



Health and Wealth

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Access to the data used in this study was provided by Statistics New Zealand in a secure environment designed to give effect to the confidentiality provisions of the Statistics Act 1975. The analysis in this paper is based on data from the Survey of Family, Income and Employment (SoFIE). Statistics New Zealand has initiated a systems review for SoFIE. Therefore data contained in this paper could be subject to change. However, any errors in the analysis are those of the author, not Statistics New Zealand.

Abstract

This paper analyses the relationship between net wealth and health using Waves 1 to 3 of the Survey of Family, Income and Employment (SoFIE). The results show that lower net wealth is associated with worse health over a range of differing measures of health. The paper acknowledges but does not attempt to resolve the complex issue of causality; does health cause wealth or vice versa?

Physical and mental wellbeing were both found to be positively associated with net wealth. These measures of wellbeing were decomposed by the occurrence of a health failure, defined as an injury or illness lasting more than one week. The results led to further inspection of the characteristics associated with health failures. This revealed that those who experienced a health failure had, on average, less wealth and worse self-rated health than those who did not.

The progressive nature of poor health and lower net wealth was reinforced by considering self-rated health. There was a clear negative relationship between poor self-rated health and lower net wealth over the five categories of self-rated health.

A series of chronic health conditions were also examined. The presence of these conditions was associated with lower net wealth though certain conditions were not always significant. Other than the presence of depression or schizophrenia, each chronic condition was decomposed by age of diagnosis revealing that asthma is more significant in the short term. For conditions other than asthma the coefficients were not significantly different.

The analysis of wealth excluded those with zero or negative values for their wealth. To provide a more complete picture, the probability of having zero or negative net wealth was modelled. This revealed that individuals reporting poorer health were more likely to have non-positive net wealth.

This study has relied on cross-sectional data from SoFIE. Once the full eight years of longitudinal data become available, a richer analysis of the impact of changes in health status over time on assets, liabilities and net wealth will be possible.

JEL CLASSIFICATION D31: Personal income and wealth distribution
I10: Health

KEYWORDS Health; Wealth; New Zealand; Self-reported health measures;
Chronic illness

Table of Contents

Abstract	i
1 Introduction	1
2 Previous studies	2
3 The Survey of Family, Income and Employment	3
3.1 Population of Interest	4
3.2 Measures of wealth	4
3.3 Measures of health	6
3.4 Strengths and limitations	10
4 Models	11
4.1 The core models	11
4.2 The logistic models	14
4.3 Modelling health	15
5 Results from core models	17
5.1 The health surveys	18
5.2 Self-rated health	21
5.3 The chronic conditions	23
5.4 Assets and liabilities	26
6 Results from logistic models	27
6.1 The likelihood of negative or zero net wealth	27
6.2 The likelihood of having liabilities	29
7 Conclusions	32
References	34
Appendix A	36
Appendix B	41
Appendix C	48

List of Tables

Table 1 – Net wealth percentiles	5
Table 2 – Proportion of longitudinal population with negative net wealth	6
Table 3 – Division of SF36 and K10 measures into categories of physical discomfort and psychological distress	8
Table 4 – Comparison of actual values to those predicted by core model two.....	13
Table 5 – Comparison of multinomial model to actual occurrences – testing independence of chronic conditions	16
Table 6 – The marginal effects of physical discomfort and psychological distress on wealth	18
Table 7 – The marginal effects of physical discomfort and psychological distress on wealth – decomposed by health failure	20
Table 8 – Means and medians of net wealth by self-rated health.....	21
Table 9 – The marginal effects of self-rated health	22
Table 10 – Marginal effects of health measures on net wealth, total assets and total liabilities.....	27
Table 11 – The association between health and the likelihood of non-positive net wealth	29
Table 12 – The association between health and the likelihood of having liabilities	31

List of Figures

Figure 1 – Distributions of K10 and physical functioning scores.....	9
Figure 2 – Comparison of actual to predicted net wealth – core model two	13
Figure 3 – Levels of estimated net wealth by physical discomfort and psychological distress.....	19
Figure 4 – Levels of estimated net wealth by self-rated health	22
Figure 5 – The estimated negative marginal effects of chronic conditions on wealth.....	23
Figure 6 – The estimated negative marginal effects of chronic conditions on wealth – weighted by prevalence	24
Figure 7 – The estimated negative marginal effects of chronic conditions on wealth – by timing of diagnosis – core model one	25

Health and Wealth

1 Introduction

The central question addressed by this paper is: To what extent can variations in net wealth among the New Zealand population, aged 15 years and older, be explained by differences in health status? There has been little study of the association between health and wealth in New Zealand, although strong links between the two have been found overseas.

Wealth can be an indicator of both economic success and of financial security. The opportunity to accumulate wealth will depend, in part, on an individual's participation in the labour force and their productivity, factors which in turn may well be governed by their health status. Accumulated wealth represents an individual's ability to consume if they are unemployed or out of the workforce and personal wealth can be invested to generate income. As the New Zealand population ages, an increasing proportion of the population will be retired and will be drawing on their accumulated wealth for consumption. Imperfect health may lead to less time spent in the workforce and higher health costs.

Health is of interest in New Zealand as the Government allocates about 20% of each year's budget to the provision of public health (Bryant, Teasdale, Tobias, Cheung and McHugh, 2004). In making funding decisions the Government decides how much of the cost of health care should be borne by the public and how much by the consumers of health care. If imperfect health has negative effects on a person's ability to accumulate wealth then finding ways to address this will improve the overall wellbeing of the New Zealand population.

The analysis reported in this paper is based on unit record data from a household survey. Regression models were estimated for net wealth as a function of health and other variables. Poor health may have negative effects on an individual's rate of wealth accumulation, while lower levels of wealth may have negative health implications. Establishing causality was not possible with the available data. The focus is on modelling the association between health and wealth without considering causality. This paper also does not consider the effects of changes in policy on health or wealth.

Health status and wealth both develop gradually over the life cycle. Furthermore, they can both also change rapidly in response to events. However, these sudden events are likely to be correlated with long-run developments: for example, people with more human capital are less likely to be hit with unemployment shocks to wealth; people with a lifetime of poor lifestyle are more likely to experience an adverse health shock, and to have less wealth. This underscores the fact that health and wealth are both jointly determined and evolve over time. Ideally, one needs longitudinal data to adequately capture the dynamic interrelationships. Furthermore, identifying the direction of causality between wealth and health is a complex challenge, and an issue far from resolved in the literature. This paper relies on exploring associations without pretending to establish causality.

This study relies on cross-sectional data and as such does not attempt to explore the long-run evolution and interrelation between health and wealth. To the extent that the study identifies an association between health and wealth from the cross-sectional data, it is recognised that this is merely a snapshot of a process that evolves over the life cycle. One can envisage that some people will place greater emphasis on the future (ie, have lower discount rates) and as a result invest more in both their human and non-human wealth, resulting in jointly determined higher levels of health and wealth.

This paper is set out as follows: Section 2 reviews work already done in similar areas. Section 3 explains the data and Section 4 sets out the models used in this paper. The main results can be found in Section 5, with supporting results in Section 6. Section 7 concludes. An extensive set of results is presented in the appendices.

2 Previous studies

Net wealth is defined as accumulated savings and asset income, plus inheritance less gifts. Individuals use their income for consumption, for savings and to improve the value of their assets. Wealth is invested to earn a return that compensates the owner for their forgone consumption (Headey, Marks and Wooden, 2005). Life cycle theory suggests wealth will increase over the course of a person's working life because of savings and investment income and will decrease after retirement as they draw down accumulated wealth to sustain consumption.

The longitudinal importance of income and age on net wealth were both identified in Australia using the Household Income and Labour Dynamics in Australia (HILDA) survey. Although wealth and income were well correlated during certain parts of the life cycle, there was an overall low correlation between wealth and income. Once people had accumulated sufficient wealth they could retire early. This was most notable amongst the self-employed (Creedy and Tan, 2007).

Headey and Wooden (2004) defined wellbeing using four different measures: personal utility and satisfaction, mental ill being, financial stress and financial security. HILDA data showed that greater financial stress and lower financial security both corresponded to progressively lower levels of net wealth and lower levels of income. Personal utility and mental ill being were both more significantly correlated with wealth than with income.

Health data from SoFIE has been used to consider labour force participation, with poor health associated with a decrease in the likelihood of labour force participation. Part-time employment is also affected, though to a reduced degree, suggesting that poorer health not only reduces the likelihood of participation but also the number of hours worked by those still participating (Holt, 2010). Both these effects will reduce an individual's income and are expected to decrease their rate of wealth accumulation.

Holt (2010) considered the possibility of "rationalisation endogeneity" biasing the relationship between self-rated health and labour force participation (ie, that a respondent who reports they are not in the labour force may be inclined to rate their health worse than it is to justify their non-participation).

Self-rated health has been shown to deteriorate faster for individuals employed in particular industries, most notably those involving manual work (Case, and Deaton 2003). Differences in self-rated health across the income distribution appear to be owing to the loss of income from health-related absence from the labour force.

Case (2001) also considered the effect of large increases in wealth owing to the introduction of pensions for black South Africans.¹ Owing to law and superannuation changes after the ending of apartheid, many black South Africans now receive superannuation income that is more than double the median income for black South Africans. When retirees live in a household where income is pooled, receiving superannuation appears to result in better health for the entire household. When retirees live in a household where income is not pooled, receiving superannuation was only associated with an improvement in the retiree's health.

While a relationship between health and wealth or health and income can often be detected, the direction of the association is ambiguous. One approach used in the literature to address this problem is through the use of instrumental variables. This technique requires identifying a variable that is associated with net wealth but not correlated with health status. Typically it has not proven easy to identify such a variable.

Meer, Miller and Rosen (2003) proposed the use of inheritance as an instrumental variable. Of 3,302 individuals, observed over two consecutive five-year periods, there were 297 recorded inheritance receipts worth more than \$10,000 (this is 4.5% of the observed person time periods). While a strong link between health and wealth was found before the introduction of inheritance, the instrumental variables approach resulted in the wealth coefficients no longer being statistically significant. It was concluded that the relationship between health and wealth was not driven by short-term changes in wealth.

Health has been identified as being associated with the composition and not just the level of assets held. Poor health was shown to be associated with a decrease in the likelihood of having less stable assets and an increase in the proportion of total assets held as "safe assets". This relationship persisted even when respondents' attitudes to risk, time horizon, bequest motives and health insurance were considered. Proof of causality was not established but was discussed. The hypothesis that investment choices might determine health status was not supported (Wu and Rosen, 2003).

3 The Survey of Family, Income and Employment

The data for this study comes from the Survey of Family, Income and Employment (SoFIE) conducted by Statistics New Zealand. SoFIE is a national longitudinal survey that commenced in 2002 and will continue until 2010.² The target population for SoFIE is the usually resident population of New Zealand, aged 15 years and older, who are living in private dwellings.

Approximately 11,500 households agreed to be interviewed, with data collected from 22,000 individuals aged 15 and over. All individuals who were interviewed in Wave 1 are Original Sample Members (OSMs). Their children under the age of 15 will be interviewed in subsequent waves once they have had their 15th birthday and will also be considered OSMs. Each year all OSMs and anyone else, aged over 15, living with them are interviewed.

¹ A stream of pension payments can be interpreted as an equivalent addition to net wealth to the extent that it is assured. For a discussion of the treatment of pension annuities as wealth in the New Zealand context, see Scobie, Gibson and Le (2005).

² Full details of the sampling design for SoFIE can be found here: <http://www2.stats.govt.nz/domino/external/pasfull/pasfull.nsf/84bf91b1a7b5d7204c256809000460a4/4c2567ef00247c6acc256fab0082e7fc?OpenDocument>. See also Carter, Cronin, Blakely, Hayward and Richardson (2009b).

Each wave of SoFIE asks about family and personal characteristics, income, education and labour force participation. Waves 2, 4, 6 and 8 contain a module of detailed wealth questions. Waves 3, 5 and 7 contain a module of detailed health questions³. This study was undertaken between the releases of Waves 3 and 4.

3.1 Population of Interest

The population of interest for this study is restricted by data availability. This population is represented by OSMs aged 17 and over in Wave 3 who answered Waves 1, 2 and 3. This sample represents 2.88 million individuals.

Statistics New Zealand provided longitudinal weights for the OSMs that adjusted for non-response and ensured that the SoFIE data matched estimates for age, sex and ethnicity of the New Zealand population as at October 2002. Longitudinal sample weights continue to be assigned for all OSMs, including those who do not respond in subsequent waves.

Although SoFIE was designed to be a random sample of the target population, non-response, subsequent attrition and non-response to particular questions have reduced its representativeness. The response rate for the first wave of SoFIE was 77% while 80% of the OSMs remained in the sample at Wave 3. A small number who responded to SoFIE did not respond to the detailed health and/or wealth modules. Because these respondents were assigned weights, they contribute to estimates of population totals. As a result, the population represented by the sample used in the analysis is reduced by the number of individuals represented by these respondents. However, the use of weights is not guaranteed to eliminate non-response bias. The base sample for the regressions reported in this paper consists of 17,043 respondents, representative of 2.78 million individuals.⁴ For the remainder of the analysis, this population will be referred to as the “longitudinal population”.

In order for non-response (owing to initial non-response, attrition and non-response to specific questions) to not bias the estimates of the relationship between health and wealth, it would need to be random with respect to health and wealth. However it is not possible to test this assumption with the available data. Ideally, results from this analysis will be representative of New Zealanders who were within the target population of the survey in 2002, and were still in the target population for Wave 3.

3.2 Measures of wealth

In Wave 2, respondents are asked to provide the values of their assets and liabilities. This includes property, mortgages, superannuation (other than New Zealand Superannuation), life insurance, trust funds, financial funds, bank assets, bank liabilities, personal loans, student loans, durables, cash, business value, hire-purchase, credit card and overdraft debt. Two non-specific categories were provided for miscellaneous assets and liabilities. These were aggregated into total assets and total liabilities, with net wealth defined as the difference.

Henderson and Scobie (2009) noted that the SoFIE data underestimates the levels of assets and liabilities when compared to data from the Reserve Bank of New Zealand. While there are elements that differ between the two, these are unlikely to explain the difference. SoFIE was not compared to the Reserve Bank of New Zealand data during the course of this study.

³ This module was developed by the University of Otago (Wellington) under funding from the Health Research Council of New Zealand.

⁴ Note that item non-responses required up to 710 observations to be excluded from certain regressions.

3.2.1 Net wealth

We consider net wealth, the dependent variable, as a function of health variables and control variables. Table 1 gives percentiles for net wealth. While net wealth has a wide range, a significant proportion of total wealth is held by the wealthiest individuals. The range between the 95th and 99.9th percentiles is of greater magnitude than that between the 5th and 95th percentiles.⁵

Table 1 – Net wealth percentiles

Percentiles	5%	10%	25%	Median	75%	90%	95%
Net wealth	750	3,000	17,730	79,350	195,000	377,950	599,120

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Taking natural logarithms of net wealth scaled down the large positive outliers. This produced a bell shaped curve with similar sized tails on both sides of the distribution. Regression models using the logarithm of net wealth as the dependent variable gave a significant improvement in goodness-of-fit relative to using actual net wealth.

Under New Zealand Superannuation (NZS), New Zealand citizens and permanent residents receive superannuation payments from the Government if they are aged 65 years or older until the time of their death. The expected future cash flows from NZS represent a significant asset to the majority of the population.⁶ The present value of future NZS payments was not included in the measure of total assets for this study. As the value to an individual depends on life expectancy, its inclusion would have necessitated allowing for the effect of an individual's health status on life expectancy. This was not attempted.

The term “wealth” in this paper refers to net wealth (assets less liabilities). So individuals with high levels of total assets, who appear to be “wealthy”, but who have high levels of total liabilities are not necessarily considered wealthy for the purposes of this report.

3.2.2 Student loans and negative net wealth

Approximately 6.5% of the longitudinal population were estimated to have total liabilities in excess of their total assets. Liabilities are often insured against a corresponding asset of equal or greater value. However, our measures of assets and liabilities consider only tangible assets and liabilities.

Many tertiary students receive student loans to fund their education. A student loan enables a person to borrow against their future earnings. Economic theory suggests that education increases a student's human capital and, because of this, their future earnings. Following the work of Henderson and Scobie (2009), the liability of a student loan was exactly offset by the conservative assumption that there would be a human capital asset of at least equal value.

⁵ The top 0.1% of the population has wealth in excess of \$5 million. The bottom 0.1% has wealth more negative than -\$160,000.

⁶ Inclusion of NZS as an asset would more than double the wealth of half the population (Scobie et al, 2005).

Table 2 summarises the percentage of the longitudinal population with negative net wealth. Only 2.5% of the longitudinal population were still estimated to have negative net wealth after the inclusion of an offsetting human capital asset.

Table 2 – Proportion of longitudinal population with negative net wealth

	Weighted total	%
Negative net wealth before any adjustments	182,300	6.5%
After adjusting for student loans		
Still negative wealth	69,900	2.5%
Changed from negative to positive wealth	112,400	4.0%

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

The assumption that investment in education creates an asset of equal value to student loans is in fact extremely conservative. In general, an individual undertaking study would expect the present value of their future earnings to increase by more than the cost of their study. Furthermore, although every individual in the population will possess human capital of some measure, we only include a human capital asset for those individuals with student loans.

When decomposing net wealth into assets and liabilities the human capital asset was included as a negative liability rather than as an asset. So human capital is not included in total assets but instead offsets student loans in the measure of total liabilities.

3.3 Measures of health

Several measures of health from the SoFIE data were used in order to provide a broader picture of the association between health and wealth. Health measures with a wider focus tend to be more subjective than measures with a narrower focus.

Each wave contains a single question asking respondents how they rate their health (this is referred to as self-rated health). In Wave 3 a more detailed module of health questions is asked. This includes several internationally recognised health surveys: the Short Form Health Survey (SF36) and the Kessler 10-item scale (K10) were both used. Respondents were also asked about the presence of eight chronic conditions.

Self-rated health is the most widely answered measure of wellbeing available with less than 0.1% of respondents failing to rate their own health. For the SF36 and K10 questionnaires 1.4% of respondents did not provide responses, and up to 0.7% of respondents did not provide answers to the questions on chronic conditions.

3.3.1 Short Form Health Survey (SF36)

The SF36 is a health questionnaire consisting of 36 questions that can be split into eight measures of health. Four of these measures relate to physical health and four relate to mental health. Physical and mental health summary variables are calculated from the health measures.

The SF36 has been tested and found reliable for use in New Zealand (Scott, Sarfati, Tobias and Haslett, 1999), but its validity for Māori or Pacific Island populations was later questioned as they do not view mental and physical health to be as separable as the survey assumes (Scott et al, 2000).⁷

⁷ 9.8% of the longitudinal population are Māori and 4% of the longitudinal population are Pacific Island.

3.3.2 Kessler 10-item scale (K10)

The K10 is a scale measuring non-specific psychological distress. It consists of 10 questions that seek to measure anxiety, depression and negative emotional states a person may have experienced in the four weeks prior to the interview. Items are rated 1 (none of the time) to 5 (all of the time). Scores for the 10 items are summed yielding a total score between 10 and 50 with lower scores signifying better health.

The K10 has been tested and validated in Australia (Andrews and Slade, 2001). It has seen wide use in Australia and around the world and has also been used in mental health surveys in New Zealand (Carter, Hayward and Richardson, 2008).

3.3.3 Choice of health survey regressors

The SF36 and K10 measures of wellbeing are referred to as the health survey measures. These surveys were analysed by the Otago School of Medicine, Wellington, who calculated measures of wellness from the raw responses.

Following the design of other analysis (Headey and Wooden, 2004), physical and mental wellbeing were treated separately. This allows for different types of ill health to have differing effects on net wealth. The physical functioning (PF) component of the SF36 survey was chosen as the preferred measure of physical discomfort. The K10 survey was chosen as the preferred measure of psychological distress.

Each of the measures of physical wellbeing collected in the SF36 survey, including the physical component summary, were considered for use in the model. The PF component was selected because of its goodness-of-fit and the nature of the questions that determine this score. The questions asked about the influence of the respondent's health on their ability to perform a range of common physical activities, including walking distances, climbing stairs, bending, lifting, bathing and dressing. The PF measure is scored from 0, representing significant problems, to 100, representing the absence of problems.

The K10 score was used as the measure of mental wellbeing, as opposed to a measure from the SF36, owing to the low correlation with the physical functioning measure and for its improvement to the goodness-of-fit of the model.⁸

3.3.4 The application of SF36 and K10 regressors

Categorical measures of physical and mental wellbeing were used as the relationship between the log of wealth and wellbeing may not be linear. Responses to each health measure were broken into three categories.

Table 3 gives the bounds on the categories, the percentage of the longitudinal population in each category and the mean and median net wealth in each category.

⁸ Correlation tables can be found at the end of Appendix C, Appendix Tables 29 to 31. Using uncorrelated variables ensures each explains a different part of the variation of the dependent variable and makes variables less likely to become redundant.

Table 3 – Division of SF36 and K10 measures into categories of physical discomfort and psychological distress

	Bounds	%	Mean net wealth \$	Median net wealth \$
Physical discomfort				
Low discomfort	75-100	85.6	172,760	75,000
Moderate discomfort	45-75	9.0	174,630	98,250
High discomfort	0-45	6.5	142,120	98,000
Psychological distress				
Low distress	10-15	79.1	186,720	90,350
Moderate distress	16-21	14.5	124,990	53,050
High distress	22-50	6.4	95,370	34,710

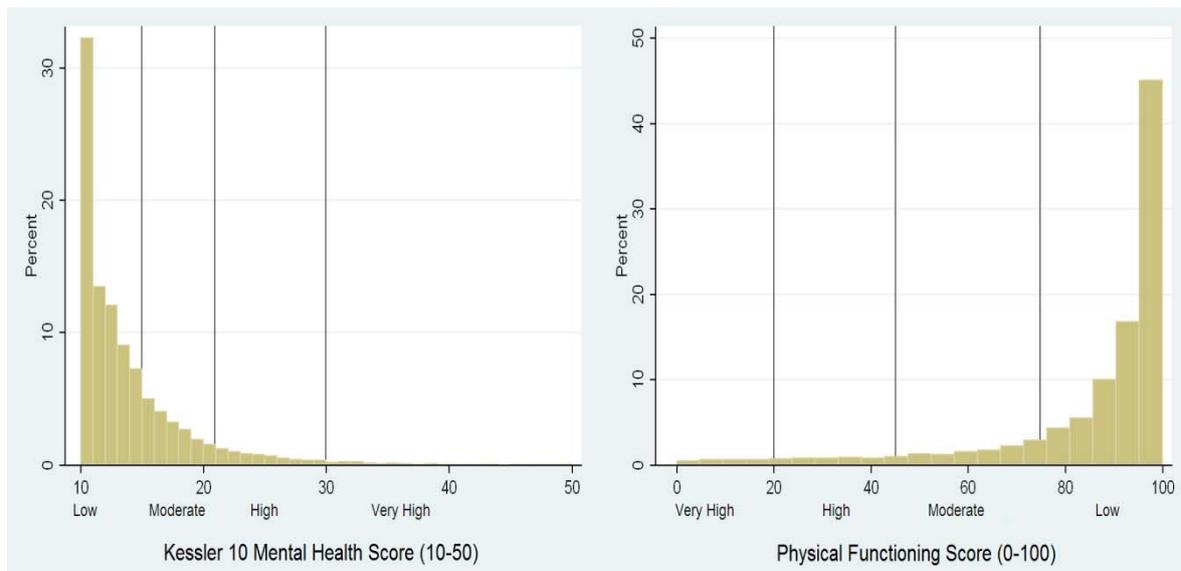
Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Note: These results are not corrected for age, and younger respondents are likely to report low net wealth and better than average health status.

The breakdown of K10 scores into categories follows recommended criteria (Diener, Suh, Lucas and Smith, 1999; Phongsavan, Chey, Bauman and Brooks, 2006). This specifies four categories, breaking the high psychological distress category into high (22-29) and very high (30-50). Individuals with K10 scores greater than 30 are expected to meet the criteria for clinical intervention. The proportion of the longitudinal population with estimated K10 scores in excess of 30 (1.6%) was too small for the regression coefficient to be of use. The high and very high psychological distress categories were therefore merged.

A fourth category was also attempted with the PF score, very high physical discomfort, separating high and very high discomfort at a score of 20. Because this created a category with too few observations to provide a useful estimator the very high and high discomfort categories were merged. Only 2.5% of the longitudinal population were estimated to suffer from very high physical discomfort.

Figure 1 – Distributions of K10 and physical functioning scores



Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Note:

1. The three vertical lines in the body of each plot show the cut-off points between the different categories. The outermost line in each plot shows the cut-off between low and moderate discomfort/distress. The middle line in each plot shows the cut-off between moderate and high discomfort/distress. The inner most line in each plot shows the attempted (but not used) cut-off between high and very high discomfort/distress.

Figure 1 shows the distributions of the PF and K10 descriptors. The divisions between the categories for high, moderate and low discomfort and distress are included to show the approximate proportions for the longitudinal population in each category. The divisions of high discomfort and distress into high and very high have also been provided.

3.3.5 Self-rated health

Respondents were asked in each wave to rate their own health. They had five choices of response: excellent, very good, good, fair and poor. Self-rated health from Wave 2 was used; this is the only measure of health that does not come from Wave 3. This measure is used as it comes from the same wave as the wealth data and because it may include aspects of health not covered by SF36, K10 or the chronic conditions.

Self-rated health was included in the model as a categorical variable. The five possible responses for self-rated health were used as distinct categories. Merging of adjacent categories was considered, but coefficient testing revealed the different self-rated health categories were distinct from each other.

Self-rated health has the potential to be misleading as there may be no standard for responses between individuals. Two respondents with the same level of wellbeing, may rate their own health differently. Headey and Wearing (1992) suggest that people rate their own health in comparison to others of the same gender and age, to their parents and siblings and to their own recent past. If a respondent's perception is affected by non-health-related events then these may also influence their response.

Furthermore, responses may change owing to factors unrelated to ongoing health, such as catching the flu in the last month. The estimated "effect" on wealth may be biased if health is not an exogenous variable (ie, it is endogenous). A variable is endogenous if it is affected by the dependent variable or if there are unobserved variables that affect both

variables. A particular type of endogeneity that is more likely to affect the self-rated health regressions than those based on more objective measures is referred to as “rationalisation bias”.⁹ It is possible that an individual’s wealth influences their current perspective about their health. For example, individuals with low levels of wealth, which may be linked to factors such as being unemployed, may be inclined to understate their health in order to justify their low wealth.

3.3.6 Chronic conditions

As part of the health module in Wave 3, respondents were asked whether they have ever been diagnosed by a doctor with any of the following conditions:

- asthma
- high blood pressure
- high cholesterol
- heart disease
- diabetes
- a stroke
- migraines
- depression or schizophrenia.

These will be referred to as the chronic conditions.

For each condition, other than depression or schizophrenia, the age of diagnosis was asked. This enabled the chronic conditions to be backdated so only respondents who had been diagnosed with a condition by Wave 2 were recorded as suffering from one. Individuals diagnosed with depression or schizophrenia in Wave 3 were assumed to have been suffering from the condition during Wave 2.

No indication of severity of the condition is asked, nor whether the respondent still suffers from the condition (or has suffered from it recently in the case of a stroke). As a consequence, some respondents who report having been diagnosed with a condition may no longer be affected by it. The chronic condition indicators may therefore not be an accurate indication of the presence of negative health effects owing to these conditions. Alternatively, the indicators may be advantageous as they enable the association between past ill health and current wealth to be considered.

3.4 Strengths and limitations

Empirical evidence shows that a significant proportion of a country’s wealth is held by a minority of the population. This means it is easy to under sample these people. The more uneven the distribution of wealth the more likely it is that the very wealthy will be excluded from the sample (Headey and Wooden, 2004). Furthermore, the wealthier members of the population may have greater incentives to withhold information about the size of their assets. Because of this, the very wealthy are unlikely to be well represented by this study.

There is a one-year difference between the collection of the wealth data, in Wave 2, and the health data, in Wave 3. As the age of diagnosis was asked for the chronic conditions these could be backdated to Wave 2. Self-rated health is asked in every wave, but there is no way to backdate the health measures calculated from the SF36 and K10 health surveys.

⁹ The responses to the SF36 and K10 questionnaires also depend on the respondent’s perspective. However, these questionnaires are guided, focused on past behaviour and both have been tested and found appropriate for use in New Zealand.

It is therefore necessary to assume that reported health from the SF36 and K10 surveys does not differ significantly from one year to the next in order to use them as proxies for health in Wave 2. For many respondents, their actual health in Wave 2 is expected to closely match their recorded health in Wave 3. The health module includes a question as to whether the respondent experienced an illness or injury that hindered their normal activities for seven days or more in the 12 months preceding the interview. For respondents who answered “yes” to this question this assumption is potentially less valid.

The SoFIE survey will collect a vast amount of information over the eight-year period, for which it runs, between 2002 and 2010. Additional waves will enable a more systematic study of the changes in wealth and health over time. Despite the fact that the complete longitudinal data set will only cover eight years, this research will be potentially more powerful than the cross-sectional analysis of the present study. Models of savings over time and comparisons between cross-sections will provide further understanding of how health and wealth change over time.

4 Models

The following analysis uses four main models – two linear regression models and two logistic models. Results from the linear regression models can be found in Section 5: Results from core models. Results from the logistic models can be found in Section 6: Results from logistic models.

4.1 The core models

In order to control for variation in wealth not directly associated with variation in health, a series of control variables were used. These were grouped in two linear regression models, referred to as core models one and two. The core models were constructed to be used as a basis from which the measures of health could be considered.

Core model one includes age (and its square root), income, geographic region, ethnicity, highest qualification achieved, housing tenure, deprivation, gender and the composition of the household. These variables were chosen because of their relative independence to each other.

Core model two builds on core model one and also includes variables for whether the respondent was born in New Zealand, the number of years of paid employment, smoking habits, benefit receipt and being a student. The core models have the following form:

For core model one: $\ln(NW) = f(H, Z_1)$

For core model two: $\ln(NW) = f(H, Z_1, Z_2)$

Where:

NW = Net wealth scores

H = The particular health variable being considered

Z_1 = The control variables included in core model one

Z_2 = The new control variables introduced in core model two

All control variables were taken from Wave 2. The variables included in core model two but not in core model one were initially excluded owing to the probable lack of independence between themselves and other control variables. For example, whether the respondent was born in New Zealand was expected to be correlated with ethnicity. Years

of paid employment and whether or not the respondent was a student were expected to be correlated with age.

Where control variables could be expressed in different forms, the significance and clarity of the variable were used to determine which form was included in the models. For completeness, the variables specified above were included in the models even if they were not found to be significant at the 10% level. Full regression tables of the core models can be found in Appendix A.

After modelling net wealth as the dependent variable, total assets and total liabilities were modelled with the same set of control variables. The aim was to identify whether changes in wealth were driven more by changes in assets or changes in liabilities.

Statistics New Zealand requires that all output is censored. All output has been weighted and counts rounded to the nearest hundred. Weighted counts of less than 1,000 are not released. Percentages are calculated after censorship. Both core models were run estimating robust standard errors. Data access was restricted to the Statistics New Zealand Datalab, where analysis was conducted using Stata Version 9.

4.1.1 Interpreting the results

The variables used in this study, including the health variables, are correlated with one another. Isolating these variables gives a simplistic representation of the factors that contribute to net wealth. In particular, we ignore the range of possible interactions between the health variables and the control variables, and interactions of the health variables with each other.

Many of the results from comparing health and wealth are given in terms of marginal effects. In the following discussion the marginal effects are talked about as “effects” on net wealth. It is important to keep in mind that these models do not prove or establish a causal link between the explanatory variables and wealth.

All marginal effects have been calculated at the mean value of the regressors. This means they apply to a theoretical person of mean age, income and number of years of paid employment. For categorical variables this theoretical person matches the weighted sample proportions. For example, because 78.7% of the longitudinal population were born in New Zealand and 21.3% of the longitudinal population were born overseas, the theoretical person uses 78.7% of the coefficient for being born in New Zealand and 21.3% of the coefficient for being born overseas. The means and proportions of the control variables used to calculate the marginal effects were computed from the entire longitudinal population and can be found in Appendix A, Appendix Table 3.

The regression methods used are known as mean regressions. The value of the dependent variable estimated by the regression model when each variable is set at its regression-sample-mean value will be its sample mean. Natural logarithms were used to transform net wealth before analysis. This greatly reduced the effects of outliers on the mean, though the median remained unchanged. As the model estimates the log of net wealth, the model's mean estimate will be the mean of the log of net wealth which, when transformed back, will be below the mean value of net wealth.

There are two age terms in the model: age and the square root of age.¹⁰ For interpretation and application of these models the square root of mean age has been used in the

¹⁰ Despite the use of age and age² being “standard”, preliminary testing suggested that age and $\sqrt{\text{age}}$ was preferable.

calculation of the marginal effects. The estimates therefore apply to someone of mean age.¹¹

4.1.2 Predicted values

Comparison of the observed logarithms of net wealth and those estimated by the models shows the model tends to provide reasonably good estimates for the population. Table 4 gives the percentiles of the logarithm of net wealth and the percentiles of the predicted logarithm of net wealth from core model two.

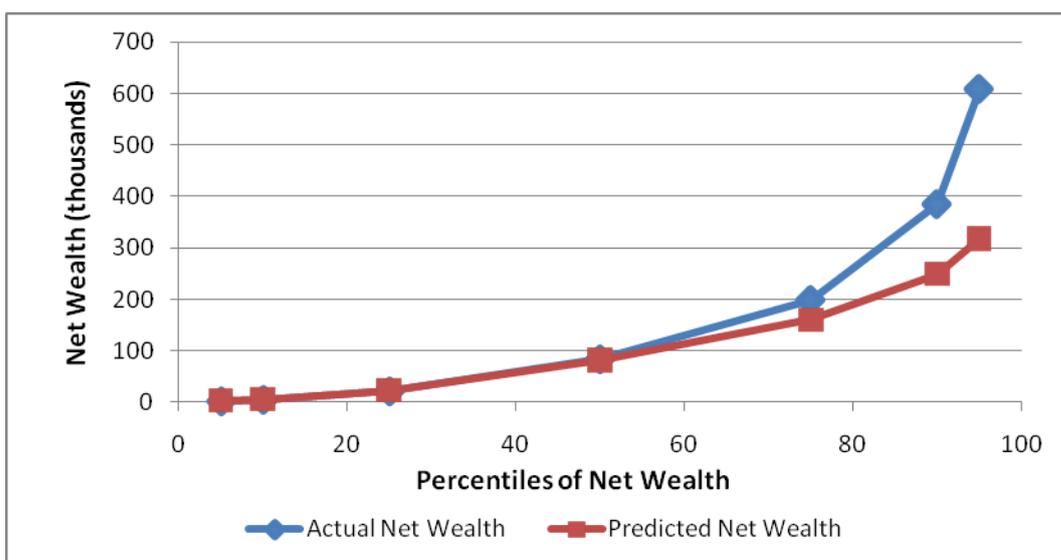
Table 4 – Comparison of actual values to those predicted by core model two

Percentiles	5%	10%	25%	Median	75%	90%	95%
Actual net wealth	7.438	8.412	9.953	11.333	12.201	12.863	13.321
Predicted net wealth	8.034	8.678	10.055	11.311	11.983	12.427	12.669

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

The predicted values, for the logarithm of net wealth, for longitudinal respondents in the 95th and the 5th wealth percentiles tended to differ more from their actual values than for any other percentile of the population.

Figure 2 – Comparison of actual to predicted net wealth – core model two



Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Figure 2 graphs the percentiles of net wealth, without logarithms, from Table 4. It should be noted that when transforming from the predicted logarithm of net wealth to predicted net wealth what seem like minor differences between the logarithms become much more significant differences between the transformed values. This is owing to the shape of the exponential curve. It would be prudent to limit the application of these models to levels of net wealth below \$400,000.

¹¹ This means that the estimated level of the dependent variable used as the base to calculate marginal effects may slightly exceed its mean value as the square root of mean age is larger than the mean of the square root of age, and the estimated coefficient of the square root of age is positive.

4.2 The logistic models

The use of logarithms in the core models excludes from analysis those respondents with negative or zero scores for the dependent variable as the logarithm of non-positive numbers is not defined. Logistic models consider the likelihood of an individual having non-positive net wealth and of having no liabilities. These individuals would have been excluded from the core model regressions of net wealth and total liabilities respectively.

Logistic models were chosen rather than probit models. This choice has little to no significance on the resulting fitted models. Logistic models are easier to calculate percentage point effects for and permit a larger variance than probit models.

4.2.1 Non-positive net wealth

Non-positive net wealth arises from having total liabilities equal to or greater than total assets. After adjustments for student loan, 2.5% of the longitudinal population had non-positive net wealth.

This logistic model was built using the same descriptors as core model two with several changes: dwelling tenure and whether the respondent was a student were excluded from the model.¹² It was decided to exclude dwelling tenure as property is typically the largest contributor to net wealth so including it could be misleading. Whether the respondent was a student or not was excluded as adjustments had already been made for the presence of a student loan. The logistic model has the following form:

$$N_i = f(H, Z'_1, Z'_2) \quad \text{for } (i = 1, \dots, n)$$

Where:

$$N_i = 1 \text{ if the } i^{\text{th}} \text{ respondent has negative or zero net wealth} \\ = 0 \text{ if the } i^{\text{th}} \text{ respondent has net wealth greater than zero}$$

H = The particular health variable being considered

Z'_k = The control variables from the core models

P_i = The probability of $N_i = 1$

The logistic model has shape:

$$P_i = \frac{e^{f(H, Z'_1, Z'_2)}}{1 + e^{f(H, Z'_1, Z'_2)}}$$

4.2.2 Zero liabilities

In order to consider total liabilities in the core models, the 28.2% of the longitudinal population who have zero reported liabilities had to be excluded. This makes the regression of total liabilities conditional on having liabilities. In order to provide a fuller picture we use a logistic model for whether an individual has liabilities or not.

The same logistic model as above was used with dwelling tenure and whether the respondent was a student or not being excluded. Dwelling tenure was excluded as the presence of a mortgage would have dominated the model. This logistic model has identical form to the above model specification with one change:

$$N_i = 1 \text{ if the } i^{\text{th}} \text{ respondent has liabilities} \\ = 0 \text{ if the } i^{\text{th}} \text{ respondent has zero liabilities}$$

¹² The initial logistic model, without health descriptors, can be found in Appendix C, Appendix Table 20.

Property and mortgages are the most significant elements of assets and liabilities. According to SoFIE, of those who own property, three-quarters have more than 48% of their assets in property with a value of at least \$70,500. Of those with a mortgage, for three-quarters of individuals their mortgage makes up at least 92% of their liabilities, with a value of at least \$30,000.

Initial attempts were made to include dwelling tenure in both logistic models. However, as expected, it dominated the model with coefficients at least twice the magnitude of other control variables.

4.3 Modelling health

This section provides some additional details that are supplementary to the regression models. These details inform parts of the results from the core models.

4.3.1 Health failures and the health survey models

Wealth was measured at Wave 2 whereas measures of physical discomfort and psychological distress were recorded in Wave 3. This may be problematic if enough individuals experienced a substantial change in health between Waves 2 and 3. Deteriorating health between these waves could push some respondents from moderate (in Wave 2) to high discomfort and distress (in Wave 3). Alternatively, an improvement in health could lead to some individuals experiencing a reduction in their levels of discomfort and distress between Waves 2 and 3.

SoFIE contains a variable that may enable some of those in the former group to be identified.¹³ Respondents were asked in Wave 3 whether they experienced an injury or illness, which restricted their usual activities, lasting seven days or more in the 12 months preceding the interview. Those who answered “yes” to this question were assumed to have experienced a health “failure”. For these respondents, their Wave 3 health is less likely to be a suitable proxy for their unobserved health in Wave 2.

This was incorporated by decomposing the measures of physical discomfort and psychological distress by the presence of a health failure. In the core models the health variable being considered changed from:

$$H = \{\text{physical discomfort, psychological distress}\}$$

to:

$$H = \{\text{physical discomfort by failure, psychological discomfort by failure}\}$$

4.3.2 Independence of the chronic conditions

Independence of the chronic conditions was tested before including multiple conditions together in the core models. This was done by treating the occurrence of each chronic condition as a Bernoulli event. Seven of these conditions (excluding depression and schizophrenia) were combined to form a single multinomial model. The model has the following form:

¹³ No means of detecting an improvement in health between Wave 2 and Wave 3 was found.

The proportion of the longitudinal population with each condition was used as the best estimator for the probability of having the condition:

$$\hat{P}(c_i = 1) = \text{proportion of the longitudinal population with } c_i = 1$$

where: $c_i = 1$ if the respondent has the i^{th} chronic condition.

From this, the probability of being diagnosed with every number and combination of conditions was calculated:

$$P(C = j) = \sum \hat{P}(c_1 = 1) \cdot \hat{P}(c_2 = 1) \cdot \dots \cdot \hat{P}(c_7 = 1)$$

with: $\sum c_i = j$

where: C = the total number of chronic conditions for a respondent

These were grouped by the number of conditions in the diagnosis and multiplied by the weighted population total to give estimates for the entire longitudinal population.

Table 5 shows the results of this model and the actual observed results.

Table 5 – Comparison of multinomial model to actual occurrences – testing independence of chronic conditions

Number of chronic conditions	Zero	1	2	3	4	5-7
Estimated	1,223,200	1,105,100	399,100	73,300	7,200	400
Actual	1,449,300	826,700	347,500	131,600	40,300	12,900

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Inspection of the results shows the theoretical model to be a poor fit; this was confirmed by a goodness-of-fit test. The model overestimates the proportion of the longitudinal population with one or two conditions and underestimates the proportion of the longitudinal population with zero or three to seven conditions.

The failure of this model highlights the lack of independence among the conditions. This was not investigated further. A successful model would be expected to include age because older respondents are seen *or* seem to have a higher likelihood of developing all conditions.¹⁴

The lack of independence between chronic conditions means that including multiple conditions in the analysis tends to make one or more of the conditions redundant. Each core model was run once for each chronic condition, so as to avoid this. A summary variable that indicated how many chronic conditions each respondent suffered from was considered, but was discarded owing to poor fit.

¹⁴ So a 60-year-old woman is more likely to have been diagnosed with heart disease than a 50-year-old woman. A 60-year-old woman is also more likely to have been diagnosed with high cholesterol than a 50-year-old woman. The chances increase for both conditions.

4.3.3 Receipt of a health tested benefit

SoFIE respondents were asked about the amount and sources of income they received over the last 12 months, including all forms of benefits. These benefits were separated into health and non-health benefits based on the requirements to qualify for each benefit.¹⁵ SoFIE estimates 10% of the longitudinal population receive some form of health tested benefit.

An attempt was made to include the receipt of a health tested benefit in the core models. This resulted in many of the health descriptors becoming no longer significant at the 10% level and the coefficients of those variables that were still significant becoming significantly lower.

Much of the change caused by the inclusion of a health tested benefit will be due to collinearity. Because the receipt of a health tested benefit is dependent on a large number of factors including health, income and wealth, it is not a truly independent variable. Results from its inclusion can be found in Appendix C, Appendix Table 19.

5 Results from core models

The core models provide a convenient base to analyse the association between health and wealth. As the regressions were run using the natural logarithm of wealth as the dependent variable, interpreting the coefficients is not straight-forward.

Positive coefficients imply the descriptor has a beneficial effect on wealth; negative coefficients imply a detrimental effect. Owing to the potential difficulty of interpreting the coefficients, marginal effects have been calculated. Full regression output (coefficients, standard errors and confidence intervals) can be found in the appendices.

To give context to the results that follow it is useful to have an idea of the marginal effects of the control variables from the core models. Ageing from about 42 to 47 is associated with an increase in wealth of \$19,420 in core model one and \$15,250 in core model two. In core model one, being of Māori or of Pacific Island descent is associated with having \$31,670 and \$62,490 less net wealth respectively than an individual of European descent. The difference between males and females is statistically significant, with males reporting \$7,230 to \$9,200 less net wealth than females. Receiving a non-health benefit is associated with having \$12,960 less net wealth than those who do not receive any income from a government benefit. See Appendix A, Appendix Table 3 for a complete list of the marginal effects.

Certain control variables were frequently redundant in the core models. Geographic region, having children over five years and having previously been a smoker were frequently not significant at the 1% level.

¹⁵ Illness-based benefits include Sickness Benefit, Invalid's Benefit, Disability Allowance, Amputee Assistance, Residential Support Subsidy and Rehabilitation Allowance.

5.1 The health surveys

Physical functioning (PF) and the Kessler 10-item scale (K10) were used in core models one and two. Over both models, progressively worse health was linked to lower wealth for both physical and mental wellbeing.

Table 6 – The marginal effects of physical discomfort and psychological distress on wealth

Dependent variable: Log net wealth	Core model 1 \$	Core model 2 \$
Physical discomfort (low discomfort is control)		
Moderate discomfort	-11,330***	-10,050***
High discomfort	-12,890***	-13,600***
Psychological distress (low distress is control)		
Moderate distress	-5,330*	-3,210
High distress	-28,850***	-18,560***

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

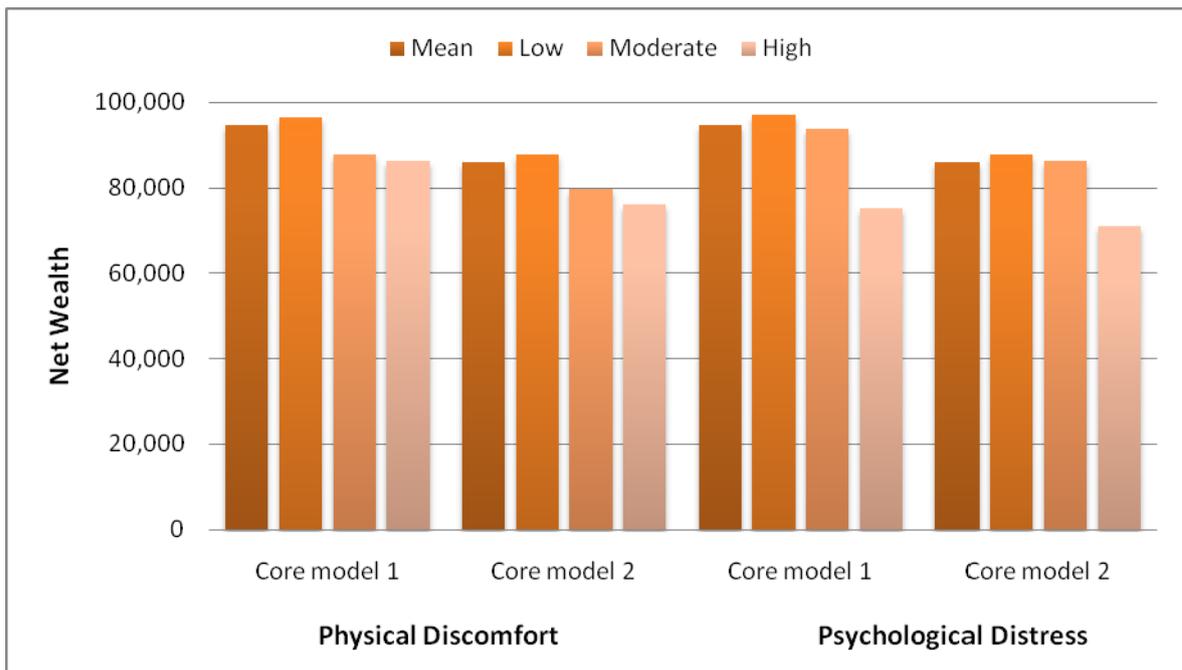
Notes:

1. * = coefficients are significant at the 10% significance level. ** = coefficients are significant at the 5% significance level. *** = coefficients are significant at the 1% significance level.
2. Marginal effects are calculated as the increase in net wealth for a change in the variable from the control with all other variables held at their mean.

Based on the marginal effects shown in Table 6 it is apparent that physical and mental wellbeing have differing effects. Those with moderate or high physical discomfort (9% and 6.5% of the longitudinal population respectively) experience similar levels of lower net wealth. Moderate psychological distress (14.5% of the longitudinal population) has a lower effect on net wealth, while high psychological distress (6.4%) has a larger effect. The coefficients for physical discomfort are not significantly different at the 10% level, whereas the coefficients for mental distress are significantly different at the 1% level.

Figure 3 shows the variation in the estimated level of net wealth for different levels of physical and mental wellbeing, with all other variables held at their mean. Net wealth is lower in every case where health status is worse.

Figure 3 – Levels of estimated net wealth by physical discomfort and psychological distress



Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. Levels of net wealth have been estimated for an individual with mean characteristics.
2. The means given here are forecasted means from the core models.
3. The differences between the bars for low and moderate, and for low and high discomfort and distress are identical to the marginal effects given in Table 6.

5.1.1 Health failures and the health surveys

A respondent’s health in Wave 3 may not be an accurate proxy for their health in Wave 2. The regressions involving the SF36 and K10 health measures were repeated, with the measures for physical discomfort and psychological distress decomposed by whether the respondent suffered a health failure or not.

Table 7 – The marginal effects of physical discomfort and psychological distress on wealth – decomposed by health failure

Dependent variable: Log net wealth	Core model 1 \$	Core model 2 \$
Without a health failure		
Physical discomfort (low discomfort is control)		
Moderate discomfort	-6,270*	-5,610*
High discomfort	-2,360	-3,300
Psychological distress (low distress is control)		
Moderate distress	-2,900	-830
High distress	-20,450***	-14,880***
With a health failure		
Physical discomfort (low discomfort is control)		
Moderate discomfort	-10,830***	-10,450***
High discomfort	-14,020***	-15,620***
Psychological distress (low distress is control)		
Moderate distress	-3,970	-1,970
High distress	-22,390***	-17,420***

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Note:

1. * =coefficients are significant at the 10% significance level. ** =coefficients are significant at the 5% significance level. *** =coefficients are significant at the 1% significance level.

Table 7 gives the results after the decomposition. In all cases the impact on net wealth was greater for those recording a health failure. However, coefficient testing showed that only the coefficients for high physical discomfort, with and without health failure, were significantly different, and these only at the 10% level in core model two.

Further investigation revealed that of those who rated their own health fair or poor in Wave 2, over half of them experienced a health failure in the following 12 months, compared with less than a quarter of those who rated their health excellent or very good. This suggests that those who already had worse health were more likely to suffer from injuries in the subsequent year. Wealth may affect the speed at which people recover from injury or illness, so those with greater wealth may have been less likely to be recorded as having experienced health failures, which require the respondent to have an injury or illness lasting seven days or more.

Compared with those not reporting a health failure, those who report a health failure were more likely to report lower self-rated health in Wave 3 than in Wave 2. This holds across all categories of self-rated health. For example, of those with excellent self-rated health in Wave 2, 49% of those who suffered a health failure rated their health worse in Wave 3, while only 34% of those who did not suffer a health failure rated their health worse in Wave 3.¹⁶

¹⁶ Tables showing the changes in self-rated health from Wave 2 to Wave 3 can be found in Appendix C, Appendix Tables 24 to 28.

5.2 Self-rated health

In each wave, respondents rated their own health. The means and medians of net wealth for each of the self-rated health categories are given in Table 8. In all categories the raw mean exceeds the median by more than \$50,000. This is owing to the skewed distribution of wealth.

Table 8 – Means and medians of net wealth by self-rated health

Self-rated Health	Raw mean \$	Modified mean \$	Median \$	Count no.
Excellent	173,880	52,050	69,990	1,136,500
Very Good	175,810	61,080	88,030	886,900
Good	171,900	59,870	84,380	552,400
Fair	142,270	59,280	89,650	177,100
Poor	104,350	34,200	50,800	45,800
Total Population	170,960	56,390	79,350	2,798,700

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Note:

1. The modified mean is calculated as the mean of the logarithms of net wealth and then transformed back (raised to the exponential power). This reduces the effect of outliers.

While there is no clear overall systematic relationship between net wealth and self-rated health, Table 8 suggests that those with poor health do in fact have lower net wealth. However, these results do not control for the possible effect of other variables, in particular age. The lower mean and median for those reporting excellent health will be influenced by the number of young people with low wealth.

5.2.1 Results from self-rated health

Self-rated health from Wave 2 was included in core models one and two. The results given in Table 9 show a progressive relationship with worse self-rated health being associated with lower net wealth. The marginal effects suggest that the relationship is stronger than was implied by the raw modified means; the difference between the raw modified means for very good and fair health is \$1,800 and the difference between the marginal effects of very good and fair health is \$21,950. Similarly, the difference between the raw modified means for excellent and poor health is \$17,850 and the marginal effect of poor health is \$46,150 (recall excellent health is the control).

Figure 4 shows net wealth declines systematically with worse self-rated health. For each core model the forecasted net wealth for an individual with the mean characteristics from the longitudinal population is given. In core model one, net wealth decreases from about \$107,000 to just under \$54,000 as health worsens from excellent to poor. In core model two, net wealth decreases from about \$96,000 to just under \$50,000.

The error bars provided in black give the ranges of forecasted net wealth for each health category if the corresponding coefficient is permitted to vary within its 95% confidence interval. The self-rated health coefficients are estimated with respect to excellent self-rated health, the error bars relate to the difference between excellent health and the corresponding category. They are not confidence intervals for the level of wealth by self-rated health.

Table 9 – The marginal effects of self-rated health on wealth

Dependent variable: Log net wealth	Core model 1 \$	Core model 2 \$
Self-rated health (excellent health is control)		
Very good health	-11,400***	-8,620***
Good health	-25,760***	-21,190***
Fair health	-35,500***	-30,570***
Poor health	-53,000***	-46,150***

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. *=coefficients are significant at the 10% significance level. **=coefficients are significant at the 5% significance level. ***=coefficients are significant at the 1% significance level.
2. Marginal effects (\$) are calculated as the increase in net wealth for a change in the variable from the control with all other variables held at their mean.
3. Coefficient testing shows all coefficients are distinct at the 5% level. The coefficient for very good health is distinct from zero (zero is equivalent to excellent health, the control) at the 1% level.

Figure 4 – Levels of estimated net wealth by self-rated health



Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Note:

1. The error bars (given in black) are calculated by estimating the log of net wealth using the bounds on the 95% confidence interval for each coefficient. This estimate is then transformed to net wealth.
2. Despite the overlap between some of the error bars, the coefficients are distinct at the 5% level. Any apparent overlap will be a result of changing from a logarithmic scale during the estimation process.
3. The means given here are those predicted by the core models for a respondent with average characteristics. They differ from those means given in Table 9 as the latter are raw means rather than predicted means.

5.3 The chronic conditions

The chronic conditions were included as a series of binary indicators in core models one and two. Owing to the lack of independence between chronic conditions, these models were run separately for each chronic condition.

5.3.1 Results from the chronic conditions

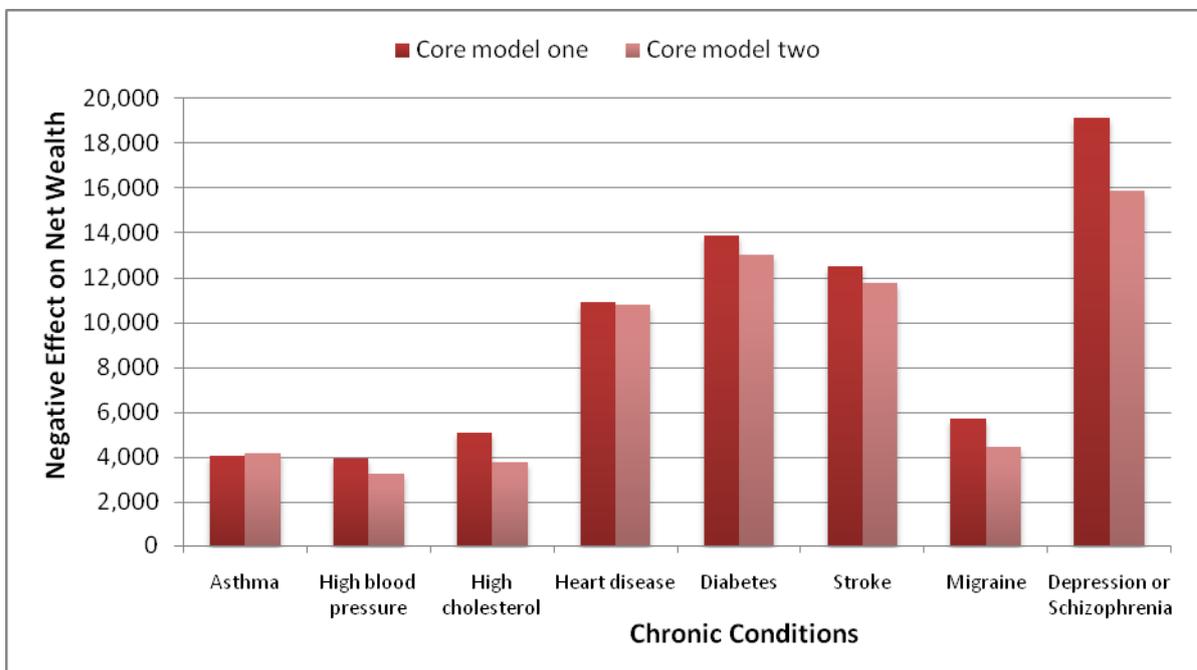
All chronic conditions had negative coefficients with only asthma and high blood pressure not significant at the 10% level.

Figure 5 shows the magnitude of the marginal effects for each chronic condition and for all conditions except asthma the marginal effect in core model two is less than the marginal effect in core model one. Some of this difference will be owing to the inclusion of additional control variables in core model two that are not in core model one. For example, smoking or receiving a non-health tested benefit may be associated with certain chronic conditions.

When interpreting these results it is important to note that they are derived by considering each chronic condition in turn, rather than simultaneously. The results can be directly compared to not having the chronic condition; comparison to other conditions can only be done indirectly. There were too few respondents with multiple chronic conditions to consider having a combination of conditions. The proportion of the longitudinal population with each chronic condition can be found in Appendix A, Appendix Table 3.

Figure 6 gives the prevalence weighted magnitude of the statistically significant chronic conditions.

Figure 5 – The estimated negative marginal effects of chronic conditions on wealth

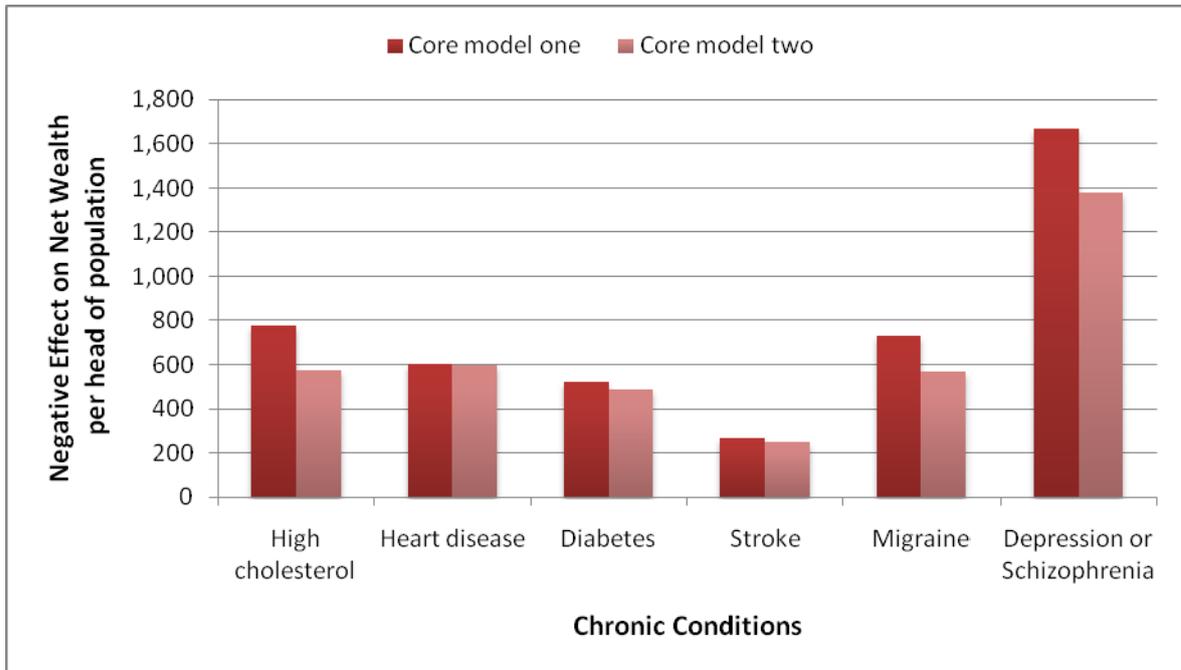


Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

For all conditions except asthma the marginal effect in core model two is less than the marginal effect in core model one. Some of this difference will be owing to the inclusion of additional control variables in core model two that are not in core model one. For example, smoking or receiving a non-health tested benefit may be associated with certain chronic conditions.

When interpreting these results it is important to note that they are derived by considering each chronic condition in turn, rather than simultaneously. The results can be directly compared to not having the chronic condition; comparison to other conditions can only be done indirectly. There were too few respondents with multiple chronic conditions to consider having a combination of conditions. The proportion of the longitudinal population with each chronic condition can be found in Appendix A, Appendix Table 3.

Figure 6 – The estimated negative marginal effects of chronic conditions on wealth – weighted by prevalence

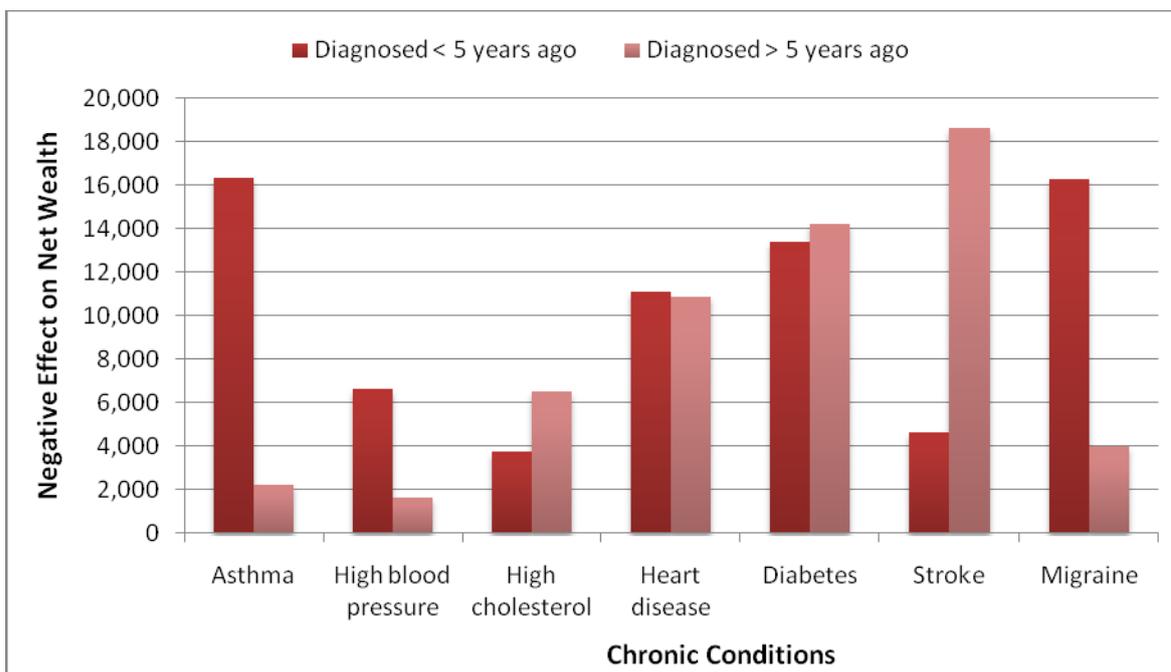


Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Results from the decomposition of the chronic conditions

All chronic conditions, other than depression and schizophrenia, were decomposed by whether diagnosis occurred within the last five years or more than five years ago. This was done to try to identify the immediate and long-term wealth effects associated with these chronic conditions. The presence of depression or schizophrenia could not be decomposed.

Figure 7 – The estimated negative marginal effects of chronic conditions on wealth – by timing of diagnosis – core model one



Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

It was unclear what effect this decomposition would have. Those who were diagnosed more than five years ago might no longer suffer the effects of their condition or might have experienced a greater effect on their wealth from having the condition for a longer period of time. Those with recent diagnoses were more likely to currently suffer from the effects of their condition, but any effect on their wealth might not yet be noticeable. Figure 7 illustrates the marginal effects on net wealth of each chronic condition depending on the timing of diagnosis.

Other than for asthma, the difference between the coefficients was not significant at the 10% level. Given the size of the differences between the marginal effects shown in Figure 7 we might have expected the differences for stroke and migraines to be significant. While the results are not generally statistically significant their relative magnitudes are consistent with the pattern that would be expected. Specifically, stroke produces permanent neurological deficit and would be expected to show a stronger effect on wealth when diagnosed more than five years previously. In contrast, asthma and migraine typically produce only short-lasting “health failures” and show a stronger effect when diagnosed within the last five years¹⁷.

Having been diagnosed with asthma does not appear to have a long term association with a person’s wealth. This may be owing to respondents being diagnosed with asthma in their youth and growing out of it as they age.

The marginal effects for heart disease and diabetes are significant and similar regardless of the length of time since diagnosis.¹⁸ This might suggest that these conditions have both an immediate and sustained impact on wealth.

¹⁷ I am grateful to Professor Tony Blakely for noting this result.

¹⁸ Diabetes differs by approximately \$800 and heart disease by approximately \$200 between those diagnosed recently and those diagnosed more than five years ago.

5.4 Assets and liabilities

Net wealth was decomposed into total assets and total liabilities. The aim was to determine how much of the change in net wealth was owing to changes in total assets or changes in total liabilities. The regression results for total assets follow a very similar form to net wealth, with all significant coefficients having the same sign and similar relative magnitude. Total liabilities were not as well explained by the core models as net wealth and total assets.¹⁹ Only the results from core model one are considered here.

The marginal effects on net wealth are not equal to the difference between the marginal effects on assets and liabilities. This occurs as the use of logarithms to transform the dependent variable results in different sample populations for each regression. To obtain such a model would require using the same sample population or solving all three regressions at once using simultaneous equations.

It is common to observe a rise in assets with a rise in liabilities or a fall in assets with a fall in liabilities associated with the same descriptor. Only age, living in a dwelling owned without a mortgage and having children under five report assets and liabilities moving in opposite directions where both coefficients are significant.²⁰

5.4.1 Assets, liabilities and health descriptors

Table 10 gives the marginal effects of health on wealth, assets and liabilities. Marginal effects are used as they are more comparable between regressions than coefficients. However, the comparison is still flawed as the marginal effects are calculated from regressions with different samples.

Lower net wealth owing to ill health appears to be associated with lower total assets. Most of the coefficients for the amount of debt held are not significant at the 10% level, and the magnitude of the marginal effects for total liabilities with significant coefficients is often less than one-tenth the size of the corresponding marginal effects for total assets. The logistic model for having liabilities, in Section 6.2, suggests only certain measures of ill health are associated with whether people are in debt or not.

¹⁹ Net wealth reported a goodness-of-fit of 0.5982 from core model one. Total assets reported 0.6103 and total liabilities 0.3651.

²⁰ Geographic region and being of Māori descent also report opposing changes in assets and liabilities but have coefficients that are not significant at the 10% level.

Table 10 – Marginal effects of health measures on net wealth, total assets and total liabilities

Dependent variable: Log net wealth	Wealth \$	Assets \$	Liabilities \$
Physical discomfort (low discomfort is control)			
Moderate discomfort	-11,330***	-13,120***	-1,730**
High discomfort	-12,890***	-12,640**	-870
Psychological distress (low distress is control)			
Moderate distress	-5,330*	-7,930***	-560
High distress	-28,850***	-33,080***	-100
Self-rated health (excellent health is control)			
Very good health	-11,400***	-12,910***	-50
Good health	-25,760***	-33,010***	-1,690***
Fair health	-35,500***	-45,330***	-2,210**
Poor health	-53,000***	-70,280***	-2,520**
Chronic conditions (not having the condition is control)			
Asthma	-4,070	-5,020	220
High blood pressure	-3,940	-5,180*	-260
High cholesterol	-5,120**	-7,340**	820
Heart disease	-10,930***	-15,330***	100
Diabetes	-13,910***	-22,810***	-2,160**
Stroke	-12,520**	-17,130**	-1,240
Migraines	-5,700**	-5,550	10
Depression or schizophrenia	-19,150***	-25,730***	70

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. *=coefficients are significant at the 10% significance level. **=coefficients are significant at the 5% significance level. ***=coefficients are significant at the 1% significance level.
2. Marginal effects (\$) are calculated as the increase in the dependent variable for a change in the variable with all other variables held at their mean. For categorical variables this is a change from the control.

The liability model is conditional on having non-zero liabilities. These results should be considered with the logistic model for whether people have or do not have liabilities.

6 Results from logistic models

The use of logarithms to transform the dependent variable in the above analysis excluded all respondents with zero or negative scores. To provide a fuller picture and to consider those respondents with zero or negative responses, a pair of logistic models was constructed.

6.1 The likelihood of negative or zero net wealth

This logistic model gives an idea of the characteristics associated with those individuals whose liabilities exceed their assets. These results should be considered in conjunction with the results for net wealth.

After the regression the only control variables significant at the 10% level were age, geographic region, ethnicity and being a current smoker. The mean longitudinal respondent has a 2.6% chance of having non-positive net wealth. In absolute terms few

coefficients had a percentage point effect of 2% or greater. However, in relative terms, a percentage point effect of 2.0% is significant as the likelihood of having non-positive net wealth close to doubles. Within the sensible bounds of the model, no individual in the longitudinal population can be estimated to have more than a 22% likelihood of having negative or zero net wealth.

To provide some context for the results below it is useful to know that being a current smoker results in a percentage point increase of 1.1 to the probability of having non-positive net wealth; being of Māori or Pacific Island descent results in percentage point increases of 1.6 and 2.4 respectively; ageing from 42 to 47 results in a 0.7 percentage point decrease. The logistic model, before the inclusion of health descriptors, can be found in Appendix C, Appendix Table 20.

The health descriptors were included in this logistic model in the same form as they were included in the core models. Table 11 gives the coefficients of the health survey descriptors and their percentage point effects. Percentage point effects for the health variables should be used for comparison as the coefficients are not directly comparable.

As an illustration of how to interpret the percentage point effects in Table 11, consider the effect of an increase in psychological distress on the probability of having non-positive net wealth: the probability of a person with average characteristics without any psychological distress of having non-positive net wealth is 2.32%. The probability of the same person but with high levels of psychological distress is 4.48%. The difference between these two (4.48 – 2.33) is 2.15; this is the percentage point difference shown in the table.

As in the core models the health surveys were decomposed by whether or not the respondent had experienced a health failure in the previous 12 months. There was no significant difference between the coefficients before and after the decomposition. For self-rated health, none of the adjacent categories are significantly different from each other at the 5% level.

Table 11 – The association between health and the likelihood of non-positive net wealth

Dependent variable	Coefficients	Percentage point effects
Likelihood of non-positive net wealth		
Physical discomfort (low discomfort is control)		
Moderate discomfort	0.0756	0.1783
High discomfort	-0.2335	-0.4760
Psychological distress (low distress is control)		
Moderate distress	0.2187	0.5529
High distress	0.6772***	2.1546
Self-rated health (excellent health is control)		
Very good health	0.1062	0.2291
Good health	0.4879***	1.2721
Fair health	0.8599***	2.7157
Poor health	1.0111***	3.4566
Chronic Conditions (not having the condition is control)		
Asthma	-0.0608	-0.1527
High blood pressure	0.0976	0.2642
High cholesterol	0.4214**	1.3363
Heart disease	1.0884***	4.8383
Diabetes	0.1657	0.4635
Stroke	0.6461	2.2918
Migraines	0.2838*	0.8411
Depression or schizophrenia	0.5118***	1.6974

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. * =significant at the 10% significance level. **=significant at the 5% significance level. ***=significant at the 1% significance level.
2. Percentage point changes are calculated as the increase in percentage points of the probability to have non-positive net wealth for a change in the variable with all other variables held at their mean. For categorical variables this is a change from the control.

Many health variables were significant and resulted in at least a 1 percentage point increase on the likelihood of non-positive net wealth.²¹ The health variables that were not significant in the logistic regression were those that were either not significant or had smaller marginal effects in the core models. The exceptions to this are diabetes and stroke, which have the greatest standard error of the chronic conditions.

The results from the core and logistic regressions show that worse health is associated with lower wealth and a higher likelihood of negative or zero net wealth. This suggests that the costs of ill health can exceed an individual’s ability to meet them and could potentially draw them into undesirable debt.

6.2 The likelihood of having liabilities

This logistic model should be considered in conjunction with the regression of the logarithm of total liabilities. It is expected that we will see most variables to have the same direction in both models (the level of total liabilities held should move with the likelihood of holding liabilities).

²¹ These are proportionally significant changes compared to the average respondent.

An individual's geographic region, having children over the age of five and receiving a benefit were the only descriptors that were not significant at the 10% level. A member of the longitudinal population with mean characteristics has an 83.4% chance of having liabilities. The likelihood of having liabilities increases until people are about 40 years of age and decreases from 40 onwards. By the age of 80 there is just more than a 15% chance of having liabilities at the mean.

To provide some context for the results below it is useful to know that having a university qualification increases the likelihood of having liabilities by 6.7 percentage points. Being moderately to heavily deprived (median to worst categories) are associated with a 3.7 to 4.4 percentage point increase in the likelihood of having liabilities. The logistic model, before the inclusion of health descriptors, can be found in Appendix C, Appendix Table 22.

The health descriptors were included in this logistic model in the same form as they are found in the core models.

Table 12 gives the coefficients and percentage point effects from these regressions. Percentage point effects for the health variables should be used for comparison as the coefficients are not directly comparable.

All significant health variables have positive coefficients. Only high physical discomfort and the chronic conditions (excluding stroke) appear to have a significant effect on whether a person has liabilities or not and all are associated with an increase in the likelihood of having liabilities.

Of the health descriptors, migraines have the greatest percentage point effect of 3.44. This effect is smaller than those associated with ethnicity, education, deprivation and family composition and is relatively minor compared to the 83.4% probability of having liabilities at the mean. Ageing from 25 to 27 has the same percentage point increase on the likelihood of having liabilities as migraines. Ageing from 56 to 58 has the reverse percentage point effect of being diagnosed with migraines.

The weak association between health and whether a member of the longitudinal population is in debt may be owing to when they enter into debt and when their health begins to deteriorate. Individuals with ill health may be less inclined to enter into debt, while healthy individuals may enter into debt and later find their health deteriorating. The logistic model will be unable to detect this as it is based on cross-section data.

Table 12 – The association between health and the likelihood of having liabilities

Dependent variable	Coefficients	Percentage point effects
Likelihood of having liabilities		
Physical discomfort (low discomfort is control)		
Moderate discomfort	0.1015	1.3739
High discomfort	0.2538***	3.2610
Psychological distress (low distress is control)		
Moderate distress	0.0853	1.1598
High distress	0.0445	0.6139
Self-rated health (excellent health is control)		
Very good health	-0.0097	-0.1335
Good health	-0.0190	-0.2631
Fair health	-0.0449	-0.6269
Poor health	0.0871	1.1618
Chronic conditions (not having the condition is control)		
Asthma	0.1157**	1.5609
High blood pressure	0.1263**	1.6968
High cholesterol	0.1534**	2.0420
Heart disease	0.2198**	2.8616
Diabetes	0.2188*	2.8487
Stroke	0.1750	0.1750
Migraines	0.2688***	3.4407
Depression or schizophrenia	0.1580**	2.1007

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. * = significant at the 10% significance level. ** = significant at the 5% significance level. *** = significant at the 1% significance level.
2. Percentage point changes are calculated as the increase in percentage points of the probability to have zero liabilities for a change in the variable with all other variables held at their mean. For categorical variables this is a change from the control.

7 Conclusions

This paper has examined the relationship between net wealth and health. Net wealth was modelled as a function of health with the inclusion of a range of control variables. Across a range of health measures it found a fairly clear association, with net wealth tending to be lower for individuals with poorer health.

Results using separate measures of physical and mental wellbeing showed both to be associated with lower net wealth. An individual with moderate physical discomfort was estimated to have \$11,330 less wealth than an individual with only low physical discomfort, holding other factors constant at their mean values. This difference was larger for an individual with high physical discomfort who was estimated to have \$12,890 less wealth. For mental health, a mean individual with moderate distress had an estimated \$5,330 less net wealth than the same individual with low distress. The difference between high and low distress was \$28,850 less net wealth.

The measures of physical and mental wellbeing were decomposed by whether the respondent had experienced a short-term health failure, defined as responding “yes” to having an illness or injury, which hindered their normal activities, lasting at least seven days in the previous 12 months. The results showed that the marginal effect of ill health on wealth for those who suffered a health failure was more negative than for those who did not suffer a health failure. Further investigation revealed that those who did not suffer from health failures had, on average, better self-rated health and greater wealth.

Respondent self-rated health was significant in almost all analyses. Self-rated health was used in order to provide a wider perspective of a person’s wellbeing than targeted questioning alone. Respondents were asked to rate their health as excellent, very good, good, fair or poor. The worse a respondent rated their health, the progressively lower their wealth. A person with average characteristics who rated their health very good was estimated to have \$11,400 less net wealth than a person with the same characteristics who rated their health excellent. The difference between good and excellent health was \$25,760, between fair and excellent health was \$35,500 and between poor and excellent health was \$53,000.

Eight chronic conditions were considered: asthma, high blood pressure, high cholesterol, heart disease, diabetes, stroke, migraines and the presence of either depression or schizophrenia. Of these, heart disease, diabetes, stroke and the presence of either depression or schizophrenia had the greatest marginal effects on wealth²². Those with these conditions had \$10,930 to \$19,150 lower net wealth, at the mean, than those who did not. Owing to a lack of independence between the conditions, and the small number of respondents with multiple conditions, the effects were all measured separately.

The marginal effects of the six statistically significant chronic conditions were weighted by prevalence of the condition in the longitudinal population. The magnitude of the marginal effects for heart disease and diabetes were reduced to similar levels of effect, per head of population, as high cholesterol and migraines, about \$600 per person. The presence of depression or schizophrenia had twice the effect per head of population with a predicted cost of \$1,380.

The chronic conditions were decomposed by whether the respondent had been diagnosed within the last five years, or more than five years ago. The variable for depression or schizophrenia was not able to be decomposed in this way. Asthma has a statistically greater effect on net wealth in the first five years. Diabetes and heart disease were the only conditions that were significant regardless of how long since diagnosis.

²² For a discussion of the relation between wealth and mental health see Carter, Blakely, Collings, Gunasekara and Richardson (2009a)

Net wealth was decomposed into assets and liabilities. Models were estimated for assets and liabilities separately using the same control variables as were used in the regression models for net wealth. From this, the majority of the lower net wealth associated with ill health appears to be the result of lower total assets with total liabilities remaining reasonably constant.

A logistic model was estimated for the probability of having negative net wealth. The likelihood of having negative net wealth was found to increase as self-rated health decreased, and to be higher for those with high psychological distress compared to those with lower psychological distress. Four of the chronic conditions were found to have significant association with a higher likelihood of negative net wealth: high cholesterol, heart disease, migraines and depression or schizophrenia. No relationship with physical health was found.

A logistic model for the probability of having liabilities was also estimated. It was found that mental wellbeing and the levels of self-rated health were largely not significant in determining whether a respondent has liabilities or not. But high physical discomfort and being diagnosed with a chronic condition, other than stroke, was found to increase the likelihood of having liabilities. Of these, migraines had the greatest percentage point effect. However this was dwarfed by the control variables, which frequently had more than twice the percentage point effect.

This analysis is only able to detect the association between health and wealth; identifying the direction of causality is not possible given the techniques used. There is the potential for health to affect wealth and for wealth to affect health. It is also difficult to be certain that the relationship detected is not owing to unobserved variables having an effect on both health and wealth. Untangling the complex relationship between health and wealth remains an area for future research. The longitudinal nature of SoFIE will eventually enable more complex modelling techniques to be applied to the data.

Despite not resolving the question of causality, this paper does provide evidence that those with poor health tend to be financially worse off. Those with ill health may have lower wealth owing to a variety of reasons, including the cost of treatment, reduced earnings and higher cost of living. How much of the cost to treat ill health is borne by those who suffer from ill health will influence the apparent magnitude of this relationship.

As with any study of this nature, the robustness of the results reflects in part the quality of the data and inevitably there will be errors of measurement in the data. The reporting of assets and liabilities relies on recall by the respondents, and some items may have been overlooked. Furthermore, it is recognised that very high net wealth individuals may not be proportionately represented in SoFIE. While self-reported health status has been widely used, there exists the potential for bias in reporting if the respondents have a perception that in responding to an official survey their present benefits might be in jeopardy.

A potential by-product from public investment in improving the health of an individual could be higher levels of net wealth. Typically those with better health status tend to have greater productivity, higher incomes and longer working lives, all of which provide an opportunity to accumulate greater net wealth. However, the impact of the taxes needed to fund such investment and the labour force participation rates of those targeted would need to be considered before affirming that such investment would have net positive benefits.

An implication of having benefits that are asset tested against net wealth is that those with poor health will have a tendency to be overrepresented among recipients. So it is expected that a greater proportion of those receiving a benefit will have ill health, compared to the proportion of the total population with ill health.

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Appendix A

Appendix A contains the results from the regressions of the core models before health variables were introduced.

Appendix Table 1 – Core regression model one – robust standard errors

Dependent variable	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Log net wealth					
Age at end of sample period					
Age	-0.2535	0.0082	0.00	-0.2696	-0.2374
√ Age	3.9230	0.1101	0.00	3.7071	4.1389
Annual personal income	5.72E-06	8.98E-07	0.00	3.96E-06	7.48E-06
Geographic region (Auckland is control)					
Waikato	0.1289	0.0411	0.00	0.0483	0.2094
Wellington	-0.0494	0.0332	0.14	-0.1144	0.0156
Rest of the North Island	0.0222	0.0318	0.49	-0.0402	0.0845
Canterbury	0.0337	0.0335	0.32	-0.0320	0.0994
Rest of the South Island	0.0633	0.0333	0.06	-0.0021	0.1287
Ethnicity (European is control)					
Māori	-0.3571	0.0434	0.00	-0.4421	-0.2720
Pacific Island	-0.8976	0.0732	0.00	-1.0412	-0.7541
Asian	-0.5267	0.0616	0.00	-0.6475	-0.4059
Other	-0.5415	0.0928	0.00	-0.7234	-0.3595
Highest qualification (no qualification is control)					
School qualifications	0.3175	0.0330	0.00	0.2529	0.3822
Vocational or higher	0.3702	0.0302	0.00	0.3110	0.4295
University or higher	0.4847	0.0411	0.00	0.4041	0.5653
Housing tenure (renting or leasing is control)					
Owned with a mortgage	0.6200	0.0321	0.00	0.5571	0.6829
Owned without mortgage	1.0438	0.0367	0.00	0.9719	1.1158
Neither owned nor renting	0.5255	0.0544	0.00	0.4188	0.6322
Deprivation (least deprived is control)					
Less deprivation	-0.1243	0.0294	0.00	-0.1818	-0.0667
Median deprivation	-0.2468	0.0316	0.00	-0.3088	-0.1848
More deprivation	-0.3391	0.0323	0.00	-0.4024	-0.2757
Most deprived	-0.6794	0.0391	0.00	-0.7560	-0.6028
Gender (female is control)	-0.0765	0.0429	0.08	-0.1607	0.0077
Partnered (non-partnered is control)					
Partnered if male	0.3481	0.0410	0.00	0.2678	0.4285
Partnered if female	0.3285	0.0321	0.00	0.2656	0.3914

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Children in household (no children is control)					
Children under 5	0.1355	0.0369	0.00	0.0631	0.2078
Children over 5	-0.0924	0.0274	0.00	-0.1461	-0.0388
Constant	-4.3310	0.3436	0.00	-5.0045	-3.6575
Regression characteristics					
R-squared value		0.5982			
Number of observations (Unweighted)		16,600			
(Weighted)		2,729,100			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 2 – Core regression model two – robust standard errors

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Age at end of sample period					
Age	-0.2081	0.0088	0.00	-0.2255	-0.1908
√ Age	3.2434	0.1209	0.00	3.0065	3.4803
Annual personal income	5.29E-06	8.25E-07	0.00	3.67E-06	6.90E-06
Geographic region (Auckland is control)					
Waikato	0.1324	0.0410	0.00	0.0520	0.2129
Wellington	-0.0511	0.0330	0.12	-0.1158	0.0136
Rest of the North Island	0.0169	0.0318	0.60	-0.0454	0.0792
Canterbury	0.0380	0.0334	0.26	-0.0275	0.1034
Rest of the South Island	0.0631	0.0331	0.06	-0.0018	0.1279
Ethnicity (European is control)					
Māori	-0.3307	0.0433	0.00	-0.4155	-0.2458
Pacific Island	-0.8176	0.0745	0.00	-0.9636	-0.6715
Asian	-0.3767	0.0630	0.00	-0.5002	-0.2531
Other	-0.4354	0.0930	0.00	-0.6177	-0.2531
Highest qualification (no qualification is control)					
School qualifications	0.3353	0.0327	0.00	0.2712	0.3993
Vocational or higher	0.3755	0.0299	0.00	0.3169	0.4341
University or higher	0.5012	0.0408	0.00	0.4212	0.5812
Housing tenure (renting or leasing is control)					
Owned with a mortgage	0.5864	0.0322	0.00	0.5232	0.6496
Owned without mortgage	1.0149	0.0370	0.00	0.9424	1.0874
Neither owned nor renting	0.5035	0.0541	0.00	0.3975	0.6096
Deprivation (least deprived is control)					
Less deprivation	-0.1234	0.0288	0.00	-0.1798	-0.0670
Median deprivation	-0.2341	0.0313	0.00	-0.2954	-0.1729
More deprivation	-0.3257	0.0318	0.00	-0.3881	-0.2633
Most deprived	-0.6321	0.0386	0.00	-0.7078	-0.5565

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Gender (female is control)	-0.1069	0.0434	0.01	-0.1919	-0.0218
Partnered (non-partnered is control)					
Partnered if male	0.2877	0.0399	0.00	0.2096	0.3658
Partnered if female	0.2769	0.0323	0.00	0.2136	0.3401
Children in household (no children is control)					
Children under 5	0.1574	0.0390	0.00	0.0811	0.2338
Children over 5	-0.0190	0.0276	0.49	-0.0732	0.0351
Student Status (non-student is control)					
Full-time student	-0.6596	0.0617	0.00	-0.7807	-0.5386
Part-time student	-0.1478	0.0384	0.00	-0.2231	-0.0725
Years paid employment	0.0060	0.0013	0.00	0.0035	0.0084
Born in New Zealand (born overseas is control)	0.1276	0.0274	0.00	0.0738	0.1813
Smoking status (never smoked heavily is control)					
Current smoker	-0.1555	0.0283	0.00	-0.2110	-0.1000
Past smoker	-0.2239	0.0299	0.00	-0.2825	-0.1653
Benefit receipt (no benefit is control)					
Non-health benefit	-0.0679	0.0228	0.00	-0.1125	-0.0232
Constant	-1.9339	0.3944	0.00	-2.7070	-1.1609
Regression characteristics					
R-squared value		0.6081			
Number of observations (Unweighted)		16,600			
(Weighted)		2,717,500			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 3 – Means and proportions for calculating marginal effects

Dependent variable Log net wealth	Mean/ proportion	Marginal effects Core model 1 \$	Marginal effects Core model 2 \$
Age at end of sample period (effect of a five-year increase)	44.29 years	19,420	15,250
Annual personal income (Effect of a \$5,000 increase)	\$34,114.98	2,710	2,280
Geographic region (Auckland is control)	0.2897		
Waikato	0.0939	12,710	11,390
Wellington	0.1190	-4,460	-4,200
Rest of the North Island	0.2276	2,070	1,440
Canterbury	0.1475	3,170	3,260
Rest of the South Island	0.1223	6,040	5,480

Dependent variable Log net wealth	Mean/ proportion	Marginal effects Core model 1 \$	Marginal effects Core model 2 \$
Ethnicity (European is control)	0.7910		
Māori	0.0979	-31,670	-26,630
Pacific Island	0.0395	-62,490	-52,830
Asian	0.0541	-43,180	-29,690
Other	0.0175	-44,100	-33,390
Highest qualification achieved (no qualification is control)	0.2177		
School qualifications	0.2867	26,440	25,430
Vocational or higher schooling	0.3500	31,690	29,090
University or higher qualifications	0.1456	44,110	41,540
Housing tenure (renting or leasing is control)	0.2435		
Accommodation owned with mortgage	0.3869	45,120	39,060
Accommodation owned without mortgage	0.2982	96,660	86,160
Neither owned nor renting	0.0714	36,320	32,060
Deprivation (least deprived is control)	0.2324		
Less deprivation	0.2172	-14,260	-12,740
Median deprivation	0.1834	-26,680	-22,900
More deprivation	0.1989	-35,080	-30,490
Most deprived	0.1681	-60,150	-51,390
Gender (female is control)	0.4818		
	0.5182	-7,230	-9,200
Partnered (non-partnered is control)	0.3746		
Partnered if male	0.3156	31,890	24,090
Partnered if female	0.3098	29,780	23,050
Children in the household (no children is control)	0.6277		
Children under 5	0.1330	13,780	14,460
Children over 5	0.2394	-8,390	-1,600
Student status (non-student is control)	0.8106		
Full-time student	0.0891		-44,820
Part-time student	0.1003		-12,750
Years paid employment (Effect of a five-year increase)	22.10 years		2,570
Born in New Zealand (born overseas is control)	0.7873		
	0.2127		10,610
Smoking status (never smoked heavily is control)	0.5506		
Current smoker	0.1971		-18,390
Past smoker	0.2523		-6,010
Benefit receipt (no benefit is control)	0.7242		
Non-health benefit receipt	0.2758		-12,960

Dependent variable Log net wealth	Mean/ proportion	Marginal effects Core model 1 \$	Marginal effects Core model 2 \$
Self-rated health (excellent health is control)	0.4068		
Very good health	0.3166	-11,400	-8,620
Good health	0.1971	-25,760	-21,190
Fair health	0.0631	-35,500	-30,570
Poor health	0.0164	-53,000	-46,150
Physical discomfort (low discomfort is control)	0.8458		
Moderate discomfort	0.0896	-11,330	-10,050
High discomfort	0.0646	-12,890	-13,600
Psychological distress (low distress is control)	0.7906		
Moderate distress	0.1451	-5,330	-3,210
High distress	0.0642	-28,850	-18,560
Chronic Conditions (not having the condition is control)			
Asthma	0.1807	-4,070	-4,190
High blood pressure	0.1887	-3,940	-3,240
High cholesterol	0.1519	-5,120	-3,780
Heart disease	0.0552	-10,930	-10,810
Diabetes	0.0374	-13,910	-13,000
Stroke	0.0214	-12,520	-11,750
Migraines	0.1281	-5,700	-4,440
Depression or schizophrenia	0.0870	-19,150	-15,860

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. Where units are provided the measurement is a mean. Where no units are provided the value is the proportion of the longitudinal population with the characteristic. The proportion of the longitudinal population with the control characteristic has also been provided for all descriptors other than the chronic conditions.
2. Proportions may not sum to 1 owing to rounding after calculation. All proportions are rounded to four decimal places.
3. For the calculation of marginal effects of the chronic conditions, the regression coefficients for the non-chronic descriptors were taken from the regression of asthma. This ensures all the marginal effects have the same control point.

Appendix B

Appendix B contains the results from the regressions including health variables. Only the health variables are reported here. The control variables differ from their values in the core models but these differences are minor and are not the focus of this paper, hence they are omitted.

Appendix Table 4 – The association between physical discomfort and psychological distress, and wealth – core model one

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.1214	0.0363	0.00	-0.1926	-0.0503
High discomfort	-0.1393	0.0440	0.00	-0.2255	-0.0531
Psychological distress (low distress is control)					
Moderate distress	-0.0552	0.0325	0.09	-0.1189	0.0084
High distress	-0.2753	0.0496	0.00	-0.3726	-0.1781
Regression characteristics					
R-squared value			0.6036		
Number of observations (Unweighted)			16,400		
(Weighted)			2,691,300		

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 5 – The association between physical discomfort and psychological distress, and wealth – core model two

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.1189	0.0357	0.00	-0.1889	-0.0489
High discomfort	-0.1645	0.0442	0.00	-0.2512	-0.0779
Psychological distress (low distress is control)					
Moderate distress	-0.0365	0.0321	0.26	-0.0995	0.0265
High distress	-0.2321	0.0493	0.00	-0.3287	-0.1355
Regression characteristics					
R-squared value			0.6129		
Number of observations (Unweighted)			16,300		
(Weighted)			2,680,200		

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 6 – The association between physical discomfort and psychological distress, and wealth – decomposed by health failure – core model one

Dependent variable	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Log net wealth					
No health failure					
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.0956	0.0489	0.05	-0.1915	0.0002
High discomfort	-0.0530	0.0618	0.39	-0.1741	0.0680
Psychological distress (low distress is control)					
Moderate distress	-0.0500	0.0418	0.23	-0.1320	0.0319
High distress	-0.2560	0.0703	0.00	-0.3938	-0.1182
Health failure					
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.1476	0.0505	0.00	-0.2465	-0.0486
High discomfort	-0.1855	0.0571	0.00	-0.2974	-0.0736
Psychological distress (low distress is control)					
Moderate distress	-0.0614	0.0483	0.20	-0.1561	0.0333
High distress	-0.2816	0.0691	0.00	-0.4169	-0.1462
Regression characteristics					
R-squared value		0.6037			
Number of observations (Unweighted)		16,400			
(Weighted)		2,691,300			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 7 – The association between physical discomfort and psychological distress, and wealth – decomposed by health failure – core model two

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
No health failure					
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.0883	0.0482	0.07	-0.1827	0.0061
High discomfort	-0.0604	0.0614	0.33	-0.1808	0.0599
Psychological distress (low distress is control)					
Moderate distress	-0.0304	0.0414	0.46	-0.1115	0.0507
High distress	-0.2067	0.0694	0.00	-0.3427	-0.0707
Health failure					
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.1491	0.0497	0.00	-0.2465	-0.0517
High discomfort	-0.2184	0.0573	0.00	-0.3307	-0.1061
Psychological distress (low distress is control)					
Moderate distress	-0.0437	0.0476	0.36	-0.1369	0.0496
High distress	-0.2423	0.0690	0.00	-0.3775	-0.1070
Regression characteristics					
R-squared value		0.6130			
Number of observations (Unweighted)		16,300			
(Weighted)		2,680,200			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 8 – The association between self-rated health and wealth – core model one

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
(excellent health is control)					
Very good health	-0.1127	0.0240	0.00	-0.1599	-0.0656
Good health	-0.2756	0.0304	0.00	-0.3353	-0.2160
Fair health	-0.4034	0.0480	0.00	-0.4976	-0.3092
Poor health	-0.6844	0.0998	0.00	-0.8800	-0.4888
Regression characteristics					
R-squared value		0.6033			
Number of observations (Unweighted)		16,600			
(Weighted)		2,729,100			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 9 – The association between self-rated health and wealth – core model two

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
(excellent health is control)					
Very good health	-0.0939	0.0237	0.00	-0.1404	-0.0475
Good health	-0.2491	0.0301	0.00	-0.3082	-0.1900
Fair health	-0.3827	0.0479	0.00	-0.4766	-0.2888
Poor health	-0.6541	0.1033	0.00	-0.8566	-0.4516
Regression characteristics					
R-squared value		0.6125			
Number of observations (Unweighted)		16,600			
(Weighted)		2,717,500			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 10 – The association between the chronic conditions and wealth – core model one

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
(no condition is control)					
Asthma	-0.0436	0.0287	0.13	-	0.0127
High blood pressure	-0.0421	0.0263	0.11	-	0.0095
High cholesterol	-0.0551	0.0275	0.05	-	-0.0012
Heart disease	-0.1216	0.0395	0.00	-	-0.0441
Diabetes	-0.1575	0.0519	0.00	-	-0.0558
Stroke	-0.1406	0.0622	0.02	-	-0.0186
Migraines	-0.0615	0.0316	0.05	-	0.0004
Depression or Schizophrenia	-0.2240	0.0347	0.00	-	-0.1559
Regression Characteristics					
R-squared value		0.5994	0.6004		
Number of observations (Unweighted)		16,500	16,600		
(Weighted)		2,711,300	2,729,100		

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. Each chronic condition was regressed separately. All eight are shown together here for compactness.
2. Regression characteristics provided give the minimum and maximum for each regression characteristic over the eight regressions.

Appendix Table 11 – The association between the chronic conditions and wealth – core model two

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
(no condition is control)					
Asthma	-0.0494	0.0285	0.08	-	0.0064
High blood pressure	-0.0380	0.0261	0.15	-	0.0132
High cholesterol	-0.0445	0.0272	0.10	-	0.0088
Heart disease	-0.1327	0.0394	0.00	-	-0.0554
Diabetes	-0.1619	0.0520	0.00	-	-0.0600
Stroke	-0.1452	0.0623	0.02	-	-0.0230
Migraines	-0.0524	0.0319	0.10	-	0.0101
Depression or Schizophrenia	-0.2015	0.0347	0.00	-	-0.1334
Regression characteristics					
R-squared value		0.6090	0.6104		
Number of observations (Unweighted)		16,400	16,600		
(Weighted)		2,699,700	2,717,500		
			0		

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. Each chronic condition was regressed separately. All eight are shown together here for compactness.
2. Regression characteristics provided give the minimum and maximum for each regression characteristic over the eight regressions.

Appendix Table 12 – The association between the chronic conditions and wealth – by timing of diagnosis – core model one

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Diagnosed up to five years ago					
(no condition is control)					
Asthma	-0.1884	0.0789	0.02	-0.3431	-0.0337
High blood pressure	-0.0718	0.0418	0.09	-0.1537	0.0100
High cholesterol	-0.0398	0.0376	0.29	-0.1136	0.0339
Heart disease	-0.1238	0.0727	0.09	-0.2662	0.0187
Diabetes	-0.1516	0.0877	0.08	-0.3234	0.0203
Stroke	-0.0494	0.0798	0.54	-0.2058	0.1069
Migraines	-0.1870	0.1261	0.14	-0.4343	0.0602
Diagnosed more than five years					
(no condition is control)					
Asthma	-0.0234	0.0303	0.44	-0.0828	0.0360
High blood pressure	-0.0173	0.0302	0.57	-0.0764	0.0419
High cholesterol	-0.0709	0.0348	0.04	-0.1391	-0.0028
Heart disease	-0.1212	0.0427	0.01	-0.2049	-0.0375
Diabetes	-0.1615	0.0612	0.01	-0.2814	-0.0416
Stroke	-0.2178	0.0890	0.01	-0.3922	-0.0433
Migraines	-0.0429	0.0302	0.16	-0.1022	0.0164
Regression characteristics					
R-squared value		0.5983	0.5985		
Number of observations (Unweighted)		16,600	16,600		
(Weighted)		2,729,100	2,729,100		

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. Each chronic condition was regressed separately. All seven are shown together here for compactness. Depression or schizophrenia was not able to be decomposed.
2. Regression characteristics provided give the minimum and maximum for each regression characteristic over the seven regressions.

Appendix Table 13 – The association between the chronic conditions and wealth – by timing of diagnosis – core model two

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Diagnosed up to five years ago					
(no condition is control)					
Asthma	-0.1925	0.0803	0.02	-0.3500	-0.0350
High blood pressure	-0.0576	0.0410	0.16	-0.1380	0.0227
High cholesterol	-0.0260	0.0370	0.48	-0.0986	0.0466
Heart disease	-0.1370	0.0712	0.05	-0.2766	0.0026
Diabetes	-0.1617	0.0871	0.06	-0.3324	0.0090
Stroke	-0.0554	0.0806	0.49	-0.2134	0.1026
Migraines	-0.1801	0.1310	0.17	-0.4369	0.0768
Diagnosed more than five years					
(no condition is control)					
Asthma	-0.0294	0.0299	0.33	-0.0879	0.0292
High blood pressure	-0.0182	0.0302	0.55	-0.0773	0.0410
High cholesterol	-0.0629	0.0346	0.07	-0.1307	0.0050
Heart disease	-0.1300	0.0432	0.00	-0.2148	-0.0453
Diabetes	-0.1617	0.0617	0.01	-0.2826	-0.0407
Stroke	-0.2207	0.0888	0.01	-0.3948	-0.0466
Migraines	-0.0330	0.0300	0.27	-0.0919	0.0258
Regression characteristics					
R-squared value		0.6082	0.6083		
Number of observations (Unweighted)		16,600	16,600		
(Weighted)		2,717,500	2,717,500		

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. Each chronic condition was regressed separately. All seven are shown together here for compactness. Depression or schizophrenia was not able to be decomposed.
2. Regression characteristics provided give the minimum and maximum for each regression characteristic over the seven regressions.

Appendix C

Asset and liability decompositions

This section contains the results from when the logarithm of total assets and the logarithm of total liabilities were run through core model one.

Appendix Table 14 – Assets regression

Dependent variable Log total assets	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Age at end of sample period					
Age	-0.2787	0.0084	0.00	-0.2951	-0.2622
√ Age	4.2165	0.1121	0.00	3.9968	4.4362
Annual personal income	5.90E-06	9.28E-07	0.00	4.08E-	7.72E-06
Geographic region (Auckland is control)					
Waikato	0.1220	0.0403	0.00	0.0431	0.2009
Wellington	-0.0176	0.0325	0.59	-0.0812	0.0460
Rest of the North Island	-0.0034	0.0314	0.91	-0.0650	0.0581
Canterbury	0.0375	0.0329	0.25	-0.0269	0.1019
Rest of the South Island	0.0352	0.0329	0.29	-0.0293	0.0996
Ethnicity (European is control)					
Māori	-0.3906	0.0439	0.00	-0.4766	-0.3045
Pacific Island	-0.9188	0.0746	0.00	-1.0651	-0.7725
Asian	-0.5631	0.0611	0.00	-0.6828	-0.4434
Other	-0.5181	0.0897	0.00	-0.6939	-0.3423
Highest qualification (no qualification is control)					
School qualifications	0.3203	0.0328	0.00	0.2559	0.3846
Vocational or higher	0.3904	0.0304	0.00	0.3308	0.4501
University or higher	0.5130	0.0410	0.00	0.4327	0.5933
Housing tenure (renting or leasing is control)					
Owned with a mortgage	0.9270	0.0323	0.00	0.8637	0.9904
Owned without mortgage	1.0570	0.0359	0.00	0.9865	1.1274
Neither owned nor renting	0.5682	0.0526	0.00	0.4650	0.6713
Deprivation (least deprived is control)					
Less deprivation	-0.0816	0.0284	0.00	-0.1373	-0.0259
Median deprivation	-0.1831	0.0306	0.00	-0.2430	-0.1231
More deprivation	-0.2517	0.0313	0.00	-0.3131	-0.1903
Most deprived	-0.6130	0.0387	0.00	-0.6890	-0.5371
Gender (female is control)	-0.1024	0.0427	0.02	-0.1860	-0.0188
Partnered (non-partnered is control)					
Partnered if male	0.4216	0.0404	0.00	0.3425	0.5008
Partnered if female	0.3643	0.0324	0.00	0.3007	0.4278

Dependent variable Log total assets	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Children in household (no children is control)					
Children under 5	0.1879	0.0366	0.00	0.1162	0.2597
Children over 5	-0.1206	0.0272	0.00	-0.1740	-0.0673
Constant	-5.1165	0.3472	0.00	-5.7971	-4.4359
Regression characteristics					
R-squared value		0.6103			
Number of observations (Unweighted)		17,000			
(Weighted)		2,799,000			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 15 – Results of health measures on total assets

Dependent variable Log total assets	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.1111	0.0360	0.00	-0.1816	-0.0405
High discomfort	-0.1068	0.0452	0.02	-0.1953	-0.0183
Psychological distress (low distress is control)					
Moderate distress	-0.0649	0.0322	0.04	-0.1281	-0.0017
High distress	-0.3037	0.0509	0.00	-0.4035	-0.2039
Self-rated health (excellent health is control)					
Very good health	-0.0985	0.0234	0.00	-0.1444	-0.0526
Good health	-0.2742	0.0304	0.00	-0.3338	-0.2146
Fair health	-0.3994	0.0466	0.00	-0.4908	-0.3080
Poor health	-0.7145	0.1006	0.00	-0.9117	-0.5172
Chronic conditions (no condition is control)					
Asthma	-0.0416	0.0287	0.15	-0.0979	0.0147
High blood pressure	-0.0429	0.0260	0.10	-0.0938	0.0080
High cholesterol	-0.0614	0.0273	0.03	-0.1149	-0.0079
Heart disease	-0.1327	0.0413	0.00	-0.2137	-0.0517
Diabetes	-0.2045	0.0530	0.00	-0.3084	-0.1006
Stroke	-0.1496	0.0674	0.03	-0.2818	-0.0174
Migraines	-0.0461	0.0307	0.13	-0.1062	0.0140
Depression or Schizophrenia	-0.2340	0.0354	0.00	-0.3034	-0.1646

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 16 – Liabilities regression

Dependent variable Log total liabilities	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Age at end of sample period					
Age	-0.3250	0.0174	0.00	-0.3591	-0.2908
√ Age	3.8751	0.2267	0.00	3.4308	4.3194
Annual personal income	2.78E-06	7.60E-07	0.00	1.29E-	4.27E-06
Geographic region (Auckland is control)					
Waikato	0.0469	0.0718	0.51	-0.0940	0.1877
Wellington	-0.1673	0.0583	0.00	-0.2815	-0.0532
Rest of the North Island	-0.2611	0.0554	0.00	-0.3697	-0.1525
Canterbury	-0.1696	0.0582	0.00	-0.2837	-0.0555
Rest of the South Island	-0.3759	0.0646	0.00	-0.5025	-0.2493
Ethnicity (European is control)					
Māori	0.0123	0.0570	0.83	-0.0994	0.1239
Pacific Island	-0.2606	0.1145	0.02	-0.4851	-0.0362
Asian	-0.3098	0.1051	0.00	-0.5159	-0.1038
Other	-0.0901	0.1490	0.55	-0.3822	0.2020
Highest qualification (no qualification is control)					
School qualifications	0.3138	0.0607	0.00	0.1948	0.4328
Vocational or higher	0.4182	0.0551	0.00	0.3102	0.5262
University or higher	0.6661	0.0703	0.00	0.5282	0.8039
Housing tenure (renting or leasing is control)					
Owned with a mortgage	1.8528	0.0503	0.00	1.7543	1.9513
Owned without mortgage	-0.3287	0.0760	0.00	-0.4778	-0.1797
Neither owned nor renting	0.2457	0.1018	0.02	0.0461	0.4453
Deprivation (least deprived is control)					
Less deprivation	-0.0661	0.0579	0.25	-0.1797	0.0475
Median deprivation	-0.1513	0.0596	0.01	-0.2682	-0.0344
More deprivation	-0.0561	0.0594	0.35	-0.1725	0.0603
Most deprived	-0.1802	0.0648	0.01	-0.3072	-0.0531
Gender (female is control)	-0.0421	0.0749	0.57	-0.1888	0.1047
Partnered (non-partnered is control)					
Partnered if male	0.2267	0.0740	0.00	0.0816	0.3718
Partnered if female	0.0364	0.0573	0.53	-0.0759	0.1486
Children in household (no children is control)					
Children under 5	-0.1599	0.0554	0.00	-0.2686	-0.0512
Children over 5	-0.1225	0.0495	0.01	-0.2195	-0.0255
Constant	-2.8298	0.7111	0.00	-4.2238	-1.4359
Regression characteristics					
R-squared value		0.3651			
Number of observations (Unweighted)		11,900			
(Weighted)		1,969,900			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 17 – Results of health measures on total liabilities

Dependent variable Log total liabilities	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.1557	0.0715	0.03	-0.2958	-0.0156
High discomfort	-0.0747	0.0907	0.41	-0.2526	0.1032
Psychological distress (low distress is control)					
Moderate distress	-0.0481	0.0541	0.37	-0.1541	0.0579
High distress	-0.0089	0.0707	0.90	-0.1475	0.1297
Self-rated health (excellent health is control)					
Very good health	-0.0039	0.0432	0.93	-0.0886	0.0809
Good health	-0.1466	0.0546	0.01	-0.2537	-0.0395
Fair health	-0.1955	0.0820	0.02	-0.3562	-0.0348
Poor health	-0.2263	0.1295	0.08	-0.4801	0.0275
Chronic conditions (no condition is control)					
Asthma	0.0181	0.0466	0.70	-0.0733	0.1094
High blood pressure	-0.0225	0.0535	0.67	-0.1273	0.0823
High cholesterol	0.0669	0.0563	0.24	-0.0436	0.1773
Heart disease	0.0086	0.0962	0.93	-0.1799	0.1972
Diabetes	-0.2003	0.1019	0.05	-0.4002	-0.0005
Stroke	-0.1104	0.1413	0.44	-0.3874	0.1666
Migraines	0.0009	0.0513	0.99	-0.0997	0.1015
Depression or Schizophrenia	0.0055	0.0566	0.92	-0.1054	0.1165

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 18 – Estimated marginal effects on wealth, total assets and total liabilities – core model one

Dependent variables: Log of net wealth, total assets and total liabilities	Wealth	Assets	Liabilities
	\$	\$	\$
Age at end of sample period (effect of a five-year increase)			
Age	19,420***	23,180***	-1,990***
√ Age			
Annual personal income (effect of a \$5,000 increase)	2,710***	3,610***	170***
Geographic region (Auckland is control)			
Waikato	12,710***	15,580***	660
Wellington	-4,460	-2,100	-2,130***
Rest of the North Island	2,070	-410	-3,170***
Canterbury	3,170	4,590	-2,150***
Rest of the South Island	6,040*	4,300	-4,320***
Ethnicity (European is control)			
Māori	-31,670***	-44,330***	150
Pacific Island	-62,490***	-82,400***	-2,810**
Asian	-43,180***	-59,030***	-3,260***
Other	-44,100***	-55,440***	-1,060
Highest qualification achieved (no qualification is control)			
School qualifications	26,440***	34,100***	3,150***
Vocational or higher school qualifications	31,690***	43,140***	4,440***
University or higher qualifications	44,110***	60,550***	8,090***
Housing tenure (renting or leasing is control)			
Accommodation owned with mortgage	45,120***	91,420***	33,930***
Accommodation owned without mortgage	96,660***	112,420***	-1,770***
Neither owned nor renting	36,320***	45,800***	1,760**
Deprivation (least deprived is control)			
Less deprivation	-14,260***	-11,760***	-830
Median deprivation	-26,680***	-25,110***	-1,820***
More deprivation	-35,080***	-33,400***	-710
Most deprived	-60,150***	-68,770***	-2,140***
Gender (female is control)	-7,230*	-12,510**	-500
Partnered (non-partnered is control)			
Partnered if male	31,890***	50,160***	2,790***
Partnered if female	29,780***	42,040***	410
Children in household (no children is control)			
Children under 5	13,780***	25,390***	-1,850***
Children over 5	-8,390***	-13,950***	-1,450***

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. * =coefficients are significant at the 10% significance level. ** =coefficients are significant at the 5% significance level. *** =coefficients are significant at the 1% significance level.
2. Marginal effects (\$) are calculated as the increase in the dependent variable for a change in the variable with all other variables held at their mean. For categorical variables this is a change from the control.
3. The liability model is conditional on having non-zero liabilities. These results should be considered with the logistic model for whether people have or do not have liabilities.

Inclusion of health tested benefit receipt

The following table gives the results from the health descriptors with the inclusion of a variable for the receipt of a health tested benefit.

Appendix Table 19 – Health descriptors with the inclusion of health benefit receipt – core model two

Dependent variable Log net wealth	Coefficient	Standard error	P-values	C.I. 95%	
				Lower	Upper
Physical discomfort (low discomfort is control)					
Moderate discomfort	-0.0171	0.0321	0.60	-0.0799	0.0458
High discomfort	-0.1778	0.0495	0.00	-0.2748	-0.0807
Psychological distress (low distress is control)					
Moderate distress	-0.0171	0.0321	0.60	-0.0799	0.0458
High distress	-0.1778	0.0495	0.00	-0.2748	-0.0807
Health tested benefit receipt	-0.5048	0.0406	0.00	-0.5844	-0.4252
Self-rated health (excellent health is control)					
Very good health	-0.0795	0.0236	0.00	-0.1258	-0.0333
Good health	-0.2065	0.0300	0.00	-0.2653	-0.1476
Fair health	-0.2725	0.0484	0.00	-0.3674	-0.1777
Poor health	-0.4763	0.1028	0.00	-0.6778	-0.2747
Health tested benefit receipt	-0.4703	0.0409	0.00	-0.5504	-0.3901
Chronic conditions (no condition is control)					
Asthma	-0.0291	0.0284	0.31	-0.0847	0.0265
High blood pressure	-0.0110	0.0260	0.67	-0.0620	0.0401
High cholesterol	-0.0243	0.0270	0.37	-0.0773	0.0287
Heart disease	-0.0562	0.0395	0.16	-0.1337	0.0213
Diabetes	-0.0459	0.0226	0.04	-0.0902	-0.0015
Stroke	-0.0942	0.0517	0.07	-0.1955	0.0071
Migraines	-0.0573	0.0594	0.33	-0.1738	0.0591
Depression or Schizophrenia	-0.0271	0.0320	0.40	-0.0898	0.0355

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

General logistic models

Appendix Table 20 – The likelihood of non-positive net wealth – initial logistic model

Dependent variable likelihood of non-positive net wealth	Coefficient	Standard error	P-values	C.I. 95%		Percentage point effects
				Lower	Upper	
Age at end of sample period						
Age	-0.3924	0.0514	0.00	-0.4932	-0.2917	-0.7400
√ Age	4.4446	0.6404	0.00	3.1895	5.6997	
Annual personal income	-2.30E-07	1.65E-06	0.89	-3.46E-	3.00E-	-0.0029
Geographic region (Auckland is control)						
Waikato	-0.5017	0.2250	0.03	-0.9427	-0.0606	-1.5411
Wellington	-0.6558	0.1939	0.00	-1.0359	-0.2758	-1.8857
Rest of North Island	-0.4282	0.1668	0.01	-0.7551	-0.1013	-1.3582
Canterbury	-0.6809	0.1934	0.00	-1.0601	-0.3018	-1.9372
Rest of South Island	-0.9277	0.2283	0.00	-1.3752	-0.4803	-2.3822
Ethnicity (European is control)						
Māori	0.5147	0.1747	0.00	0.1724	0.8571	1.6018
Pacific Island	0.6961	0.2348	0.00	0.2359	1.1563	2.3742
Asian	-0.4151	0.2824	0.14	-0.9686	0.1383	-0.8289
Other	0.1677	0.4250	0.69	-0.6654	1.0007	0.4396
Highest qualification (no qualification is control)						
School qualifications	-0.2697	0.1854	0.15	-0.6331	0.0938	-0.6352
Vocational or higher	0.0831	0.1722	0.63	-0.2545	0.4206	0.2307
University or higher	0.0174	0.2081	0.93	-0.3905	0.4253	0.0469
Deprivation (least deprived is control)						
Less deprivation	0.0383	0.2011	0.85	-0.3558	0.4324	0.0995
Median deprivation	-0.1096	0.2072	0.60	-0.5157	0.2965	-0.2653
More deprivation	-0.0866	0.1926	0.65	-0.4641	0.2910	-0.2117
Most deprived	0.1952	0.2086	0.35	-0.2137	0.6042	0.5462
Gender (female is control)	0.0588	0.1853	0.75	-0.3044	0.4220	0.1506
Partnered (non-partnered is control)						
Partnered if male	-0.0770	0.2161	0.72	-0.5006	0.3466	-0.2015
Partnered if female	-0.1229	0.1824	0.50	-0.4803	0.2345	-0.3147
Children in household (no children is control)						
Children under 5	-0.1232	0.1787	0.49	-0.4736	0.2271	-0.3163
Children over 5	-0.2038	0.1417	0.15	-0.4816	0.0740	-0.5040
Years of paid employment	-0.0123	0.0114	0.28	-0.0346	0.0100	-0.1573

Dependent variable likelihood of non-positive net wealth	Coefficient	Standard error	P-values	C.I. 95%		Percentage point effects
				Lower	Upper	
Born in New Zealand (born overseas is control)	-0.2719	0.1696	0.11	-0.6042	0.0605	-0.7503
Smoking status (never smoked is control)						
Current smoker	0.3998	0.1364	0.00	0.1326	0.6671	1.0921
Past smoker	0.2268	0.1570	0.15	-0.0809	0.5344	0.5685
Benefit receipt (no benefit is control)	0.2235	0.1521	0.14	-0.0746	0.5216	0.5876
Constant	-15.0189	1.9291	0.00	-	-	
Regression characteristics						
Pseudo R-squared value			0.0945			
Number of observations (Unweighted)			16,900			
			2,787,900 (Weighted)			

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Note:

1. Percentage point changes are calculated as the increase in percentage points of the probability to have non-positive net wealth for a change in the variable with all other variables held at their mean. For categorical variables this is a change from the control. For age and years of paid employment this is a five-year change, for personal income a change of \$5,000.

The probability of a European with average characteristics having non-positive net wealth is 2.48%. The probability of the same person if they were Māori is 4.08%. The difference between these two (4.08 – 2.48) is 1.60, the percentage point difference.

Appendix Table 21 – Health and the likelihood of non-positive net wealth

Dependent variable likelihood of non-positive net wealth	Coefficient	Standard error	P-values	C.I. 95%		Percentage point effects
				Lower	Upper	
Physical discomfort (low discomfort is control)						
Moderate discomfort	0.0756	0.2186	0.73	-0.3529	0.5041	0.1783
High discomfort	-0.2335	0.2958	0.43	-0.8133	0.3463	-0.4760
Psychological distress (low distress is control)						
Moderate distress	0.2187	0.1554	0.16	-0.0859	0.5232	0.5529
High distress	0.6772	0.1961	0.00	0.2929	1.0616	2.1546
Self-rated health (excellent health is control)						
Very good health	0.1062	0.1430	0.46	-0.1740	0.3864	0.2291
Good health	0.4879	0.1653	0.00	0.1639	0.8120	1.2721
Fair health	0.8599	0.2487	0.00	0.3725	1.3474	2.7157
Poor health	1.0111	0.3843	0.01	0.2578	1.7643	3.4566

Dependent variable likelihood of non-positive net wealth	Coefficient	Standard error	P-values	C.I. 95%		Percentage point effects
				Lower	Upper	
Chronic conditions (no condition is control)						
Asthma	-0.0608	0.1479	0.68	-0.3507	0.2291	-0.1527
High blood pressure	0.0976	0.1903	0.61	-0.2754	0.4705	0.2642
High cholesterol	0.4214	0.2037	0.04	0.0222	0.8207	1.3363
Heart disease	1.0884	0.2742	0.00	0.5511	1.6258	4.8383
Diabetes	0.1657	0.3071	0.59	-0.4363	0.7677	0.4635
Stroke	0.6461	0.4561	0.16	-0.2478	1.5399	2.2918
Migraines	0.2838	0.1562	0.07	-0.0223	0.5899	0.8411
Depression or Schizophrenia	0.5118	0.1767	0.00	0.1654	0.8582	1.6974

Source and Note: See Appendix Table 20.

Appendix Table 22 – The likelihood of having liabilities – initial logistic model

Dependent variable Likelihood of liabilities	Coefficient	Standard error	P-values	C.I. 95%		Percentage point effects
				Lower	Upper	
Age at end of sample						
Age	-0.4523	0.0139	0.00	-0.4796	-0.4250	
√ Age	5.6022	0.1804	0.00	5.2487	5.9557	-2.1793
Annual personal income	3.11E-06	1.11E-06	0.01	9.39E-07	5.28E-	0.2148
Geographic region (Auckland is control)						
Waikato	-0.1222	0.0795	0.12	-0.2779	0.0335	-1.7650
Wellington	0.1940	0.0713	0.01	0.0543	0.3338	2.5208
Rest of North Island	-0.1032	0.0630	0.10	-0.2268	0.0203	-1.4821
Canterbury	0.0905	0.0681	0.18	-0.0429	0.2239	1.2178
Rest of South Island	0.0402	0.0713	0.57	-0.0995	0.1800	0.5509
Ethnicity (European is control)						
Māori	-0.2207	0.0735	0.00	-0.3647	-0.0767	-3.0822
Pacific Island	-0.4484	0.1101	0.00	-0.6642	-0.2326	-6.7431
Asian	-0.9305	0.1011	0.00	-1.1286	-0.7325	-16.1065
Other	-0.2999	0.1693	0.08	-0.6317	0.0318	-4.2996
Highest qualification (no qualification is control)						
School qualifications	0.2690	0.0604	0.00	0.1507	0.3874	4.0261
Vocational or higher	0.3156	0.0576	0.00	0.2027	0.4286	4.6546
University or higher	0.4756	0.0802	0.00	0.3183	0.6329	6.6643
Deprivation (least deprived is control)						
Less deprivation	0.1987	0.0656	0.00	0.0702	0.3273	2.9301
Median deprivation	0.2778	0.0669	0.00	0.1468	0.4089	3.9941
More deprivation	0.3083	0.0660	0.00	0.1790	0.4375	4.3879
Most deprived	0.2558	0.0711	0.00	0.1164	0.3952	3.7033
Gender (female is control)	-0.2886	0.0667	0.00	-0.4193	-0.1579	-4.0035

Dependent variable Likelihood of liabilities	Coefficient	Standard error	P-values	C.I. 95%		Percentage point effects
				Lower	Upper	
Partnered (non-partnered is control)						
Partnered if male	0.6724	0.0720	0.00	0.5313	0.8135	9.2691
Partnered if female	0.3745	0.0612	0.00	0.2545	0.4945	5.6725
Children in household (no children is control)						
Children under 5	0.3726	0.0827	0.00	0.2105	0.5347	4.6597
Children over 5	-0.0410	0.0524	0.43	-0.1437	0.0617	-0.5896
Years of paid employment	0.0088	0.0026	0.00	0.0037	0.0138	0.6060
Born in New Zealand (born overseas is control)	0.1356	0.0621	0.03	0.0139	0.2573	1.9224
Smoking status (never smoked is control)						
Current smoker	0.1641	0.0568	0.00	0.0527	0.2754	2.2844
Past smoker	0.2425	0.0529	0.00	0.1389	0.3462	3.2901
Benefit receipt (no benefit is control)	0.0235	0.0523	0.65	-0.0790	0.1260	0.3242
Constant	-16.7378	0.5591	0.00	-17.8336	-	
Regression Characteristics						
Pseudo R-squared value			0.1968			
Number of observations			17,000			
(Unweighted)			2,794,300			
(Weighted)						

Source and Note: See Appendix Table 20.

The probability of a person with average characteristics who is European having liabilities is 84.71%. The probability of the same person if they were Māori is 81.63%. The difference between these two (81.63 – 84.71) is -3.08, the percentage point difference.

Appendix Table 23 – Health and the likelihood of having liabilities

Dependent variable likelihood of liabilities	Coefficient	Standard error	P-values	C.I. 95%		Percentage point effects
				Lower	Upper	
Physical discomfort (low discomfort is control)						
Moderate discomfort	0.1015	0.0768	0.19	-0.0489	0.2520	1.3739
High discomfort	0.2538	0.0928	0.01	0.0719	0.4358	3.2610
Psychological distress (low distress is control)						
Moderate distress	0.0853	0.0599	0.16	-0.0322	0.2027	1.1598
High distress	0.0445	0.0867	0.61	-0.1254	0.2145	0.6139
Self-rated health (excellent health is control)						
Very good health	-0.0097	0.0508	0.85	-0.1092	0.0898	-0.1335
Good health	-0.0190	0.0607	0.75	-0.1381	0.1000	-0.2631
Fair health	-0.0449	0.0888	0.61	-0.2189	0.1290	-0.6269
Poor health	0.0871	0.1468	0.55	-0.2006	0.3747	1.1618

Dependent variable likelihood of liabilities	Coefficient	Standard error	P-values	C.I. 95%		Percentage point effects
				Lower	Upper	
Chronic conditions (no condition is control)						
Asthma	0.1157	0.0565	0.04	0.0051	0.2264	1.5609
High blood pressure	0.1263	0.0593	0.03	0.0100	0.2425	1.6968
High cholesterol	0.1534	0.0654	0.02	0.0252	0.2815	2.0420
Heart disease	0.2198	0.0972	0.02	0.0293	0.4103	2.8616
Diabetes	0.2188	0.1152	0.06	-0.0071	0.4446	2.8487
Stroke	0.1750	0.1577	0.27	-0.1341	0.4840	0.1750
Migraines	0.2688	0.0658	0.00	0.1398	0.3978	3.4407
Depression or Schizophrenia	0.1580	0.0751	0.04	0.0109	0.3051	2.1007

Source and Note: See Appendix Table 20.

Changes in self-rated health decomposed by health failures

This section contains supporting tables for Section 5.1.1.

Appendix Table 24 – Changes in self-rated health – before decomposition

Counts	Health Wave 3					Proportions		
	Excellent	Very good	Good	Fair	Poor	Up	Same	Down
Health Wave 2								
Excellent	717,100	315,100	89,700	12,800	1,800	-	0.6310	0.3690
Very good	199,700	464,700	189,400	29,200	3,900	0.2252	0.5240	0.2509
Good	52,900	161,900	259,000	68,500	10,100	0.3888	0.4689	0.1423
Fair	4,800	17,000	60,400	74,400	20,500	0.4641	0.4201	0.1158
Poor	1,400	1,900	7,600	14,900	20,000	0.5633	0.4367	-

Appendix Table 25 – Changes in self-rated health – with health failure

Counts	Health Wave 3					Proportions		
	Excellent	Very good	Good	Fair	Poor	Up	Same	Down
Health Wave 2								
Excellent	111,900	67,400	29,500	6,700	1,100	-	0.5166	0.4834
Very good	32,100	103,700	58,000	12,800	2,800	0.1533	0.4952	0.3515
Good	11,400	38,800	84,000	37,000	6,600	0.2823	0.4724	0.2452
Fair	1,700	7,500	26,100	42,900	14,300	0.3816	0.4638	0.1546
Poor	S	S	3,800	11,000	14,400	0.5068	0.4932	-

Appendix Table 26 – Changes in self-rated health – without health failure

Counts	Health Wave 3					Proportions		
	Excellent	Very good	Good	Fair	Poor	Up	Same	Down
Health Wave 2								
Excellent	605,200	247,800	60,200	6,100	S	-	0.6583	0.3417
Very good	167,600	361,000	131,400	16,400	1,100	0.2474	0.5328	0.2198
Good	41,500	123,100	175,000	31,500	3,500	0.4394	0.4672	0.0934
Fair	3,100	9,600	34,300	31,400	6,200	0.5556	0.3712	0.0733
Poor	S	S	3,900	3,900	5,700	0.5778	0.4222	-

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Notes:

1. The proportions given on the right hand side show the proportion of the longitudinal population whose self-rated health improved, worsened or stayed the same between waves.
2. S = results censored due to too few observations. These cells contained less than 1,000 weighted observations before release.

From the above tables it can be seen that a greater proportion of the longitudinal population who suffer a short-term health failure rate their health worse between waves, and a smaller proportion rate their health better between waves, than those who do not suffer a health failure.

Health failures and self-rated health

Appendix Table 27 – Wave 2 self-rated health against health failures

	<i>Without health failure</i>		<i>With health failure</i>	
	Count	Proportion	Count	Proportion
Excellent	920,100	0.4438	216,800	0.2981
Very Good	678,000	0.3271	209,300	0.2878
Good	375,100	0.1809	177,800	0.2445
Fair	84,500	0.0408	92,500	0.1272
Poor	15,300	0.0074	30,900	0.0425
Total	2,073,000	1	727,300	1

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Of individuals with fair or poor self-rated health more than half suffered a health failure between Waves 2 and 3. Only 18% of those with excellent self-rated health suffered a health failure between Waves 2 and 3.

Health failures could be caused by injury or an illness lasting more than a week. Whether the health failure was caused by injury or illness was not considered in this analysis. Consideration of the difference between these two may be useful in further research.

Wealth and health failures

Appendix Table 28 – Net wealth percentiles – with and without health failures

Percentiles	5%	10%	25%	Median	75%	90%	95%
Net wealth with failure (\$)	600	2,560	16,070	74,210	186,000	335,000	493,000
Net wealth without failure (\$)	800	3,130	18,700	80,920	197,300	395,800	632,550

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Note:

1. These measures of net wealth have not had student loans offset against them.

For all percentiles, those who experienced a health failure have lower net wealth than those who did not experience a health failure. The difference between the net wealth of those who experienced a health failure and those who did not increases as the overall level of net wealth increases. This suggests that health failures are associated with lower net wealth. However, these results do not control for the possible effect of other variables.

Tables of correlations

This section contains tables of correlations to support references to the correlation between certain variables throughout this paper.

The SF36 physical health measures are: physical functioning (PF), role limitations owing to physical functioning (RP), bodily pain index (BP), general health perceptions (GH) and the physical component summary measure (PCS).

The SF36 mental health measures are: social functioning (SF), role limitations owing to emotional functioning (RE), general mental health perceptions (MH), vitality (VT) and the mental component summary measure (MCS).

Appendix Table 29 – Correlation between SF36 physical measures of wellbeing

	PF	RP	BP	GH	PCS
PF	-	0.6506	0.5233	0.5465	0.8595
RP	0.6506	-	0.7099	0.5389	0.8237
BP	0.5233	0.7099	-	0.4431	0.7826
GH	0.5465	0.5389	0.4431	-	0.6074
PCS	0.8595	0.8237	0.7826	0.6074	-

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 30 – Correlation between SF36 mental measures of wellbeing

	SF	RE	VT	MH	MCS
SF	-	0.5928	0.4865	0.5279	0.6725
RE	0.5928	-	0.4344	0.5879	0.7111
VT	0.4865	0.4344	-	0.5996	0.7407
MH	0.5279	0.5879	0.5996	-	0.9053
MCS	0.6725	0.7111	0.7407	0.9053	-

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand

Appendix Table 31 – Correlation between SF36 physical and mental measures of wellbeing and K10 survey

	PF	RP	BP	GH	PCS	K10
SF	0.4151	0.5695	0.4422	0.4140	0.4247	-0.5699
RE	0.2911	0.4091	0.2936	0.3668	0.2017	-0.6368
VT	0.4521	0.5137	0.4360	0.5339	0.3914	-0.5646
MH	0.2211	0.3375	0.3012	0.3876	0.0573	-0.7672
MCS	0.1602	0.3241	0.2371	0.4527	0.0303	-0.7691
K10	-0.3044	-0.4121	-0.3388	-0.4214	-0.2017	

Source: SoFIE Waves 1-3, OSMs, longitudinal weights, supplied by Statistics New Zealand