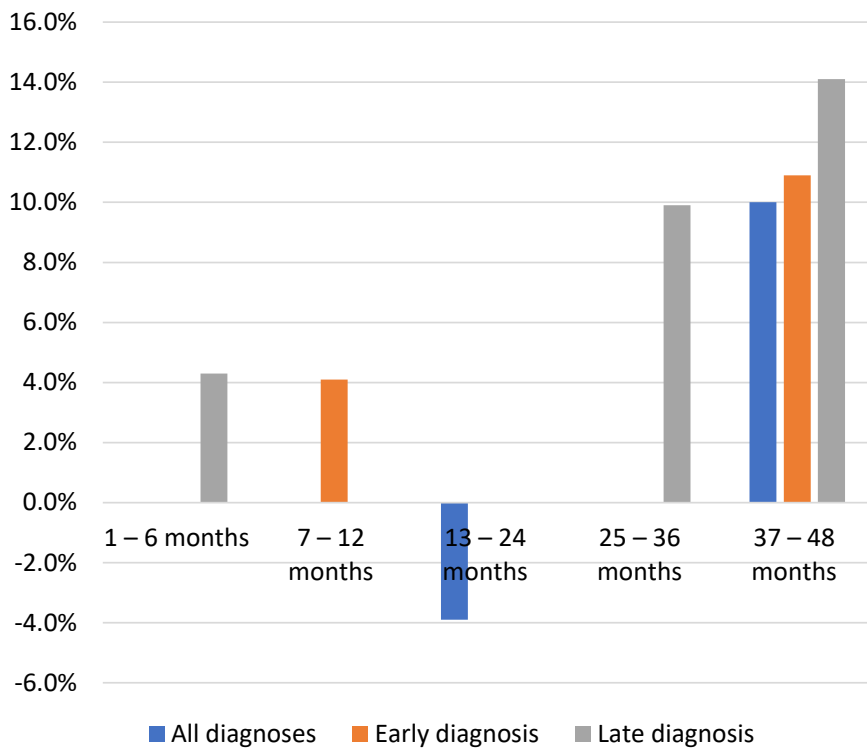

Source: NZIER

To better understand the value of these lost earnings, we calculated the dollar amount based on the average monthly earnings of men in our study. These figures indicate that over the four years post-diagnosis:

- younger men experience no loss of earnings compared with matched controls at any point in the four years following diagnosis if their diagnosis was early

- younger men experience less than $2,000 in lost earnings compared with matched controls in the first six months post-diagnosis if their diagnosis was later.

These results are shown in Figure 20 below.

Figure 20 Value of lost earnings – younger men, unconditional on employment
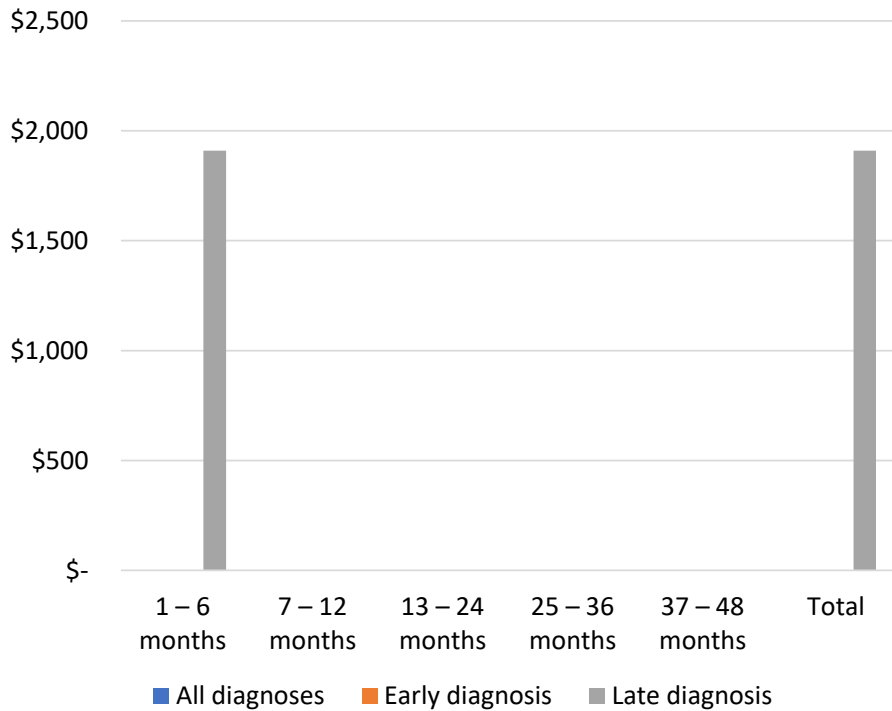
Source: NZIER

In contrast, calculating the value of lost earnings reveals significant costs to older men (those aged 60 to 64) at the time of diagnosis. These results include:

- early earnings losses (in the first two years post-diagnosis are small (approximately $1,500 per six-month period) and apply equally to early and late diagnoses compared with their respective matched controls

- for older men with a later diagnosis, earnings losses become more significant in the third year post-diagnosis, climbing to over $6,000 in year 3 and over $8,000 in year 4 compared with matched controls

- older men with an early diagnosis also lose more earnings compared with their matched controls in the fourth-year post-diagnosis

- in total, older men with a later diagnosis miss out on over $16,000 in employment earnings compared with their matched controls, while for those with an earlier diagnosis, the total loss is just over $8,000.

These results are shown in Figure 21 below.

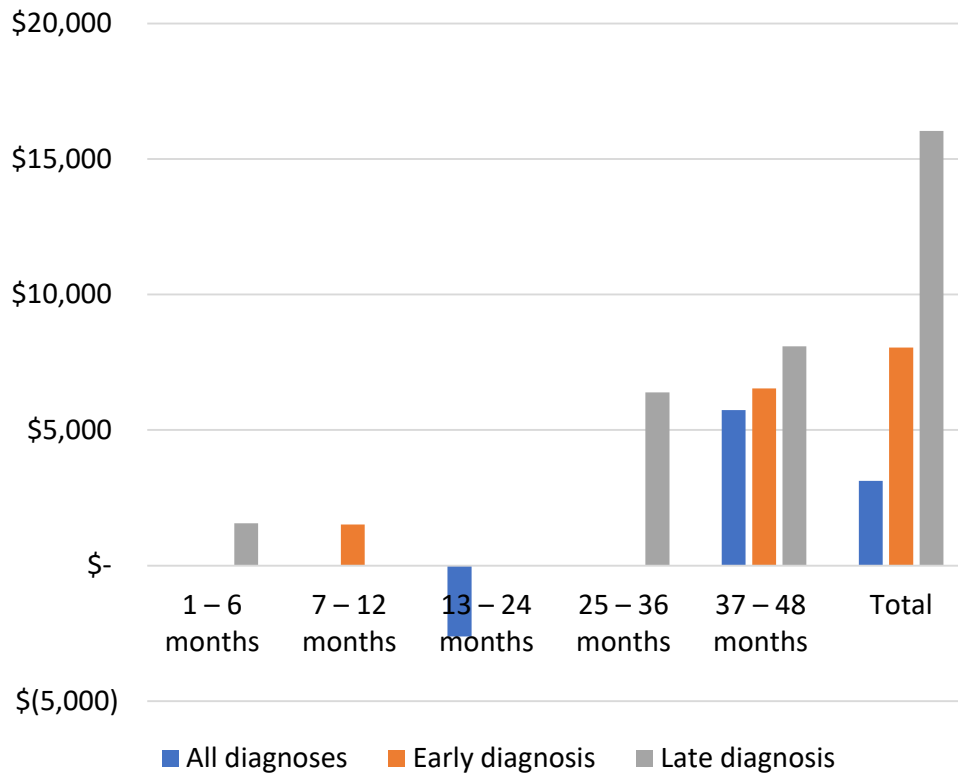**Figure 21 Value of lost earnings – older men, unconditional on employment**

Source: NZIER

## Lost employment earnings – by age group, conditional on employment

In our analysis of earnings conditional on employment (discarding any months with a zero income to consider only losses in the months when some employment income was recorded) and splitting the overall group into the two age-related subgroups, 60-64 years and 40-59 years, we found that:

- on average, younger men with a prostate cancer diagnosis experienced 4 percent lost conditional earnings in the first six months post-diagnosis compared with matched controls, with these losses dropping to just over three percent in the third year post-diagnosis

- younger men with an early diagnosis of prostate cancer experienced no statistically significant loss of conditional earnings at any stage compared with their matched controls

- younger men with a later prostate cancer diagnosis experienced 6.3 percent reduced conditional earnings in the first six months post-diagnosis compared with their matched controls, dropping to 4.8 percent loss in the third year post-diagnosis.

These results are shown in Figure 22 below.

Figure 22 Percentage reduction in earnings – younger men, conditional on employment
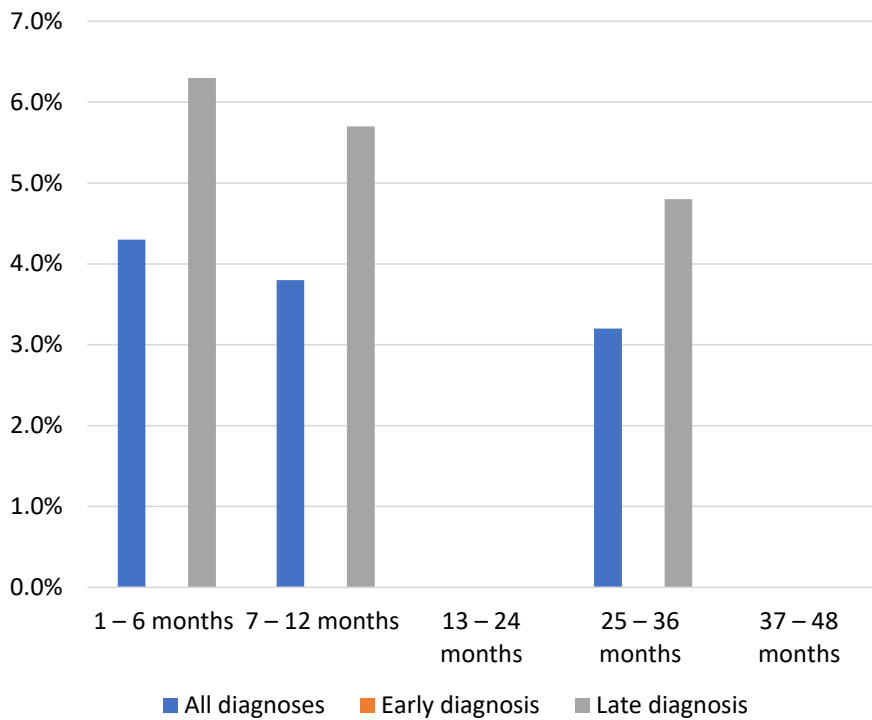
Source: NZIER

Older men in our study – those aged 60-64 at the time of diagnosis – experienced similar short-term conditional earnings losses to the younger men in the short term but saw earnings losses increase over time:

• older men with an early diagnosis experienced no statistically significant earnings losses compared with matched controls

• older men with a late diagnosis experienced 5 percent earnings loss compared with matched controls in the first six months post-diagnosis, increasing to 7 percent for the period 6 to 12 months post-diagnosis, and ongoing losses of 6 to 7 percent persisting into the third and fourth years post-diagnosis

These results are shown in Figure 23 below.

Figure 23 Percentage reduction in earnings – older men, conditional on employment
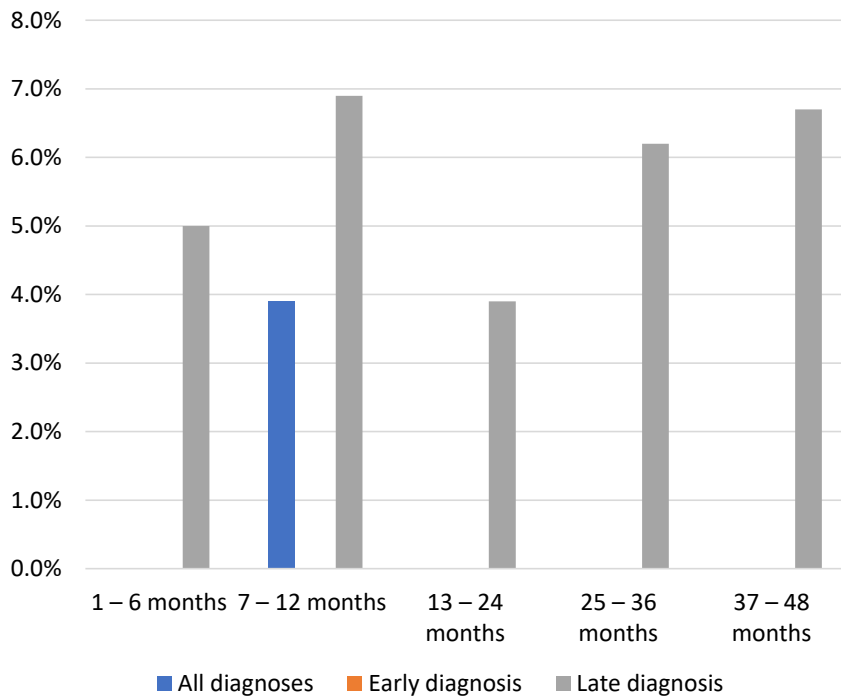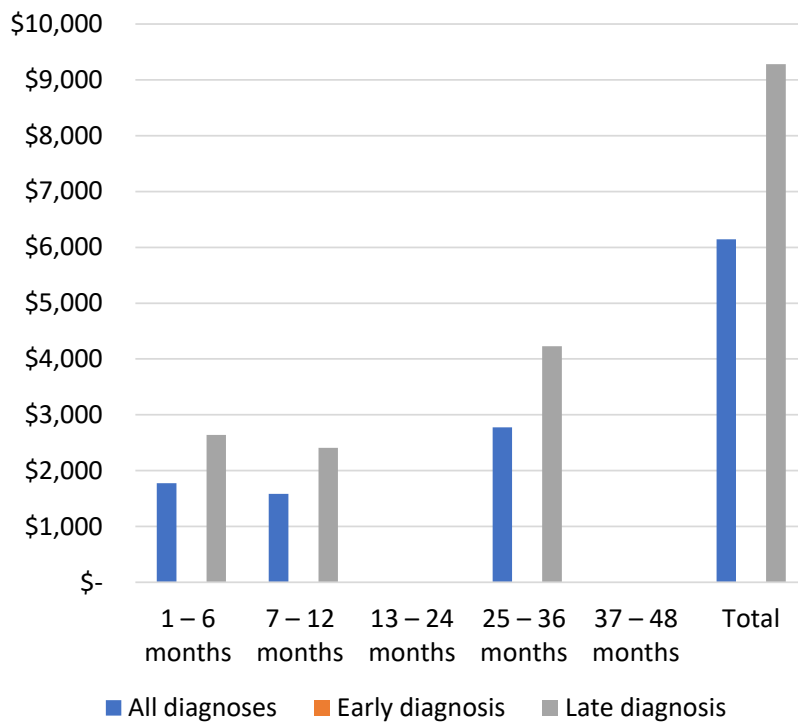

Source: NZIER

To better understand the value of these lost earnings, we calculated the dollar amount based on the average monthly earnings of men in our study. These figures indicate that over the four years post-diagnosis:

- on average, younger men with a prostate cancer diagnosis experience losses of conditional earnings of between $1,000 and $2,000 in each six-month period in the first 12 months post-diagnosis compared with matched controls, rising to over $4,000 in the third year post-diagnosis, for a total of just over $6,000

- younger men with an early diagnosis experience no statistically significant loss of conditional earnings compared with matched controls

- younger men with a later diagnosis experience losses of conditional earnings of between $2,000 and $3,000 in each six-month period in the first 12 months post-diagnosis compared with matched controls, rising to over $6,000 in the third year post-diagnosis, for a total of just over $9,000.

These results are shown in Figure 24 below.

Figure 24 Value of lost earnings – younger men, conditional on employment

Source: NZIER

Calculation of the value of lost conditional earnings for older men reveal significant costs to older men (those aged 60 to 64) at the time of diagnosis. These results include:

- older men, on average, experience a small conditional earnings loss (approximately $1,500) only in the period 7-12 months post diagnosis compared to matched controls

- older men with an early diagnosis experience no statistically significant less in conditional earnings compared with matched controls

- older men with a later diagnosis lose an increasing amount of conditional earnings over time, from just under $2,000 in the first six months, rising in every period to reach over $5,000 in the fourth year post-diagnosis, for a total of nearly $18,000 in lost conditional earnings compared with matched controls.

These results are shown in Figure 25 below.

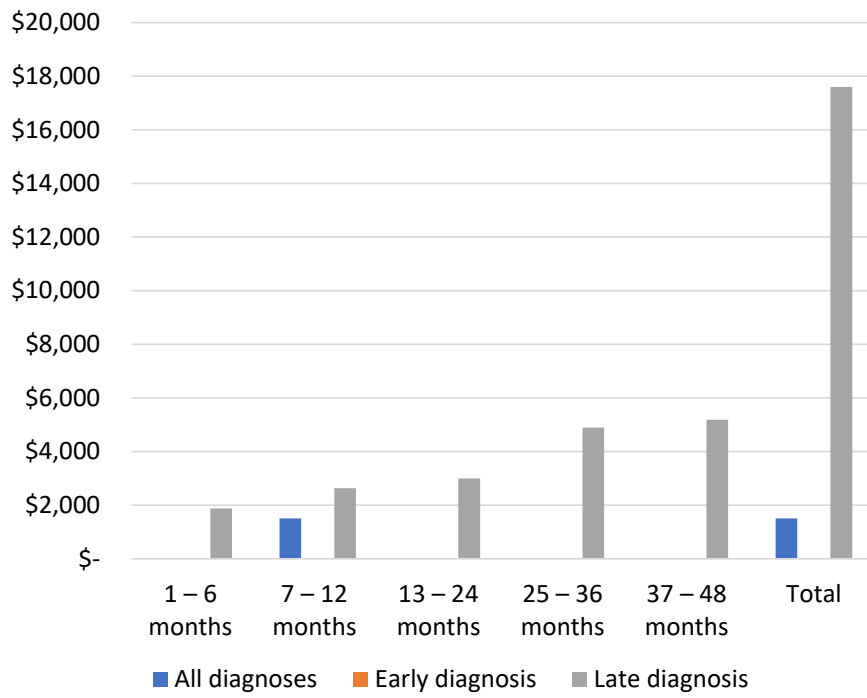**Figure 25 Value of lost earnings – older men, conditional on employment**

Source: NZIER

5 Conclusions and recommendations

Our IDI research into the private economic impacts of late versus early prostate cancer diagnosis revealed that there have been previously hidden costs to New Zealand's disorganised approach to prostate cancer detection. While the impact of poor health on personal incomes and employment is well recognised, our research indicates that men whose prostate cancer is not detected early experience more significant negative private economic impacts – up to $12,000 on average and up to $18,000 for men aged 60 to 64.

Early diagnosis of prostate cancer is an equity issue

Our analysis of IDI data confirmed previously published claims that low socioeconomic status is correlated with later diagnosis. In our study sample, mean living in areas with a high level of deprivation (NZDep18 level 9 or 10) were significantly more likely to have a later diagnosis.

While many equity issues were difficult to describe, particularly any relating to Pacific men, for whom the study sample proved to be too small to provide reliable results, there were several statistically significant results indicating previously unknown inequities:

- Māori men with a later prostate cancer diagnosis experience a significant loss of employment earnings in the 48 months following diagnosis.

- Māori men with a later prostate cancer diagnosis experience a reduction in employment while Māori men with an early diagnosis do not, and non-Māori, non-Pacific men with either early or late diagnosis experience no such impact.

- Likely related to the above result, Māori men with a later prostate cancer diagnosis experience an increase in welfare dependency while Māori men with an early diagnosis do not and non-Māori, non-Pacific men with either early or late diagnosis experience no such impact.

The possible reasons for the impacts of later diagnosis on employment status and welfare dependency for Māori men include:

- Increased participation in physical work amongst Māori men and the difficulty of maintaining this through the effects of more advanced cancer and the treatment of more advanced cancer.

- Reduced willingness of employers of Māori men to accommodate a change in needs, such as different types of work, more flexible work hours, or a greater need for toilets on building sites, etc.

- Living further away from cancer treatment centres resulting in a greater difficulty maintaining employment when frequent absences from work to attend medical appointments and treatments.

Previous research with Māori men with prostate cancer indicates that the ability to continue working and financially supporting whānau is important to Māori men, so these impacts should be interpreted as evidence of greater challenges facing Māori men's ability to maintain the same level of employment, and not as a choice that Māori men make for cultural or other reasons. Māori men who experience a reduced ability to financially support their whānau or an increased dependency on social welfare are likely to also experience increased institutional racism from social and health services.

Decision-making should reflect societal costs and benefits

While governments and health sector decision-makers do, in principle, attempt to base health sector funding decisions on societal costs and benefits, the reality is that many costs and benefits outside the public health system remain hidden until research brings them to light. But now that these previously hidden costs have been revealed, it is essential that future decisions about the funding of prostate cancer detection, diagnosis and treatment take these into account to ensure the system delivers the best value for money. The private impacts, productivity impacts on the New Zealand economy, social welfare costs and lost tax revenue, as well as equity dimensions, have important implications for the balance of costs and benefits of interventions to improve early detection.

Because our research has demonstrated that there can be significant private costs associated with later diagnosis, the implication is that earlier diagnosis is more cost-effective than previously thought. This means decisions on early detection and diagnosis are likely to require reconsideration.

The health and disability sector reforms are intended to place the person and whānau at the centre

A person is more than a patient. As such, decisions that impact a person's life – beyond morbidity and mortality – should consider those broader impacts. Employment and earnings are important to New Zealand men, their families, and whānau.

Beyond the high-level decisions about screening programmes and service funding, even the everyday interactions between clinicians and patients must expand to properly consider the non-health impacts of decisions. This is important because PSA testing, which remains a man's best chance at an early diagnosis, currently depends on individual clinicians advising their patients – or choosing to remain silent on the issue, as the case may be. It is critical that all men be offered the choice and advised about the implications of their choice so they can consider it within the context of their own personal and family or whānau circumstances.

We recommend

In light of our findings, we recommend that:

- The Ministry of Health, Te Whatu Ora and Te Aka Whai Ora undertake to explore the new evidence on costs and benefits of prostate cancer screening in New Zealand, from a societal rather than health system perspective, with a view to improving men's access to early detection.

- The Ministry of Health fund further research to better understand the other hidden costs of prostate cancer, and later prostate cancer diagnosis in particular. Another major area of hidden costs is the use of private cancer treatment services.

- The Ministry of Health fund further research to better understand the impacts of late prostate cancer diagnosis on men's families and whānau, in particular how the financial impacts of late diagnosis impact on family stress, material hardship, and housing security, including for Māori for whom these impacts may be more significant.

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