Through-Time Analyses of National Health Surveys

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# Table of Contents

**Executive Summary**

1 **Introduction**
   1.1 Conceptual Framework  
   1.2 Measures of Health  
   1.3 Measures of Labour Force Status and Outcomes  
   1.4 Research Questions

2 **Data Sources and Description**
   2.1 Criteria for Selecting the Variables of Interest  
   2.2 Final Selection of Variables  
   2.3 Data Construction

3 **Changes in Health Status - A Descriptive Analysis**

4 **Methodology**

5 **Regression Results**
   5.1 Diagnostic Tests  
   5.2 Results for Women and Men Aged 24-60 Years  
      5.2.1 Long term health conditions  
      5.2.2 Risk factors  
      5.2.3 Consultation with general practitioners and specialists  
      5.2.4 Year effects  
      5.2.5 Age effects  
      5.2.6 Cohort effects  
   5.3 Results for Women Aged 44-60 Years

6 **Conclusions**

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**List of Boxes**

Box 1 Measures of Health  
Box 2 Labour Force Status and Outcomes  
Box 3a Graphs for Selected Health Measures: Women  
Box 3b Graphs for Selected Health Measures: Men  
Box 4 Description of Long Term Conditions  
Box 5a Prevalence Rates of Long Term Conditions: Women  
Box 5b Prevalence Rates of Long Term Conditions: Men  
Box 6 Age, Period and Cohort Effects  
Box 7 Balanced and Unbalanced Model
List of Tables
Table 1  Variables and Definitions 14
Table 2  Odds Ratios for Not in the labour force: Women and men aged 24-60 years by selected health variables using three National Health Surveys (1989-90,1995, 2001) 24
Table 3  Odds Ratios for Not in the labour force: Women and men aged 44-60 years by selected health variables using three National Health Surveys (1989-90,1995, 2001) 28

List of Figures
Figure 1  Conceptual Framework: Health, Its Determinants and Health’s Link with Labour Force Outcomes 4
Figure 2  Repeated Cross-section Data from the 3 Health Surveys 13
Figure 3  Odds Ratios: Age Effect for Women and Men: Age-Cohort Model 26
Figure 4  Odds Ratios: Cohort Effect for Women and Men: Age-Cohort Model 27

Appendices
Appendix 1a  Graphs for Long Term Conditions for Men and Women Aged 24-44 years Across Three NHSs 30
Appendix 1b  Graphs for Long Term Conditions for Men and Women Aged 30-50 years Across Three NHSs 32
Appendix 1c  Graphs for Long Term Conditions for Men and Women Aged 24-44 years Across Three NHSs 34
Appendix 2a  Odds Ratios of Ages: For Women and Men Aged 24-60 years 36
Appendix 2b  Odds Ratios of Cohorts: For Women and Men Born Between 1965 and 1945 37
Appendix 3  Odds Ratios of Ages: For Women and Men Aged 44-60 years 38
Appendix 4  Correlation Analysis Among the Explanatory Variables 39

Bibliography 40
Executive Summary

This paper provides a ‘through-time’ analysis of the relationship between labour force status and health status. It is widely known that health status affects a person’s capacity to work productively. Chronic health conditions that diminish basic physical and mental capabilities are typically expected to disrupt normal work functioning. As a result, individuals with poor health status are expected to spend less time in the labour force, retire younger and/or change the kind of work performed.

Previous studies have examined the associations using cross sectional data. But for the first time, using the pooled data from 1989, 1995 and 2001 ABS health surveys, this project undertakes a ‘through-time’ analysis of these associations. We use Not in the labour force (NILF) as the labour force status measure and long term health conditions, risk factors and health related actions as the health measures.

We followed selected birth cohorts over time to examine the changes in health status. Our analysis shows that long term conditions worsened over time for those born between 1965 and 1945 who are not in the labour force. People not in the labour force have higher prevalence rates for certain conditions than people in the labour force. The prevalence rates of arthritis, hypertension and anxiety exhibit the largest gap between people not in the labour force and people in the labour force.

The associations between people’s labour force and health status were analysed employing multivariate logistic regression. We used Age-Cohort and Age-Period models to examine the associations between the people not in the labour force and their health status by controlling for socio-demographic factors.

Six long term health conditions that are in the National Health Priority Areas (NHPAs) were included in the analysis. These are hypertension, asthma, arthritis, diabetes, cancers and anxiety.

For men, estimated odds ratios of the long term health conditions indicate that those who suffer from anxiety are three times more likely to be outside the labour force and asthma sufferers are 25% more likely to be outside the labour force. Odds ratios for women show that diabetes and cancer sufferers are more likely to be outside the labour force than those with the other long term conditions.

Specific lifestyle and related risk factors are associated with major causes of ill health and disability. Three risk factors included in the analysis are lack of physical activity, smoking and body mass index (BMI). The odds ratios of risk factors indicate that both women and men are more likely to be NILF if they are: current smokers, overweight and obese, and doing little exercise.

A person’s health related actions are generally related with health status and therefore his or her need for medical attention. Visits to general practitioners (GPs) or specialists is the health related action variable we used. Odds ratio for women indicate that those who consult a doctor are 28% more likely to be outside the labour force. Odds ratio estimates indicate that men who visit GPs or specialists are more than twice as likely to be NILF than those who did not see a doctor or specialist.
Our models contained age-cohort and age-period effects.

Both age-cohort and age-period models indicate that young people are less likely to be in the 'Not in the labour force' sub-population compared to people aged in their late 40s and above. This result is true for both men and women, but stronger for women.

Period effects are influences associated with each period of time (i.e. survey year), regardless of age. They represent the impact of periodic phenomena such as the economic cycle. The odds ratios of the variable 'Year' indicate that women were less likely to be NILF in 1995 and 2001 than they were in 1989, while men were more likely.

Cohort effects reflect changes in the response variable (people not in the labour force) that have occurred and are exclusive to a particular birth cohort. This effect influences a particular cohort for their entire life and it is independent from period effects. The magnitude of the odds ratios of birth cohorts are much smaller than the odds ratios of age. Results show that people born between the mid 1940s to mid 1950s are more likely to participate in the labour force than the younger cohorts.

Acknowledgments

The authors would like to thank Godfrey Lubulwa, Jon Hall, Ruel Abello (ABS-Analysis Branch), Gemma Van Halderen, Sally Goodspeed, Paul Atyeo (ABS-Health and Community Statistics), Jenny Badham (Department of Health and Aging), and Annette Dobson (University of Queensland) for their help with and/or comments on this paper. Responsibility for any mistakes or omissions remains with the authors.
1 Introduction

The relationship between labour force status and health status is not one directional. Past studies have shown (in one direction) that a person's labour force status and outcomes have an influence on a person's health. For example, Theodossiou (1998) found that a person's labour force status was linked to poor health status defined to include physiological effects, demoralisation and lower esteem. Clarke and Oswald (1994) found that the unemployed are relatively unhappy and show higher levels of mental distress than their employed counterparts. Marmot et al, (1997) reported that a personal sense of satisfaction with the job is also an important determinant of health while Martikainen and Volkonen (1996) and Bartley (1994) observed that the psychological impacts of being unemployed include a loss of a sense of identity, lowered self esteem, marginalisation and alienation from society which reduced social contact and support.

In another direction, the number of hours worked can influence a person's health status. For example, Schofield (1996) and Shields (1999) reported that working excessive hours increased the risk of certain health behaviours and outcomes. Prolonged periods of long hours may also increase anxiety, strain and irritability. Long working hours have often been mentioned as a cause of occupational disease and stress related diseases.

Furthermore, health risk behaviours have important implications for individual psychological and physical health, both in the short term and long term. Several studies (for example, Morris et al, 1994; Mathers and Schofield, 1998; Morris et al, 1992; and Wilson and Walker, 1993) reported that there are higher rates of smoking and alcohol use and poor diet behaviour among unemployed people.

This paper reports a 'through-time' analysis of the relationship between labour force status and health status. In this study labour force status is the dependent or explained variable. Health status affects a person's capacity to work or be productive. Chronic health conditions that diminish basic physical and mental capabilities are typically expected to disrupt normal work functioning (Chirikos, 1993; Mathers, 1994; and Bound et al, 1999). As a result, individuals with poor health status are expected to reduce the amount of time they spend in the labour force, retire earlier and/or change the kind of work they perform. Mitchell (1990) found that the deterioration of health over time is the most significant determinant of why people with chronic diseases leave the labour force earlier than their otherwise healthy counterparts.
1.1 Conceptual Framework

Figure 1 illustrates the framework we adopt in a 'through-time' analysis of the relationships between individual and environmental factors, health status, and labour force status (and outcomes). Labour force status is influenced by socio-economic, individual and health factors either directly or through health status. It also shows how lifestyle behaviour is linked to labour force status directly or indirectly through health status.

Figure 1 Conceptual Framework: Health, Its Determinants, and Health's Link with Labour Force Outcomes

Source: This framework is a modified version of the one used by the Australian Institute of Health and Welfare (2002). The AIHW framework does not include the link between health and labour force statuses.

Past empirical studies of labour force participation focus on the importance of economic variables in one's decision to participate in the labour force (Dunlop et al, 1984). These economic variables have included:

- the real wage rate;
- the prices of consumption goods;
- non-wage income;
- wealth accumulation;
- human capital; and
- variables representing labour market disequilibrium - for example, the unemployment rate.
These studies assume that an individual is healthy enough to participate in the labour market. This paper explores, through time, the relationship between the labour force status 'Not in the labour force' and a number of health variables. The economic variables are not included in this study. First because the National Health Survey does not collect data on many of them. And Second - and perhaps more importantly - most of the economic-oriented studies focus on the second part in what is a two part problem. This paper deals with the first part - the association between health variables and labour force participation.

1.2 Measures of Health

Health status refers to a person's state of being, and therefore its meaning varies according to individual or community expectations and context (ABS, 2001). Physiologically, health status relates to both the physical and mental state of a person. However, it is not simply about the absence of disease or disability, but is "a continuum that includes states of well-being" (ABS, 2001 p. 84). Some people may have a disease or disability but still consider themselves as being in good health if they are able to manage their condition or maintain their quality of life (ABS, 2001). Being a continuum, health status is indicated not by one but by several health measures (see Box 1).
Box 1 Measures of Health

1. Presence of disease, injuries or disability
Though people suffer from a variety of diseases, injuries (or disability) the National Health Priority Area Initiative (NHPA) focuses on major chronic diseases and conditions as well as injuries. The initiative recognises the need to cover the continuum of care across prevention, treatment and management. The following diseases and injuries are identified as NHPA conditions: 1) cardiovascular diseases; 2) cancers; 3) injuries; 4) mental problems and disorders; 5) diabetes; 6) asthma; and 7) arthritis and musculoskeletal diseases.

2. Self-assessed health status
A measure of self perceived health status represents the general public's subjective impression about their status of health. Self assessed health is based on a single question asking "How do you consider your health status in general or how do you rate your health”.

3. Risk factors
A range of biomedical and behavioural risk factors are associated with major causes of ill health, disability and death. Specific lifestyle and related factors which have been identified as (positively and/or negatively) impacting on health include diet and nutrition, use of medicines, overweight and obesity, physical activity, high blood cholesterol, inadequate sun protection, high blood pressure, oral hygiene, smoking, alcohol use, lack of or incomplete immunisation and use of illicit drugs (ABS 2001).

- Biomedical risk factor - Overweight and obesity:
  Overweight and obesity are associated with coronary heart disease, type 2 diabetes, breast cancer, gallstones, degenerative joint disease and obstructive sleep apnoea.

- Lifestyle and behaviour:
  - Tobacco smoking
    Smoking is associated with coronary heart disease, several cancers including lung, mouth, cervical, stroke and lung disease.
  - Alcohol consumption
    Excess alcohol consumption is associated with coronary heart disease, liver and pancreatic disease, stroke, high blood pressure, cancers of the digestive system, accidents, mental illness and violence.
  - Physical inactivity
    Physical inactivity is associated with coronary heart disease, stroke, type 2 diabetes, colon cancer, osteoporosis, bone fractures, falls, mental illness and obesity.

4. Health related actions
A person’s health related actions generally indicates his or her need for medical attention as a result of health condition. There are a range of actions available including: Stays in hospital, Visits to casualty (emergency) and outpatient units at hospital, Visits to day clinics, Consultations with doctors (and specialists), Dental consultations, Consultations with other health professionals, Days away from work or school/study, Other days of reduced activity, Use of medications including vitamins and natural/herbal preparations.

Although there are various health measures covered we use only selected measures that are available and comparable across the surveys (see Section 2.1 for more details). The selection of health variables are based on:

- our conceptual framework (see section 1.1), and
- availability and comparability of data across the health surveys.
The health conditions (NHPAs) are long term in nature. A long term condition is defined as a condition the respondent had experienced or expected to have for six months or more.

1.3 Measures of Labour Force Status and Outcomes

**Employed** people are defined as people (15 years old and over) who, during the reference week worked for one hour or more for pay, profit, commission or payment in kind, in a job or business or on a farm.

**Unemployed** are defined as people 15 years old and over who (i) were not employed during the reference week, and (ii) had actively looked for full-time or part-time work at any time in the four weeks up to the end of the reference week and (iii) were available for work in the reference week; or (iv) were waiting to start a new job within four weeks from the end of the reference week, and could have started in the reference week if the job had been available then.

People **not in the labour force** are defined as people (15 years old and over) who were not employed or unemployed (as defined above). This group includes: people who were keeping house (unpaid), retired, voluntarily inactive, or permanently unable to work, and people in institutions. (For more detailed information on the definitions see the ABS publication Labour Statistics: Concepts, Sources and Methods, cat. no. 6102.0).

**Box 2 Labour Force Status and Outcomes**

Our conceptual framework (Figure 1) shows the links between health status and labour force status and outcomes. Labour force status can be expressed as:

- labour force participant (employed or unemployed) and non participant (Not in the labour force);

and labour force outcomes for an individual can be expressed as the individual's:

- occupation;
- industry of work;
- number of hours worked;
- number of jobs held; and
- (if unemployed), length of unemployment

This paper reports on a through-time analysis of the association between the labour force status 'Not in labour force' and health status and selected socio-economic variables. Other analyses which are possible include through-time analysis of the associations between:

- employed people and their health status;
- unemployed people and their health status; and
- labour force outcomes and health status.
1.4 Research Questions

This paper focuses on the associations of men's and women's 'Not in the labour force' status and their health status for those aged 24-60 years. Some of the specific questions which can be answered using this analysis are:

1. How did the health status change over time for those people born between 1945 and 1965?
2. What is the probability of one not being in the labour force, given one's health status? As some selected NHPAs and certain risk factors are more prevalent in older age groups we undertake separate analysis for people more than 44 years old.
3. Do older cohorts participate more in the labour force compared to their younger counterparts, given their health status?

Addressing Question 1, requires panel data where individuals are tracked over time. In the absence of panel data we can follow a group of people from one birth year using pooled data from cross-sectional health surveys. Although such analysis cannot capture changes in health status at an individual level, it can at a group level. We use descriptive analysis to examine how health status changes over time.

To address Question 2 we make use of modelling techniques. When establishing the association between health and labour force status we control for the socio-demographic characteristics (age, sex and cohorts) simultaneously.

Research Question 3 is answered using the results from Question 2.

This paper is organised as follows: Section 2 outlines the data sources, description and associated comparability issues across the NHSs, Section 3 analyses the changes in health status for selected cohorts over time, Section 4 deals with the methodology to address the research question 2 and question 3, Section 5 presents the preliminary regression results and analysis. Finally, Section 6 provides some concluding remarks of the study.
2 Data Sources and Description

The National Health Surveys (NHSs) conducted by the Australian Bureau of Statistics (ABS) are the sources of data for this analysis. The ABS conducts the national health survey every six years. Five surveys have so far been conducted: in 1977-78, 1983, 1989-90, 1995 and in 2001. These surveys collect information on the health status of the population, use of health services, health related aspects of people's lifestyles, and some demographic and socioeconomic characteristics of respondents. Over the period however, there have been a number of changes to the scope of the surveys, survey design, questionnaire design, definitions, classifications and concepts.

There are notable differences between the first two health surveys (1977-78 and 1983) and the last three health surveys (1989-90, 1995 and 2001), which in general pose comparability issues. These include:

- Although the 1977-78 survey has information on people who are employed it does not distinguish between people who are unemployed and people who are not in the labour force.

- The 1983 health survey differs from the other surveys. In particular, chronic (long term) conditions (illness, injury or impairment the respondents had for more than six months) were not specifically identified. The health conditions captured in the 1983 survey are mostly short term conditions (those respondents had for the two weeks previous to interview).

- Both the 1977-78 and 1989-90 surveys captured long term conditions of the respondents. However, there are differences in the corresponding questions. The 1977-78 included conditions which the respondent had had for more than six months. In 1989-90 survey chronic conditions included all conditions which the respondent had had or expected to have for six months or more.

- In 1977-78 survey, some of the conditions were captured based on prompt cards whereas the other surveys used a separate module asking whether the respondent has ever been told by a doctor or nurse that he or she had the condition.

Considering the comparability issues across all surveys we only make use of the last three surveys (1989-90, 1995 and 2001).

2.1 Criteria for Selecting the Variables of Interest

Although the 2001 survey is similar to the 1995 survey, in many ways, there are important differences between them. The variables of interest included in the analysis are determined by the following criteria:

- the importance and usefulness of particular time series (for example, health conditions identified in the National Health Priority Areas (NHPAs);
- consistency of the trend from 1989 to 2001; and
We also referred to the questionnaire as well as the scope and coverage to assess each variable of interest. It is not possible to quantify the effect of changing questionnaire designs independently from the actual change in prevalence of health conditions between 1989-90 and 2001.

2.2 Final Selection of Variables

Long term conditions. The NHPA conditions 'cardiovascular disease' and 'mental problems and disorders' do not satisfy the selection criteria (of comparability across the surveys) hence, both are excluded from the analysis. However, Hypertension as a sub-category of cardiovascular disease is included. Anxiety is also included as a sub-category of mental problems and disorders. The long term conditions (identified in the NHPAs) included in this analysis are: Hypertension, Asthma, Arthritis, Diabetes, Cancer and Anxiety.

Risk factors. Among the risk factors, we exclude alcohol consumption as it does not meet the inter-survey comparability criteria. The risk factors included in the analysis are: Body Mass Index (BMI), Smoking and Exercise level.

Health related actions. Among the health related actions only general practitioner or specialist visits are included. The other health related actions such as visits to the casualty (emergency), visits to day clinic, stays in hospital and use of medications are excluded as they do not satisfy the comparability criteria.

People who rate their health as poor or fair tend to have at least one long term condition or a disability. Despite its subjective nature, the self assessed health measure appears to be a useful indicator of a person’s health status. It has also been established that this measure is associated with a number of other measures of health status (and usages) and is an independent predictor of future health care use and survival (Jee and Or, 1999).

Association between the explanatory variables

As a first step in quantifying the associations between the explanatory variables we undertook a pair-wise correlation analysis and the results indicate that (refer to Appendix 4):

- Self assessed health is strongly correlated with a number of long term conditions, particularly with asthma. Hence, we exclude the self assessed health variable from our analysis.
- Other health professional (OHP) visits is excluded as it is correlated with general practitioner or specialist visits.
- The days away from work, days of reduced activity and being NILF are mutually exclusive events, so we exclude them from the analysis.

The final list of explanatory variables include: six long term conditions, three risk factors and general practitioner (or specialist) visits. The graphs presented in Box 3 show a description of the selected variables over the time period.
The percentage of women with a long term health condition

The proportion of women suffering from arthritis and hypertension declined between 1995 and 2001. The proportion of cancer sufferers declined slightly in 2001 over the same period. There was an increase in the incidence of asthma, diabetes and anxiety sufferers over the period.

The percentage of women with selected risk factors

The proportion of women who exercised at low levels increased from 1989-90 to 2001, as did the proportion of those overweight and obese (measured by Body Mass Index). The proportion of smokers, ex-smokers and those who are underweight declined over the same period.

The percentage of women who visited a doctor/specialist

There has been an increasing trend in the proportion of women who consulted a general practitioner (GP) or specialist over the period.
Box 3b Graphs for Selected Health Measures: Men

The percentage of men with a long term health condition

<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15.0%</td>
</tr>
<tr>
<td>10.0%</td>
</tr>
<tr>
<td>5.0%</td>
</tr>
<tr>
<td>0.0%</td>
</tr>
<tr>
<td>Arthritis</td>
</tr>
<tr>
<td>Asthma</td>
</tr>
<tr>
<td>Hypertension</td>
</tr>
<tr>
<td>Cancers</td>
</tr>
<tr>
<td>Diabetes</td>
</tr>
<tr>
<td>Anxiety</td>
</tr>
</tbody>
</table>

The proportion of men suffering from arthritis and hypertension declined between 1995 and 2001. The proportion of cancer sufferers increased slightly over the period and the proportion of asthma sufferers stabilised around 10.5% in 2001. There was an increase in the incidence of diabetes and anxiety sufferers over the period.

The percentage of men with selected risk factors

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>50.0%</td>
</tr>
<tr>
<td>40.0%</td>
</tr>
<tr>
<td>30.0%</td>
</tr>
<tr>
<td>20.0%</td>
</tr>
<tr>
<td>10.0%</td>
</tr>
<tr>
<td>0.0%</td>
</tr>
<tr>
<td>Exercise low</td>
</tr>
<tr>
<td>Smoker</td>
</tr>
<tr>
<td>Ex-smoker</td>
</tr>
<tr>
<td>Underweight</td>
</tr>
<tr>
<td>Overweight</td>
</tr>
<tr>
<td>Obese</td>
</tr>
</tbody>
</table>

The proportion of men who exercised at low levels increased from 1989-90 to 2001, as did the proportion of those overweight and obese (measured by Body Mass Index). The proportion of smokers, ex-smokers and those who are underweight declined over the same period.

The percentage of men who visited a doctor/specialist

<table>
<thead>
<tr>
<th>Visited doctor/specialist: Men, 1989-90, 1995 and 2001</th>
</tr>
</thead>
<tbody>
<tr>
<td>25.0%</td>
</tr>
<tr>
<td>20.0%</td>
</tr>
<tr>
<td>15.0%</td>
</tr>
<tr>
<td>10.0%</td>
</tr>
<tr>
<td>5.0%</td>
</tr>
<tr>
<td>0.0%</td>
</tr>
<tr>
<td>1989-90</td>
</tr>
<tr>
<td>1995</td>
</tr>
<tr>
<td>2001</td>
</tr>
</tbody>
</table>

There has been an increasing trend in the proportion of men who consulted a general practitioner (GP) or specialist over the period.
2.3 Data Construction

The survey micro data file contains 54,241 observations (persons) in the 1989 survey; 53,828 observations in the 1995 survey; and 29,107 observations in 2001. We excluded those who did not respond to the questions that are related to the variables of interest in our analysis from the three surveys. The final pooled sample size for the age 24-60 years was 62,319 persons. Of this total 31,371 were women and 30,948 were men.

By pooling the data from the three NHSs it is possible to track a group of people based on the birth year. Figure 2 shows this in diagrammatic form for the most recent three surveys.

**Figure 2  Repeated Cross-section Data from the 3 Health Surveys**

The construction of data allows a sequential cross-sectional perspective. The data is put in a pseudo-longitudinal format that enables the consideration of the effects of current and past period's health status or risk factors in the analysis of labour force participation, for selected birth cohorts. The list of variables in the data set is in Table 1. For each person, we assign a value '1' if a condition (or event or characteristic) exists, or '0' otherwise.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not in the Labour Force</td>
<td>A dummy variable equal to 1 if the respondent is not in the labour force</td>
</tr>
<tr>
<td>Long term health conditions:</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>A dummy variable equal to 1 if the respondent has Hypertension</td>
</tr>
<tr>
<td>Asthma</td>
<td>A dummy variable equal to 1 if the respondent has Asthma</td>
</tr>
<tr>
<td>Arthritis</td>
<td>A dummy variable equal to 1 if the respondent has Arthritis</td>
</tr>
<tr>
<td>Diabetes</td>
<td>A dummy variable equal to 1 if the respondent has Diabetes</td>
</tr>
<tr>
<td>Cancer</td>
<td>A dummy variable equal to 1 if the respondent has Cancer</td>
</tr>
<tr>
<td>Anxiety</td>
<td>A dummy variable equal to 1 if the respondent has Anxiety</td>
</tr>
<tr>
<td>Risk factors:</td>
<td></td>
</tr>
<tr>
<td>Body Mass Index (BMI):</td>
<td>A dummy variable equal to 1 if the respondent is underweight;</td>
</tr>
<tr>
<td></td>
<td>A dummy variable equal to 1 if the respondent has acceptable weight; and</td>
</tr>
<tr>
<td></td>
<td>A dummy variable equal to 1 if the respondent is overweight.</td>
</tr>
<tr>
<td>Smoking</td>
<td>A dummy variable equal to 1 if the respondent is a current smoker</td>
</tr>
<tr>
<td></td>
<td>A dummy variable equal to 1 if the respondent is an ex smoker</td>
</tr>
<tr>
<td></td>
<td>A dummy variable equal to 1 if the respondent never smoked</td>
</tr>
<tr>
<td>Exercise level</td>
<td>A dummy variable equal to 1 if the respondent's level of exercise is low;</td>
</tr>
<tr>
<td></td>
<td>A dummy variable equal to 1 if the respondent's level of exercise is</td>
</tr>
<tr>
<td></td>
<td>moderate; and</td>
</tr>
<tr>
<td></td>
<td>A dummy variable equal to 1 if the respondent's level of exercise is</td>
</tr>
<tr>
<td></td>
<td>high;</td>
</tr>
<tr>
<td>Health Related Actions:</td>
<td></td>
</tr>
<tr>
<td>GP/Specialist visit</td>
<td>A dummy variable equal to 1 if the respondent visited doctor/GP in the</td>
</tr>
<tr>
<td></td>
<td>last two weeks</td>
</tr>
<tr>
<td>Sex</td>
<td>A dummy variable equal to 1 if the respondent is a female</td>
</tr>
<tr>
<td>Age (single age)</td>
<td>A dummy variable equal to 1 if the respondent belongs to that particular</td>
</tr>
<tr>
<td></td>
<td>age</td>
</tr>
<tr>
<td>Year</td>
<td>A dummy variable equal to 1 if it corresponds to a particular survey year</td>
</tr>
<tr>
<td>Cohort (single birth cohort)</td>
<td>A dummy variable equal to 1 if the respondent belongs to a particular birth</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Box 4 briefly describes the long term health conditions which are included in the analysis. These conditions have a general effect on people’s well being and hence their ability to participate in the labour force.
**Box 4 Description of Long Term Conditions**

**Hypertension**
Hypertension is a major risk factor for coronary heart disease, stroke, heart failure, peripheral vascular disease and renal failure. The risk of the disease increases as the level of blood pressure increases. High blood pressure is more likely to develop among people who are overweight or are physically inactive, or have high dietary salt intake. About 10% of the Australian population suffers from hypertensive disease and the prevalence is more among the aged 45 years and above.

**Asthma**
Asthma is an inflammatory disease of the lung's air passage that makes them prone to narrow too easily and too much in response to 'triggers', causing episodes of shortness of breath and wheezing or coughing. The symptoms are usually reversible, spontaneously or with treatment. Though there are about 12% people who suffer from asthma, it is more prevalent in younger age groups (5-14 years). In older age groups asthma is more common among women than among men.

**Arthritis**
Musculoskeletal disorders are among the most common health conditions and have a substantial influence on quality of life. They affect almost every individual at some time in their lifetime. Many of these conditions are minor, but some can cause lifelong disability. A major subgroup is arthritis, which refer broadly to inflammation of the joints with associated stiffness, pain and deformity. About 14% of Australian population has arthritis disease.

**Diabetes**
Diabetes is a long term condition in which blood glucose levels become too high because the body produces little or no insulin or cannot use insulin properly. Although diabetes accounts for around 3% of the population it can lead to a range of complications hence affecting health status.

**Cancer**
Cancer is a diverse group of diseases in which some of the body's cells become defective, begin to multiply out of control, can invade and damage the area around them, and can also spread to other parts of the body to cause further damage. Some risk factors are modifiable through lifestyle changes whereas others are inherited. Based on 2001 NHS estimates, about 1.6% of the population had a medically diagnosed cancer. Cancer incidence increases with age. Women have a higher incidence than men between 25 to 54 years, but men have higher incidence beyond 55 years.

**Anxiety**
Anxiety and nervousness are the disturbance of mood or thought that can affect behaviour and distress the person or those around them. As a result the person cannot function normally. They impose a heavy burden of human suffering including stigmatisation of those affected. 2001 NHS estimates indicate that about 3.4% of men and 5.6 % of women suffer from anxiety and nervousness.

*Source: AIHW 2002 and ABS 2001*
3 Changes in Health Status - A Descriptive Analysis

We make use of the sequential cross-sectional data to analyse the changes in health status over time. Provided that the population is not affected by migration (both immigration and emigration) successive cross sectional surveys can be used to follow cohorts (based on their birth year) over time.

The following graphs show how health status changed over time for both men and women born between 1965 (24 years in 1989) and 1945 (44 years in 1989). These cohorts are aged 30-50 years in 1995 and 36-56 years in 2001. The prevalence rates are expressed as percentages of people who have a long term condition among the total number of people in the respective sub populations (i.e., not in the LF and in the LF) for a particular survey year.
Box 5a Prevalence Rates of Long Term Conditions: Women

Hypertension: Women not in the LF and in the LF by age group

Asthma: Women not in the LF and in the LF by age group

Arthritis: Women not in the LF and in the LF by age group

Diabetes: Women not in the LF and in the LF by age group

Cancer: Women not in the LF and in the LF by age group

Anxiety: Women not in the LF and in the LF by age group
The above graphs show that the prevalence rates of long term conditions increase
as cohorts get older for both women and men who are in and out of the labour force. For both women and men who are NILF have higher prevalence rates than those in the labour force (except for the women asthma sufferers aged 24-44 years). Among the long term conditions, for women aged 36-56 years, arthritis and hypertension exhibit the highest gap between those NILF and those in the labour force. For men, the prevalence rates of arthritis and anxiety exhibit the highest gap between those NILF and people in the labour force. Although these estimated rates do not control for age and economic conditions in the survey years, they provide some valuable information about the changes in long term conditions over time.

We also compare the prevalence rates of the long term conditions between women and men who are in and out of the labour force for the same age groups across the three NHSs. Results show (see graphs in Appendix 1) that prevalence rates increase with age for both groups of people. However, for both sexes people who are NILF have a higher prevalence of long term conditions than those who are in the labour force across the three age groups we examined.

4 Methodology

The observed variables of interest from the micro (individual level) data are categorical and we use a multiple logistic regression approach. The model may be expressed by the following:

$$\log \left( \frac{P_i}{1 - P_i} \right) = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ij}$$

..............................(1).

where $P_i$ is the probability of an event and $(1 - P_i)$ is the probability of a non-event. The intercept is denoted by $\beta_0$ and the logistic coefficients for independent variables are denoted by $\beta_j$ s. The explanatory variables $X_{ij}$ s are the long term health conditions, risk behaviours, health related actions, age, year (period) and cohort dummies.

We use age, year and birth cohorts as the socio-economic variables. Age is a matrix for age dummies, Year is a matrix for year dummies and Cohort is a matrix for cohort dummies. The inclusion of dummies for age, year, and cohorts allows us to control for age, year and cohorts to analyse and establish a meaningful relationship between labour force status and health variables.

Age, birth year and calendar year are linearly dependent. That is if we know the calendar year and a cohort's birth year we can deduce the cohort's age. Because of this linear relationship (across the all three matrices) the model cannot be estimated. In order to avoid the linear dependency issue we use Age-Cohort and Age-Period models separately. When the response variable is dichotomous we can use standard logistic regression (Stokes et al, 1997).

The dependent variable $\log \left( \frac{P_i}{1 - P_i} \right)$ is known as the log of odds ratios in favour of an event. For example, as our response variable is people who are not in the labour
force the dependent variable is interpreted as log of odds of being NILF. The model (1) can be estimated using maximum likelihood method.

Based on each person's birth year, this study makes use of single year birth cohorts. Variables of interest for single year age cohorts were constructed from the NHSs for selected ages.

**Box 6 Age, Period and Cohort Effects**

**Age effects** are influences produced by growing older. They reflect changes in the labour force variable due to the ageing processes common to all people over the periods.

**Period effects** are influences associated with each period of time (i.e. survey year), regardless of age. They represent the impact of periodic phenomena such as economic cycles.

**Cohort effects** reflect changes in the response variable (people not in the labour force) that have occurred and are exclusive to that particular birth cohort. This effect influences that particular cohort for their entire life and it is independent from period effects.
Box 7 Balanced and Unbalanced Model

By pooling the three NHSs we are able to use as much information as possible. If we use a balanced model we can follow cohorts born between 1945 (44 years in 1989) and 1965 (24 years in 1989). People born after 1965 (for example, people who were born in 1970 who were 25 years in 1995) will be excluded as cohorts. However, they will be included in the model through the age dummy. On the other hand, people who were born before 1945 will also be excluded as cohorts. Using this approach, though we can still capture people age 24-60 years we exclude cohorts who were born after 1965 and before 1929.

However, in the unbalanced model we can capture people born after 1965 and born before 1945 as cohort dummies. This is done by assigning a single dummy for those born after 1965 and another dummy for those born before 1945. Capturing people who were born before 1945 and after 1965 in the analysis will help to keep large number of observations hence maintain the richness of the pooled micro dataset.
5 Regression Results

The results of the multiple logistic regression analyses are summarised in Table 2. The analysis are based on weighted data. The results indicate the factors associated with not being in the labour force. The explanatory variables are listed in the first column and the relative odds ratios for women and men are listed in the succeeding columns, for the two models (age-cohort and age-period), respectively. Odds ratio estimates for single ages and single birth cohorts are available but for clarity in presentation, they are presented in graphs.

5.1 Diagnostic Tests

Test of significance for Individual variables
We use the standard Chi square test to test the significance of the individual variables. All the variables whose odds ratios are in Table 2 are statistically significant at 5% level. The level of significance of the age and cohort effects are indicated in Appendix 2 and 3.

Test for joint significance of the explanatory variables
The likelihood ratio (Chi square) test is used to test the joint significance of all the explanatory variables. The log likelihood is computed with only a constant term and then with all the explanatory variables. Twice the difference in the maximum likelihood is distributed asymptotically as Chi square with m (number of explanatory variables) degrees of freedom. The degrees of freedom for the model (age 24-60 years) is 74 (long term conditions=6, risk factors categories=7, doctor visits=1, age=37 and cohorts=23). Under the null hypothesis all the slopes of the explanatory variables are zero. In all the models estimated in this paper the null hypothesis is rejected.

Goodness of fit tests for the models
Two tests were used to test goodness of fit. The first is the likelihood ratio test which is an analog to the $R^2$ in a conventional regression. The likelihood ratio index (LRI) = $1 - \ln L/\ln L_0$. In this index, $\ln L_0$ is the value of the log likelihood function assuming that all variables in the model have zero coefficients, $\ln L$ is the maximised log likelihood function. The LRI is bounded by zero and 1. The LRI values are shown in Table 2 and Table 3. For all models reported in this paper, this test shows that the log likelihood values for each one of the models are an improvement on the null hypothesis where all coefficients are assumed to be zero (Greene, 1994).

The second test used to assess the model performance is the Hosmer-Lemeshow (H-L) test. The H-L goodness-of-fit statistic is obtained by calculating the Pearson chi-square statistic from the observed and expected frequencies of event outcomes. A small $p$-value indicates a lack of fit of the model (Stokes et al, 1997). The test shows good fit for all the models for both men and women.
5.2 Results for Women and Men Aged 24-60 Years

Table 2 shows the results of the Age-Cohort and Age-Period models. The rest of this section discusses these results. The results are reported in the format of ‘odds ratios’. An odds ratio of greater than one indicates that particular variable is positively influencing the response variable and a less than one indicates it is negatively influencing the response variable.

5.2.1 Long term health conditions

Results show that all the long term health condition variables are statistically significant. In the Age-Cohort model for women the odds ratios for long term conditions range from 1.02 to 1.71. That is asthma sufferers are 2% more likely to be NILF than the non asthma sufferers, while diabetes sufferers are 71% more likely to be NILF than non-diabetes sufferers. We can interpret the odds ratios for other NHPAs in similar fashion.

In the Age-Cohort model, men have higher odds ratios than women. Among the long term conditions anxiety exhibits the largest difference in odds ratio between women and men. Men who suffer from anxiety related problems are about three times more likely to be NILF than the non-anxiety sufferers.

Odds ratios for long term conditions based on the Age-Period model are similar to the results in the Age-Cohort model for both women and men.

5.2.2 Risk factors

Results from the Age-Cohort model shows, for women, that current smokers are 15% more likely to be NILF than those who never smoked. The reference category is never smoked where the odds ratio is assumed to be one. Those who previously smoked are 7% less likely to be NILF than those who never smoked. For men, current smokers are 77% more likely to be NILF while ex smokers are 13% more likely to be out of the labour force.

Women who are obese are 29% more likely to be NILF than women who are in the acceptable weight range (reference group). Similarly, women who are overweight are 15% more likely to be NILF than those in the reference group. In comparison women who are underweight are 8% more likely to be NILF than those with acceptable weight.
Table 2  Odds Ratios for Not in the labour force: Women and men aged 24-60 years by selected health variables based on three National Health Surveys (1989-90, 1995, 2001) (a), (b)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Age-Cohort Model</th>
<th>Age-Period Model</th>
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</thead>
<tbody>
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<td></td>
<td>Women : Age 24-60 years</td>
<td>Men : Age 24-60 years</td>
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<tr>
<td>Hypertension</td>
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<td>--</td>
</tr>
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<td>H-L test p-value (c)</td>
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a. All variables are statistically significant at 5% level of significance.
b. All tests for joint significance of the explanatory variables reject the null hypothesis that all coefficients in the model are zero. And the likelihood ratio index test show that the models are improvements on restricted model with all coefficients set to zero.

Men who are obese are 22% more likely to be NILF. However, the odds ratio for men who are overweight shows otherwise. In the case of obese condition, the odds ratio for men are lower than women. These results may be due to the under reporting of men's actual weights. For example, in 2001 men tended to perceive their weight as being in the acceptable range when it was not. Whereas 30% of men assessed themselves as overweight while 58% were classified as overweight (and obese). On the other hand, the women's self-assessment of weight was more accurate (ABS, 2001). It appears that the under reporting of the men's weights tends to distort the results.

The odds ratio of 1.08 for Low exercise in women (this include those who do not do
any exercise) indicates that those who do a low level of exercise, as opposed to those who do moderate exercise, are 8% more likely to be NILF. Women who do a higher level of exercise are 3% more likely to be NILF than those who do a moderate level of exercise.

However, for both low and high level of exercises the opposite was true for men. Again, this could be attributed to data quality problems - men may be exaggerating their level of exercise. It is also possible that men who are participating in the labour force find inadequate time to exercise.

Odds ratios for the risk factors based on the Age-Period model are similar to the results in the Age-Cohort model for both women and men.

5.2.3 Consultation with general practitioners and specialists

The odds ratio for this variable for women and men are 1.28 and 2.42, respectively. These results could be partly explained by the fact that men are more likely than women not to be in the labour force because of a health problem (and so are consulting a doctor or a specialist). The odds ratios of this variable are similar to those derived in the Age-Period model.

5.2.4 Year effects

Odds ratios of the Year 1995 and 2001 based on Age-Period model show that the year effect works in opposite directions between women and men. It shows that in recent times women are less likely to be outside the labour force than they once were, and vice versa for men. This is a well documented trend (ABS cat. no. 6202.0, January 2004).
5.2.5 Age effects

The odds ratios of Age for women are significant, except for the age 51, in the Age-Cohort model. Figure 3 shows that women who are in their late 20s to early 30s are more likely to be NILF (or less likely to be participating in the labour force) compared to those who are aged 24 years (the reference age). This trend is also evident for women who are above 50 years old.

The odds ratios of Age for men are significant. Men aged above 50 years are more likely to be NILF compared to the younger age groups.

The higher odds for NILF for both women and men aged above 50 years could be attributed to factors affecting older age groups including voluntary early retirement and choosing to leave the labour force rather than remain unemployed. The effect of age is more strongly associated with labour force participation among women than men (see Figure 3). The difference in age effect tends to narrow towards the 30s and then widens again after 40 years of age. Appendix 2 gives detailed estimates of the age effects.

5.2.6 Cohort effects

The odds ratios for birth cohorts are statistically significant (except for women born in 1952 and 1949, see Appendix 2b). However, the odds ratios of cohorts are much lower than the odds ratios of age. As shown in Figure 4 the odds ratios exhibit a downward trend for men. Although the graph shows peaks and troughs, it appears that the younger (recently born) cohorts are more likely to be NILF than the older cohorts. This could partly be explained by increases in the number of people among recently born undertaking further study.

Men's odds ratios for the birth cohorts are more volatile than the women's odds ratios. Compared to the 1945 born cohorts, women born in the 1960s are increasingly participating more in the labour force than the men. It could be partly explained by the fact that more and more men are undertaking further studies than women. On the other hand, more and more women are participating in the labour market, particularly through part-time employment. Appendix 3 gives detailed
estimates of the cohort effects.

Note: The reference category is cohort born in 1945.

5.3 Results for Women and Men Aged 44-60 Years

The analysis so far has focused on people aged 24-60 years. This age group is not homogeneous and includes people who are: working, retired, still undertaking studies (students), keeping house (unpaid), not working and not wanting to work (voluntarily inactive), those who have exited the labour market after being long term unemployed, discouraged workers and the permanently unable to work.

This section looks separately at an older group - those aged 44-60 years - to consider the question: 'How is the labour force participation of older people associated with their long term health condition and health risk factors, given that certain long term conditions are more prevalent in older people than the younger group?'.

The results of the multivariate analysis for the 44-60 year age group are shown in Table 3. Broadly, the odds ratios for both men and women are higher than those of aged 24-60 years. That is, people aged 44-60 years with long term medical condition are more likely to be out of the labour force than people aged 24-60 years.

The odds ratios for men and women for this age group who suffer from long term condition(s) are statistically significant. This indicates that men and women are both vulnerable to leave the labour force due to illness. However, the results for men are generally higher than for women.
### Table 3. Odds Ratios for Not in the labour force: Women and men aged 44-60 years by selected health variables based on three National Health Surveys (1989-90, 1995, 2001) (a), (b)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Age-Cohort Model</th>
<th>Age-Period Model</th>
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<td></td>
<td>Women : Age 44-60 years</td>
<td>Men : Age 44-60 years</td>
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<tr>
<td>Hypertension</td>
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a. All variables are statistically significant at 5% level of significance.

b. All tests for joint significance of the explanatory variables reject the null hypothesis that all coefficients in the model are zero. And the likelihood ratio index test show that the models are improvements on restricted model with all coefficients set to zero.

In general, we found that a person's health status affects his or her labour force participation. The likelihood of participation varies depending on their long term health condition(s). Women, who suffer from diabetes as a long term condition are the least likely to participate in the labour force. For men, anxiety sufferers are the least likely to participate in the labour force. Women, who are obese are least likely to participate in the labour force. Men, who are underweight are found to be more likely to be NILF. Men and women who consulted a doctor (or specialist) are also found to be less likely to participate in the labour force.
6 Conclusions

The ABS conducts the national health survey every six years. Using 1989, 1995, 2001 national health surveys we examined the associations between the people not in the labour force and a range of health variables. The health variables include long term health conditions, risk factors and health related actions.

The sequential cross-sectional data let us track selected birth cohorts over time. We undertook a descriptive analysis to assess the changes in health status over the period of study. People who are NILF have higher prevalence rates for many conditions than the people who are in the labour force. Women, who are in the 36-56 age group with arthritis and hypertension exhibit the highest likelihood to be not in the labour force. Men in the same age group with arthritis and anxiety exhibit the highest likelihood to be not in the labour force.

We examined the associations between the people not in the labour force and their health status in a regression framework. Multivariate logistic regression enabled us to control for sex, age and birth cohorts when analysing the associations. We used age-cohort and age-period models.

Our results showed that there is a strong association between labour force participation and long term health conditions, risk factors and health related actions.

The multivariate analysis for the sub-population aged 44-60 years yielded generally higher odds ratios than those of aged 24-60 years, for both men and women. The results reinforce the conclusion that the older age group have greater vulnerability to be outside the labour force due to long-term medical conditions and health risk factors.
Appendix 1

Appendix 1a Graphs for Long Term Conditions for Men and Women Aged 24-44 Years Across Three NHSs

Long term health conditions
Men: Age 24-44 years
NHS 1989-90

Long term health conditions
Women: Age 24-44 years
NHS 1989-90

Long term health conditions
Men: Age 24-44 years
NHS 1995

Long term health conditions
Women: Age 24-44 years
NHS 1995
Long term health conditions
Men: Age 24-44 years
NHS 2001

Long term health conditions
Women: Age 24-44 years
NHS 2001
Appendix 1c  Graphs for Long Term Conditions for Men and Women Aged 36-56 Years Across Three NHSs

Long term health conditions
Men: Age 36-56 years
NHS 1989-90

Long term health conditions
Women: Age 36-56 years
NHS 1989-90

Long term health conditions
Men: Age 36-56 years
NHS 1995

Long term health conditions
Women Age 36-56 years
NHS 1995
Long term health conditions
Men: Age 36-56 years
NHS 2001

Long term health conditions
Women: Age 36-56 years
NHS 2001
Appendix 2

Appendix 2a Odds Ratios of Ages: For Women and Men Aged 24-60 years

<table>
<thead>
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<th>Age</th>
<th>Age-Cohort Model</th>
<th>Age-Period Model</th>
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<td>0.89</td>
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</tr>
<tr>
<td>age47</td>
<td>0.92</td>
<td>2.38</td>
</tr>
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<td>1.91</td>
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<tr>
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</table>

† Indicates not significant at 5% level.
## Appendix 2b  Odds Ratios of Cohorts: For Women and Men born between 1965 and 1945

<table>
<thead>
<tr>
<th>Birth year</th>
<th>Age 24-60 years</th>
<th>Age 44-60 years*</th>
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<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>1965</td>
<td>0.76</td>
<td>2.08</td>
</tr>
<tr>
<td>1964</td>
<td>0.82</td>
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</tr>
<tr>
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</tr>
<tr>
<td>1962</td>
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<td>2.32</td>
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<tr>
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<tr>
<td>1958</td>
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<td>1.12</td>
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<tr>
<td>1957</td>
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<td>1.47</td>
</tr>
<tr>
<td>1956</td>
<td>0.95</td>
<td>1.38</td>
</tr>
<tr>
<td>1955</td>
<td>0.96</td>
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</tr>
<tr>
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</tr>
<tr>
<td>1953</td>
<td>0.97</td>
<td>0.85</td>
</tr>
<tr>
<td>1952</td>
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<td>0.89</td>
</tr>
<tr>
<td>1951</td>
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<tr>
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<tr>
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<td>1946</td>
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<td>1.03</td>
</tr>
<tr>
<td>1945</td>
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</tbody>
</table>

- People born after 1957 are excluded as they have not reached 44 years in all the survey years.
- †Indicates not significant at 5% level. Reference category is 1945 born cohorts.
- Odds ratios for persons born before 1945 and born after 1965 are not presented.
### Appendix 3  Odds Ratios of Ages: For Women and Men Aged 44-60 years

<table>
<thead>
<tr>
<th>Age</th>
<th>Age-Cohort Model</th>
<th>Age-Period Model</th>
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<td>age44</td>
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<td>1.00</td>
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<tr>
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<td>1.85</td>
</tr>
<tr>
<td>age47</td>
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<tr>
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<td>1.29</td>
<td>2.27</td>
</tr>
<tr>
<td>age49</td>
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<td>2.16</td>
</tr>
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<td>1.53</td>
<td>2.17</td>
</tr>
<tr>
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<td>3.34</td>
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<td>4.20</td>
</tr>
<tr>
<td>age53</td>
<td>1.81</td>
<td>4.38</td>
</tr>
<tr>
<td>age54</td>
<td>2.30</td>
<td>4.75</td>
</tr>
<tr>
<td>age55</td>
<td>2.46</td>
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</tr>
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<td>age57</td>
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<td>8.98</td>
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<td>10.13</td>
</tr>
<tr>
<td>age59</td>
<td>3.92</td>
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</tr>
<tr>
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</tr>
</tbody>
</table>

†Indicates not significant at 5% level.
### Appendix 4 Correlation Analysis of Explanatory Variables

<table>
<thead>
<tr>
<th>Variables</th>
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<th>3</th>
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<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
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<td>0.126</td>
<td>0.114</td>
<td>0.023</td>
<td>0.023</td>
<td>0.052</td>
<td>-0.036</td>
<td>0.024</td>
<td>0.079</td>
</tr>
<tr>
<td>Asthma</td>
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<td>-</td>
<td>0.034</td>
<td>0.013</td>
<td>0.009</td>
<td>0.029</td>
<td>-0.011</td>
<td>0.010</td>
<td>0.001</td>
<td>0.074</td>
</tr>
<tr>
<td>Arthritis</td>
<td>0.126</td>
<td>0.034</td>
<td>-</td>
<td>0.052</td>
<td>0.036</td>
<td>0.047</td>
<td>0.043</td>
<td>0.003</td>
<td>0.031</td>
<td>0.090</td>
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<tr>
<td>Diabetes</td>
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<td>0.013</td>
<td>0.052</td>
<td>-</td>
<td>0.009</td>
<td>0.013</td>
<td>0.014</td>
<td>-0.006</td>
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<tr>
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<td>0.036</td>
<td>0.009</td>
<td>-</td>
<td>0.003</td>
<td>0.007</td>
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<tr>
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<td>0.029</td>
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<td>0.013</td>
<td>0.003</td>
<td>-</td>
<td>-0.002</td>
<td>0.023</td>
<td>0.048</td>
<td>0.073</td>
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<tr>
<td>Overweight</td>
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<td>-0.011</td>
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<td>0.007</td>
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<td>-</td>
<td>-0.021</td>
<td>0.022</td>
<td>-0.003</td>
</tr>
<tr>
<td>Current smoker</td>
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<td>-0.006</td>
<td>-0.006</td>
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<tr>
<td>Low exercise</td>
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<td>-</td>
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<tr>
<td>Doctor visits</td>
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<td>0.073</td>
<td>-0.003</td>
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</tr>
</tbody>
</table>

Figures in brackets are \( p \) values.

Most of the variables selected are not significantly correlated except for a few. For example, it is expected that people with asthma as a long term condition only do little exercise or vice versa. Similarly, cancer is expected to be more prevalent with those suffering from anxiety, are overweight or doing low exercise, or vice versa.

A positive correlation coefficient suggests that as the incidence of a condition is increased, there is a corresponding increase in the incidence of another condition. For instance, anxiety is positively correlated with overweight and cancer.

Alternatively, a negative correlation coefficient suggests opposite direction of the variables in question. For example, the increase in diabetes or cancer shows lower incidence of current smoker.
Bibliography


Jee, M and Or, Z (1999), 'Labour market and social policy, health outcomes in OECD Countries: a framework of health indicators for outcome oriented policy making', OECD occasional papers, No. 36.


