Health and Productivity: Psychological Distress is a Major Factor in Productivity Loss for a Range of Health Conditions Affecting Australian Workers

Author

Holden, Elizabeth (Libby)

Published

2011

Thesis Type

Thesis (PhD Doctorate)

School

School of Medicine

DOI

10.25904/1912/3550

Health and Productivity: Psychological distress is a major factor in productivity loss for a range of health conditions affecting Australian workers

Elizabeth (Libby) Holden, MPH
Student number s2177570

School of Medicine, Health Group, Griffith University

Submitted in fulfilment of the requirements of the degree of Doctor of Philosophy

June 2010

Abstract

Background

The global economic uncertainties, an ageing Australian workforce, increasing health care costs, and increasing rates of chronic disease all combine to create an urgency to better understand the relationship between health and productivity. Little is known about the impacts of health status on productivity in Australia. Even less is known about the impacts of co-morbid psychological distress on productivity losses for individual health conditions and clusters of non-randomly occurring health conditions, both in Australia and internationally. This study addresses these gaps in knowledge by exploring associations between health and productivity, adjusting for known demographic and working conditions factors, in a large sample of working Australians.

Methods

The Australian Work Outcomes Research Cost-benefit (WORC) study cross-sectional screening dataset (approximately 78,000 working Australians) was used to explore productivity losses associated with individual health conditions and clusters of non-randomly occurring health conditions; with and without co-morbid psychological distress. The study used the World Health Organisation Health and Productivity Questionnaire adjusting for known demographic characteristics, health status and working conditions. Data were analysed for individual health conditions both with and without co-morbid psychological distress using negative binomial logistic regression and multinomial logistic regression models for absenteeism and self-reported work performance (presenteeism) respectively. Clusters of multi-morbid health conditions were identified using tetrachoric correlation matrices and exploratory factor analysis. The impacts of these clusters on productivity both with and without co-morbid psychological distress were then analysed using the same methods (negative binomial logistic regression and multinomial logistic regression) as described above. As these are cross-sectional data from a non-

representative sample, extrapolation of these findings to the broad population should be done with caution.

Results

Health conditions impacted more on presenteeism than absenteeism. Mental health conditions, specifically drug and alcohol problems and psychological distress, had a greater impact on absenteeism and low self-reported work performance than other chronic physical illnesses. Demographic characteristics, health status (number of co-morbidities) and working condition characteristics all impacted significantly on both absenteeism and self-reported work performance. Psychological distress was significantly associated with all investigated health conditions in both crude and adjusted estimates. When co-morbid with psychological distress, all conditions except diabetes had a significant increased risk of both absenteeism and presenteeism. Diabetes only had a significantly increased risk for presenteeism. The highest ranking health conditions impacting on absenteeism when co-morbid with psychological distress were cancers, injury, and arthritis. For presenteeism, the same conditions were high ranking in slightly different order; with arthritis, injury, and cancers being the highest ranking. The increase in the size of the risk when co-morbid with psychological distress was greater for presenteeism than absenteeism.

The following four factors were found: factor 1: arthritis, back/neck pain, migraine, other chronic pain; factor 2: asthma, COPD, allergies; factor 3: CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity; and factor 4: irritable bowel syndrome, ulcer, heartburn. After adjusting for demographic characteristics, treatment-seeking behaviour and known working conditions, all clusters demonstrated an increased risk of absenteeism. When combined with co-morbid psychological distress the risk was greater for all clusters except the third (CVD, diabetes, high cholesterol, fatigue, high blood pressure, and obesity); however a number

of these conditions had a significant protective association with absenteeism when considered independently. In adjusted models for presenteeism, all clusters of health conditions had an increased risk and when combined with co-morbid psychological distress the risk was greater than the combined additive risk (three-to-five-fold increase). However, the confidence intervals were very wide due to small numbers. The effect of multi-morbid clusters was greater on presenteeism than absenteeism; either when with and without co-morbid psychological distress. This was the same as for individual health conditions.

Conclusions

When exploring the impacts of individual health conditions on productivity, mental health conditions contributed more strongly to absenteeism and presenteeism than other investigated chronic illnesses. Health status and other associated factors such as income and working conditions, if not included in estimation models, can inflate the perceived relationship between health and productivity. Psychological distress was strongly associated with all 14 health conditions or risk factors investigated in this study. Co-morbid psychological distress had an increased risk of productivity loss for both outcome measures of presenteeism and absenteeism for all but one of the health conditions explored. Losses were greater for presenteeism than absenteeism. For some health conditions and clusters of multi-morbid health conditions; the productivity loss was greater than an additive effect.

This research highlights that psychological distress is a major issue affecting the health and productivity of Australian workers, as are working conditions. It suggests that a multi-directional relationship between health, productivity and working conditions is likely; and indicates a mediating role of psychological distress in the relationship between health and productivity regardless of working conditions. These findings provide empirical evidence of the impacts of chronic health conditions and risk

factors on productivity losses for a large Australian sample of workers and provide greater understanding of the composition of clusters of non-randomly occurring health conditions. These research findings have implications for health promotion and for future research in public health and health economics.

Statement of Originality:

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself. Sections of discussion have been incorporated into papers submitted to peer-reviewed journals for publication. In these instances the discussion sections were written by myself as first author and edited by supervisors and co-authors.

LIST OF CONTENTS

GLOSSARY	
$AUD	Australian dollars
ABS	Australian Bureau of Statistics
AIC	Akaike information criteria
AIHW	Australian Institute of Health & Welfare
AUD	Alcohol use disorder
BMI	Body mass index
BIC	Bayesian information criteria
CFI	Comparative fit index
CHD	Coronary heart disease
CIRS	Cumulative Illness Rating Scale
COPD	Chronic obstructive pulmonary disease
CVD	Cardiovascular disease
D&A	Drug and alcohol
DEST	Department of Education, Science and Training
DSM	Diagnostic and Statistical Manual of Mental Disorders
EHC	Employer Health Coalition of Tampa Assessment Instrument
GAD	Generalised anxiety disorder
GERD	Gastroesophageal reflux disease
GDP	Gross Domestic Product
HAS	Australian version of the Health & Productivity Questionnaire
HLQ	Health and Labour Questionnaire
HPQ	Health and Productivity Questionnaire (World Health Organisation)
HRA	Health risk assessment survey

GLOSSARY	
HSVD	Heart, stroke and vascular disease
IRR	Incidence Rate Ratio
K6	Kessler 6 screening tool for psychological distress
MD	Major depression
MDD	Major depressive disorder
MDE	Major depressive episode
MI	Myocardial infarction
QoL	Quality of Life
RMR	Root mean square residual
RMSEA	Root mean square error of approximation
RRR	relative risk ratio
SPS-6	Stanford Presenteeism Scale
TLI	Tucker Lewis index
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation
WLQ	Work Limitations Questionnaire
WORC	Work Outcomes Research Cost-benefits project (Australian-based)
WPAI	Work Productivity and Activity Impairment Questionnaire

ACKNOWLEDGEMENTS

The author would like to acknowledge PhD supervisors Paul Scuffham, Harvey Whiteford and Nerina Vecchio. The contributions of Michael Hilton, Rob Ware, as co-authors on papers arising from the thesis; To Angus Ng and Sandy Muspratt for statistical help; Geoffrey Waghorn, as confirmation reviewer, for advice regarding the direction of the research for the PhD; Professor Ron Kessler and Dr Philip Wang for their guidance in establishing the parent study protocol; and Michael Hilton, Cathy Cleary and Judith Sheridan for implementation of the parent study protocol. The author would also like to acknowledge the support of Gemma Hynard, Michael Yelland and Judy Hardy-Holden. This work was financially supported by (1) the Department of Health and Ageing, Mental Health Strategy Branch, Australian Government, Canberra, ACT, Australia (2) *beyondblue: the national depression initiative*, Melbourne, VIC, Australia (3) The Australian Rotary Health Research Fund, Parramatta, NSW, Australia; and (4) Griffith University, Primary Health Care Research Evaluation and Development Program; Brisbane Australia.

LIST OF PUBLICATIONS ARISING FROM THESIS

1. **Holden L**, Scuffham P, Hilton M, Vecchio N, Whiteford H; "Psychological distress is associated with a range of high priority health conditions affecting working Australians", *Australian & New Zealand Journal of Public Health*, volume 34 number 3, June 2010, pp 304-310.
2. **Holden L**, Scuffham P, Hilton M, Vecchio N, Whiteford H; "Work performance decrements are associated with Australian working conditions, particularly the demand to work longer hours". *Journal of Occupational and Environmental Medicine*, Vol 52, number 3, March 2010, pp281-290.
3. **Holden L**, Scuffham P, Hilton M, Ware R, Vecchio N, Whiteford H; "Which health conditions impact on productivity in working Australians?" *Journal of Occupational and Environmental Medicine,* Vol 53, number 3, March 2011, pp253-257.

1. INTRODUCTION

Health related productivity losses are a concern for Australian industry and government. While there is considerable evidence of the link between health status and productivity losses from the USA, limited evidence is available from within the Australian context.

The World Health Organisation (WHO) advocates the importance of the link between health and productivity, stating that health and wealth reinforce each other and that healthier people are more productive. [1] A report by the WHO Commission on Macroeconomics and Health tabled at the 2008 WHO Conference states that healthier people are more productive and that poor health in low-income countries reduced economic growth. This also applies in high and middle-income countries. People in poor health are less likely to work, and when employed are less productive. [2] This relationship is bi-directional. The same WHO conference reported that it has long been accepted that greater wealth allows people to make better health choices. [2]

While there is a growing body of evidence regarding the impact of health conditions on work performance, [3-11] most of these studies have occurred in the Unites States of America (USA). [3-5, 7, 8, 10, 11]
This thesis explores the relationship between health and worker productivity in a large sample of working Australians, with particular interest in the role of psychological distress on productivity loss.

1.1 The Australian Context

Australia faces significant fiscal and policy challenges resulting from an ageing workforce, rising health care costs and increased global competition. In response to this, the Council of Australian Governments (COAG) introduced the National Reform Agenda (NRA) in 2006 to address known impediments to future national productivity and

workforce participation and productivity. [12] The NRA comprises three streams - competition, regulation and improvements to human capital. The human capital stream covers the three areas of health, education and training. The health element comprises two parts, the first relates to improved health service delivery and payments, the second relates to improved workforce participation and productivity by reducing the incidence of illness, injury, disability and chronic disease in the population. [12] Many of the reforms are now in place. However, a report by the Australian Productivity Commission recommends that further change is needed to secure Australia's future standard of living. [12]

Australia's financial pressures are exacerbated by increasing health care costs. [13] In 2003-04, an estimated $3,931 was spent per person on health, with health expenditure accounting for 9.7% of the Gross Domestic Product (GDP). This level of expenditure has increased over time [14] The proportion of the population aged over 65 years will double over the next forty years and exert more pressure on health care resources. This will also result in an increasingly ageing workforce.

The Australian workplace is changing rapidly. New technologies, globalization, industrial relations and regulatory reforms are all impacting on Australian workers. [12, 15] Over the last decade the increased pressure on industries to be more competitive has seen an increase in the number of employees engaged in shift-work, working irregular and longer hours; and has often been associated with increased job complexity and work intensification. [16] Concurrent to these changes have been industrial relations changes dating from the 1993 enterprise bargaining agreements through to the more contentious Australian Workplace Agreements introduced in 2005. [17] Emerging risks associated with these workplace changes include increased pace of work, longer hours, greater cognitive demands, and job insecurity. [15]

Job demands, effort-reward imbalance, and reduced decision-making control have all been linked to poor health outcomes. [18-25]

Despite the implementation of the Australian National Reform Agenda to improve productivity, the Australian Productivity Commission insists that further change is needed to secure Australia's future standard of living amid increased global competition and an ageing Australian population. The pressure to change work practices and improve performance put additional pressure on workers. A careful balance is needed to ensure improved productivity without negatively impacting on workers' health. The impact on health and productivity resulting from recent and rapid industrial relations and workplace changes such as working longer hours, increased shift work and individual workplace agreements are still to be ascertained.

1.2 Australia's Health

To establish and maintain a globally competitive edge, and a health and productive workforce, policy makers need to better understand the health issues affecting Australia's ageing workforce, and the impacts of these conditions on worker productivity. This is particularly important for chronic conditions that are largely lifestyle related and therefore preventable or treatable.

Several Government reports have been generated that identify national health priorities based on either prevalence of the condition [14] or the economic burden of the disease on Australians. [26] The Australian Institute of Health & Welfare (AIHW) regularly reports on health conditions impacting on Australians in their publications titled 'Australia's Health'. The Australia's Health 2006 Report identified the most common (prevalent) long-term health conditions affecting working Australians as allergies, back pain, asthma, arthritis, and hypertensive disorders. [14] The Australia's Health 2008 Report identified the 20 leading causes of

burden of disease and injury in Australia. The top ten are coronary heart disease, anxiety and depression, Type 2 diabetes, stroke, dementia, lung cancer, chronic obstructive pulmonary disease (COPD), adult onset hearing loss, colorectal cancer and asthma. [26]

Similarly, the AIHW report on chronic diseases 2006 identified the following conditions as major health concerns for Australians: arthritis, asthma, cardiovascular disease, cerebro-vascular disease, chronic kidney disease, chronic obstructive pulmonary disease (COPD), colorectal cancer, depression, diabetes, lung cancer, oral disease and osteoporosis. [27] It also identified that many people were at risk of developing a chronic disease and reported that 54% of Australians were overweight.

Mental health has been also identified as a priority health condition in several reports by the AIHW. [14, 27] The recent Australia's Health 2008 reported a close to two-fold increase in the prevalence of very high psychological distress from 1997 to 2005.

Several conditions are consistent across these reports, namely depression, diabetes, asthma, arthritis, COPD, colorectal cancer, and lung cancer. Other conditions not listed above but included in the top twenty priority health conditions are listed in Appendix A2. Conditions available in our data set that are consistently indicated as being of high priority to Australians due to prevalence or burden of disease [14, 27, 28] and / or were identified in meta-analyses as impacting strongly on worker productivity [10, 11] have been included in analyses in this study where possible. (See Appendix A2 for the list of health conditions and risk factors included in this study).

In response to the National Productivity Commission's continued concern regarding our future quality of living, the 2009 National

Preventative Health Strategy identified the need to improve Australian's health between now and 2020 to minimise the impending overload on the health and hospital systems and to increase productivity and therefore the competitiveness of the Australian workforce. [29] To support this goal, the Australian Government has also introduced the National Health Reform Agenda and several specific strategies such as the Chronic Disease Strategy and the Primary Health Care Strategy.

With additional pressure to increase production and gain a competitive edge, workers are at risk of experiencing compromising health environments. Lack of Australian data regarding the relationship between health and productivity could result in increased productivity coming at the cost of compromising workers' health. More research is needed to better understand how health status impacts on Australian workers' productivity, and what health decrements Australian workers' experience as a result of stressful work situations and recent industrial relations changes.

1.3 Health and Workforce Participation

Unemployment has a direct relationship with health status, and the relationship may be bi-directional. Brennan and Mooney (1983) reportedly found evidence relating health and unemployment at every level of social science analysis. He cited literature associating health indicators with economic growth, socioeconomic status, socio-cultural change, economic stability, the status of being unemployed, social stress and work stress. [30]

A report by the Australian Productivity Commission on men outside the workforce found that many males leave the labour force due to injury, illness, disability or 'premature retirement'. [31] Another Productivity Commission report on the effects of health and education on labour force participation found that participation rates were consistently and

considerably lower for people with a health condition. This report found that labour force participation rates were even lower for people with more than one condition. [32]

An Australian study of the impacts of chronic disease on workforce participation reported that the probability of workforce participation varied by gender and age group. Older workers were more likely to respond to chronic disease by dropping out of the workforce. They also found that the highest effect was from mental health in men aged 50-65 years where the probability of labour-force participation drops from 80% to 54% with the onset of mental health problems. [33] Other studies have also found that people with mental health problems have an increased likelihood of not being in the workforce. [34-38] Co-morbidity [32, 34] and co-morbid depression significantly impact on labour-force activity. [34] While it is understood that those of working age who are not in the workforce may be unemployed due to health status, the focus of this study is on the impact of health status of those still in the workforce.

1.4 Health and Productivity

There are two leading theories on the relationship between health and productivity, the human capital-cost approach and the friction cost method. The theoretical underpinnings of these approaches were largely based on the work of Weisbrod, Grossman and Koopmanschap. From an economic perspective, this dialogue began in the early sixties with the work of Weisbrod (1961) in measuring the impact of disease and the valuation of human capital. [39, 40] The human capital-cost approach evolved, largely through the work of Michael Grossman and others who applied and developed Grossman's model. [39-47]. The model assumes that health can be viewed as a durable stock that produces output of healthy time. An individual has an initial stock of health that depreciates with age and can be increased by investment. In the demand for health or health care, the 'shadow price' of health rises with age. The rate of

depreciation of health stock rises over the life cycle and falls with factors such as education if more educated people are more efficient producers of health. [46] This model has been applied and adapted by several theorists including Michael, Schultz, Wagstaff, Becker and Kaestner; who have contributed to its development and application over time, Grossman [43] acknowledges the contribution of these theorists to the development and refinement of the model.

The human capital-cost approach has been applied in the calculation of in-direct health costs (i.e. individuals' loss of production of good and services due to their disease) as defined by loss of gross income during the time absent from work and in estimates of willingness-to-pay for health improvements in cost-benefit analyses. [40] While there has been considerable uptake of the human-capital cost method in the measurement of indirect costs of health, there has also been considerable criticism, particularly with regard to what should be included in the estimation of indirect costs associated with health.

In addition to the human-capital cost method which considers costs associated with absenteeism, the friction cost method considers other costs including replacement costs and reduced productivity while at work. Advocates of the friction cost method of measuring indirect costs of disease question what should be included in these estimates. [48-50] The friction-cost method argues that indirect health costs should not include all time absent from work, only time until a replacement can be found (the friction period). However the model then debates other factors that could be included as indirect costs to the broader community, such as when illness causes the person to leave work and receive a disability payment, or when the person dies. [50] What followed was a debate regarding the need to consider quality of life when measuring indirect costs of health. [51-53]

In response to the quality of life debate, Brouwer, Koopmanschap and Rutten (1997), quotes a definition of productivity costs given by the Washington Panel as "... costs associated with lost or impaired ability to work and engage in leisure activities due to morbidity and lost economic productivity due to death" (p254, [52]) . Brouwer et al (1997) go on to give a revised definition of productivity costs as "Costs associated with production loss and replacement costs due to illness, disability and death of productive persons both paid and unpaid". (p254 [52])

In recent years a number of survey tools have been developed to measure productivity loss; often based on either the human-capital approach or the friction cost approach (see section 1.5 below for further discussion of tools). Numerous studies have been conducted using these tools to explore the impact of health conditions on work performance. [3, 4, 7] This is particularly true for the United States of America (USA) where employers pay for staff health care as part of their employee entitlement packages. [3-11] However little evidence is available from outside the US.

This study will provide a better understanding of specific health conditions affecting Australian worker productivity, and can assist policy makers to design evidence-based strategies to target health conditions and risk factors that result in the greatest decrement of worker productivity.

1.5 Co-morbidity / Multi-morbidity and Productivity

The terms co-morbidity and multi-morbidity are used inter-changeably in the literature. However for the purpose of this thesis the following definitions are applied. The term 'co-morbidity' was first used in 1970 by Feinstein to refer to situations where an individual has two or more physical and/or mental health conditions (as cited in Kessler, 2001 [54]

and van den Akker et al. [55]). More recently the term multi-morbidity has been introduced. [55, 56] With this term a distinction is made whereby co-morbidity is used as described above, that is, when an index condition of interest is being discussed; and multi-morbidity is used when no reference condition is considered. [56]

Kessler states that co-morbidity is important for three reasons; firstly, some co-morbidities complicate diagnosis; secondly some complicate treatment; and thirdly some co-morbidities can magnify the functional impairment and adversely influence the course of other conditions. [54] International research demonstrates the prevalence of co-morbidity or multi-morbidity as quite high and increasing significantly with age. One study reported rates of two or more medical conditions in the 18-44 year, 45-64 year and 65 year and older groups were respectively 68%, 95%, and 99% among women and 72%, 89% and 97% among men. [57] For Australia, with its ageing population and the increasing prevalence of chronic disease, these rates are expected to increase in the near future. [58]

It is possible that some long term conditions share common causal mechanisms and risk factors, whereas other co-morbidities may be age related. [14] Limited research has been done in Australia to explore patterns of co-morbidity or multi-morbidity. [59-61] A recent Australian study exploring data obtained through 305 general practitioners in 2005 reported that the prevalence of multi-morbidity was estimated as 37% for surveyed patients, and 25.5% of the Australian population. Prevalence increased with age, with 83% of surveyed patients aged 75 years or older having multi-morbidity. They also reported that multi-morbidity did not differ between the sexes. [61]

Depression is often co-morbid with other chronic diseases and can worsen patients' associated health outcomes. [62-68] Psychological distress has also been found to increase with multi-morbidity when

disease severity is accounted for. [66] Although few studies have explored the relationship between psychological distress and multi-morbidity, a study by Fortin et al. demonstrated an increased risk of psychological distress by a factor of five from those with high level multi-morbidity compared to those with no multi-morbidity. They also found that one in three people with multi-morbidity met the criteria for psychological distress. [69] A Netherlands study found that all physical disorders except injury by accident were significantly related to anxiety and depression and that co-morbid physical-mental co-morbidity lead to increased work-loss. [70]

A recent Australian study found that most chronic physical illnesses were associated with increased odds of depression and those with numerous medical morbidities and higher functional impairment were three to four times more likely to have a depressive illness. [71] Co-morbid depression is associated with reduced productivity, [64, 72] and significantly increased disability days. [64, 72, 73] Similarly, Munce et al. (2007) found that co-morbid depression represented a three-fold increased risk of absenteeism for pain. [73] Absenteeism has increased over the past 20 years and depression or psychological distress is a major factor in this. [74]

As demonstrated in studies reported above, co-morbidity and multi-morbidity are becoming increasingly prevalent. [56-58, 75] Although we are gaining a clearer understanding of the enormity of these escalating rates of co-morbidity and multi-morbidity, few studies which explore the relationship between health and productivity adjust for co-morbidity. [76] Studies that do not adjust for co-morbidities are likely over-estimating the effect size of the health condition of interest in productivity. Unfortunately, even less is known about patterns of non-randomly occurring clusters of health conditions and their impacts on productivity.

1.6 Measuring Productivity Loss

Several validated tools have been developed to measure the impact of health on productivity. These tools differ in health conditions included, outcome measures assessed and psychometric properties. This diversity indicated a need for a more consistent approach to designing, critiquing and applying health-related productivity measures. An 'expert panel' of eighteen was convened by the American College of Occupational and Environmental Medicine to establish agreed health-related productivity measures and critique existing health-related productivity tools. They identified absenteeism, presenteeism and employee turnover / replacement costs as key elements of workplace health-related productivity measurement. [77]

The expert panel agreed that "absenteeism is generally defined as the number of days missed from the workplace" (Burton, 1999 as cited in [77]). They also agreed that "reasons for absenteeism include workers compensation, short-term disability, long-term disability, sick leave, family medical leave, personal time off, and unpaid leave". [77]

The expert panel also agreed that "presenteeism is the health-related productivity loss while at paid work (Burton, 1999 as cited in [77]). They agreed that "presenteeism may include: 1) time not on task (e.g. in the workplace but not working); 2) decreased quality of work (e.g. increased injury rates, product waste, product defects); 3) decreased quantity of work; 4) unsatisfactory employee interpersonal factors (e.g. personality disorders); and 5) unsatisfactory work culture". [77]

Employee turnover and replacement costs were determined by the expert panel to "include the decreased productivity output associated with the cost of hiring and training new employees". [77] The panel also identified a list of key criteria for the selection of sound

instruments to measure productivity loss and, based on these criteria, reviewed six instruments that were available at the time. When this paper was published in 2003 none of the instruments reviewed held up well under scrutiny and the panel concluded that more research and validation work was required. [77] Although no gold standard tool was identified by the expert panel, they did come to agreement on what should be measured as health-related productivity loss, recommending that absenteeism, presenteeism and employee replacement costs be included, as was later described in the 2005 model by Koopernamschap et al. [49]

While there is consensus among experts that employee turnover should be included in measures of productivity loss, this is a recent development. Traditionally, the most common method of calculating productivity loss was through sickness absence. [7] Absenteeism has been linked to both unemployment and mortality. Sickness absence has been identified as a risk factor for job termination, unemployment and disability pension [78, 79], particularly for people suffering with depression. [80-82] Mental illness in the previous 12 months has also been associated with reduced earnings. [83] A Finnish study found that sickness absence and the length of absence in the previous year were both predictors of deaths from cardiovascular disease, cancer, alcohol related causes and suicide. [84] Similarly, presenteeism has also been linked to serious coronary events. [85]

Including the measurement of presenteeism is a more recent method of calculating the total cost of health conditions to an employer and there has been debate about how best to measure this. [5, 7, 9-11] However, research by Dew et al. (2009) suggests that presenteeism is a common phenomenon and is linked to economic and social constraints and workplace cultures. They argue that presenteeism needs to be more prominent in discourse related to health and the

workplace. [86] Another study found that in most cases presenteeism costs were higher than medical costs. [11]

Diseases causing time off work can also cause reduced productivity on the days prior to and after a sickness absence. A study by Brouwer found that approximately 25% of respondents reported productivity loss prior to absence and a further 20% post-sickness absence. [48] It has also been found that workers may be choosing to work when sick due to inability to get relief staff, lack of sick leave entitlements or other work-load related reasons. [87] More recent studies that include presenteeism are finding that presenteeism accounts for a greater proportion of the loss than absenteeism. [86, 88] A study of chronic disease on work performance and absence for a large American company found that the total costs of the chronic conditions was 10.7% of the total labour costs, with 6.8% attributable to work impairment (presenteeism) alone. [88]

Using a variety of tools, health status has been linked to both absenteeism and presenteeism for a range of health conditions. [3, 7, 9, 32, 88-90] Since the publication of the recommendations of the expert panel convened by the American College of Occupational and Environmental Medicine, [77] two literature reviews were published in 2004 critiquing health-related workplace productivity loss instruments. [91, 92] The expert panel identified nine tools available at the time, and eliminated three based on not meeting the criteria of applicability" across industries and disease states, for business decision-making and practicality. They reviewed the following six tools however one was migraine-specific so not included here: the EHC (Employer Health Coalition of Tampa Assessment Instrument; the HPQ (Health and Performance Questionnaire); the SPS-6 (Stanford Presenteeism Scale; the WLQ (work Limitations Questionnaire); and the WPAI (Work Productivity and Activity Impairment Questionnaire). [77].

The following year, the two reviews were published [91, 92] Both reviews included several of the tools list above and added a few others. None of the tools reviewed measured employee replacement costs. The review by Lofland et a. included twelve tools but six of these were specific to one health condition so are not discussed here. [92] However, Lofland et al. did review the WPI (Worker Productivity Index) which at the time was only available in computer-based form and had only been applied to customer service telephone operators, and the HLQ (Health and Labour Questionnaire or illness and labour questionnaire) which only had a small list of health conditions. [92] The review by Lofland et al. was more of a descriptive summary, focusing on which outcomes measures were used (most used absenteeism and presenteeism, except the SPS-6 and the WLQ which only used presenteeism). It also discussed suitability of tools to translate into a monetary figure and of those reviewed only two were suitable (WPAI and WPI). The HPQ is suitable but was not included in this review. [92]

The second review by Prasad et al. [91] also had twelve tools, half of which were specific to one disease and therefore not discussed here. The review by Prasad et al. included three of the tools reviewed by the expert panel (HPQ, WLQ and WPAI) and included the HLQ reviewed by Lofland et al [92]. The Prasad et al review [91] focused more on psychometric properties of the tools but also critiqued generalisability and applicability for economic evaluation. The only tool reported to have construct validity, internal consistency reliability and test-retest reliability was the Endicott Work Performance Scale, which Lofland et al. reports as only being tested in a cohort with depression [92] and the Prasad et al. review reports as not being applicable for economic review. [91] No other tool was reported as having all recommended psychometric properties (construct validity, internal consistency reliability and test-retest reliability). This finding supports the

conclusions drawn by the expert panel that more research and validation is required of tools used to measure health-related productivity losses. [77]

The expert panel was unable to find a tool that met the gold standard requirements, neither did the subsequent literature reviews conducted by Lofland et al. [92] or Prasad et al. [91] There continues to be a need for a more rigorous tool that can accurately measure presenteeism and costs associated with replacement, to a standard acceptable to the experts in the field. More validation work has been undertaken since these reviews. For example, the HPQ which was used in this study has been validated, as has the Kessler, a validated measure of psychological distress included in the HPQ. The psychometric properties of the HPQ and the K6 are described in Section 3.5 in the Methods section.

1.7 The Current Study

This study used a cross-sectional design obtaining approximately 78,000 responses from employees of the 58 large Australian organisations invited to participate in the study. Participation was optional: no information was available on the number or characteristics of those employees who chose not to participate. The sampling approach did not involve a stratified or purposive sampling method to ensure the sample was representative of Australian workers or the Australian population as a whole. An explanation of how non-representativeness of the sample was managed is described in the Methods section. Characteristics of the sample are discussed in the Results section. A discussion of the impacts of these variations from the norm is described in the Discussion section under “Strengths and Limitations”.

The hypothesis of this study is that:

"Psychological distress is a major factor in productivity loss for a range of health conditions affecting Australian workers".

The following analytic model provides a visual representation of the hypothesis to be tested in this study. Evidence to support this hypothetical model is discussed below, followed by specific objectives related to this hypothesis.

1.7.1 Theoretical framework informing the study hypothesis

Health and productivity: (see boxes (A) and (B) in Figure 1 below)

As discussed earlier, health status has been linked to both absenteeism and presenteeism for a range of health conditions. [3, 7, 9, 32, 88-90]

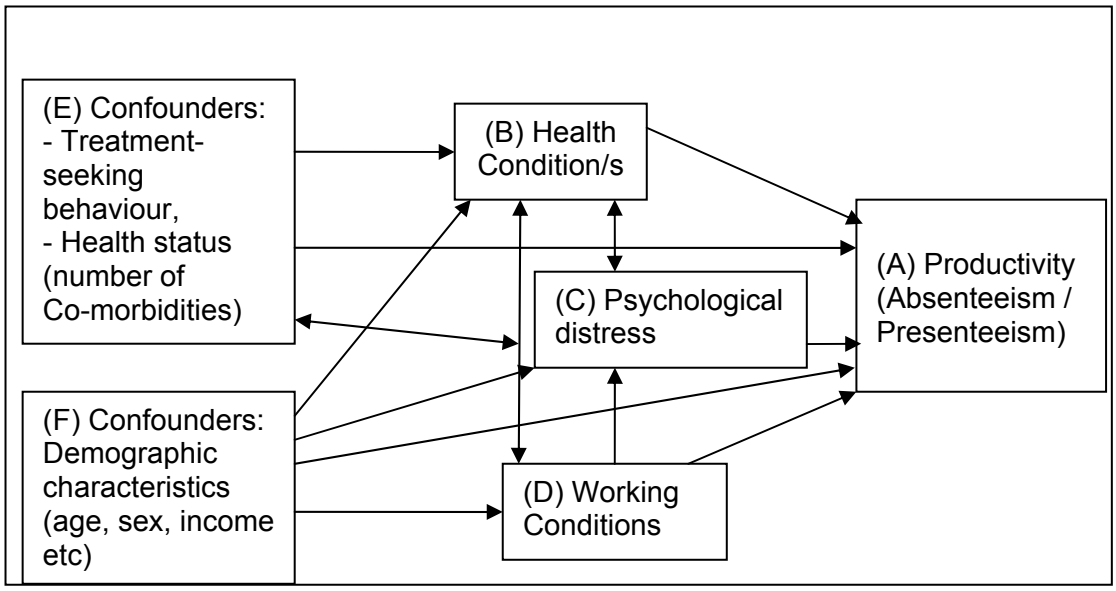


Figure1: Analytic model

Health risk factors also impact on productivity. A 2010 AIHW report stated that 96% of working-age Australians had one or more of the following health risk factors (with 75% having multiple risk factors): smoking, risky alcohol consumption, obesity, physical inactivity, low fruit or vegetable consumption, high blood pressure or high cholesterol. The report highlighted that those with health risk factors had a greater

likelihood of not being in the workforce compared to those without risk factors. [93]

The role of psychological distress: (see box (C) in Figure 1)
A strong association has been found between mental health, particularly depression, and other health conditions. [14, 62, 67] Depressed people report significantly more co-morbid medical conditions than non-depressed people. [82, 94] The prevalence of psychological distress has been found to increase with multi-morbidity after accounting for disease severity. [66, 69, 95] One study demonstrated that the risk of psychological distress increased by a factor of five for those with high level multi-morbidity compared to those without multi-morbidity. [95] A recent Australian study found that most chronic physical illnesses were associated with increased odds of depression and those with numerous medical morbidities and higher functional impairment were three to four times more likely to have a depressive illness. [71] Similarly, a study by Munce (2007) found that co-morbid depression represented a three-fold increased risk of absenteeism for pain. [73]

Poorer health outcomes are reported for people with co-morbid psychological distress or depression, [62-69, 96] as are poorer quality of life [72, 97, 98], higher health care usage [72, 99], decreased adherence to medical treatments [64, 100-102] and significantly increased disability days. [64, 72, 103-105]

Multi-morbidity and Productivity (see boxes (A) and (B) Figure 1)
While research shows that co/multi-morbidity is quite prevalent, [56-58, 75] and therefore should be considered in studies exploring health and productivity. [76] Little is known about the relationship between multi-morbid clusters of health conditions and productivity.

A Netherlands study by van den Akker et al. (2000) did a nested case-control study using primary care data. Increased age, higher numbers of previous diseases, and low socio-economic status were all strongly associated with both morbidity and multi-morbidity. After adjusting for these factors, the occurrence of multi-morbidity was more common among subjects who did not report work or study activity. [55]

Few studies are available that report on multi-morbid clusters of health conditions impacting on productivity. A US study that explored the association between work productivity and the following conditions: diabetes, hypertension, and high cholesterol in overweigh and obese adults found that the presence of all three conditions had the strongest correlation to work productivity loss. [106]

The role of working conditions: (see box (D) in Figure 1)
A range of working conditions has been found to negatively impact on productivity. Studies both overseas and in Australia have found that adverse working conditions result in both productivity decrements (through absenteeism) [107-121] and health decrements. [121-129] Adverse working conditions have also been associated with depression and stress. [15, 19, 21, 22, 24, 129-137]

The role of demographic characteristics: (see box (F) in Figure 1)
Kessler et al. (2004), author of the Health and Productivity Questionnaire, recommends adjusting for the following demographic characteristics: age, gender, marital status, number of children, education level. [76] Research has found that factors such as age, [138] sex, [137-141] occupation grade, [138, 139, 141] socio-economic differences, [138, 139] and blue/white collar differences [138] all impact on the relationship between health and absenteeism.

Figure 1 (boxes (A), (B) and (F)) proposes a link between demographic characteristics and both health and productivity. These assumptions are supported by several theorists. Theories on health and wealth have been debated since the early 1970s. [47, 142-148] In more recent decades, subsequent debates have also centred on concepts of health inequalities [149, 150] and the social gradient of health. [151, 152] Even more recently theories on the impact of the work environment on health inequalities have been raised. [153] Each of these theories is relevant to the analytic model applied in this study and is discussed below.

Similarly, Figure 1 proposes a link between demographic characteristics, psychological health and productivity (boxes (A), (C), and F)).A recent New Zealand study found that inequalities in wealth are strongly associated with psychological distress over and above other confounding demographic variables and baseline health status. [142] Another study from Finland found that past and present economic difficulties were strongly associated with common mental disorders, whereas conventional past and present socio-economic status measures, such as education, showed weak or slightly reverse associations. [144]

<u>The role of health related confounders</u>: (see box (E) in Figure 1)
Adjusting for the number of co-morbidities: Kessler states that co-morbidity is important for three reasons; firstly, some co-morbidities complicate diagnosis, secondly some complicate treatment and thirdly, some can magnify the functional impairment and adversely influence the course of other conditions. [54] Kessler et al. also recommend accounting for the number of co-morbid health conditions when exploring impact of health on productivity. [76] Several papers have emphasised the importance of including the number of co-morbidities as a confounding factor in studies that

explore the impacts of health conditions on productivity. [8, 75, 76, 154]

The need to adjust for treatment-seeking behaviour is evident through studies such as Waghorn's which found that current treatment for depression has been associated with reduced work performance. [155] However, other studies have found that treatment can be effective, even in those with mental / physical co-morbidity. [65, 94, 156] A study looking at co-morbid painful physical symptoms and depression found approximately one in two persons with a mood disorder also reported painful physical symptoms and that this co-morbidity results in decreased rates of treatment-seeking. [64] Other studies have also found lower rates of treatment seeking in people with psychological distress. [157, 158]

1.7.2 The research objectives for this study:

The following research objectives take into account the analytic model and the limitations of a cross-sectional data set:

i) to determine the impact of a range of health conditions on workplace productivity using absenteeism and presenteeism as measures of productivity loss

ii) to determine the impact of co-morbid psychological distress and other health conditions on workplace productivity using absenteeism and presenteeism as measures of productivity loss

iii) to e determine the impact of each identified cluster of multi-morbid conditions; with and without co-morbid psychological distress, on work place productivity using absenteeism and presenteeism as measures productivity loss

To assist in achieving objectives two and three the following sub-objectives will also be addressed:

- identify associations between psychological distress and other health conditions (objective two)
- Identify clusters of non-random multi-morbid health conditions (objective three)

Research objective one (above) examines the relationship between health and productivity (items A and B in the analytic model) while adjusting for demographic confounders, health related confounders and working conditions (items F, E and D of the analytic model respectively).

Research objective two includes all these factors in models that examine the relationship between health conditions (item B) and productivity (item A) when co-morbid with psychological distress (item C), and adjusting for confounders as described earlier. To enable this, sub-objective A (identifying associations between psychological distress and other health conditions) is first undertaken to determine which health conditions are significantly associated with psychological distress after adjusting for health status (item E) and demographic characteristics (item F).

Research objective three covers all aspects described in the analytic model however is only concerned with clusters of health conditions identified through sub-objective B as non-randomly occurring clusters of health conditions.

This chapter has provided the context for the research in health and productivity. It is anticipated that through undertaking this research, a greater understanding will be achieved regarding the relationship between health and productivity in working Australians and the role of psychological distress in productivity loss. By using statistical methods to identify non-randomly occurring clusters of health

conditions, this study will be able to determine the impacts these clusters of complex diseases have on productivity both with and without co-morbid psychological distress.

2. LITERATURE REVIEW

This literature review focuses on studies that explore the impacts of health status on productivity loss. This review aims to provide comparative studies and a context in which the results of this research can be interpreted. The literature search strategy is provided in Appendix A. It includes a flow chart of the exclusion process to obtain the most relevant articles for the purpose of this study. An annotated bibliography is also provided in Appendix A3 for "Health and Productivity" studies and "Co-morbidity and Productivity" studies. As there are only two studies to include in the section on "Multi-morbidity and Productivity", these are included in the body of the thesis. The following discussion and critique of the literature is structured according to the research objectives.

2.1 The Impact of Different Health Conditions on Productivity

Seventeen studies have been found to date which compare impacts on productivity for a range of health conditions. Of these, fourteen are from the United States (USA) [3, 7-11, 74, 75, 88, 154, 159-162] and one each from Australia [90], Canada [73], The Netherlands [70] and Sweden [89]. Table 1 describes key characteristics of these studies, demonstrating the diversity of study populations and outcome measures used. Table 2 lists the health conditions considered in this thesis that are available for comparison in these studies, and their association with productivity loss.

This literature review focuses on studies that have either absenteeism, presenteeism or both as outcome measures of interest. As is seen in Table 1, nine studies explored both absenteeism and presenteeism [7, 10, 11, 74, 75, 88, 90, 160, 162], four studies assessed impacts of health on absenteeism only [8, 70, 159, 161]; two studies only used presenteeism as the outcome measure [9, 89],

and two studies used a combined absenteeism and presenteeism outcome measure. [3, 154] As mentioned in chapter one, an expert panel identified that absenteeism, presenteeism and employee turnover / replacement costs are all key elements in measuring health-related productivity loss. [77] None of the seventeen studies in Table one reported findings related to employee turnover or replacement.

Table 1 also demonstrates the variety of tools used to measure productivity loss. The WHO Health and Productivity questionnaire was used in four studies. The Medistat Groups' Health & Productivity Management database was used in three papers from two study populations. The Health Risk Assessment tool was also used in three studies. A further six tools were used, each one being used only once.

Study sample size varied across the studies described in Table 1, ranging from 224 workers to 9,238,154 workers. Unfortunately the only Australian study exploring the impact of health on productivity had a sample of only 224 people. Given the low prevalence of some health conditions the findings of this study may not be very informative.

The composition of the study population also varied across the group of studies described in Table 1. All studies except two had samples that were from within the work force when completing the survey. Those study participants not in the workforce were drawn from population-based household samples. [8, 70] For the other studies, there are marked differences in the composition of the study samples. For example, four studies did not state how many organisations the study sample was drawn from [3, 89, 161, 162]; five studies had samples that were recruited from only one

organisation [9, 88, 90, 154, 159, 160]; three studies recruited from a number of employers and obtained larger numbers of study participants compared to the other studies; [10, 11, 75] and two studies used small samples of 2 or 3 organisations. [7, 74] For studies with only one or two organisations it is very difficult to generalise these findings to the working population.

Of the seventeen comparative studies, ten used a cross-sectional study design, [3, 7, 9, 70, 73, 88-90, 154, 160, 162] which is an easier and less expensive method than a cohort study. One used a cross-sectional design but also used retrospective database data. [75] Five studies used a retrospective cohort design which is a sound method for medical record auditing but not very rigorous if relying on participant recall. [8, 10, 11, 159, 161] One study used a prospective cohort however only baseline data was reported. The study had a small sample drawn from only two organisations making findings questionable for conditions of low prevalence and making generalisation to the broader working population difficult. [74] The other study used a retrospective method but only included cases and matched controls. [161] A prospective cohort study would be best to answer this research question, however this is very costly. A design using cases and matched controls would also be valuable if a very large sample was available and reliable records used rather than subject recall.

Several studies used a retrospective cohort design which could provide valuable results if the data was drawn from a reliable source such as employer records rather than employee recall, and if the sample was large enough to accommodate health conditions of low prevalence. Of the studies that used a retrospective of study design, [8, 10, 11, 75, 159, 161] three studies had a good size sample of over 50,000 [10, 11, 75] but only one of these studies [75] adjusted for any

potential confounders. Although a cross-sectional study design is not the ideal for this research question it is often the most feasible. A study by Munce et al. (2007) obtained a nationally representative sample of 9,238,154 people,; unfortunately they only included a small number of health conditions. [73]

Few studies adequately adjusted for the range of potential confounders associated with the relationship between health and productivity, which can result in over-estimation of effect sizes. Section 2.4 describes studies included in this literature review that have adjusted for potential confounders; the remaining studies did not report adjusting for any covariates.

To explore the impacts of a range of health conditions on worker productivity loss very large sample sizes are required to accommodate for health conditions which may not be very prevalent but may result in severe productivity and health decrements. Of the studies reported below in Table 1, only four papers were included with good sample sizes; however, two of these four were from the same sample. [10, 11] These two studies by Goetzel et al. used pooled data from several studies so were limited to a list of ten conditions common to all the studies. They were also not able to adjust for any potential confounders. A study by Munce et al. had a remarkable sample of 9,238,154 individuals from a population based household survey who reported having at least one chronic pain condition. Unfortunately the study only considered a few conditions: fibromyalgia, arthritis, back problems, migraines and depression. [73] The study by Loeppke et al. had a sample of 51,648 drawn from ten organisations; they used the HPQ survey so had a list of 25 health conditions. [75]. The studies by Leoppke et al. and Munce et al. both adjusted for potential confounders. Loeppke et al. adjusted for age, sex, occupation and co-morbidities. Munce et al. adjusted for age, sex, martial status, income

and level of education. Two other studies [9, 159] had samples of moderate size (approx 16,000 people) but both obtained their sample from only one employer making it difficult to generalise the findings. While many of the remaining studies did not have large sample sizes, they were, in most instances able to report significant impacts of some health conditions on productivity. However, as highlighted by Kessler et al. [76] the majority of working people with chronic disorders tend to suffer from more than one condition. He states that co-morbid disorders are in general more impairing than pure disorders for either condition, and that the incremental effects of additional disorders on diverse measures of functioning generally decrease as the number of co-morbid conditions increases. [76].

Table 1: Summary of comparative studies for Health Conditions associated with Productivity losses

Year and Reference	Country	Study Population	Study Design	Data collection Tool	Outcome Measures	Study Purpose	Key Results	Quality of Studies			
								Category Score			
								1	2	3	4
2000 [159]	USA	15,153 employees from one organisation	Although not stated a retrospective cohort is assumed	Corporate personnel records	Absenteeism only	Compare absenteeism among those with depression and those with four other conditions: heart disease, diabetes, hypertension, and back problems.	Employees treated with depression had greater costs followed by heart disease, back problems, diabetes, and hypertension.	2	3	1	2
2001 [3]	USA	2,074 working age adults	cross-sectional	Midlife Development in United States (MIDAS) survey	Work impairment (Absenteeism and presenteeism combined)	comparison of health conditions on workplace functioning	Cancer top burden, then ulcers, depression, panic, heart disease, high BP.	1	1	3	2
2006 [89]	Sweden	3801 employed	cross-sectional	Statistics Sweden's monthly labour market survey (& interview questions not explained)	Presenteeism only	sickness presenteeism re occupation, ill-health, income, org downsizing, etc	Back/neck, fatigue & depression were associated with high presenteeism	1	1	3	2
2004 [160]	USA	2264 employees from one employer	Cross-sectional	Health risk assessment tool (HRA)	Absenteeism and presenteeism	Explore relationship between health risks and self-reported productivity.	Participants with more risks reported greater productivity losses	1	1	1	1
2006 [90]	Aust	224 workers from 1 company	cross-sectional	Health Risk Assessment (HRA)	Absenteeism and Presenteeism	Absenteeism, presenteeism and range of health conditions & risk factors	Presenteeism assoc with back pain, stress, and life dissatisfaction. Absenteeism assoc with diabetes, being overweight, poor perception of health, high blood pressure, drug use.	1	1	1	2
2005 [88]	USA	7,410 working adults from 1 company	cross-sectional	Stanford Presenteeism Scale	Absenteeism and Presenteeism	estimate prevalence & total costs of chronic disease in one company (presenteeism & absenteeism)	for all conditions studied the cost of presenteeism greatly exceeded the costs of absenteeism and medical treatment combined. Depression greatest impairment costs followed by anxiety or emotional disorders were associated with the most work impairment, but migraine, breathing disorders, and back/neck pin were also predictors of work impairment.	1	2	1	3

Year and Reference	Country	Study Population	Study Design	Data collection Tool	Outcome Measures	Study Purpose	Key Results	Quality of Studies			
								Category Score			
								1	2	3	4
2003 [7]	USA	441 reservation agents, 501 customer service, 554 executives, 850 engineers	cross-sectional	Health and Work Performance Questionnaire (HPQ)	Absenteeism and Presenteeism	Association between chronic conditions, presenteeism & absenteeism	Presenteeism responsible for more productivity loss than absenteeism. Conditions: arthritis, asthma, COPD, depression, & headaches. High blood pressure, diabetes, CVD, cancer, and back pain	1	1	1	2
2004 [74]	USA	105 airline reservation, 181 telephone customer service staff (2 companies)	prospective cohort	Health and Work Performance Questionnaire (HPQ)	Absenteeism and Presenteeism	Relationship between depression & work performance	major depression was the only condition significantly correlated with decrements in both dimensions of work performance - task focus and productivity	1	1	1	2
2007 [8]	USA	5962 participants from population based household survey	retrospective interviews	WHO Disability Assessment Schedule, National Health Interview survey & CIDI version 3	Disability days (absenteeism)	To estimate the comparative effect of common mental and physical conditions on role disability.	Mental health accounted for more than half disability days.	1	2	3	2
2004 [9]	USA	16,651 employees of 1 company	cross-sectional	Health Risk Assessment (HRA); and questions from Work Limitations Questionnaire	Presenteeism only	explore patterns & severity of lost productivity assoc with several common health conditions. Health conditions explored were: heart disease, diabetes, cancer, hypertension, depression, back pain, heartburn, irritable bowel syndrome, kidney disease, osteoporosis, asthma, seasonal allergies, and menopause	Depression was highly associated with work limitations in time management, interpersonal mental function and overall output. Arthritis and lower back pain were associated with physical functioning limitations. The other conditions were associated with one or more of the four WLQ domains, these were diabetes, heart disease and hypertension..	1	3	1	2
2003 [10]	USA	374799 people From 6 employers	Retrospective cohort	Medistat Group's Health and Productivity Management (HPM) database	Absenteeism only	to provide precise expenditure estimates of high cots health conditions typically paid by employers	The 5 most costly physical conditions were angina, hypertension, diabetes, lower back pain, and COPD. The top 5 most costly mental disorders were bipolar disorder, depression, depressive episode in bipolar disorder, neuroticism, personality and psychotic disorders.	3	3	2	0

Year and Reference	Country	Study Population	Study Design	Data collection Tool	Outcome Measures	Study Purpose	Key Results	Quality of Studies			
								Category Score			
								1	2	3	4
2004 [11]	USA	374799 employees & meta analysis of several studies	Retrospective cohort	Medistat Group's Health and Productivity Management (HPM) database	Absenteeism and presenteeism	examines studies that quantify productivity losses to report prevalent and costly conditions (only 10 conditions common across studies)	Overall presenteeism costs were higher than absenteeism. Depression had the highest percent productivity losss for absenteeism and second highest for presenteeism.	3	3	1	2
2008 [154]	USA	7320 worker from one company	Cross-sectional	Health and Work Performance Questionnaire (HPQ)	Absenteeism and presenteeism combined	To explore the comparative and interactive workplace costs of depression compared to other health conditions	Depression had the largest individual effect on work performance of any condition examined.	1	1	1	2
2006 [161]	USA	8,502 workers with arthritis & matched control (same number)	observational study (retro) of cases and matched controls	Medistat Group's Health and Productivity Management (HPM) database	Absenteeism only	impacts of arthritis on absenteeism, short term disability benefits & health care costs	Arthritis fourth most costly condition overall but highest for absenteeism alone, followed by bipolar disorder, COPD, renal failure, lower back disorders, hypertension, heart disease, depression, cancer, asthma.	2	1	3	2
2003 [162]	USA	610 workers from one organisation	Cross-sectional	Work Productivity Short Inventory (WPSI)	Absenteeism and presenteeism	Validation of the WPSI tool	Allergies, migraine, respiratory infections, high stress, arthritis, depression, high blood pressure, asthma, diabetes, CHD were associated with productivity loss.	1	1	1	1
2007 [73]	Canada	9,238,154, National representative sample	Cross-sectional	Canadian Commonwealth Health Survey	Absenteeism	Test hypothesis that major depressive disorder would be associated with absenteeism	Depression, back problems, migraine, and arthritis were all associated with absenteeism	2	3	3	2
2009 [75]	USA	51,658 employees from nine employers	Cross-sectional and retrospective database data	Health and Work Performance Questionnaire (HPQ)	Absenteeism and presenteeism	To explore methodological refinements in measuring health related lost productivity and assess business implications.	All conditions (such as depression, obesity, arthritis, back/neck problems) were associated with productivity loss when compared to those with no chronic conditions.	2	3	2	2

Categories of Study Quality = Category 1: Study Design; Category 2: Sample size; Category 3: Sample bias; Category 4: Adjusted for confounders; Scoring system 0= lowest, 3=highest score

Table 2: Health conditions relevant to this study that are in comparative studies

Study: first author and year	Arthritis	Asthma	Back/neck Pain	Cancer	COPD	CVD	Drug & Alcohol	Diabetes	Fatigue	High Blood Pressure	High Cholesterol	Obesity	Psychological Distress	Migraine	Injury
Druss, 2000 [159]			H			H		M		M			H		
Kessler, 2001 [3]				↑		↑		↑		↑			↑		
Aronsson, 2000 [89]			↑						↑				↑		
Boles, 2004 [160]							Ø	↑		Ø	Ø	↑	↑		
Musich, 2006 [90]	Ø	Ø	↑		Ø	Ø	Ø	↑		↑	Ø	↑	↑		
Collins, 2005 [88]	Ø	↓	↑			Ø		↓					↑	↑	
Wang, 2003 [7]	H	H	L	M	H	L		M		L			M	L	
Wang, 2004 [74]	M	M	L	M	H	L		M		L			M	L	
Merikangas, 2007 [8]	L		H	H	H		H						M		
[9]	↑	Ø	↑	Ø		↑		↑		↑			↑		
Goetzel, 2003 [10]			M	L	M	M	L	H		H			H		L
Goetzel, 2004 [11]	M	M		M		H		H		H			H	H	
Ozminkowski, 2006 [161]	H	L	M	L	H	L		M		M			L		
Goetzel, 2003	M	L				L		L		M			M	H	

Study: first author and year	Arthritis	Asthma	Back/neck Pain	Cancer	COPD	CVD	Drug & Alcohol	Diabetes	Fatigue	High Blood Pressure	High Cholesterol	Obesity	Psychological Distress	Migraine	Injury
[162]															
Munce, 2007 [73]	H		H										L	M	
Loeppke, 2009 [75]	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑		↑	↑	↑	

Key: i) where statistical tests have been used: ↑ = significant increased risk of absenteeism or presenteeism; Ø = not statistically significant; ii) where the list of conditions have been compared to each other regarding strength of impact on productivity: H= high impact, M= moderate impact; and L=low impact

Table 2 above lists the health conditions relevant to this thesis that have been included in the eighteen comparative studies described in Table 1. While there is a lack of consistency in the health conditions included in these studies, the following conditions are listed in order of frequency of their inclusion in the studies listed in Table 2: psychological distress, high blood pressure, diabetes, (CVD, back pain, arthritis, and asthma were all equally present), migraine, cancer, COPD, drug and alcohol problems, obesity, fatigue, high cholesterol, and injury. What is interesting is that psychological distress (or depression) was the only health condition to be included in all eighteen studies. Also of interest is that diabetes and asthma were the only two conditions to demonstrate a statistically significant reduced risk of productivity loss. [88] All other conditions demonstrated either a statistically significant increased risk of productivity loss, or a greater loss compared to others when measured by days of absence or cost associated with absence or underperformance, or demonstrated no significant effect on productivity.

In addition to differences in which conditions were included in the studies, there were also discrepancies regarding the strength of the impact of specific health conditions on productivity. This could be due to the variety of other comparison conditions and whether confounders such as co-morbidities were included. It could also be due to inadequate sample size for some health conditions of low prevalence impacting on statistical power. Other differences across studies include the method by which the outcome of productivity loss is measured. Some studies count the number of days, some calculate a dollar value associated with time lost, while others compare relative risk or odds ratios to consider the likelihood of one condition impacting on productivity loss compared to a reference condition. We have also found that including all health conditions in the one model can result in co-linearity which can distort the results of the statistical test. Given these differences in methods and conditions included in models, it is interesting to note that all studies included psychological distress (or depression) and all found depression or PD to negatively impact on productivity loss. Similarly fourteen studies included high

blood pressure and twelve of these found high blood pressure to impact negatively on productivity.

2.2 Co-morbid Psychological Distress and Productivity

Co-morbidity

Loeppke et al. (2009) state that more research is needed to understand the impacts of co-morbidity. [75] Merikangas et al. reported that the productivity loss for all conditions examined in their study reduced considerably when co-morbidity was accounted for, suggesting the prior studies which do not adjust for co-morbidity have over-estimated the effects on disability. [8] Loeppke et al. reported that co-morbidities have significant non-additive effects on both absenteeism and presenteeism. [75] However, Buist-Bouwman et al, claim that the effect of physical and mental co-morbidity is synergistic, that is, the two problems together are more than the sum of the disability associated with the physical and mental disorders separately. [70] Co-morbidities have been found to impact negatively on productivity and to be associated with greater productivity decrements, [72, 163] increased functional disability [163], and reduced likelihood of being employed. [55] More research is needed to better understand the role of co-morbidity on productivity decrements.

Co-morbid Psychological Distress

There is now considerable evidence that psychological distress is often co-morbid with other health conditions and can worsen health outcomes. [62-68] Psychological distress is a key indicator of emotional problems and is highly correlated with stress and several mental health problems particularly depression. It refers to subjective general distress rather than disorders. [66] Psychological distress is highly prevalent in the community. One Australian study reporting that over 30% of patients presenting to general practice had a diagnosable mental disorder however between 30-50% of these problems go undetected. [164] Forty-five percent of Australians will experience some mental health disorder in their lifetime. [165] As psychological distress is a strong indicator for depression, [66] this thesis draws on literature exploring the

effects of psychological distress as well as depression. Depression has been found to increase with co-morbidity when disease severity is adjusted for. [66] Co-morbid depression is associated with poorer quality of life, [72, 97, 98] higher health care usage, [72, 99] and significantly increased disability days. [64, 72]

Co-morbid Psychological Distress and Productivity Loss

A number of studies have found a strong association between mental health, particularly psychological distress or depression, and other health conditions [14, 62, 67]; between depression and productivity loss [7, 166-168]; and between depression and injury. [169-171] One study demonstrated that the risk of psychological distress increased by a factor of five for those with high level multi-morbidity compared to those without multi-morbidity. [95] A recent Australian study found that most chronic physical illnesses were associated with increased odds of depression and those with numerous medical morbidities and higher functional impairment were three to four times more likely to have a depressive illness. [71] Similarly, a study by Munce (2007) found that co-morbid depression represented a three-fold increased risk of absenteeism for pain. [73]

Co-morbid depression is associated with reduced likelihood of working full-time, [72] an increased likelihood of reduced productivity. [64, 72] and significantly increased disability days. [64, 72, 73] A Netherlands study found that all physical disorders except injury by accident were significantly related to anxiety and depression and that co-morbid physical-mental co-morbidity lead to increased work-loss. [70]

Absenteeism has increased over the past 20 years and depression or psychological distress is a major factor in this. [74] Several studies that explored productivity loss for another condition or a range of conditions also explored the relationship between depression and productivity loss

[3, 10, 11, 88, 172-175], and all found depression to be associated with either productivity loss, work limitation, or costs due to productivity loss.

Table 3 below provides a summary of studies available for comparison with this study. Of the nine studies included the study samples ranged from 4,181 to 9,238,154 people. Most were cross-sectional studies with the exception of a retrospective case/control study. Seven of the nine studies used a different data collection tool, studies by Egede et al. and Stein et al. both used a different population-based survey but both included the CIDI-SF. [163, 176] More than half the studies were conducted in the USA, with one from each of the following countries: Germany, [72] Netherlands, [70] Canada, [163] and one study that used data from six European countries [64].

Few studies adequately adjusted for the range of potential confounders associated with the relationship between health and productivity. This can result in over-estimating the effect size of the health condition on productivity loss. Section 2.4 describes studies that adjust for potential confounders; the remaining studies did not report adjusting for any covariates.

The results from these studies consistently demonstrate the strong effect of co-morbid psychological distress / depression on productivity loss [64, 70, 72, 159, 176] and that co-morbid depression accounted for most of the lost productivity. [73, 154, 163, 177] The conditions most commonly included in the above studies (see Table 4) were arthritis, back / neck pain and high blood pressure, all demonstrating an increased risk of productivity loss when co-morbid with psychological distress or depression. Only one study included injury and it found no association between co-morbid psychological distress, injury and productivity loss. [70]

Some studies did not differentiate between health conditions to enable them to be placed within Table 4 below. [64, 72, 176] Baune et al. (2007)

grouped health conditions into classes using the following categories: endocrine / metabolic, allergic, cardiovascular, neurological gastrointestinal and respiratory conditions and compared the disability days for each of these groups of conditions with and without co-morbid major depressive disorder. They reported all classes of conditions had higher rates of disability days than those without the co-morbidity. [72] Demyttenaere et al. (2006) compared persons with painful physical symptoms with and without a major depressive episode (MDE) and reported the presence of MDE to increase the work loss days. [64] Similarly, Egede (2007) compared productivity loss (days in bed) for persons with one of the following chronic diseases both with and without depression: hypertension, diabetes, congestive heart failure and COPD. Results were combined for these conditions, that is, the authors found that persons with any one of these conditions had greater absenteeism when the condition was co-morbid with depression. [176]

For all nine studies that explored the impacts of health conditions on productivity when co-morbid with psychological distress, there were considerably greater productivity decrements. In fact, many of these studies reported that co-morbid depression was the factor that created the productivity decrement and without it there would be no significant loss of productivity for that health condition.

Table 3: Studies of Productivity and Health Conditions with Co-morbid Psychological Distress

Year and Reference	Country	Study Population	Study Design	Data collection Tool	Outcome Measures	Study Purpose	Key Results	Quality of Studies			
								Category Score			
								1	2	3	4
2000 [159]	USA	15,153 employees from one organisation	Although not stated a retrospective cohort is assumed	Corporate personnel records	Absenteeism only	Compare absenteeism for those with four other conditions: heart disease, diabetes, hypertension, and back problems.	Employees treated with depression had greater costs and those with co-morbid depression had 1.7 greater costs and greater absenteeism.	2	3	1	2
2005 [70]	Netherlands	7076 participants	Stratified random sample – prospective cohort, 3 waves of data	Aggregated data from Netherlands Mental Health Survey and Incidence study (NEMESIS) and interview using DSM-111	Absenteeism	Assess co-morbidity between common physical and mental disorders and investigate the separate and joint effects on work-loss	All physical disorders except injury were all related to mood and anxiety disorders. All conditions except digestive and injury were significantly related to work loss when co-morbid with depression. These were: back trouble, rheumatism, hypertension, asthma, migraine, and sinus infection	2	2	3	2
2003 [177]	USA	5877 respondents of a household survey	Cross-sectional	National Health Interview Survey (NHIS)	Role impairment (Absenteeism and presenteeism)	To demonstrate the effects of co-morbid mental disorders on absenteeism and presenteeism among people with chronic disorders – only 4 conditions explored – hypertension, arthritis, asthma, ulcers	All conditions has a significant impact on role impairment in bivariate analyses but further analysis showed that most of this impairment was due to co-morbid mental disorders.	2	2	3	2
2006 [163]	Canada	130,880 people	cross-sectional	Sample selected from Canadian Community Health Survey then Composite International Diagnostic Interview (CIDI- SF) used	Work loss and functional disability	examine the relative and combined effects of depressive and chronic physical conditions on functional status and health care use	co-morbid major depressive disorder was associated with significantly greater (approx double) the likelihood of health care use and increased functional disability and work absence compared to the presence of chronic physical illness without co-morbid major depression	1	3	3	3
2007 [72]	Germany	4181 participants from a community sample aged <=65	cross-sectional	German Health Interview and examination survey	Disability days (absenteeism)	compare HRQoL, disability, work productivity and health care utilisation in a variety of medical disorders with and without co-morbid major depressive disorder (MDD) in the general population	Co-morbid MDD was strongly associated with lower full-time work status and increased disability days in the presence of any medical disorder.	1	1	3	2

Year and Reference	Country	Study Population	Study Design	Data collection Tool	Outcome Measures	Study Purpose	Key Results	Quality of Studies			
								Category Score			
								1	2	3	4
2006 [64]	6 European countries	21,425 community adult Europeans	Cross-sectional	CIDI 3.1, and WHO disablement Assessment Scale version 2	Absenteeism	examine prevalence of painful physical symptoms (PPS) in patients with major depressive episode	Approx one in two persons with a mood disorder also reported presence of painful symptoms, resulting in decreased productivity and in lower rates of help seeking.	1	3	3	1
2008 [154]	USA	7320 participants	Cross-sectional	Health and Work Performance Questionnaire (HPQ)	Absenteeism and presenteeism combined	To explore the comparative and interactive workplace costs of depression comparative to other health conditions	Depression had the largest effect on work performance. Several co-morbid conditions exacerbated the effect of depression but had no effect in the absence of depression. These were fatigue, sleep problems, anxiety; with the exception of migraine which had an independent effect on work loss regardless of co-morbid depression.	1	2	2	1
2007 [176]	USA	30,801 participants	Cross-sectional	National health interview survey, included Composite International Diagnostic Interview (CIDI-SF)	Absenteeism	To determine the prevalence and odds of major depression and the incremental effect of major depression on utilisation, lost productivity, and functional disability	The odds of depression are high in people with chronic medical conditions and major depression is associated with increase in utilization, lost productivity and functional disability for all conditions explored.	1	2	3	2
2007 [73]	Canada	9,238,154, National representative sample	Cross-sectional	Canadian Commonwealth Health Survey	Absenteeism	Test hypothesis that major depressive disorder would be associated with absenteeism	The presence of co-morbid depression represented a three-fold increase in absenteeism.	2	3	3	2
2007 [8]	USA	5962 participants from population based household survey	retrospective case-control	WHO Disability Assessment Schedule, National Health Interview survey & CIDI version 3	Disability days (absenteeism)	To estimate the comparative effect of common mental and physical conditions on role disability.	Mental health accounted for more than half disability days. Disability for specific health conditions decreased substantially when adjusted for co-morbid mental health problems	1	2	3	1

Categories of Study Quality = Category 1: Study Design; Category 2: Sample size; Category 3: Sample bias; Category 4: Adjusted for confounders; Scoring system 0= lowest, 3=highest score

Table 4: Health conditions (when co-morbid with psychological distress) relevant to this study that are explored in comparative studies

Health condition	Druss [159]	Buist-Bouwman [70]	Kessler [177]	Stein [163]	Kessler [154]	Egede [176]	Munce [73]
Arthritis		M	↑	↑	↑		Ø
Asthma		M	↑	↑	↑		
Back/neck pain	↑	H		↑	↑		↑
Cancers							
COPD				↑		↑	
CVD	↑			↑		↑	
Drug & Alcohol problems							
Diabetes	↑			↑		↑	
Fatigue/Sleep problems					↑		
High Blood Pressure	↑	H	↑		↑	↑	
High Cholesterol					↑		
Obesity							
Migraine/severe headache		M			↑		↑
Workplace Injury		Ø					

Key: i) where statistical tests have been used: ↑ = significant increased risk of absenteeism or presenteeism; Ø = not statistically significant; ii) where the list of conditions have been compared to each other regarding strength of impact on productivity: H= high impact, M= moderate impact; and L=low impact

2.3 Multi-morbidity and productivity

Multi-morbidity

For this thesis co-morbidity is used to describe two or more health conditions in relation to an index condition of interest; and multi-morbidity is used to describe clusters of non-randomly occurring health conditions when no reference condition is considered. [58] Sometimes health conditions can be co-morbid purely by chance; however, certain co-

morbidity or multi-morbidity clusters can also occur at higher than chance levels. [54]

The study of patterns of multi-morbidity is a new field. While there is a growing body of evidence regarding the prevalence of co/multi-morbidity, [56-58, 75] most studies use either a count of the number of co-morbidities such as the Charlson Index [178] or a Cumulative Illness Rating Scale (CIRS) which groups conditions by body systems affected. [61, 66, 179, 180] The above approaches do not use statistical methods to identify the non-random cluster patterns of individual health conditions into groups of multi-morbid conditions. This is potentially due to the limitations of statistical methods to date. Most statistical packages that can perform exploratory factor analysis require the data to be in a continuous format but health conditions are usually dichotomously represented; that is, the person either has the condition or does not. Recent refinements to statistical analysis software now allow for the dichotomous nature of disease data and enable the identification of non-randomly occurring clusters of multi-morbid health conditions.

International and Australian research demonstrates the prevalence of co-morbidity or multi-morbidity increases significantly with age. [56-58, 61] With Australian's ageing population this suggests that patients with multi-morbidity in general practice represent the rule rather than the exception.[57, 69, 181] For example, an Australian study exploring data obtained through 305 general practitioners in 2005 reported that the prevalence of multi-morbidity increased with age, with 83% of surveyed patients aged 75 years or older having multi-morbidity. [61]

The AIHW reported co-morbid mental health with HSVD (heart, stroke, and vascular disease), diabetes, asthma and arthritis in its report on Australia's Health 2006. [14] It also reported these conditions to be co-morbid with each other, having high rates of co-morbidity with diabetes,

arthritis and HSVD. In 'The Burden of Disease and Injury in Australia 2003', the AIHW reported that co-morbidity may reflect causal pathways where one disease may increase the risk of another, or common risk factors for both conditions. They suggest that the severity of health states associated with two or more conditions in combination may be more or less the sum of the disability weights for each condition. [28]

Multi-morbidity and Productivity

A recent Australian study found that most chronic physical illnesses were associated with increased odds of depression and those with numerous medical morbidities and higher functional impairment were three to four times more likely to have a depressive illness. [71] Co-morbidity particularly co-morbid depression has a significant impact on labour-force activity. [32, 34]

To date, only two studies have been found that explore the relationship between multi-morbid clusters of health conditions and their impacts on worker productivity (see Table 5 below). Both studies are from the USA. [3, 106] The Kessler et al. study, with a sample of 2074 people from a nationally representative general population sample, conducted a series of regression equations to identify conditions that had the highest impact on productivity; they then adjusted for the non-additive effect of some people having more than one condition. Finally a series of moderated regression equations evaluated the relative effects of different conditions on impairment as a function of age, sex, education and occupation. [3] Results were weighted to adjust for different probabilities of selection within households, and for differences between the sample distribution and the census population distribution on a range of socio-demographic variables. Fifty percent of the sample reported having one of the following health conditions: arthritis, asthma, diabetes, high blood pressure, autoimmune disease, ulcer, cancer, heart disease, major depression, panic, generalized anxiety disorder, or substance dependence. Close to one-fourth reported having two or more of these conditions. The authors

stated that “it is conceivable that particular combinations of these conditions are associated with more or less impairment than predicted on the basis of a model like the one used to generate these results”. They also reported that six of the twelve interactions in their models were found to be significant at a much greater proportion of significance than would be expected by chance. The conditions involved in these interactions were: two physical disorders (arthritis and ulcers) and four mental disorders (major depression, panic, generalised anxiety disorder, and substance dependence) [3]

The only other study found to explore multi-morbidity and productivity loss was also from the USA but had a larger sample drawn from a National Health and Well-being Survey of 42,024 people. Of these, 19,759 were identified as being in the overweight or obese category based on BMI score. Of those in the overweight or obese categories, 43% reported having co-morbid hypertension, 18.1% reported having Type 2 diabetes, 38.8% high cholesterol. Of those who reported having co-morbidity, 59.4% reported having one co-morbidity; 31.3% reported having two co-morbidities; and 9.21% reported having all three co-morbidities: namely type 2 diabetes, high cholesterol, and hypertension. [106]

Table 5: Multi-morbidity Clusters and Productivity Studies

Year and Reference	Country	Study Population	Study Design	Data collection Tool	Outcome Measures	Study Purpose	Key Results	Quality of Studies			
								Category Score			
								1	2	3	4
2001 [3]	USA	2,074 working age adults	cross-sectional	Midlife Development in United States MIDAS survey	Absenteeism and presenteeism combined	comparison of health conditions on workplace functioning	Co-morbid conditions arthritis, ulcers, mental health, and D&A had greater impact than additive effect. They also reported co-morbidities involving combining arthritis, ulcers, mental disorders and substance dependence as being associated with high impairment	1	1	3	1
2008 [106]	USA	19,759 overweight or obese individuals	Cross-sectional	2006 National Health and Wellness Survey and Work productivity and Activity Impairment questionnaire (WPAI)	Absenteeism and presenteeism	To assess the association between diabetes, hypertension, and high cholesterol among overweight and obese people.	Co-morbid conditions had significant independent effects on productivity. The presence of all three co-morbid conditions was the strongest correlate of work productivity loss and activity impairment	1	3	1	1

Categories of Study Quality = Category 1: Study Design; Category 2: Sample size; Category 3: Sample bias; Category 4: Adjusted for confounders; Scoring system 0= lowest, 3=highest score

2.4 Other influences on productivity

As discussed in chapter one, section 1.7.1, there are a range of factors that impact on productivity regardless of health status. Therefore it is important to include these characteristics so as not to over-estimate the effect size of the health on productivity by not attributing some of the productivity loss to these other factors.

The role of demographic characteristics:

Research has found that factors such as age, [138],sex, [137-141] and socio-economic differences, [138, 139] all impact on the relationship between health and absenteeism. Of the twenty-four comparative studies (see tables 1, 3, 5) in this literature review, few studies adequately adjusted for the range of potential confounders associated with the relationship between health and productivity. This can result in an over-estimate the effect size of the health condition on productivity loss. The most common factors adjusted for in the studies in this literature review were age [3, 7-9, 70, 72, 74, 75, 88, 90, 154, 159-163, 176, 177] and sex [3, 7-9, 64, 70, 72, 74, 75, 88-90, 154, 159-163, 177], followed by education level. [3, 7, 8, 70, 89, 154, 159, 176, 177], Two studies adjusted for the number of children [8, 154], and three adjusted for annual wage [159, 163, 176]. The remaining studies did not report adjusting for any covariates.

The role of health related confounders:

Co-morbidities can complicate diagnosis and complicate treatment. They can magnify the functional impairment and adversely influence the course of other conditions. [54] Several studies have emphasised the importance of including the number of co-morbidities as a confounding factor in studies that explore the impacts of health conditions on productivity. [8, 75, 76, 154] Of the twenty-four comparative studies described in Tables 1-3 above, only eight studies adjusted for the number of co-morbidities. [3, 7-9, 72, 88, 90, 154, 163, 176]

The role of working conditions:

The following working conditions are associated with either productivity or health decrements or both: job security [19, 22, 23, 129, 182-185]; job strain / high demand [19, 25, 114, 121, 122, 128, 186-188]; co-worker/ social support [23, 25, 114, 116, 136, 137, 184, 187, 189]; working hours [108, 112, 137, 190]; job autonomy [23, 25, 115, 116, 121]; effort reward balance [108, 118]; shift work [86, 187]; issues with management [116, 118, 122, 182]; demand / control [187, 191]; organization restructure [117, 192-194]; work-family conflict [137, 184, 195]; workplace bullying [194, 196]; and role conflict / clarification [118, 193]. Of the twenty-four comparative studies used in this thesis, very few work-related characteristics were included in models. Six studies included occupation, [7, 74, 75, 88, 89, 154] two included job security, [89, 159] and two included hours worked. [88, 162]

2.5 Summary and the need for further research

2.5.1 Summary of key findings from literature review

Many health conditions have been found in overseas studies to impact on both presenteeism and absenteeism. Most productivity studies have been undertaken in the USA. Many health conditions, which have a high prevalence in Australia, have been associated with lost productivity in overseas studies; however, little is known about the association between health and productivity in working Australians.

There is no consistency across studies in the conditions selected or confounders included in models. Only a few studies adjust for the number of co-morbidities and those that do report considerable reduction in the risk of productivity loss for the condition/s under consideration. Even fewer studies exploring health and productivity adjust for working conditions, although there is considerable evidence of the effects of a range of working conditions on productivity losses.

Depression had been found through numerous studies to have a strong impact on both presenteeism and absenteeism. Depression or psychological distress had been found to be co-morbid with a large range of health conditions of concern to Australians, yet little is known about the association between co-morbidity (or multi-morbidity) and productivity either in Australia or internationally.

Most studies that explore multi-morbidity use a count of the number of conditions present, sometimes weighting some conditions based on perceived impact on overall health or functioning; or group conditions based on organ system then explore presence of more than one organ system related illness. No studies have been found that explore patterns of association of non-randomly occurring multi-morbidity or explore the impacts of these clusters of conditions on productivity.

2.5.2 The need for further research

This field of research needs greater consistency across studies in the types of health conditions compared, outcome measures used and confounding variables included in models that explore the relationship between health and productivity loss. There is a need for more evidence of health and productivity associations in contexts outside the USA. Large sample sizes are required to adequately model for impacts of health on productivity, adjusting for appropriate confounders, for health conditions with low prevalence rates. There is good evidence of the association between health and productivity, working conditions and productivity, working conditions and health, and demographic characteristics and health; yet few studies that explore the relationship between health and productivity adjust for all these potential confounders. Given the considerable evidence of high rates of co-morbid depression, and of high impacts of depression on both health status and productivity, more studies are needed which explore the impacts of co-morbid depression on productivity for a range of health

conditions known to impact on productivity independently. Methods of identifying clusters of multi-morbidity are still in their infancy. However given the growing evidence of high rates of multi-morbidity, more research is needed in this area. More research is also needed to explore the impacts of multi-morbidity on productivity losses, including when co-morbid with psychological distress or depression.

2.5.3 How this study addresses gaps

These gaps in knowledge are addressed by using a large sample of working Australians to explore the impacts on absenteeism and presenteeism for a range of health conditions. These analyses are made for health conditions individually and when co-morbid with psychological distress. Models adjust for a range of working conditions and demographic characteristics, and overall health status as measured in the number of co-morbidities and treatment-seeking behaviour. This thesis also identifies clusters of non-randomly occurring multi-morbid health clusters. It explores their impacts on absenteeism and presenteeism, both with and without co-morbid psychological distress, adjusting for the same factors listed above.

3. METHODS

3.1 Introduction

To date little is known about the association between health status and productivity in Australian workers. This study will enable greater understanding of the extent to which absenteeism and presenteeism are affected by a range of health conditions of concern to the Australian population. This chapter describes the analysis methods used to explore the association between health status and productivity. First, the data made available for this study through the WORC project (parent study) will be described. As this is a sub-study from a larger case-control cohort study, the parent study is described including its strengths and limitations. Following this all further methodological information pertains to the cross-sectional study reported in this thesis. The following aspects of the methodology for this study are then explained and critiqued; the study design (including a rationale for its appropriateness to the Australian context), study population, study instruments used, data items and definitions, and the statistical analysis methods applied.

3.2 Parent Study

The Australian Work Outcomes Research Cost-benefit (WORC) Project, being conducted through the University of Queensland (in collaboration with staff from Griffith University) is the Australian component of an international study developed by Harvard University (USA). It has been slightly modified to be relevant to Australian culture. The aim of the Australian WORC study (referred to from here on as the WORC study) was to test the hypothesis that: the cost of proactive screening and treatment of depression in the labour force improves depressive symptoms, which in turn, increases employee productivity resulting in a net benefit to employers and society.

The study used a prospective, randomised intent-to-treat research design. Large employers (>1000 full-time employees) agreed to provide access to their pool of employees for screening for health and depression symptom screening. Participants were recruited through employers. Employees were invited to complete a confidential general health and emotional well-being questionnaire covering 26 physical health conditions and the Kessler 6 [197] which is designed to screen employees for depressive symptoms. Organisations chose mode of survey distribution (paper, internet or combination) depending on the nature of their operation and employee access to internet. Employees whose responses to the survey indicated potential symptoms of psychological or emotional problems were further assessed and, where appropriate, referred for treatment in a longitudinal study.

This study, used data from the initial screening phase of the Australian-based WORC project to explore the relationships between health conditions and productivity. This dataset consisted of approximately 78,000 working Australians and included all those who completed the initial screening survey prior to any further screening or randomising.

This opportunistic sample obtained from data collected for another study is not ideal for several reasons. Firstly it is not representative of the Australian working community (discussed in more detail in 4.4). Secondly it uses self-reported data on both outcomes measures (absenteeism and presenteeism) and on presence of health conditions, with the exception of psychological distress. In addition, the research objectives of this study were not considered when the data were collected. As a result some key items are missing (discussed in more detail in 4.5). However, the data is of sufficient quality to explore research questions of interest not previously considered in Australia, adding value to the investment of the parent study.

3.3 Study Design

A cross-sectional study design was used for this study to survey working Australians to obtain information on health status, current psychological distress, work performance, work characteristics and demographic characteristics. The cross-sectional data was collected to identify potential recruits for a longitudinal study described above as the parent study. The cross-sectional data was then used to undertake this study. Cross-sectional studies are descriptive in nature and generally not suitable for assessing causal pathways as the temporal relationship between exposure and disease cannot be clearly determined because exposure and disease are assessed at the same point in time. Therefore cross-sectional studies are more useful for raising the question of the presence of an association rather than testing a hypothesis. [198] Although not the case for this analytic model, there are occasions when cross-sectional studies can be analytic in nature and used to test epidemiological hypotheses. However, this is only appropriate when the exposure variables are unalterable over time. [198]

A longitudinal study design would be preferable however not feasible for several reasons. Cross-sectional studies are far more cost-effective than longitudinal studies, which often suffer from loss-to-follow-up affecting the generalisability of findings. It would be difficult to find and recruit a large cohort of healthy workers of varying ages representative of the working population and even more challenging to control their exposure to factors of interest such as working conditions and health conditions. Other analytic study designs such as randomised control trials (RCT) and case control studies are not appropriate for this research question. An RCT is inappropriate as no intervention is being trialled. A case control study design could be possible however a different sample of study subjects would be required for each health condition and those selected may not be representative of the working conditions and demographic characteristics of the Australian community. Perhaps the most ideal study

design would be a stratified random sample cohort followed annually over a period of years and stratified to ensure appropriate representation of the proportion of working Australians in relation to gender, industry groups and occupation type. However given that at present there is only one Australian study exploring the impacts of health on productivity with a sample of only 224 people, this cross-sectional study provides valuable preliminary data to inform future research.

3.4 Study Population

Employees of 58 large Australian based companies (representing over 350,000 employees) across Australia were invited to participate in the WORC study. The response rate was 24.7% (90,279 employees). From this, 78,587 valid surveys were obtained for this sub-study. Respondents' demographic characteristics available through the HPQ are summarised in Appendix D Tables D1 and D5. The study sample has proportionally more females than the Australian workforce overall (65% and 45% respectively). [199] It also has greater representation of workers from industries of health, education, and government administration; and fewer from retail, construction and mining. [199] The average income and education level are fairly representative of the Australian population. [199]. In addressing the issue of representativeness of the sample, where possible these variables (e.g. industry type and occupation grade) are adjusted for in models. This study also analysed large sub-sections of the sample to check the validity of results. Both teachers and nurses' sub-sets have results consistent with those found for the sample as a whole. These methods and the rationale are explained in section 3.7.4 below.

3.5 Study Instruments

The screening instrument used for the WORC Project is the Health and Productivity Questionnaire (HPQ). [4] Kessler and the World Health Organization researchers originally developed the HPQ to estimate the

impact of health problems on the workplace, including absenteeism and presenteeism. The HPQ consists of 26 questions about general physical health, depression, work performance and demographics. Prior research has found good agreement between self-reported absenteeism (as used in the HPQ) and employer records (Revecki DA, 1994 as cited in Kessler, 2003 [4]). Blinded validation studies have documented significant associations (r=0.61 to 0.87) of HPQ absenteeism reports with employer payroll records. [154] Psychometric testing of the presenteeism measure used in the HPQ found good concordance (Cronbach's alpha 0.74 and 0.81) between the HPQ and archival measures of work performance (presenteeism) across a number of occupational groups. [4] Significant associations of HPQ work performance reports with supervisor ratings (0.52) and other administrative indicators (0.58-0.72) of job performance. [154]

The HPQ was reviewed by Prasad et al [91] who at the time had no published data on the psychometric properties of the tool however the review reported the tool to be a low/moderate burden on respondents, with high generalisability and applicability for economic evaluation. [91] The HPQ was also reviewed by the expert panel convened by the American College of Occupational and Environmental Medicine to establish agreed health-related productivity measures and critique existing health-related productivity tools. Professor Ron Kessler was on the panel and able to provide confidential information of results of HPQ validation work in progress. The paper published by the expert panel in 2003 [77] stated that their review of this additional information on the HPQ suggests that its "overall performance items are likely to be good indicators; and, with careful modifications, the nine performance measures might become useful tools". They go on to say that in terms of practicality the HPQ has been translated into 29 languages and appears applicable across many industries and occupations and appears able to

capture absenteeism and presenteeism which can be used to estimate the value of productivity loss. [77]

The HPQ uses absenteeism and presenteeism as outcome measures of productivity loss. These represent two of the three outcomes measures identified by the expert panel convened by the American College of Occupational and Environmental Medicine to establish agreed health-related productivity measures and critique existing health-related productivity tools. No tool has been found that also measures the third measure of employee replacement costs recommended by the expert panel. [77]

The HPQ was modified slightly for the Australian-based WORC study to suit Australian employees and renamed as the Health Appraisal Survey (HAS). Modifications were approved by the original survey author, Professor Ronald Kessler, and were not considered to alter the properties of the survey in any way. These changes included spelling modifications from US to Australian spelling, and the inclusion of additional questions regarding occupation and employee status.

Other than employer personnel database records and national medical claims data (which can only report absenteeism and health care expenditure data), the HPQ was the most commonly used survey tool for comparison studies relevant to this thesis. Although employer personnel database records and national medical claims data were more commonly used this is probably due to study feasibility issues. Using routinely collected data is far more cost effective than having to undertake a data collection process where accessing a large representative sample can also prove difficult. As the prevalence of some health conditions is quite low, large sample sizes are required, making the data collection process quite expensive. The advantage of using the HPQ over routinely collected data is that information on presenteeism can also be collected, whereas

routinely collected personnel or medical claims data only report absenteeism or health care costs. Recent health and productivity studies that include presenteeism report that it is responsible for a greater proportion of productivity loss than absenteeism and therefore is important to include in studies exploring the association between health and productivity. [86] Other advantages of the HPQ are the inclusion on questions relating to demographic characteristics and some working conditions. Both of which have been found to impact on the relationship between health and productivity and therefore are important to adjust for. [76]

Embedded in the HPQ is the Kessler 6 (K6), a six-item scale of psychological distress with excellent internal consistency and reliability (Cronbach's alpha = 0.89). The K6 has consistent psychometric properties across major socio-demographic sub-samples and strongly discriminates between community mental health cases and non-cases. [197] The majority of comparative studies relevant to this thesis which explored the impact on productivity of co-morbid psychological distress used a version of the Composite International diagnostic Interview (CIDI). Although this is the gold standard in diagnosing depression or psychological distress it is a diagnostic tool not a screening tool and involved lengthy interviews with all study participants, a costly exercise given the sample size required for this type of study. The K6 or K10 are well validated tools that is commonly used for screening purposes in general practice and has been used in the Australian National Health and well-being studies.

3.6 Data Items and Definitions

Descriptions of the coding and composition of data items used for this thesis are described below:

3.6.1 Dependent (outcome) variables

Absenteeism

The HPQ asks several questions to identify the number of days and part days missed from work in the past four weeks for health or vacation reasons. The HPQ absenteeism score includes both sickness and annual leave, under the assumption that workers sometimes use annual leave to accommodate bouts of illness. Any bias resulting from including both types of leave would be the same for those with and without a health condition. [76] Days and part days (estimated as 0.5 of a day) were tallied to arrive at the total number of days absent in the past four weeks.

Presenteeism

To facilitate an effective subjective measure of work performance (presenteeism), the HPQ used a global rating approach where respondents are asked to rate their overall work performance during the past four weeks on a 0-10 scale where zero means the 'worst possible performance' and ten means the 'top possible performance' for this job. In preparation for the global rating question, respondents are first asked a series of memory priming and decomposition questions which are sufficiently general to apply to all occupations but focused enough to facilitate memory search and review of critical aspects of their work performance. Internal anchoring questions are then asked to facilitate a comparison to the average worker and their own usual performance using the same scale as the global rating question, which is asked last. The global rating question is then used to measure presenteeism using low, average and high categories. Respondents tend to score themselves highly on the 0-10 scale [4]; therefore, 'low' equals a score of less than six, 'average' equals a score between six and nine, and 'high' equals a score of ten. [76]

Psychological Distress

Each of the six-items of the K6 are scored on a 0-4 scale with zero being 'none of the time' and four being 'all of the time'; the scores are additive and the total score ranges from 0 to 24. [200] The optimal cut point on the K6 to equalize false-positives and false negative results in the weighted

sample was 0-12 Vs 13 or more. At this cut point sensitivity was 0.36 and specificity was 0.96 and the total classification accuracy was 0.92. [200] A score of 13 or more is regarded as severe psychological distress and is indicative of a mental health disorder. This study

used a dichotomous variable to indicate 'yes' or 'no' for the presence of high psychological distress where a score of 0-12 is coded as 'no' and a score of 13+ is coded as 'yes'. The maximum score on the K6 is 24. Due to the design of the HPQ, respondents with answer bias that record a response "Not at all" to physical health symptom questions continue to the K6 questions and answer the maximum score "All of the time" on the K6. Therefore, the K6 = 24 group consists of those that have severe psychological distress and those that do not read the questions. As it is not possible to guarantee that all answer-bias respondents have been removed from the sample, instances where the K6 = 24 have been removed from analyses (<1% excluded).

3.6.2 Independent (explanatory) variables

Health conditions

From the health conditions listed in the HPQ, a sub-set of health conditions was selected for this study (and discussed in the literature review) based on one or more of the following criteria:

a. The condition has been identified as an Australian national health priority, a burden of disease or a significant chronic disease
b. There is a high prevalence of the condition in Australia,
c. There is evidence that the health condition impacts on productivity
d. The condition is considered as a risk factor to one of the health conditions already identified above.

The HPQ asked questions on self-reported health status for 26 health conditions. The following self-reported conditions were included in the study (in alphabetical order): Arthritis, asthma, back/neck pain, cancer, chronic obstructive pulmonary disease (COPD), cardiovascular disease

(CVD), psychological distress, drug & alcohol problems, diabetes, fatigue/sleep problems, high blood pressure, high cholesterol, injuries, migraine/severe headache, and obesity. NB: self-reported depression and anxiety are excluded from the analysis in favour of using the more reliable K6 measure. [200] Some conditions of priority in Australia, such as kidney disease, were not measured in the HPQ. Appendix A provides a more detailed explanation of the extent to which each of the selected health conditions meets the above criteria.

Respondents of the HPQ were asked to indicate for each health condition in the list whether they: i) do not have the condition, ii) have the condition but have never had treatment, iii) have the condition and have previously had treatment, and iv) have the condition and are currently having treatment.

To avoid misclassification, for all health conditions responses were excluded if the respondent indicated that they had the condition but had never been treated as the researcher could not be sure whether the person had self-diagnosed or been professionally diagnosed and refused treatment (average of 0.05% excluded per condition). For the same reason, for certain conditions only, responses were excluded if the respondent indicated they had the condition but were not currently on treatment as the researcher could not be confident that the person genuinely had the condition. These conditions were: arthritis, asthma, COPD, diabetes, fatigue, high blood pressure, and high cholesterol.

For each selected health condition, the responses have been coded into a yes/no response. 'Yes' includes those with the condition who have currently or previously been treated and 'no' for those who self-report as not having the condition (with the exception of those identified above). Where there are additional criteria for inclusion specific to the particular conditions, these are discussed below:

- COPD: People indicating that they have COPD, chronic bronchitis or emphysema were all included in the category COPD
- CVD: People indicating that they have either congestive heart failure or coronary heart disease were included in the category of CVD
- Obesity: respondents who self reported with obesity and respondents who scored a BMI greater than 30 based on height and weight information provided in the demographic category were all included.
- Psychological distress: a dichotomous variable with yes/no. Those with a K6 score of 13 or more are scored as 'yes' and those with a K6 score of 12 or less are scored as 'no'.
- Injury was derived from a HPQ question asking the number of days missed due to work related accident, injury or poisoning in the past year. Any days missed were categorised as a workplace injury and no missed days were categorised as no work place injury.

The following additional conditions are only included in the multi-morbidity analysis (described in section 3.7.7) as they were not identified as individually impacting on productivity or identified as a high priority health conditions by the Australian Government, and therefore were not included in earlier analyses: bladder problems, heart-burn, skin cancers, irritable bowel disorder, ulcers, osteoporosis, or other chronic pain. For these conditions the same coding applied as for the majority of conditions above, i.e. 'Yes' includes those with the condition who have currently or previously been treated and 'no' for those who self-report as not having the condition.

<u>Co-morbid psychological distress and individual health conditions</u>

Co-morbidity of each health condition and psychological distress was coded using the interaction function. That is, if a person had the health

condition and had psychological distress then they were coded as 'yes' for having co-morbid psychological distress with that health condition. If however the person had either the health condition or psychological distress but not the two together, they would be coded as 'no'.

3.6.3 Confounding (explanatory) variables

Co-morbidity as a confounder

Kessler [76] recommends accounting for the number of co-morbid health conditions when analysing these data. Among workers with high multiple health conditions, the number of co-morbidities is often more important than the nature of the conditions. [76] This study used the method for coding and categorizing co-morbidities outlined by Kessler. [76] This involved tallying the full set of health conditions listed in the HAS (using Kessler's inclusion criteria where all 'yes' responses were totalled) and coding the total number as follows: sole (1 condition), low co-morbidity (2-4 conditions), medium co-morbidity (5-7 conditions), high co-morbidity (8-10 conditions), and very high co-morbidity (11 or more conditions). This study also included a category of 'no health conditions' for those who self-report they have no health conditions at all.

Treatment-seeking behaviour as a confounder

Treatment-seeking can have an impact on both health and productivity; therefore, it has been included in the analysis as a potential confounding factor. Treatment-seeking was calculated by tallying the total number of occasions of health service utilization for any type of health service for any reason other than pregnancy. This count was then categorised based on the most equal distribution across groups, resulting in the following categories: no services used, low service use (1-3 services), moderate service use (4-9 services) and high service use (10+ services).

Demographic Characteristics

We included the following demographic characteristics in the analysis: age, gender, marital status, number of children, education level following Kessler. [76] In addition, the study included annual wage as a proxy for socio-economic status.

Where possible the same classification system as Kessler [4] has been used to enable ease of comparison to other studies using the HAS:

- Age: 18-29 years, 30-44 years, 45-59 years, 60+ years. This study excluded those aged under 18 and over 70 years as these were considered not reflective of the working population of Australia (0.2% excluded)
- Education: was categorised as 'did not complete high school', 'high school', 'some college', 'completed college or university'.
- Number of children: These were categorised as: no children, one-to-three children and four or more children.
- Sex was categorised as male and female.
- Marital status was categorised as married/ co-habiting or not married/ not co-habiting (separated, divorced, widowed, and never married).
- Annual wage: This was calculated using the question on annual income before tax. A list of income categories were given as options. Then grouped them into the following categories. The income groupings were: ≤$29,999pa, $30,000-$39,999pa, $40,000-$49,999pa, $50,000-$74,999pa, $75,000-$99,999pa, and ≥$100,000 pa. As there were many responses with an unexpectedly low annual income, it was thought that the respondent may have inadvertently stated their fortnightly income rather than their annual income. Therefore, those with an hourly wage (estimated using the median annual income) of less than $7.50 per hour were excluded. Hourly wage rather than annual wage was used to discern those genuinely on a low income to

allow for those who only work a few hours per week and therefore genuinely received a low annual wage.

Working conditions

Working conditions, including both job characteristics and features of the workplace, have been identified in the literature as impacting on both productivity and health status. Not all the working conditions identified in the literature are available for analysis in this study; for example, union membership was not recorded in the HAS. In addition, instruments to measure decision-making control and workplace bullying were not included in the HAS. However, other available factors listed below are used:

- *Occupational category*: The HAS job categories were re-categorised based on the ABS occupation classification system, resulting in the following categories: manager, professional/technical, sales, clerical/service, and trades/labour.
- *Industry type*: Participating organizations were categorised based on the Australian Bureau of Statistics (ABS) industry type classification system, resulting in the following categories: agriculture, communication, education, electricity/gas/water, finance, government administration, health/community, manufacturing, media, and retail.
- *Private/public sector*: Options for these were federal, state, local government and private sector.
- *Job security*: A proxy based on whether the respondent is employed as a casual (poor job security) compared to part-time or full-time (greater job security).
- *Contractor*: Respondents state if they work as a contractor ‘yes’ or ‘no’.
- *Workplace accident rate*: This was calculated by tallying the respondents who indicated that they had experienced an accident

or near misses in the previous four weeks then calculating the rate of accidents or near misses per hundred workers for each employer. The groups were then classified based on the most equal distribution across categories. The following categories were established: <0.25 accidents per hundred workers, ≥0.25 - <0.75 accidents, 0.75 - <1.5 accidents, 1.5 - <3.0 accidents, 3.5 - <5.0 accidents, and ≥5.0 accidents per hundred workers.

- *Hours worked in past seven days*: This is a continuous variable of the actual hours worked.
- *Number of staff supervised*: Respondents were asked the number of staff they are responsible to supervise. These were categorised based on the most equal and meaningful distribution across groups as follows: zero staff supervised, 1-2 staff, 3-9 staff, 10-19 staff, 20 or more staff supervised.
- *Hours expected to work*: respondents were asked how many hours their employer expected them to work in a typical week. The response range allowed them to select between 0 and 97 hours. The following categories were established: ≤35 hours pw, >35 & ≤ 40 hours pw, >40 & ≤ 50 hours pw, >50 & ≤ 60 hours pw, > 60 hours pw.

3.7 Statistical Analysis Methods

3.7.1 Regression models

All data were coded in SAS version 9 as described above. All data analysis was performed in STATA version 10. Different types of regressions have been used depending on the outcome used and are described in detail below. Briefly, negative binomial logistic regressions were used for absenteeism and multinomial logistic regressions for presenteeism. The analyses for both absenteeism and presenteeism were conducted in stages (see Box 1).

Stages one, two and three involved bivariate analyses of i) each individual health condition, ii) each demographic characteristic and health

characteristic (treatment seeking and number of co-morbidities) and iii) each working condition as explanatory variables with absenteeism (or presenteeism) as the dependent variable to estimate the crude association ("crude risk") between each potential covariate and absenteeism (or presenteeism). The fourth stage involved multivariate analyses with all relevant covariates included in multivariate models with absenteeism (or presenteeism) as the dependent variable and each health condition as the explanatory variable of interest. Separate models for each condition were used due to collinearity when health conditions were all in the one model.

In the analyses stages one to four addresses research objective one: to explore the impacts of health conditions on productivity. Stages five and six involved bivariate analyses of associations between i) each health condition, ii) each demographic characteristic or health characteristic (treatment seeking and number of co-morbidities) with psychological distress, using psychological distress as the dependent variable. Stage seven involved multivariate analyses with psychological distress as the outcome of interest and each health condition as the explanatory variable of interest adjusting for relevant covariates to identify which health conditions had a significant adjusted association with psychological distress. Stage eight involved multivariate analyses using absenteeism (or presenteeism) as the outcome variable of interest. The explanatory variables of interest were each health condition (again separate models for each individual health condition) and psychological distress also in the model along with any relevant covariates.

Stages five to eight addressed research objective two: to explore the impacts of health conditions on productivity when co-morbid with psychological distress. Post estimation calculations were performed after each multivariate model to determine the exact risk of absenteeism (or

presenteeism) from that health condition when co-morbid with psychological distress.

Stages nine to eleven were used to address research objective three: to explore the impacts on productivity for each cluster of multi-morbid health group with and without co-morbid psychological distress. In the analyses stage nine involved exploratory factor analysis with no outcome variable of interest, to identify clusters of non-randomly occurring multi-morbidity. Stage ten involved bivariate analyses of each cluster of multi-morbidity as the explanatory variable and absenteeism (or presenteeism) as the outcome variable of interest. Stage eleven used multivariate analyses with absenteeism (or presenteeism as the outcome variable of interest) and each cluster of multi-morbidity (separate models for each cluster) as the explanatory variable of interest, adjusting for all relevant covariates (both with and without psychological distress included in models using the same analyses methods as described above in stage eight).

Table 6: Summary of Estimation Process

Objective	Stage	Dependent variable	Explanatory variables
1. To explore the impact of a range of health conditions on workplace productivity	1	Absenteeism/presenteeism	Health conditions
	2	Absenteeism/presenteeism	Demographic and health characteristic
	3	Absenteeism/presenteeism	Working conditions
	4	Absenteeism/presenteeism	Health condition adjusting for: demographics and health characteristics (treatment-seeking behaviour, and number of co-morbidities), and working conditions
2. To explore the impact of co-morbid	5	Psychological distress	Health condition
	6	Psychological distress	Demographic characteristics

Objective	Stage	Dependent variable	Explanatory variables
psychological distress and other health conditions on workplace productivity	7	Psychological distress	Health condition adjusting for demographics
	8	Absenteeism/presenteeism	Psychological distress, adjusting for health condition, demographic health characteristics (treatment-seeking behaviour, and number of co-morbidities), and working conditions
3 To explore the impact of each identified cluster of multi-morbid conditions; with and without co-morbid psychological distress, on work place productivity	9	none	Exploratory factor analysis to identify clusters of non-randomly occurring multi-morbidity
	10	Absenteeism/presenteeism	Cluster of health conditions
	11	Absenteeism/presenteeism	Cluster of health conditions, adjusting for demographics, treatment-seeking behaviour, and working conditions (not number of co-morbidities as this caused collinearity)

3.7.2 Absenteeism Models

For absenteeism, the data were most suited to a negative binomial regression model. This was assessed using a function in STATA which reports the appropriateness of different models to the data distribution.

The reference category for all health conditions was persons who do not have the condition. Therefore, the risk ratio of absenteeism for any given health condition is compared to those without the health condition. The

risk ratio for other explanatory variables is relative to the reference category, indicated by a ratio of 1.0 in all tables of results.

Regressions of absenteeism with each demographic characteristic and working conditions factor were performed to determine which potential confounders to include in the multivariate models. Separate models were developed for each individual health condition to avoid co-linearity.

The full multivariate models included all confounders identified in the previous stages. The relative risk of a particular health condition in a full model is relative to someone not having the condition but in the full models the model has also adjusted for the other factors known to impact on absenteeism.

Initially forward stepwise methods were used, identifying the need to perform separate models for each health condition to avoid colinearity. Following this, all covariates were included that were found to be significant in bi-variate analyses to impact on the outcome variable (absenteeism). These were kept in the models to adjust for this covariate regardless of whether they became insignificant in the full model. Separate models were used for each health condition to avoid colinearity. For absenteeism the models were developed in two stages, firstly through running a negative binomial regression model in STATA to generate the exact alpha statistic for that model, then using that alpha statistic, an extension of a generalise linear regression model to suit a negative binomial distribution was developed which provides goodness of fit tests including AIC and the same risk ratio as that generated in the earlier model.

3.7.3 Presenteeism Models

Presenteeism has three categories, low, average and high productivity. ‘Low’ equals a score of less than six, ‘average’ equals a score between

six and nine, and ‘high’ equals a score of ten. [76] Multinomial logistic regression was used for all regressions with ‘average’ productivity used as the reference category. The regressions of presenteeism and each health condition were performed to provide a crude relative risk estimate. In the multinomial regressions the relative risk is again in relation to the reference category. In this instance, consideration was given not only to the effects of the health condition, but also to the comparison of both low and high productivity with the reference category of average (or moderate) productivity. Therefore, the relative risk of both low and high productivity were described with crude estimates using regressions of presenteeism with each health condition, demographic characteristic and working condition factors. Then, using full models for each health condition separately; relative risks for both low and high productivity were estimated adjusting for all known demographic and working condition confounders. Individual models were developed for each health condition separately to avoid co-linearity.

3.7.4 Management of aspects of non-representativeness of the sample

In addition to including all covariates that demonstrated a variation from the proportions seen in the Australian working population, for example sex and industry type, separate analyses were performed using the same data analysis methods, on the two largest homogenous subsets of the data. This was to compare the consistency of the findings from these homogenous groups with those of the complete data set. Results of these analyses for the Teachers (n=12.342) and Nurses (n=14,962) sub-sets of data are reported in Section 4.5. This approach was based on the assumption that if the results of these two large homogenous groups were consistent with those of the complete dataset, then concerns regarding the conclusions drawn from this non-representative full sample could be diminished. That is, although the full sample may not be representative of the Australian working population in general, if conclusions from the representative groups are the same as for the full sample then the effect

the effect on conclusions from having a non-representative sample will be minimal.

The representativeness of the both the nurses and teachers samples were compared with the Australian workforce data for sex, income, and education. For sex, the Australian nursing workforce 91% female and our sample had 77% female. [201] For teachers 69% female and our sample had 78% female. [202] No data was available on income or education however income was based on awards set at a state level so there would not likely be differences between our sample and the working population. Similarly education qualifications required are set at an Australian level so no differences would be expected for this characteristic either. The number of teachers without children was unexpectedly high; it is possible this was a sampling bias issue. That is, those younger teachers without children would have more time to complete surveys as older teachers without children may have lost motivation to participate in any non-essential teaching related events. However, the number of children was not significant in multi-variate models for the teachers' analysis or the sample as a whole.

While the complete dataset is not representative of working Australians, the following factors should be considered: The data was obtained from a sample of willing employees from 58 large organisations. The sample had more white-collar workers than the general population. Approximately 80% were aged 30-59 years. More than half (65%) were female, which is greater than the proportion in the Australian workforce [199]. The sample also had greater representation of workers from industries of health, education, and government administration; and fewer from retail, construction and mining. [199] The average income and education level are fairly representative of the Australian population. [199] To adjust for these differences, the following covariates were included in models: age, sex, education level, industry type, work role, job security along with other working conditions and demographic characteristics (see Appendix D

Table 30). Strengths of the study include the large sample size, the range of data available relating to health conditions, work-related characteristics, demographic characteristics and the sample representing regional, rural and urban Australia.

3.7.5 Associations with Psychological Distress Models

Logistic regression was used for modelling the association between each individual health condition and psychological distress. Bi-variate models were conducted then multivariate models adjusting for the following confounders: age, sex, marital status, education, number of children and annual income as a socio-economic status indicator. Only demographic characteristics and working conditions with a significance level of $p<0.05$ were included. Individual models were developed for each health condition separately to avoid collinearity.

3.7.6 Co-morbid Psychological Distress and Productivity Models

The same methods were used as above for absenteeism and presenteeism when considering the impacts of co-morbid psychological distress and health conditions under investigation in this study, i.e negative binomial logistic regression for absenteeism and multinomial logistic regression for presenteeism. The only difference was that rather than having a dichotomous variable of interest (those with or without the disease of interest in that model) an alternative was used as follows. The indexed health condition was categorised as follows: i) the reference category which had neither the indexed health condition nor co-morbid psychological distress (but could also have other health conditions); ii) has the indexed health condition but not co-morbid psychological distress, (but could have also other health conditions); or iii) has the indexed health condition and co-morbid psychological distress, (and could also have other health conditions).

3.7.7 Multi-morbidity Analysis

The study of patterns of multi-morbidity is a new field. While there is a growing body of evidence regarding the prevalence of co/multi-morbidity, most studies use either a count of the number of co-morbidities such as the Charlson Index [178] or a cumulative Illness rating Scale (CIRS) which groups conditions into organ systems. [57, 179] These methods do not identify the non-random cluster patterns of individual health conditions into groups of multi-morbid conditions. This is potentially due to the limitations of statistical methods to date. Most statistical packages that can perform exploratory factor analysis require the data to be in continuous format and health conditions are usually dichotomously represented, that is, the person has the condition yes or no. We chose to use exploratory factor analysis using software which accommodates dichotomous data.

The Exploratory Factor Analysis (EFA) for our analysis was performed in the software package, *Mplus* [203] which accommodates exploratory factor analysis of dichotomous variables by calculating tetrachoric correlations among the variables. When working with tetrachoric correlations, there are no assumptions concerning the shapes of the frequency distributions, and as a consequence, there is no need to be concerned that some distributions are skewed. Factor solutions of one factor to eight factors were explored with the data. The factor analysis principles of an eigenvalues-greater-than-one more than two items per factor were applied. A factor loading threshold of ±0.50 was applied, along with goodness-of-fit indices were also used (RMSEA: root mean square error of approximation; RMR: root mean square residual) both of which should be less than 0.05); CFI/TLI tests (CFI: comparative fit test and TLI: Tucker Lewis test) both of which should be greater than 0.95; and orthogonal quartimax rotation was used to obtain the most appropriate fit for the data. Items contributing to the definition of factors are bolded. The above process will enable health clusters to be identified and explored with relation to productivity losses associated with each cluster of co-

morbidly occurring health conditions. Regression models will then be used to identify characteristics of each class, and to explore how each of these multi-morbid clusters impacts on productivity (absenteeism and presenteeism)

For the multi-morbidity analysis, exploratory factor analysis was performed on 23 health conditions to identify non-randomly occurring clusters of multi-morbid health conditions. These conditions were allergies, arthritis, asthma, back/neck pain, bladder problems, cancer (not including skin cancer), all other cancers, COPD, CVD, drug and alcohol problems, diabetes, fatigue/sleep problems, heartburn, high blood pressure, high cholesterol, workplace injuries, irritable bowel syndrome, psychological distress, migraine and other sever headaches, obesity, osteoporosis, other chronic pain, and ulcers. This list of 23 conditions was derived from the 26 conditions available through the HAS. The following conditions were listed separately but grouped together for this analysis largely due to small sample size or due to similar biological characteristics. These were: i) migraine and other severe headaches; ii) congestive heart failure and coronary heart disease, iii) chronic bronchitis or emphysema and chronic obstructive lung disease, iv) chronic sleep problems and chronic fatigue or low energy. The HPQ survey also lists anxiety disorders, depression and other emotional problems as three separate conditions, this study used the results of the validated K6 score for psychological distress which covers these three factors. In addition the HAS asks a question whether the respondent had a work-related injury that required medical attention, this was also included as a health condition.

The exploratory factor analysis (EFA) of these 23 conditions resulted in the formation of four clusters of non-randomly occurring multi-morbid health conditions. These clusters were then grouped and separate models

developed to explore each of their impacts on absenteeism (or presenteeism) both with and without co-morbid psychological distress.

3.7.8 Limitations of Models

As this is a cross-sectional data-set, This study was limited to reporting associations only. Van der Akker (2001) discusses three types of co-/multi-morbidity: simple co-/multi-morbidity (the occurrence of diseases, whether coincidental or not), associative co-/multi-morbidity (statistical association not or not known to be causal) and causal co-/multi-morbidity (implying a causal relation among co-occurring diseases). [58] It is not within the capacity of this study to report on the causal relationship of these co-morbid or multi-morbid conditions; however, reporting non-randomly occurring health conditions was possible. These findings can assist in understanding the patterns of multi-morbidity occurring within Australian workers. Additional research would be needed using longitudinal or case-control study designs to determine causal pathways.

3.8 Conclusion

The above methods provide an approach to exploring the impacts on productivity loss for a range of individual health conditions; of comparing the impacts on productivity loss for individuals with the condition of interest both with and without co-morbid distress, compared to those with neither condition. In achieving this it also explores the associations between individual health conditions and psychological distress. In addition these methods; use statistical software that enables the identification of patterns of non-randomly occurring clusters of health conditions and compares their impact on productivity loss both with and without co-morbid psychological distress.

4. RESULTS: HEALTH AND PRODUCTIVITY

This chapter on health and productivity losses reports the results relevant to research objective one: to explore the impact of a range of health conditions on productivity using both absenteeism and presenteeism productivity measures. It also reports briefly on these same analyses performed on discrete sub-sets of the data; that of teachers and nurses, to check consistency between the results for the whole study sample with those of discrete sub-sets of the sample.

The chapter is structured as follows: Firstly, Absenteeism is discussed in terms of associated demographic characteristics and health conditions. Unadjusted results (bivariate analyses) are discussed briefly with relevant tables available in appendix D. Multivariate analyses results are provided in the body of the chapter along with a detailed description of findings. The same approach is then taken for presenteeism. A brief description of the health conditions with the greatest impact on both productivity measures is then provided. Next a profile of characteristics associated with productivity loss is described, first for absenteeism then presenteeism. This profile includes all factors adjusted for in analysis models including working conditions. Following this, further analysis is undertaken using the same methods on two large homogenous sub-sets of the data to compare these findings to the whole sample. Finally a summary of key findings of the chapter is provided along with a discussion of issues impacting on the interpretation of findings and a discussion of conclusions that can be drawn from these data.

4.1 Absenteeism

4.1.1 Demographic characteristics of the sample used to explore the associated between health conditions and absenteeism

A sample of 78,430 workers: including part-time, full-time and casual workers was analysed to explore relationships between health conditions

and absenteeism. (Appendix D, Table D1 describes the demographic characteristics of this sample.) Of the 78,430 Australian workers in the study of absenteeism, 65% were female and 35% male. The two largest age groups were those aged 30-44 years and those aged 45-59 years, comprising of all but 20% of the sample, with only 17% aged less than 30 years and 3% aged over 60. Those aged less than 18 years and over 70 years were excluded from the study as they were considered not representative of the Australian workforce (0.2% deleted).

Slightly more than two-thirds of the sample was married or cohabiting. Nearly 70% had no children, only 3% had four or more children and the remainder had 1-3 children. Nearly half had completed a college or university program. Approximately one quarter had an annual income of less than $39,999 and approximately half earned $50,000 or more per annum. Income of less than $7.50 per hour was treated as missing data as respondents may have inadvertently reported fortnightly rather than annual income. (See Figure 2 below)

In this sample, the mean (standard deviation) reported number of days absent in the last four weeks was 2.44 (Std dev 4.44).

4.1.2 Bivariate (unadjusted) analysis of health conditions associated with absenteeism

All health conditions had significant ($P<0.001$) impact on absenteeism prior to adjusting for known confounders (see Appendix D, Table D2). The impact ranged in risk from RR 1.95 (95% CI: 1.81-2.10) for drug and alcohol problems to a risk of 1.12 (1.09-1.14) for high cholesterol (see Figure 2). In order of greatest to lowest risk the conditions were: drug & alcohol problems, current psychological distress, COPD, arthritis, injury, fatigue, cancer, migraine, asthma, back/neck pain, obesity, diabetes, CVD, high blood pressure, and high cholesterol.

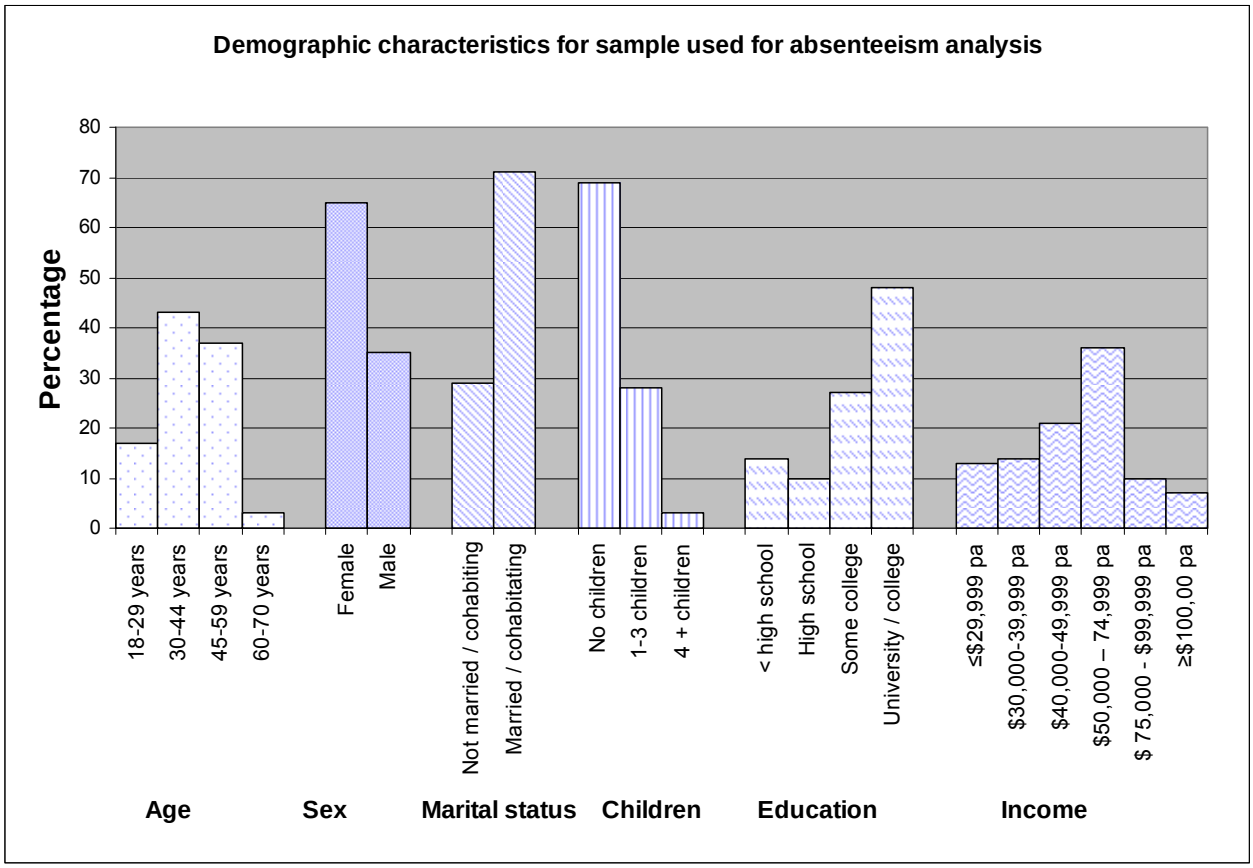


Figure 2: Demographic characteristics of sample for Absenteeism analysis

4.1.3 Multivariate analysis of health conditions associated with absenteeism (adjusting for demographic characteristics, number of co-morbidities, treatment-seeking behaviour and working conditions)

The impact of health conditions on absenteeism, after adjusting for demographic characteristics, the number of co-morbidities, treatment-seeking behaviour and working conditions are described below in Table 7 and Figure 3. Treatment-seeking behaviour is not specific to a particular condition. (Table D2 in Appendix D reports bi-variate treatment-seeking risks associated with absenteeism, Table D3 reports bi-variate working conditions risks associated with absenteeism).

Self-reported drug & alcohol problems had the highest risk of absenteeism (RR1.41, 95%CI: 1.13-1.77), followed by psychological distress (K6), COPD, workplace injury, cancer, arthritis, obesity,

back/neck pain, and asthma. Conditions that were not significantly associated with absenteeism were fatigue, migraine and CVD. Conditions that were associated with a reduced risk of absenteeism were diabetes, high cholesterol, and high blood pressure. Although most of the Risk Ratio values were statistically significant, effect sizes were quite small.

The number of co-morbidities was also associated with an increased risk of absenteeism. The greater the number of co-morbid health conditions, the higher the risk of absenteeism. The adjusted risk increased from 1.07 (1.03-1.11) for one health condition to 1.62 (1.52-1.72) for eleven or more co-morbid conditions, increasing in risk as the number of health conditions increased. The above health conditions were explored in models with and without treatment-seeking behaviour. All health conditions that had a significant impact on absenteeism had a greater effect when treatment-seeking was not included in models. (See Appendix D Table D4)

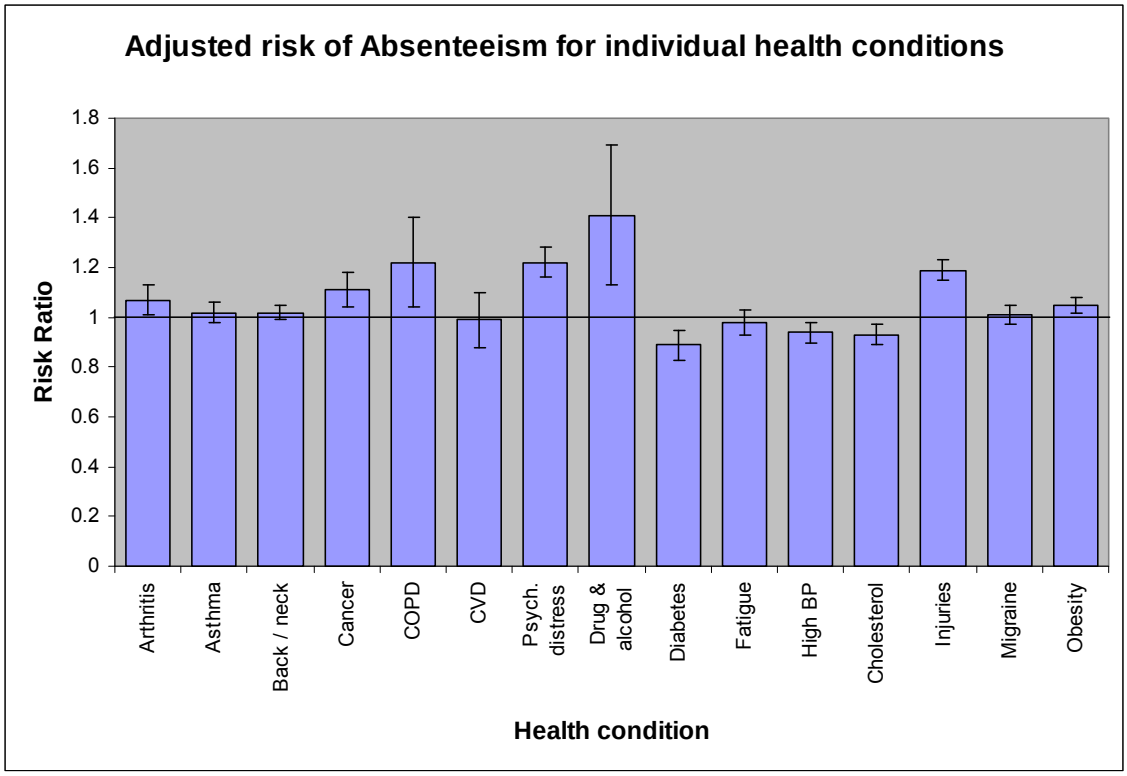


Figure 3: Adjusted risk ratio of absenteeism associated with individual health conditions

Table 7: Multivariate negative binomial regression for each HEALTH CONDITION by ABSENTEEISM

	Unadjusted %	n	IRR	95% CIs	p-value
ARTHRITIS ϒ π		64,893			
no arthritis	96		1.00		
arthritis	4		1.07	1.01-1.14	0.03
ASTHMA ϒ π		65,581			
no asthma	94		1.00		
asthma	6		1.02	0.98-1.07	0.30
BACK/NECK PAIN ϒ		69,548			
no back / neck pain	70		1.00		
back / neck pain	30		1.02	0.99-1.05	0.12
CANCERS (excluding skin cancer) ϒ		74,567			
no cancers	97		1.00		
cancer/s	3		1.11	1.04-1.17	0.001
CARDIOVASCULAR DISEASE ϒ		74,106			
no cardiovascular disease	99		1.00		
cardiovascular disease	1		0.99	0.88-1.12	0.91
COPD/BRONCHITIS/EMPHYSEMA ϒπ		71,768			
no COPD/Bronchitis/Emphysema	99.6		1.00		
COPD/Bronchitis or emphysema	0.4		1.22	1.04-1.43	0.02
DIABETES ϒπ		73,895			
no diabetes	98		1.00		
diabetes	2		0.89	0.83-0.96	0.002
DRUG & ALCOHOL PROBLEMS ϒ		72,114			
no drug & alcohol problems	99.8		1.00		
drug & alcohol problems	0.2		1.41	1.13-1.77	0.003
FATIGUE/SLEEP PROBLEMS ϒπ	99	74,696			
no fatigue/sleep problems	1		1.00		
fatigue/sleep problems	92		1.01	0.89-1.14	0.93
HIGH BLOOD PRESSURE ϒπ	8	70,791			
no high blood pressure	94		1.00		
high blood pressure	6		0.94	0.90-0.97	0.001
HIGH CHOLESTEROL ϒ		68,537			
no high cholesterol	94		1.00		
cholesterol	6		0.93	0.89-0.98	0.01
MIGRAINE/SEVERE HEADACHES ϒπ		70,378			
no migraine/severe headaches	90		1.00		
migraine/severe headaches	10		1.01	0.97-1.05	0.65
OBESITY ϒπ		71,512			
no obesity	89		1.00		
obesity	11		1.05	1.02-1.09	0.002
PSYCHOLOGICAL DISTRESS ϒ		74,497			
no psychological distress	97		1.00		
psychological distress	3		1.22	1.16-1.29	<0.001
WORKPLACE INJURIES ϒ		75,002			
no injuries	93		1.00		
injuries	7		1.19	1.15-1.24	<0.001
COMORBIDITY ϒ		75,132			
no health conditions	13		1.00		
1 health condition only	16		1.07	1.03-1.11	0.001
2-4 health conditions	41		1.15	1.12-1.19	<0.001
5-7 health conditions	19		1.29	1.24-1.34	<0.001
8-10 health conditions	8		1.44	1.38-1.51	<0.001
11 or more health conditions	3		1.62	1.52-1.72	<0.001

	Unadjusted %	n	IRR	95% CIs	p-value
Adjusting for: treatment-seeking behaviour, co-morbidity, median annual wage, industry type, public/private sector, occupation grade, contractor, number of staff supervising, number of work accidents per hundred workers for employer, age, education, sex, job security, hours worked in last week, marital status, number of children and number of hours expected to work by employer; ϒ: number of children and π: contractor not significant at p<0.05					

4.2 Presenteeism

4.2.1 Demographic characteristics associated with presenteeism

A sample of 77,455 workers, including part-time, full-time and casual workers, was analysed to explore relationships between health conditions and presenteeism. This sample is smaller than the 78,430 sample analysed in Section 4.1 due to some missing values. Of the 77,455 working Australians in the presenteeism analysis (profiled in Figure 4 and described in Appendix D, Table D5), 65% were female and 35% male. Bi-variate analyses were performed on demographic characteristics to determine the crude estimates of their association with presenteeism. Presenteeism, or under-functioning while attending work, is measured using the HAS. Both low and high productivity were compared to average productivity, ('low' = <6, 'average' = 6-9, 'high' = 10. [76]) However, the focus was on factors that increase the risk of low productivity.

In this sample, the mean reported score of overall productivity on a score range of 0-10 (with 10 being very high productivity) in the last four weeks was 7.97 (Std dev 1.35). When grouped into low, moderate and high productivity, 5% reported low productivity, 86% reported moderate productivity and 9% reported high productivity.

The two largest age groups were those aged 30-44 years and those aged 45-59 years, comprising all but 20% of the sample, with only 17% under 30 years of age and 3% aged over 60.

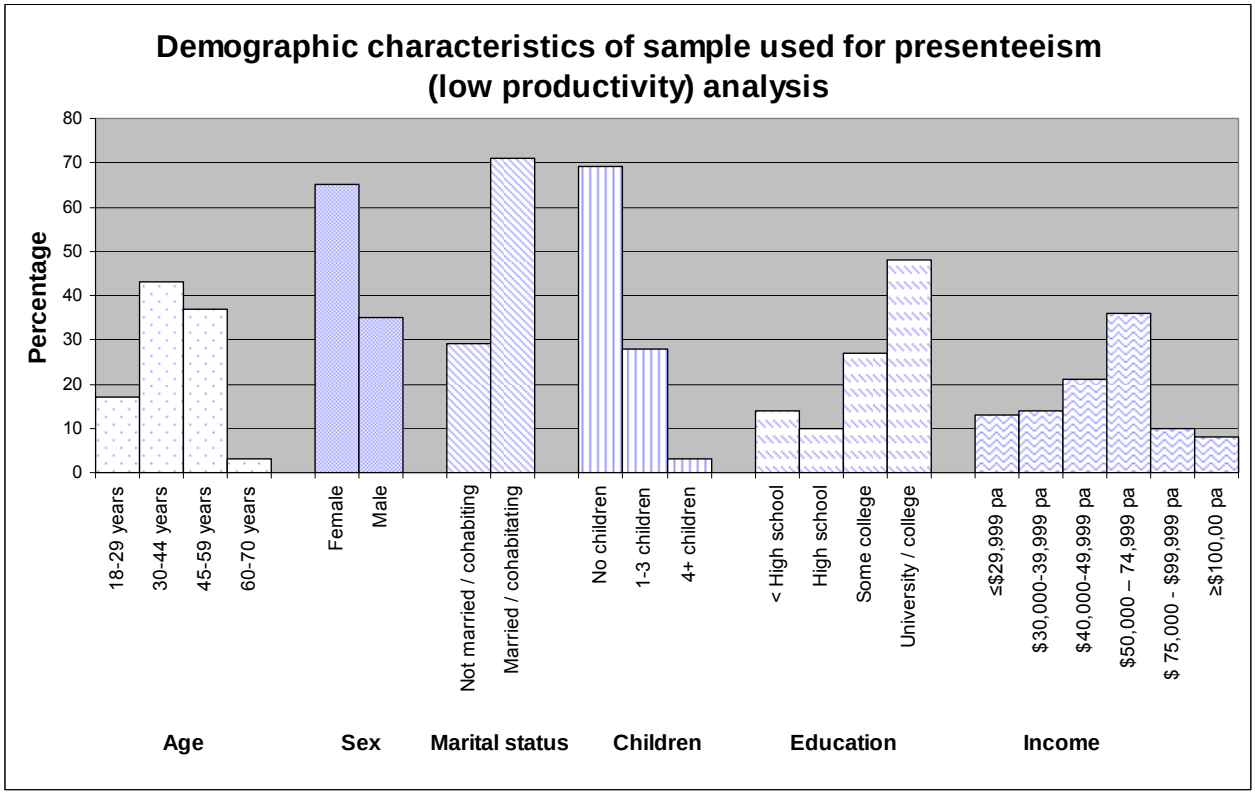


Figure 3: Demographic characteristics of sample used for presenteeism (low productivity) analysis

Slightly more than two-thirds of the sample was married or cohabiting. Nearly 70% had no children, only 3% had four or more children and the remainder had 1-3 children. Nearly half had completed a college or university program. Approximately one quarter had an annual income of less than $39,999 and approximately half earned $50,000 or more per annum. (Income of less than $7.50 per hour was treated as missing data as respondents may have inadvertently reported fortnightly rather than annual income).

4.2.2 Bi-variate (unadjusted) analysis of health conditions associated with presenteeism

With the exception of cancer, high blood pressure and high cholesterol, all health conditions demonstrated an unadjusted increased risk of low self-reported work performance (see Appendix D, Table D6). The increased

relative risk ranged from RR6.72 (95%CI: 6.11-7.39) for psychological distress to RR1.21 (95%CI: 1.02-1.44) for arthritis.

4.2.3 Multivariate analysis of health conditions and presenteeism (adjusting for demographic characteristics and working conditions)

Figure 4 and Table 8 below describes the association between presenteeism after adjusting for demographic characteristics, the number of co-morbidities, treatment-seeking behaviour and working conditions. Treatment-seeking behaviour is not specific to a particular condition. (See Appendix D Table D6 for treatment-seeking bi-variate association with presenteeism and Table D7 for bi-variate working conditions and presenteeism).

The health conditions most strongly associated with an increased risk of low productivity (presenteeism) after adjusting for a range of confounding factors are: psychological distress (RR 4.32, 95%CI: 3.88-4.80), drug and alcohol problems, fatigue, work related injury, and obesity. COPD also had an increased risk of however this was a trend only.

Several conditions were associated with a reduced risk of low productivity; these were asthma, high blood pressure, and back/neck pain. The following conditions also demonstrated a trend of reduced risk: cancer, migraine, and high cholesterol. Several conditions were not significantly associated with presenteeism (arthritis, CVD, and diabetes).

The number of co-morbidities was also associated with an increased risk of low productivity. The greater the number of co-morbid health conditions, the higher the risk of low productivity. The adjusted risk increased from 1.23 (1.05-1.43) for one health condition to 4.86 (4.06-5.82) for eleven or more co-morbid conditions.

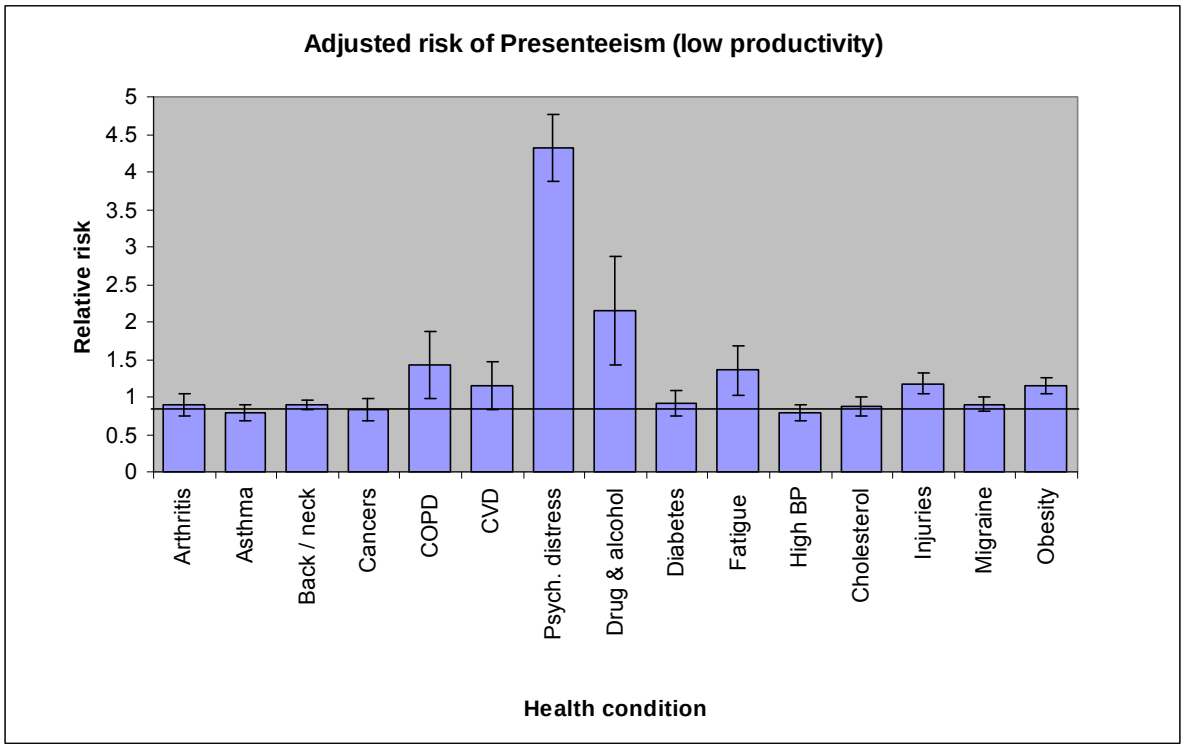


Figure 4: Adjusted risk of presenteeism associated with individual health conditions

The health conditions in table two were explored in models with and without treatment-seeking behaviour included. (See Appendix D Table D8 for comparison of results of models with and without adjusting for treatment seeking behaviour). All health conditions that had a significant impact on presenteeism had a greater effect when treatment-seeking was not included in the models.

Table 8: Multivariate multinomial regression for LOW PRODUCTIVITY (Presenteeism)
(Reference category moderate productivity, only low productivity reported)

	Unadjusted %	n	RRR	95% CIs	p-value
ARTHRITIS ϒ π		63,627			
no arthritis	96		1.00		
Arthritis	4		0.89	0.74-1.08	0.23
ASTHMA π		64,199			
no asthma	94		1.00		
Asthma	6		0.79	0.69-0.90	0.001
BACK / NECK PAIN ϒ		68,069			
no back / neck pain	70		1.00		
back / neck pain	30		0.89	0.82-0.97	0.006
CANCERS ϒ (excluding skin cancer)		72,966			
no cancers	97		1.00		
cancer/s	3		0.83	0.68-1.00	0.06
CARDIOVASCULAR DISEASE ϒ		72,523			
no cardiovascular disease	99		1.00		

	Unadjusted %	n	RRR	95% CIs	p-value
cardiovascular disease	1		1.15	0.84-1.58	0.38
COPD/BRONCHITIS/EMPHYSEMA$^{\Upsilon\pi}$		70,353			
No COPD / Bronchitis / Emphysema	99.6		1.00		
COPD / Bronchitis or emphysema	0.4		1.43	0.98-2.10	0.06
DIABETES $^{\Upsilon\pi}$		72,439			
no diabetes	78		1.00		
Diabetes	2		0.92	0.75-1.13	0.43
DRUG & ALCOHOL PROBLEMS$^{\Upsilon\pi}$		70,544			
no drug & alcohol problems	99.8		1.00		
drug & alcohol problems	0.2		2.15	1.43-3.24	<0.001
FATIGUE / SLEEP PROBLEMS$^{\Upsilon\pi}$		73,095			
no fatigue / sleep problems	99		1.00		
fatigue / sleep problems	1		1.36	1.03-1.78	0.03
HIGH BLOOD PRESSURE $^{\Upsilon}$		69,384			
no high blood pressure	92		1.00		
high blood pressure	8		0.79	0.69-0.91	0.001
HIGH CHOLESTEROL$^{\Upsilon}$		67,083			
no high cholesterol	94		1.00		
Cholesterol	6		0.87	0.75-1.01	0.08
MIGRAINE/SEVERE HEADACHES$^{\Upsilon\pi}$		68,993			
No migraine / severe headaches	90		1.00		
Migraine / severe headaches	10		0.90	0.80-1.00	0.06
OBESITY$^{\Upsilon\pi}$		70,119			
no obesity	89		1.00		
Obesity	11		1.15	1.05-1.27	0.005
PSYCHOLOGICAL DISTRESS $^{\Upsilon}$		72,898			
no psychological distress	97		1.00		
psychological distress	3		4.32	3.88-4.80	<0.001
WORKPLACE INJURIES$^{\Upsilon}$		73,415			
no injuries	93		1.00		
Injuries	7		1.18	1.05-1.32	0.005
CO-MORBIDITY$^{\Upsilon}$		73,568			
no health conditions	13		1.00		0.02
1 health condition only	16		1.23	1.05-1.43	0.008
2-4 health conditions	41		1.70	1.49-1.94	<0.001
5-7 health conditions	19		2.59	2.25-2.98	<0.001
8-10 health conditions	8		3.62	3.11-4.24	<0.001
11 or more health conditions	3		4.86	4.06-5.82	<0.001
Adjusting for number of co-morbidities, treatment-seeking behaviour, age, sex, education, marital status, income, number of children, occupation, industry type, public/private sector, job security, contractor, hours worked in last week, supervisory role, rate of work accidents by employer, and hours expected to work per week; Υ: number of children and π: contractor not significant at p<0.05					

4.3 Health Conditions with the Greatest Impact on Productivity

When considering the top four individual health conditions affecting absenteeism, three of these four conditions are also within the top four health conditions associated with presenteeism.

Psychological distress, drug & alcohol problems, and injury were among the top four for both absenteeism and presenteeism. COPD also demonstrates a high risk for both productivity measures but is only a trend of p=0.06 for presenteeism.

4.4 Profile of Characteristics Associated with Productivity Loss

The following profile describes the potential characteristics of those with an increased risk of absenteeism and presenteeism: (not in any particular order).

Table D9 in Appendix D provides two examples of full models for absenteeism, giving details of the relative risk of each explanatory variable included in the models used to explore the impact of individual health conditions on absenteeism. The table demonstrates that the explanatory variables for each model of absenteeism produce similar risks regardless of the health condition under consideration. This is the case for all health conditions explored in relation to absenteeism. Therefore, a profile of absenteeism can be developed that describes the known characteristics associated with absenteeism as listed below.

Similarly for presenteeism, Table D10 in Appendix D provides two examples using the same two health conditions. For brevity, only low productivity results are reported. It should be noted that because education level is significantly associated with high productivity it remains in the model even though it is not significantly associated with low productivity. As with absenteeism, the explanatory variables for each model of presenteeism produce similar risks regardless of the health condition under consideration. This is the case for all health conditions explored in relation to presenteeism. Therefore, a profile of presenteeism can be developed that describes the known characteristics associated with absenteeism as listed below.

The number of children was not significantly associated with absenteeism or presenteeism. Profiles for absenteeism are virtually the same for all health conditions. Variations were that contractor was not significant for some conditions and there were some slight variation with regard to industry, occupation and supervision of staff. Profiles for presenteeism were also the same across health conditions except that the impacts of treatment-seeking patterns differed for some health conditions and contractor was not significant for some conditions.

Table 9 Profile of characteristics Associated with absenteeism and presenteeism (all these characteristics have a significant association with absenteeism or presenteeism at <0.05 or <0.001 unless otherwise indicated)

Characteristic	Absenteeism	Presenteeism
Health conditions of:	Drug and alcohol problems, psychological distress, COPD, injury, cancer, arthritis, obesity, diabetes, high blood pressure and high cholesterol.	Psychological distress, drug and alcohol problems, fatigue/sleep problems, injuries, obesity, back/neck problems, high blood pressure. In addition both COPD and cancer demonstrated a trend of association (p=0.06)
Co-morbidity present	As the number of co-morbid conditions increases the risk of absenteeism increases.	As the number of co-morbid conditions increases the risk of absenteeism increases.
Treatment-seeking behaviour	The more occasions of treatment the greater risk of absenteeism.	Varying treatment-seeking effect (i.e. lower rates of treatment-seeking are associated with reduced risk of presenteeism and higher rates of treatment-seeking associated with increased risk of presenteeism)
Age	Younger	Younger (as age increases the reduced risk is greater i.e. age is protective)
Sex	Male	Male
Marital status	Not married	Not married
Number of children	Not significant	Not significant

Characteristic	Absenteeism	Presenteeism
Education	Lower level of education (higher education associated with reduced risk)	Not significant
Annual Wage	The higher the annual wage the higher the risk	The higher the annual wage the higher the risk
Industry type	More likely in service industries (electricity, gas, water); education, or media (by comparison, all other industries have no significant association when compared to agriculture)	In agriculture industry (by comparison, all other industries have a reduced risk)
Public/Private Sector	Public sector employees	Federal government workers (state government demonstrated a reduced risk, others not significant)
Occupation Role	Not trades & labour workers (compared to managers, all other occupations had no significant association with absenteeism)	Not managers (by comparison, all other occupations have higher risk or a non-significant risk)
Supervisory role	Not significant	Supervising staff role (risk reduced when supervising any number of staff)
Job security	Not casual workers	Full-time or part-time but not casual workers (trend only)
Contract or waged	Not contractors	Wages workers, not contractors
Rate workplace accidents	Lower rate of workplace accidents (workplaces with moderate to high rates of workplace accidents had a reduced likelihood of absenteeism)	Moderate number of workplace accidents (low and high numbers of accidents not significant)
Hours worked in previous week	Relatively fewer hours worked in last 7 days (greater number of	Relatively fewer hours worked in last 7 days (greater number of hours

Characteristic	Absenteeism	Presenteeism
	hours worked associated with reduced risk of absenteeism)	worked associated with reduced risk of absenteeism)
Hours per week expected to work (as perceived by employee)	Being expected to work more hours per week (as hours expected increased risk of absenteeism increased).	Being expected to work more hours per week (as hours expected increased risk of absenteeism increased).

When comparing profiles of absenteeism and presenteeism, there are few differences. These differences are based on the particular individual health conditions that are significantly associated with: the productivity measure, the impacts of treatments seeking patterns, education, industry, workplace accidents and supervisory role.

For treatment-seeking there was an increased risk of absenteeism as the number of occasions of health care increase. Conversely, for presenteeism there was an association whereby low numbers of health care occasions were associated with reduced risk of presenteeism and high numbers of health care occasions were associated with increased risk of presenteeism.

Education was a significant factor for absenteeism but not presenteeism. Low levels of education were associated with an increased risk of absenteeism but had no effect on low productivity. A low rate of workplace accident rates per hundred workers was associated with a reduced risk of absenteeism; however, for presenteeism, moderate rates of accidents were associated with an increased risk of presenteeism.

Industry types differed for absenteeism and presenteeism. For presenteeism all industries were associated with low productivity compared to agriculture. Whereas, for absenteeism, only electricity/gas/water, education and media were associated with

absenteeism compared to agriculture. Patterns of staff supervision also differed in profiles for absenteeism compared with presenteeism. For presenteeism, compared to those not in a supervisory role, there was a reduced risk of presenteeism for any supervisory role regardless of the number of staff supervised; whereas, for absenteeism, there was no significant association.

4.5 Analysis of Two Large Homogenous Sub-sets of the Data

As some Australian industries were under-represented and others over-represented in this sample; two large sub-sets of homogenous workers: Teachers (n=12,342) and Nurses (n=14,962) were analysed separately. These results were then compared to findings of the overall sample to assess the consistency of these findings with those of the complete data set. The teachers and nurses data were analysed using the same methods as those used for the whole sample. This approach was undertaken to check that the results of these homogenous groups were consistent with those of the complete dataset; and if so, concerns regarding the representativeness of the overall sample could be diminished. More information on aspects where the whole sample does not align with the general Australian working population are described in section 3.7.4; however, key aspects are discussed below.

4.5.1 Demographic profiles for Teachers and Nurses subsets

When comparing the two sub-samples with each other and with the sample as a whole, there were no differences in marital status and only slight difference in age for the teaching subset which had slightly higher proportion of those aged 45-59 and slightly fewer aged 30-44 years. (See Appendix D, Tables D10 and D14 for absenteeism and D17 and D20 for presenteeism demographic characteristics). For sex, the overall sample has more females than the Australian workforce (65% and 45% respectively). [199] This is further skewed in the subsets of data with 77% of teachers and 81% of nurses being female. The number of people with

no children was also greater in the subsets than in the whole sample with 89% of nurses and 98% of teachers having no children compared to 69% in the whole sample.

The average income and education level for the sample as a whole are fairly representative of the Australian population. [199] Comparatively, the nursing and teaching sub-samples have a greater proportion with tertiary qualifications (65% and 80% respectively compared to 48% for the whole sample). However, nursing and teaching sub-samples both have a lower proportion earning more than $75,000pa compared to the whole sample (9%, 2%, and 18% respectively). And nurses have a lower proportion (45%) earning $50,000 or more compared to either the teaching sub-sample (54%) or the sample as a whole (55%). For teachers what is striking is that 80% have tertiary qualifications compared to 48% for the sample as a whole, yet only 2% of teachers earn $75,000 or more compared to 18% for the whole sample. As discussed in section 3.7.4, the representativeness of the both the nurses and teachers samples were compared with data on nurses and teachers for the Australian workforce as a whole. As income was based on awards set at a state level and education qualifications requirements set at an Australian level, no differences would be expected for these characteristics between our sample and the Australian workforce for these groups.

4.5.2 Proportion of sample with health conditions

There were only minor differences in the proportion with each health conditions for nurses and teachers sub-sets compared to the whole sample.

4.5.3 Absenteeism

Teachers and Nurses

Compared to the whole sample, both the teachers' and nurses' sub-samples (see Tables D13 and D16 in Appendix D) reported the same

patterns of adjusted absenteeism as the whole sample for arthritis, cancer, CVD, high cholesterol, work place injury and number of co-morbidities. For COPD and diabetes the same pattern trends as the whole sample were present. However, the results were only significant for the whole sample. This could be a statistical power issue. Similarly for psychological distress, drug and alcohol, and obesity the same pattern trends were present. However, these were only statistically significant for the whole sample and only one of the sub-samples; again possibly a power issue. For asthma, back/neck, high blood pressure and migraine the direction of the effect was different to the sample for one of the sub-samples compared to the sample as a whole. In these cases the differing sub-sample had confidence intervals straddling one that included the point estimates for the whole sample and the other sub-sample. Fatigue was not significant for the whole sample or for the teachers sub-sample but demonstrated a significant reduced risk of absenteeism for nurses where the confidence intervals did not quite overlap with the sample as a whole.

It is worth noting that teachers demonstrated a significant risk of back/neck pain that was not significant for the sample as a whole or the nursing sub-sample. Teachers also demonstrated higher risks of psychological distress than the sample as a whole or the nursing sub-sample. Both teachers and nurses had higher risks of workplace injury than the sample as a whole.

4.5.4 Presenteeism

Teachers and Nurses

Compared to the whole sample, both the teachers' and nurses' sub-samples (see Tables D19 and D22 in Appendix D) reported the same patterns of adjusted presenteeism as the whole sample for psychological distress, diabetes, back/neck pain, cancers, high blood pressure, high cholesterol, migraine and numbers of co-morbidities. For asthma, COPD,

drug and alcohol, and workplace injury the same pattern trends as the whole sample were present however the results were only significant for the whole sample. For CVD, fatigue and obesity the direction of the effect was different to the sample for one of the sub-samples compared to the sample as a whole. In these cases the differing sub-sample had confidence intervals straddling one that included the point estimates for the whole sample and the other sub-sample. Arthritis was not significant for any of the samples but the direction of risk was different in nursing sub-sample compared to the whole sample or for the teachers sub-sample and the point estimate for the whole sample was not within the nursing confidence intervals but the confidence intervals did overlap.

4.6 Summary of Key Findings

For absenteeism all health conditions had a significant negative impact on absenteeism in bivariate analyses. When models adjusted for demographic characteristics, working conditions, treatment seeking behaviour and number of co-morbidities the following conditions no longer had a significant impact: asthma, back/neck pain, CVD, fatigue, and migraine.

For presenteeism all health conditions except cancer, high blood pressure and high cholesterol had a significant negative impact on presenteeism in bivariate analyses. When models adjusted for demographic characteristics, working conditions, treatment seeking behaviour and number of co-morbidities the following conditions were no longer significant: arthritis, CVD, diabetes, and high cholesterol. COPD, migraine and cancer demonstrated a trend of ($p=0.06$)

In general, health conditions were associated with a higher risk of presenteeism than absenteeism. Although there were some slight differences in the confounders included in models, the risks of

absenteeism and presenteeism were very similar in the homogenous sub-sets of teachers and nurses, supporting the findings of the whole sample.

4.7 Issues Impacting on Interpretation of Findings

A number of factors need to be considered when interpreting these results. For example, all health conditions are self-reported with the exception of psychological distress which was obtained using a validated screening tool (K6). Some health conditions such as kidney disease are not represented in the list of health conditions explored. Some significant health confounders are not available such as smoking status, rurality and Indigenous status. Some working conditions were not available such as effort-reward balance. Given, the non-representativeness of the sample, although addressed through several means including adjustment for confounders in models, extrapolation of these findings to the general employed population should be undertaken with caution, especially with blue / white collar workers.

4.8 Conclusions

A range of individual health conditions have a significant impact on both absenteeism and presenteeism however this impact was reduced when models adjusted for number of co-morbidities, demographic characteristics, working conditions and treatment seeking behaviour. Generally, there was a greater risk of productivity loss associated with presenteeism than absenteeism. The results of the teachers and nurses data sub-sets were sufficiently consistent with those of the complete cohort to have confidence that the co-variates included in the models to adjust for variations in the population were sufficient to diminish concerns regarding the non-representativeness of the sample due to industry type.

5. RESULTS: CO-MORBIDITY AND PRODUCTIVITY

The following chapter on co-morbidity and productivity reports the results relevant to research objectives two and three: to explore the association between psychological distress and other health conditions; and to explore the impact of co-morbid psychological distress and other health conditions on productivity (absenteeism and presenteeism). The chapter is structured as follows: Firstly, demographic and health conditions associations with psychological distress are examined. Unadjusted results are discussed briefly. Adjusted results (multivariate analyses) are provided in the body of the chapter along with a detailed description of findings. Secondly, the impacts on absenteeism for a range of health conditions, when co-morbid with psychological distress are explored. Again unadjusted results are mentioned briefly. Adjusted results are provided in the chapter and discussed in more detail. The same approach is then taken for presenteeism. A brief description of the health conditions with the greatest impact on both productivity measures when co-morbid with psychological distress is then provided. Then a summary of key findings of this chapter is provided along with a discussion of issues impacting on the interpretation of findings and a discussion of conclusions that can be drawn from these data.

5.1 Health Conditions Associated with Psychological Distress

5.1.1 Demographic characteristics associated with psychological distress

A sample of 77,841 workers was analysed to explore relationships between health conditions and psychological distress. Of the sample, 65% were female and 35% male. (See Table D23 in Appendix D) The two largest age groups were those aged 30-44 years and those aged 45-59 years, comprising 80% of the sample, with only 17% aged less than 30 years and 3% aged over 60. Slightly more than two-thirds of the sample (71%) was married or cohabiting. Nearly 70% had no children, only 3% had four or more children and the remainder had 1-3 children. Nearly half

had completed a college or university program (48%). Approximately one quarter had an annual income of less than $39,999 and approximately half earned $50,000 or more per annum.

5.1.2 Bivariate (unadjusted) analysis of health conditions associated with psychological distress

The conditions with the highest unadjusted odds were: drug and alcohol problems (OR = 14.00), fatigue or sleep problems (OR = 5.04), migraine (OR = 2.80), COPD (OR = 2.46), CVD (OR = 2.18), and to a lesser extent injury (OR = 1.96), obesity (OR = 1.94), back/neck pain (OR = 1.93), diabetes (OR = 1.72), arthritis (OR = 1.48), asthma (OR = 1.47), cancer (OR = 1.37), high blood pressure (OR = 1.31), and high cholesterol (OR = 1.3). All investigated conditions, had a significant association with psychological distress. (See Table D24 Appendix D)

5.1.3 Multivariate analysis of health conditions associated with psychological distress (adjusting for age, marital status, children, sex, education level, and income)

After adjusting for socio-demographic characteristics all investigated health conditions had a significant association with psychological distress (Table 10 and Figure 5). The conditions with the greatest association were: drug and alcohol problems, fatigue, migraine, CVD, COPD, and to a lesser extent back/neck pain, injury, obesity, diabetes, arthritis, high blood pressure, high cholesterol, asthma, and cancer. For some conditions, the odds of having psychological distress were increased after adjusting for known confounders, these conditions were: CVD, cancer, fatigue, high blood pressure, high cholesterol, arthritis, back/neck pain diabetes and cancer.

The likelihood of having psychological distress increased as the number of health co-morbidities increased. After adjusting for known confounders the OR of someone having psychological distress when they had 2-4

health conditions was 3.36. This increased to an OR of 10.94 for 5-7 health conditions, an OR of 24.10 for 8-10 health conditions and an OR: 46.39 for eleven or more health conditions.

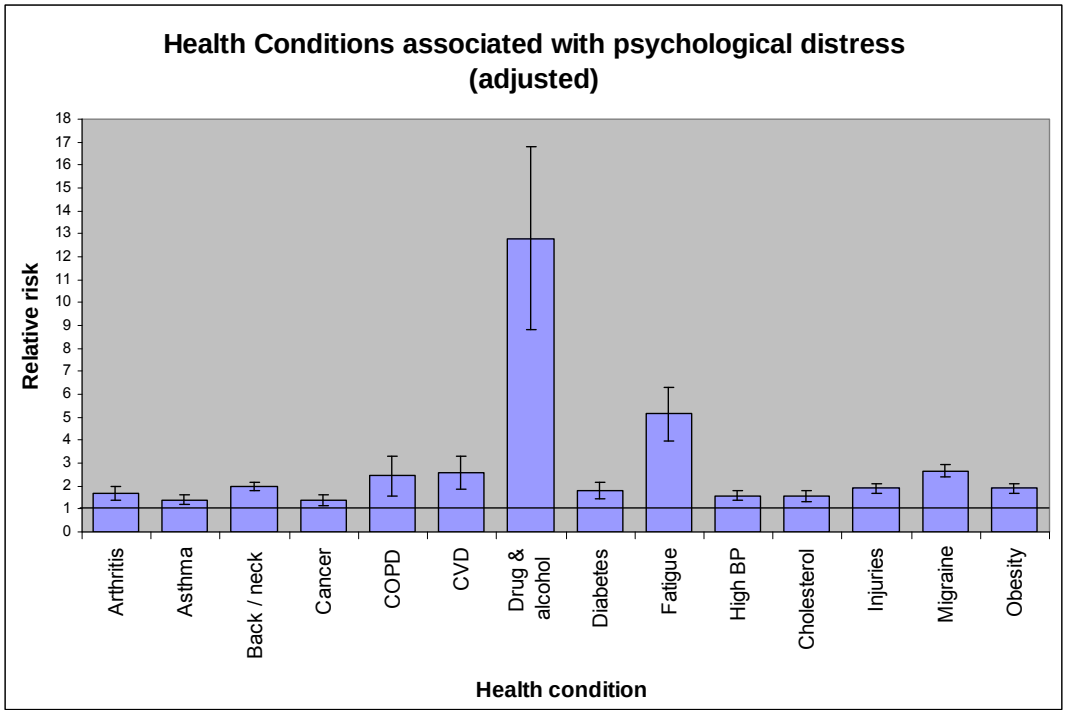


Figure 5: Odds of association with Psychological distress for investigated health conditions

Table 10: HEALTH CONDITIONS associated with PSYCHOLOGICAL DISTRESS

	n	%	OR	95% CI	P value
ARTHRITIS§	65,230				
no arthritis		96	1.0		
arthritis		4	1.66	1.36-2.04	<0.001
ASTHMA§	65,937				
no asthma		94	1.0		
asthma		6	1.40	1.20-1.63	<0.001
BACK / NECK PAIN§	69,898				
no back / neck pain		70	1.0		
back / neck pain		30	1.98	1.81-2.16	<0.001
CANCERS (excluding skin cancer) §	74,970				
no cancers		97	1.0		
cancer/s		3	1.40	1.15-1.72	0.001
CARDIOVASCULAR DISEASE§	74,506				
no cardiovascular disease		99	1.0		
cardiovascular disease		1	2.61	1.85-3.60	<0.001
COPD/BRONCHITIS/EMPHYSEMA§	72,150				
no COPD / Bronchitis /emphysema		99.6	1.0		
COPD / Bronchitis / emphysema		0.4	2.43	1.57-3.78	<0.001
DIABETES§	74,295				

	n	%	OR	95% CI	P value
no diabetes		98	1.0		
diabetes		2	1.79	1.43-2.24	<0.001
DRUG & ALCOHOL PROBLEMS§	72,490				
no drug & alcohol problems		99.8	1.0		
drug & alcohol problems		0.2	12.80	8.82-18.57	<0.001
FATIGUE / SLEEP PROBLEMS§	75,103				
no fatigue / sleep problems		99	1.0		
fatigue / sleep problems		1	5.15	3.98-6.64	<0.001
HIGH BLOOD PRESSURE§	71,153				
no high blood pressure		92	1.0		
high blood pressure		8	1.58	1.36-1.82	<0.001
HIGH CHOLESTEROL§	68,890				
no high cholesterol		94	1.0		
cholesterol		6	1.58	1.32-1.86	<0.001
MIGRAINE / SEVERE HEADACHE§	70,735				
no migraine / severe headaches		90	1.0		
migraine / severe headaches		10	2.71	2.41-2.96	<0.001
OBESITY§	71,883				
no obesity		89	1.0		
obesity		11	1.90	1.71-2.11	<0.001
WORKPLACE INJURY§	75,281				
no injury		93	1.0		
injury		7	1.90	1.68-2.14	<0.001
CO-MORBIDITY	75,891				
no health conditions		13	1.0		
1 health condition only		16	1.39	1.01-1.92	0.04
2-4 health conditions		41	3.36	2.57-4.38	<0.001
5-7 health conditions		19	10.94	8.40-4.38	<0.001
8-10 health conditions		8	24.20	18.52-31.60	<0.001
11 or more health conditions		3	46.18	35.05-60.83	<0.001
§ Adjusting for age, marital status, the number of children, sex, education level, and annual income; §= sex not significant at <0.05					

5.2 Health Conditions Associated with Absenteeism when Co-Morbid with Psychological Distress

Absenteeism:

Compared to the reference category (having neither the indexed condition nor co-morbid psychological distress (PD)), those with the indexed condition had a significantly increased incidence rate ratio (IRR) of absenteeism in unadjusted models (see Appendix D Table D25). This was the case for all explored health conditions. For example, a person with arthritis but no psychological distress has a 40% higher risk of absenteeism compared to a person with neither

arthritis nor psychological distress. However a person with both arthritis and psychological distress has a 124% higher risk of absenteeism".

Those with the indexed condition and co-morbid PD also had a greater IRR than the reference category for all conditions explored. The IRR for those with co-morbid PD was greater than that of persons with the indexed condition and no co-morbid PD for all conditions explored. Conditions with the highest ranking IRR when not co-morbid with PD were drug and alcohol (D&A) (IRR: 1.74: CI: 1.30-2.32), COPD, fatigue, injury, arthritis, and cancers. When co-morbid with PD, conditions with the highest raking IRR were COPD (IRR: 2.80 CI: 1.55-4.92), injury, cancer, D&A, and arthritis.

The IRR effect sizes were reduced in adjusted models (see Table 11). Some health conditions, with or without co-morbid PD, no longer had a significantly increased IRR compared to the reference category (having neither the indexed condition nor co-morbid PD). These were asthma, COPD, CVD, and fatigue. Some conditions only demonstrated a significantly increased IRR when co-morbid with PD. These were back/neck pain and migraine. Conditions with the highest IRR effect without co-morbid PD were D&A (IRR: 1.32 CI: 1.00-1.75), injury, and arthritis. When co-morbid with PD the highest ranking conditions were cancers (IRR: 1.83 CI: 1.44-2.43), injury, and arthritis.

Table 11: Adjusted risk of Absenteeism for those with and without co-morbid psychological distress compared to the reference group that had neither the indexed health condition nor co-morbid psychological distress, using negative binomial logistic regression; reporting Incidence Rate Ratios (IRR)

		Without co-morbid PD		**With co-morbid PD**	
HEALTH CONDITION	**Model n**	**%**	**IRR (CIs)**	**%**	**IRR (CIs)**
Arthritis	62,295	3.5	1.07* (1.01-1.13)	0.2	1.41* (1.08-1.83)
Asthma	63,021	6.3	1.03 (0.99-1.08)	0.3	1.15 (0.94-1.40)
Back/neck pain	67,715	29.6	1.02 (0.99-1.05)	1.5	1.33** (1.22-1.46)
Cancers	71,446	3.1	1.08* (1.02-1.15)	0.14	1.83** (1.44-2.43)
COPD	68,787	0.4	1.44 (0.96-1.35)	0.03	1.63 (0.91-2.91)
CVD	70,954	0.8	0.96 (0.85-1.08)	0.06	1.34 (0.87-2.06)
Drug & Alcohol	69,237	3.0	1.32* (1.00-1.75)	0.5	1.48† (0.99-2.23)
Diabetes	70,816	2.0	0.89*(0.83-0.96)	0.12	1.15 (0.85-1.55)
Fatigue/sleep problems	71,555	0.6	0.99 (0.86-1.13)	.010	1.28 (0.93-1.74)
High Blood Pressure	68,091	8.1	0.94* (0.90-0.98)	0.3	1.19† (1.00-1.42)
High Cholesterol	65,817	5.7	0.93* (0.89-0.98)	0.2	1.27*(1.03-1.57)
Migraine/severe headache	67,969	9.1	1.01 (0.97-1.05)	0.7	1.29** (1.14-1.46)
Obesity	68,980	11.0	1.06* (1.02-1.09)	0.7	1.33** (1.17-1.51)
Workplace Injury	72,095	7.0	1.19** (1.14-1.24)	0.5	1.46** (1.26-1.69)

Adjusting for treatment-seeking behaviour, number of co-morbidities, income, industry, public/private sector, occupation, contractor, supervisory role, rate of work accidents per employer, age, education, sex, job security, hours worked in last week, marital status, children, and hours expected to work p.w.
*: p<0.05; **: p<0.001; † trend <0.1

5.3 Health Conditions Associated with Presenteeism when Co-Morbid with Psychological Distress

Presenteeism

In unadjusted models (see Appendix D Table D26) all health conditions, when co-morbid with PD, had a significantly increased risk compared to the reference category (having neither the indexed condition nor co-morbid PD). Some conditions only had a significantly increased effect size when co-morbid with PD. These conditions were arthritis, cancers, CVD, high blood pressure, and high cholesterol.

Conditions with the highest IRR when not co-morbid with PD were D&A (IRR: 2.57 CI: 2.25-2.94), fatigue, COPD, obesity and injury. Conditions with greatest effect sizes when co-morbid with PD were injury (IRR: 9.46 CI: 7.47-11.99), fatigue, D&A, arthritis, back/neck pain, diabetes, and COPD.

In adjusted models (see Table 12 below) all conditions were associated with an increased RRR of presenteeism when co-morbid with PD, compared to the reference category (having neither the indexed condition nor co-morbid PD). Some health conditions were only significant when co-morbid with PD. These were arthritis, asthma, cancers, COPD, CVD, diabetes, high cholesterol and migraine. The largest effect sizes for conditions when not co-morbid with PD were for D&A (RRR: 2.04 CI: 1.16-3.59), fatigue, and obesity. The largest effect sizes compared to the reference category for conditions that were co-morbid with PD were for: arthritis (RRR: 5.06 CI: 3.18-8.05), injury, cancers, and back/neck pain.

Table 12: Adjusted Relative Risk Ratio (RRR) of Presenteeism for those with and without co-morbid psychological distress compared to the reference group that had neither the indexed health condition nor co-morbid psychological distress. Using multinomial logistic regression, reporting relative risk ratios for low productivity compared to average productivity (high productivity not reported)

		Without co-morbid PD		**With co-morbid PD**	
HEALTH CONDITION	**Model**	**%**	**RRR (CIs)**	**%**	**RRR (CIs)**
Arthritis	61,081	3.5	0.90 (0.73-1.12)	0.2	5.06** (3.18-8.05)
Asthma	61,785	6.3	0.88 (0.76-1.02)	0.3	2.59** (1.79-3.75)
Back/neck pain	66,278	29.6	0.91* (0.83-0.99)	1.5	4.20** (3.53-4.99)
Cancers	70,037	3.1	0.80† (0.64-1.00)	0.14	4.44** (2.75-7.18)
COPD	67,437	0.4	1.43 (0.92-2.23)	0.03	3.52* (1.30-9.54)
CVD	69,564	0.8	1.17 (0.82-1.69)	0.06	3.58** (1.69-7.58)
Drug & Alcohol	67,737	3.0	2.04* (1.16-3.59)	0.5	3.23** (1.64-6.36)
Diabetes	69,422	2.0	0.96 (0.77-1.22)	0.12	3.62** (2.15-6.10)
Fatigue/sleep problems	70,146	0.6	1.47* (1.06-2.04)	.010	3.82** (2.23-6.56)
High Blood Pressure	66,741	8.1	0.81* (0.69-0.93)	0.3	3.65** (2.63-5.07)

		Without co-morbid PD		With co-morbid PD	
HEALTH CONDITION	**Mode**	**%**	**RRR (CIs)**	**%**	**RRR (CIs)**
High Cholesterol	64,532	5.7	0.87 (0.73-1.03)	0.2	4.03** (2.74-5.93)
Migraine/severe headache	66,632	9.1	0.90† (0.79-1.02)	0.7	3.57** (2.83-4.49)
Obesity	67,640	11.0	1.24** (1.11-1.38)	0.7	3.90** (3.08-4.93)
Workplace Injury	70,682	7.0	1.11† (0.98-1.27)	0.5	4.83** (3.73-6.25)

Adjusting for number of co-morbidities, treatment-seeking behaviour, age, sex, education, marital status, children, occupation, industry type, public/private sector, job security, contractor, hours worked in last week, supervisory role, rate of work accidents per employer, and hours expected to work p.w.
*: p<0.05; **: p<0.001; † trend <0.1

5.4 Co-Morbid Health Conditions Associated with Greatest Productivity Loss

When co-morbid with psychological distress, cancers, injury, and arthritis were the highest ranking health conditions impacting on absenteeism. For presenteeism, the same conditions were high ranking in slightly different order; with arthritis, injury, and cancers being the highest ranking. When co-morbid with psychological distress, all conditions except diabetes had a significant increased risk of both absenteeism and presenteeism. Diabetes only had a significantly increased risk for presenteeism. The increase in the size of the risk when co-morbid with psychological distress was greater for presenteeism than absenteeism.

5.5 Summary of Key Findings

For both absenteeism and presenteeism productivity measures there was a greater risk of productivity loss associated when health conditions were co-morbid with psychological distress. For some conditions this risk was much greater for those with co-morbid psychological distress compared to those without.

5.6 Issues Impacting on Interpretation of Findings

A number of factors need to be considered when interpreting these results. The reference category had neither the indexed health condition nor co-morbid psychological distress, the second category has the indexed health condition but not co-morbid psychological distress, and the third category has the indexed health condition and co-morbid psychological distress. This method of coding provides the same reference group for those with the health condition of interest but not co-morbid distress and for those with both the health condition of interest and psychological distress. Therefore any comparisons to results in chapter four are inappropriate; rather comparisons within the models provided in chapter five for health conditions with and without psychological distress, both being compared to the same reference group, are appropriate. All health conditions are self-reported with the exception of psychological distress which was obtained using a validated screening tool (K6). Some health conditions such as kidney disease are not represented in the list of health conditions explored; and some health confounders are not available such as smoking status, rurality and Indigenous status. Several working conditions were also not available such as effort-reward balance.

5.7 Conclusions

The same conditions, arthritis, cancers and injury, were the highest ranking for both presenteeism and absenteeism. The size of the risk was greater for presenteeism and all conditions, when co-morbid with psychological distress, were associated with a significant increased risk of presenteeism, whereas this was not the case for absenteeism.

6. RESULTS: MULTI-MORBIDITY AND PRODUCTIVITY

The following chapter on multi-morbidity and productivity reports the results relevant to research objectives three: to identify clusters of non-random multi-morbid health conditions and to explore the impact of each identified cluster on productivity (absenteeism and presenteeism), with and without co-morbid psychological distress. The structure of the chapter is as follows: Firstly results of analyses to identify clusters of non-randomly occurring multi-morbidity are described. Impacts of these clusters on absenteeism are then discussed. Unadjusted results are discussed briefly. Adjusted results are provided in the chapter along with a more detailed discussion of these results. The same approach is then taken for presenteeism. A summary of multi-morbid health clusters associated with the greatest productivity losses for both productivity measures is then discussed. Finally summary of key findings for the chapter, a discussion of issues impacting on the interpretation of these findings and a discussion of conclusions that can be drawn from these data are provided.

6.1 Patterns of Multi-Morbidity

Table 13 shows the pattern coefficients for the four-factor solution after orthogonal quartimin rotation, along with additional goodness of fit measures (CFI and TLI). Using a threshold of ±0.5, items contributing to the definition of factors are bolded. A tetrachoric correlation matrix suited to dichotomous data to explore patterns of multi-morbidity associated with 23 health conditions. The four factor solution has an Eigenvalue greater than one and has adequate goodness of fit based on the RMSEA, RMR, CFI and TLI statistics.

The following four factors were found:

Factor 1: arthritis, back/neck pain, migraine, other chronic pain

Factor 2: asthma, COPD, allergies

Factor 3: CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity

Factor 4: irritable bowel syndrome, ulcer, heartburn

Table 13: The four factor structure based on exploratory factor analysis

	Factor 1	Factor 2	Factor 3	Factor 4
Arthritis	0.581	0.231	0.425	-0.414
Back/neck	0.661	0.219	0.141	-0.203
Migraine	0.566	0.300	0.080	-0.146
Other chronic pain	0.678	0.228	0.286	-0.422
Asthma	0.223	0.937	0.139	-0.136
COPD	0.294	0.622	0.306	-0.281
Allergies	0.384	0.807	0.104	-0.305
CVD	0.042	0.013	0.682	-0.417
Diabetes	0.196	0.154	0.824	-0.021
High cholesterol	0.102	0.090	0.733	-0.389
Fatigue	0.482	0.285	0.880	-0.002
High blood pressure	0.150	0.132	0.758	-0.306
Obesity	0.267	0.209	0.508	-0.113
Irritable bowel	0.442	0.312	0.106	-0.571
Ulcer	0.285	0.245	0.153	-0.925
Heart burn	0.341	0.330	0.265	-0.796
The following conditions did not meet the inclusion criteria for any of the four clusters				
Bladder problems	0.390	0.242	0.279	-0.349
Cancer (not skin)	0.192	0.088	0.148	-0.219
Drug & Alcohol	0.396	0.246	0.266	-0.291
Injuries	0.415	0.108	0.114	-0.087
Osteoporosis	0.349	0.199	0.219	-0.314
Psychological distress	0.334	0.148	0.137	-0.089
Skin cancer	0.152	0.090	0.220	-0.227
Using MPlus to calculate a tetrachoric correlation matrix suited to dichotomous data to explore patterns of multi-morbidity associated with 23 health conditions; CFI: 0.923, TLI: 0.947; RMSEA: 0.015, SRMR 0.062; Quartimin oblique rotation, 0.5 cut point				

6.2 Clusters of Multi-Morbidity Associated with Absenteeism

In the unadjusted models, all clusters of health conditions had increased risks of absenteeism. When combined with co-morbid psychological distress the risk was greater than the combined additive risk. After adjusting for demographic characteristics, treatment-seeking behaviour and known working conditions, all clusters demonstrated an increased risk of absenteeism. When combined with co-morbid psychological distress the risk was greater for first and fourth clusters. (See Table D27 Appendix D for full model example using cluster 2).

Table14: RISK OF ABSENTEEISM BY HEALTH CONDITION for Australian workers when CO-MORBID with PSYCHOLOGICAL DISTRESS ∂

	Multi-morbid clusters without co-morbid Psychological Distress					Multi-morbid clusters with co-morbid Psychological Distress				
	Unadjusted n	%	RRR	95% CI	P value	Unadjusted n	%	RRR	95% CI	P value
Factor 1: ϒΨ										
No arthritis, back/neck pain, migraine, other chronic pain	36,228	99.9	1.00			35,845	99.9	1.00		
Arthritis, back/neck pain, migraine, other chronic pain	103	0.1	1.62	1.22-2.16	<0.001	13	0.04	1.64	1.17-2.30	0.004
Factor 2: ϒΨΦ										
No asthma, COPD, allergies	38,846	99.9	1.00			38,437	99.9	1.00		
Asthma, COPD, allergies	66	0.1	1.59	1.12-2.27	0.01	4	0.01	1.81	1.22-2.68	0.003
Factor 3: ϒΨμÞ										
No CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity	49,179	100	1.00			48,712	100	1.00		
CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity	15	0	2.65	1.27-5.53	0.01	1	0	2.46	1.09-5.56	0.03
Factor 4: ϒΨ										
No irritable bowel syndrome, ulcer, heartburn	54,170	99.9	1.00			53,624	99.9	1.00		
Irritable bowel syndrome, ulcer, heartburn	108	0.01	1.36	1.02-1.81	0.04	18	0.03	1.41	1.01-1.97	0.04

Using negative binomial logistic regression and adjusting for treatment-seeking behaviour, co-morbidity, median annual wage, industry type, public/private sector, occupation grade, contractor, number of staff supervising, number of work accidents per hundred workers for employer, age, education, sex, job security, hours worked in last week, marital status, number of children and number of hours expected to work by employer; ∂: reference category is those without all conditions of interest. The number of co-morbidities was not included in any multi-morbidity and productivity models as this caused collinearity The following covariates were not significance at <0.05: ϒ: number of children; Ψ: number of staff supervised; μ: marital status; Þ: occupation; and Φ: age category

6.3 Clusters of Multi-Morbidity Associated with Presenteeism

In the unadjusted models, all clusters of health conditions had an increased risk of presenteeism. (See Table D28 appendix D). When combined with co-morbid psychological distress the risk was greater than the combined additive risk. After adjusting for demographic characteristics, treatment-seeking behaviour and known working conditions, all clusters demonstrated an increased risk of presenteeism. When combined with co-morbid psychological distress the effect had a three-to-five-fold increased risk of presenteeism however the confidence intervals were very wide. (See Table D29 Appendix D for full model example using cluster 2).

6.4 Clusters of Multi-Morbidity Associated with the Greatest Productivity Loss

For both absenteeism and presenteeism the cluster of health conditions in factor two had the greatest impact on productivity, both with and without co-morbid psychological distress. Due to low numbers the confidence intervals were very wide; however, the results were statistically significant. As was the case with the individual conditions, the effect of multi-morbid clusters was greater on presenteeism and absenteeism: both with and without co-morbid psychological distress.

6.5 Summary of Key Findings

Psychological distress was not included in any of the four multi-morbid clusters based on the exploratory factor analysis methods used to identify clusters. However, when comparing the impacts on absenteeism for each cluster with and without co-morbid psychological distress. Three of the four factors showed significantly greater impact on absenteeism when co-morbid with psychological distress. For factor three (CVD, diabetes, high cholesterol, fatigue, high blood pressure and obesity) the impact was significant both with and without psychological distress however the risk was slightly lower with psychological distress. For presenteeism, the

impacts were also significantly greater when clusters were co-morbid with psychological distress. However, the risk ratio rates were much higher, for clusters with psychological distress, some having a two-five fold increase.

Table 15: Multivariate multinomial logistic regression for clusters multi-morbid health conditions and PRESENTEEISM

	Multi-morbid clusters without co-morbid Psychological Distress					Multi-morbid clusters with co-morbid Psychological Distress				
	Unadjusted n	%	RRR	95% CI	P value	Unadjusted n	%	RRR	95% CI	P value
Factor 1: ϒΨ										
No arthritis, back/neck pain, migraine, other chronic pain	36,626	99.9	1.00			36,232	99.9	1.00		
Arthritis, back/neck pain, migraine, other chronic pain	103	0.1	3.58	2.00-6.42	<0.001	13	0.04	13.53	5.90-31.05	<0.001
Factor 2: ϒΨ										
No asthma, COPD, allergies	39,199	99.9	1.00			38,784	99.9	1.00		
Asthma, COPD, allergies	66	0.1	3.48	1.75-6.93	<0.001	4	0.01	18.82	8.08-43.85	<0.001
Factor 3: ϒΨ										
No CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity	49,466	100	1.00			48,995	100	1.00		
CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity	15	0	8.54	2.57-28.46	<0.001	1	0	26.65	5.01-141.8	<0.001
Factor 4: ϒΨ										
No irritable bowel syndrome, ulcer, heartburn	54,693	99.9	1.00			54,135	99.9	1.00		
Irritable bowel syndrome, ulcer, heartburn	108	0.1	2.64	1.44-4.83	0.002	18	0.03	8.71	3.41-22.22	<0.001

Adjusting for age, sex, education, marital status, income, number of children, occupation, industry type, public/private sector, hourly wage, job security, contractor, hours worked in last week, number of staff supervising, number of work accidents per hundred workers for employer (with co-morbidity and contractor dropped in all); ∂: reference category is those without **all** conditions of interest. The number of co-morbidities was not included in any multi-morbidity and productivity models as it caused collinearity The following covariates were not significance at <0.05: ϒ: number of children; Ψ: number of staff supervised.

6.6 Issues Impacting on Interpretation of Findings

Several issues should be considered when interpreting these findings. To be included in a multi-morbid cluster the person needed to have all of the conditions identified as being part of the cluster. The comparison group was those with none of these conditions. Therefore sample sizes were very small in some cases. This potentially impacted on the significance of some confounding factors in models. Confidence intervals are wide particularly for presenteeism results. As with other issues raised in earlier results chapters, some confounders and health conditions are missing and the self-reported nature of health conditions could bias results.

6.7 Conclusions

Clusters of non-randomly occurring multi-morbid health conditions seem to group loosely around organ systems. Psychological distress was not present in any of these clusters when exploratory factor analysis grouped the health conditions into clusters. However when comparisons are made between the impacts of these clusters on productivity both with and without co-morbid psychological distress, the risks are higher with co-morbid psychological distress particularly for presenteeism.

7. DISCUSSION

This chapter discusses the findings outlined in Chapters' Four to Six drawing on evidence from other studies to either support or contrast with findings of this study. A description of the study sample and how it compares to Australian workers to determine the generalisability of findings is provided, and then a discussion of the impact of individual health conditions on productivity, compared to other studies. Consideration of the role of other factors; such as working conditions, demographic characteristics and health status follows; drawing on Australian evidence where possible. Health conditions associated with psychological distress and their co-morbid impacts on productivity are then discussed in comparison to the literature; and finally clusters of multi-morbidity and their impacts on productivity are discussed in comparison to the literature.

7.1 Study Participants

The study sample has more females than the Australian workforce (65% and 45% respectively). [199] It also has greater representation of workers from industries of health, education, and government administration; and fewer from retail, construction and mining. [199] The average income and education level are fairly representative of the Australian population. [199] Generalizing of these findings to all working Australians should be done with caution, particularly for blue-collar workers.

7.2 Health and Productivity

7.2.1 Impacts of individual health conditions on absenteeism and presenteeism

More health conditions were associated with a risk of absenteeism than presenteeism. However the magnitude of the risk was greater for low self-reported work performance. Other studies have also reported health

conditions impacting more strongly on work performance than absenteeism. [5, 7, 11, 88]

In adjusted models, mental health factors such as drug and alcohol problems and psychological distress had a greater impact on self-reported work performance than any other health condition considered. This pattern was the same for absenteeism. It is difficult to compare across studies when ranking the impact of health conditions on absenteeism or work performance, because studies differ in productivity measures used, health conditions investigated, covariates included and the samples used. Therefore the discussion was limited to whether other studies also found an association, not the comparative size of their effect.

There is evidence of drug and alcohol problems being associated with productivity losses, [3, 8] however drug and alcohol problems are not commonly included in the list of health conditions investigated. More common is psychological distress (including depression), which is often found to adversely impact on productivity. [3, 10, 11, 88, 175] This finding is consistent with evidence using Australian data that showed averting a mental health condition had the largest positive impact on labour force participation compared to cancer, cardiovascular disease, major injury, diabetes and arthritis. [32] There is also evidence of COPD impacting heavily on productivity losses. [7, 8, 10] Other health conditions that were found to be associated with productivity loss are supported by the literature. For example, in one study, [204] workplace injury and obesity were both found to be associated with productivity loss; other studies [11, 88, 90, 205, 206] also reported obesity to be associated with productivity loss.

7.2.2 Other factors contributing to the association between health and productivity: The role of health status, demographic characteristics and working conditions

Potential confounding factors need to be included in models exploring health impacts on productivity. Demographic factors, health status and working conditions all significantly impact on both absenteeism and low self-reported work performance. This study found that while all health conditions had a significant effect on both absenteeism and low self-reported work performance in unadjusted models, these effects diminished considerably after associated factors were included. Some health conditions no longer demonstrated a significant impact after adjustment. Kessler (2004) emphasised the importance of including co-morbidities in estimating productivity losses associated with health conditions. [76] Much research has been done to demonstrate the effects of working conditions on productivity. [107-111] However, only two studies were found that explore the relationship between health and productivity that had included working conditions in their analysis. [88, 90] One study adjusted for job satisfaction only, [90] and the other adjusted for occupation only. [88] This brings into question the validity of the strength of association for particular health conditions when these factors are not adjusted for.

In many studies on productivity and health, other covariates tend not to be considered. For example, this study found that annual wage was significantly associated with both absenteeism and self-reported work performance both in bi-variate and multivariate models. Including available confounding factors in these analyses enables better adjustment for these factors. To demonstrate, this study found arthritis was associated with absenteeism but not low self-reported work performance in adjusted models. Conversely, two other studies report a larger proportion of productivity loss associated with work performance than absenteeism. [173, 207] One was a case-control study, the other a retrospective audit of arthritis sufferers only. [173] Comorbidity was not taken into account for either of these studies. This study also found an association with low self-reported work performance using crude estimates, but once comorbidity and other covariates were included this association was no longer

significant. This finding is consistent with a US study which looked at co-morbidity with arthritis and found that 81% of people with arthritis had at least one other co-morbid condition. [208]

This study also found treatment-seeking to have an impact on the association between health and productivity. For all health conditions showing a significant association with either absenteeism or presenteeism; that association is reduced when treatment-seeking is included in the model (see Tables D7 and D8 in Appendix D). Although including treatment-seeking behaviour in the models reduced the relative risk, within the models the effect varied for absenteeism compared to presenteeism. For absenteeism the greater number of treatment-seeking occasions was associated with an increased risk of absenteeism. Perhaps this is because more treatments required more time off work or perhaps those requiring more treatment were also more ill / disabled.

For presenteeism, low rates of treatment-seeking were associated with a protective effect against presenteeism, whereas high rates of treatment were associated with an increased risk of presenteeism. Perhaps early treatment seeking reduces the amount of treatment required and the associated low productivity pre and post illness absence. As has been reported in one study, approximately 25% of respondents reported productivity loss prior to absence and a further 20% post sickness absence. [48] This suggests early intervention is protective against presenteeism.

Several other working conditions were found in this study to have a significant role in models exploring the relationship between health and productivity. In fact, some working conditions had a risk of productivity loss as high as or higher than the risk of having several co-morbid health conditions. For example, being expected to work more than 40 hours per week (reference: ≤ 35 hours) was associated with a risk of absenteeism similar to that of having 5-7 health conditions. As the number of hours

expected increased so does the risk of absenteeism, with those expected to work 60 or more hours per week having an increased risk of absenteeism higher than someone with 8-10 co-morbid health conditions. What these data suggests is that while controlling for health status, increased expected hours increases risks of absenteeism. Thus it appears that long expected working hours per se significantly increases the risk of absenteeism. Effort reward imbalance has previously been shown to decrease employee health. [21, 209, 210] Expected long hours likely represent increased effort. What the current data suggests is that the expectation to work long hours may be counter productive and induce economic losses through increased absenteeism. There is considerable evidence of the association between work demands and both poor health [24, 211-213] and to a lesser extent, productivity. [214] It could be that the expectation to work long hours is a proxy for job demand regardless of the hours actually worked.

This was also the case for presenteeism. This study found that working more than sixty hours per week was associated with a RR (relative risk for presenteeism and risk ratio for absenteeism) of 2.4 for low performance. This was greater than the risk associated with having 2-4 health conditions. The risk associated with working 51-60 hours per week was also close to that of having 2-4 health conditions. This highlights that increased perceived working time pressure not only increased absenteeism, as described above, but also decreased employee performance whilst at work. Thus, it may be counterproductive for employers to expect long working hours as employees are likely to take more time off and work less efficiently. Few studies report associations between working conditions and self-reported work performance. [154, 215-217] Studies found that do discuss the relationship between job stress and work performance support these findings. [216, 217]

Similarly, annual wage was also associated with an increased risk of lost productivity. As the annual wage increased, the risk of absenteeism increased. This finding is consistent with those of Virtanan (2007), who reported a significant effect of job strain on absenteeism for high socio-economic positions but not among low socioeconomic positions. [218] This could be associated with greater leave entitlements. Alternatively, it could also be that being expected to work longer hours is related to being on a higher salary, and as reported above, being expected to work long hours was associated with an increased risk of absenteeism. A further conjecture is that those on higher salaries can financially afford to take time off as compared to casual employees for example. For presenteeism, annual wage was also associated with an increased risk of low performance. As the wage increased the risk of low performance also increased. To my knowledge this is an original and somewhat unexpected finding. However, it could be related to factors regarding type of work role and perceived ability to function, for example the degree of difficulty in moving boxes compared to complex problem solving.

Certain occupations were associated with an increased risk of productivity losses. For presenteeism, these were sales, trade/labour and to a lesser extent, professional/technical roles, compared to the reference group of managers. However, for those reporting high performance, the trades/labour group was also associated with an increased likelihood of high performance as was clerical/sales to a lesser extent. It could be that positions requiring more cognitive skills and/or interpersonal communication are more affected by factors that impact on performance. It may also be that employees in managerial categories rate their performance differently to blue collar workers.

Being a casual worker has a reduced risk of absenteeism compared to full-time and part-time workers. Casual workers likely represent employees with job insecurity. Given that job insecurity is negatively associated with health

outcomes [20, 101, 219] and workplace injuries [220]; it would be expected that job insecurity would be associated with an increased risk of absenteeism. In fact, the opposite of the effect was noted. Characteristics about casual employment may contribute to reduced absenteeism. Casual employees are paid on an hourly basis with no sick leave entitlements. Therefore, if casual employees do not work they will not be paid. This is a financial incentive not to take time off work even when ill. Other studies have found similar results. That is, absenteeism is consistently lower in fixed contract staff compared to permanent employees [221]; and that changing from fixed term to permanent employment led to an increase in absenteeism. [222]

Workplace accidents also demonstrated a mixed pattern. Compared to no workplace accidents, those with moderate accident rates had a slightly increased risk of absenteeism and those employers with higher rates of accidents had a reduced risk of absenteeism. Whereas for presenteeism, high rates of workplace accidents were associated with an increased likelihood of high productivity, suggesting that productivity was occurring at the cost of workplace accidents (see Table D10 on appendix D).

This study found that the largest factors contributing to absenteeism were (1) increasing the number of hours employees are expected to work (2) increasing the number of health conditions, (3) increasing annual wages and (4) job insecurity. Although other demographic and employment factors were significant in the model the relative risk effects were smaller. The association between health conditions and absenteeism is well established. [11, 75, 154] Evidence that increasing work demands (i.e. number of hours expected to work in this study) negatively impact on health is also available. [24, 211-213] The data presented suggests that expectations to work long hours produces increased absenteeism and reduced productivity.

Overall, these findings indicate that employers striving to increase productivity by expecting employees to work long hours may not increase performance at all as the employees work less effectively and absenteeism increases (described above). The association between workplace accidents and high performance may also be related and warrants further study. Although other demographic and employment factors were significant in the model, the RR effects were not as strong.

7.2.3 Supporting findings using subsets of the data

Results of analyses specific to the subsets of nurses and teachers describe the extent to which the above findings are supported in occupational subsets of the dataset. These findings were consistent for both subsets and the overall dataset. The same patterns of association were found in all groups for the majority of health conditions and, where there were differences, the results for the subset data were within the confidence intervals of the overall dataset findings.

Differences that did emerge were notable in that teachers had higher qualifications but lower rates in the higher wage categories. They had higher rates of absenteeism and presenteeism for psychological distress compared to the whole sample and the nursing sub-sample. The risk of absenteeism from back/neck pain was significantly increased for teachers but not significant for the sample as a whole or for nurses. Teachers, and to a lesser extent nurses, had higher risks of absenteeism due to workplace injuries compared to the whole population.

7.3 Co-Morbidity and Productivity

7.3.1 Health conditions associated with psychological distress

For each health condition under investigation, the odds ratios of having high psychological distress were computed for those who reported having current or previous treatment for the investigated condition and compared to those who reported not having the investigated condition. As this is a

cross-sectional study, no conclusions can be drawn regarding causal pathways.

After accounting for socio-demographic details, a significant association was found between psychological distress and all investigated health conditions in unadjusted estimates. The strength of that association varied between conditions. The health conditions with the strongest adjusted associations with psychological distress were: drug and alcohol problems, fatigue, migraine, CVD, COPD, injury, obesity, diabetes, arthritis, high blood pressure and high cholesterol, asthma and cancer.

These findings are supported by international studies [66, 67, 82, 94, 223-226] and to some extent in Australia. [61, 181, 227] One Australian study found that one of the strongest correlates for reported current depression was having a medical condition. [227] Similarly, Britt [61] and Saltman [181] also demonstrate high prevalence rates of co-morbid psychological distress in Australian general practice. Overseas research has found that depressed people report significantly more co-morbid medical conditions, [82, 94] with one Netherlands study reporting an extensive range of 26 disease categories associated with depression. [67]

The model adjusts for known demographic characteristics, an approach supported by Marmot's social gradient theory which highlights the socioeconomic determinants of health status. [151] More recently Manoux & Marmot (2005) argue that social class has a powerful influence on psychosocial vulnerability, as individuals in lower social strata have fewer psychosocial resources to cope with life events. [152] The findings suggest that these associations exist but may not be explained by socio-economic characteristics alone. It could be that work-related factors may be another causal link influencing the relationship between health status and psychological distress in these study subjects. Rather, aspects of employment such as structure, status, income, high demands, low decision

authority, effort-reward imbalance, and social interaction play an important role in mental health. [153] The nature of the relationship between employment status and mental illness is unclear as to both direction of causality and the impact of other confounding factors. However, regardless of the causal pathway and confounding factors, the presence of this relationship between psychological distress and other chronic health conditions warrants further public health consideration.

The findings that the health conditions reported in the present study were significantly associated with an elevated risk for psychological distress has implications for public health, particularly health promotion, and for screening and early intervention in general practice. Given that the majority of individuals has at least one physical health condition, the high prevalence of mental disorders, [14, 62, 64, 66] the low treatment rates for mental disorders, [157] and the fact that mental illness is costly and disabling, [74, 82, 157, 159, 228-230] the Australian government's recent focus on preventative health care [231] should include providing adequate screening and early intervention of mental health conditions in working Australians.

This present study also found that the number of co-morbidities was strongly associated with psychological distress. There is evidence from Australia [61, 181] and overseas [66, 69] to support this association between psychological distress and multi-morbidity. Psychological distress has been found to increase with multi-morbidity when disease severity is accounted for. [66, 69, 95] Patients with multi-morbidity in general practice represent the rule rather than the exception. [57, 69, 181] These rates are likely to increase with the ageing population, the increasing prevalence of chronic disease, and the improvements in medical technologies that enable people with chronic illness to live longer. [55, 58] Given the strong likelihood of someone with multiple chronic conditions having co-morbid psychological distress, as evidenced by these findings, psychological

screening of patients who present with multi-morbidity should be advocated in general practice.

These findings highlight the importance of co-morbid psychological distress as a public health issue for working Australians, as demonstrated by its strong association with all health conditions explored. These results, combined with a two-fold increase in psychological distress in Australia from 1997-2005, [26] the low rates of treatment-seeking, [157, 158] and reported poorer health outcomes for people with co-morbid psychological distress or depression [62-69, 96] indicate co-morbid psychological distress as a growing challenge for Australia.

7.3.2 Impacts of co-morbid health conditions on absenteeism and presenteeism

Both individual health conditions and conditions when co-morbid with psychological distress had a greater impact on presenteeism than absenteeism in terms of the effect sizes in adjusted models. All conditions had a greater risk of either absenteeism or presenteeism when co-morbid with psychological distress. The increase in the size of the risk when co-morbid with psychological distress was greater for presenteeism than absenteeism. A larger number of conditions was associated with significant increased risk of absenteeism when not co-morbid with psychological distress compared to presenteeism (7 and 3 conditions respectively). However when co-morbid with psychological distress all 14 conditions were significantly associated with productivity loss for presenteeism compared to seven of 14 for absenteeism.

These findings suggest a greater than additive effect for some health conditions, particularly those that demonstrate a two-five fold increased IRR. The literature supports the finding that co-morbid depression can have an additive effect [64, 72] and a greater than additive effect. [70, 73, 232] Co-morbid physical-mental health problems has reportedly led to a mainly

additive increase in work-loss [64, 72], lower full-time working status, [72] and a significant increase in disability days when depression is co-morbid with any other medical disorder. [72]

The current study found that cancers when co-morbid with psychological distress had a significant impact on productivity losses for both absenteeism and presenteeism. No previous studies have been found that explore the impacts of co-morbid cancer and psychological distress / depression on productivity. Arthritis and workplace injury were both found in our study to be associated with an increased risk of both absenteeism and presenteeism when co-morbid with psychological distress. A study exploring associations with depression across a number of health conditions and their impacts on productivity losses [70] found no significant impact on role impairment when depression is co-morbid with injuries, however this study found a significant impact on both productivity measures.

Several studies report that co-morbid depression and COPD have a significant impact on productivity loss. [72, 163] However, in this study the impact was only significant for presenteeism. A review of the link between depressive disorders and chronic disease reported that obese women had a 50% increased lifetime prevalence of depressive disorders. [68] No studies were found that explored the impacts on productivity of obesity when co-morbid with psychological distress, however one study that focused specifically on productivity losses related to obesity adjusted for the number of co-morbid conditions, indicating the importance of co-morbidity on lost productivity estimates for this condition. [233] This study found obesity when co-morbid with PD to be significantly associated with both presenteeism and absenteeism.

Co-morbid mental disorders and substance use disorders are prevalent in 12% of people presenting to general practice in Australia. [164, 234] Those

with this co-morbidity were found to have more days out of role than people with either of these conditions in isolation. [234] However, little is known about the impact of this co-morbidity on productivity. This study found a significant increased RRR of presenteeism when D&A is co-morbid with PD and a trend of increased IRR for absenteeism (p= 0.06).

Co-morbid depression and CVD has been reported to impact on work absence [163] and on role impairment. [72] However, this study found the impact only significant for presenteeism. Consistent with our findings, fatigue has been found to impact on work performance when co-morbid with depression. [154] Depression has been found to have a potential mediating effect on the relationship between fatigue and absenteeism for persons with insomnia. [235] Other studies have adjusted for co-morbid depression when exploring the impacts of fatigue on productivity losses [127, 236, 237] demonstrating the importance of co-morbid depression on productivity losses for this condition. This study found fatigue, when co-morbid with PD significantly impacted on presenteeism but not absenteeism.

Although some conditions were found to demonstrate a protective effect when considered independently, many demonstrated an increased likelihood of productivity decrement when co-morbid with psychological distress. These were high blood pressure, and high cholesterol for absenteeism; and back/neck pain and high blood pressure for presenteeism. Diabetes also demonstrated the same pattern but not at statistically significant effect sizes. These findings are consistent with the literature in that employees with depressive illness and either heart disease, diabetes, hypertension or back problems were found to cost the employer 1.7 times more than those with the comparative condition alone. [159] One study found that employees with diabetes had a 2.15-fold excess risk of absenteeism but that up to 55% was attributable to depression and only 7% was purely attributable to diabetes. [232]

This research demonstrates that psychological distress is an exacerbating factor in productivity loss for a range of high priority health conditions. It also raises the question of whether psychological distress is a potential mediating factor in lost productivity. Further research with a large representative sample and a prospective study design is needed to confidently answer this question. Depression has been flagged as a mediating factor: in sickness absence for other diseases, [238] in work related disability for chronic back pain and arthritis, [34] and in pain severity [239]. Given the evidence of a strong association between mental health, particularly depression, and other health conditions; [14, 62, 67] between depression and productivity loss [7, 166-168]; and a growing prevalence of psychological distress [26], more research is needed to determine conclusively whether psychological distress, a treatable condition, is a mediating factor in productivity loss.

7.4 Multi-Morbidity and Productivity

7.4.1 Clusters of multi-morbidity

The following groups of health conditions were found to cluster in a non-random manner. Factor 1: arthritis, back / neck pain, migraine, other chronic pain; factor 2: asthma, COPD, allergies; factor 3: CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity; and factor 4: irritable bowel syndrome, ulcer, and heartburn.

The above groups of health conditions identified through exploratory factor analysis appear have some pattern to their clustering. Factor one is largely related to chronic pain, factor two could be related to respiratory conditions, factor three related to circulatory/vascular conditions, and factor four related to digestive conditions. It could also be argued that these clusters group loosely around organ system functioning, which is similar to the method of measuring multi-morbidity developed by Hudon, Fortin and Vanasse which uses 14 organ system groups including respiratory, vascular,

musculoskeletal and upper and lower gastrointestinal groupings. [180] Other commonly used measures of multi-morbidity calculate a co-morbidity score based on the number of co-existing conditions, with some weights applied to adjust for severity of condition such as the Charlson Index, [178, 240-242] or impact on functional status such as the Functional Comorbidity Index. [243]

Studies that explore multi-morbidity tend to use one of these instruments to determine co/multi-morbidity. As the Charlson Index required hospital admissions data and accurate ICD-10 records to calculate, many of these studies are not reflective of the population as a whole. Two community-based studies have been undertaken in Australia using general practice data, one uses the CIRS organ system method, [61] the other tallies occasions of care at individual level for the top ten presenting conditions. [181] It could be argued that those presenting to a GP for treatment are unwell and therefore not representative of the community as a whole. Similarly this study uses those still in the workforce so perhaps under-estimates health status due to the sample being persons well enough to be in the work-force. Further research is required in this area to determine prevalence and structure of multi-morbid clusters of health complaints occurring in Australia.

7.4.2 Multi-morbid clusters and psychological distress

Our exploration of psychological distress and the numbers of co-morbid conditions (see Table 10) demonstrate an increasing likelihood of having co-morbid psychological distress as the number of co-morbidities increases. A study by Britt et al. which used the CIRS organ system method, then explored the further grouping of these clusters. They found that the second and third most common groupings were psychological problems and arthritis/back pain; and psychological problems and vascular disease. [61] Similarly, Fortin et al. found that psychological distress

increased with multi-morbidity when disease severity was accounted for. [66]

While psychological distress did not feature in any of the clusters in this study, the fact that the risk of psychological distress increases as the number of co-morbidities increases, along with findings of other studies discussed above encouraged us to suggest that further exploration of the relationship between health and productivity for these clusters with and without psychological distress is needed.

7.4.3 Impacts of multi-morbid health condition clusters on absenteeism and presenteeism (with and without co-morbid psychological distress)

For absenteeism, after adjusting for demographic characteristics, treatment-seeking behaviour and known working conditions, all clusters demonstrated an increased risk of absenteeism. When combined with co-morbid psychological distress the risk was greater for all clusters except the third (CVD, diabetes, high cholesterol, fatigue, high blood pressure, and obesity). It should be noted that a number of these conditions had a significant protective association with absenteeism when considered independently.

For presenteeism, after adjusting for demographic characteristics, treatment-seeking behaviour and known working conditions, there was a significant increased risk of presenteeism for all clusters but when combined with co-morbid psychological distress the effect had a three-to-five-fold increase, although the confidence intervals were very wide.

The impact on presenteeism is greater than that on absenteeism for these clusters of health conditions. This was also the case when health conditions were explored independently and when co-morbid with psychological distress.

There is very little evidence on the impacts of multi-morbid health clusters on productivity. The only studies found to date are those of Kessler, 2001 and Kannan, 2008. [3, 106] However, the Kessler study primarily reported relationships between individual health conditions and role impairment but also reported that co-morbidities involving arthritis, ulcers, mental disorders and substance dependence were highly associated with role impairment. [3] It was not clearly stated in the methods how this cluster arose. The other study focused on type-2 diabetes, high cholesterol, and hypertension in workers who are overweight or obese. [106] It found that as the number of these co-morbidities increased so did the work productivity loss. Several other studies adjusted for co-morbidities in their analysis supporting the importance of including the number of co-morbidities as a confounding factor. [8, 75, 76, 154]

7.5 Strengths and Limitations

Strengths of the study include the large sample size, the range of data available relating to health conditions, work-related characteristics, demographic characteristics and the sample representing regional, rural and urban Australia.

Associations between factors were determined in this cross-sectional study; however, no conclusions can be drawn regarding causal pathways. This is an opportunistic sample of willing employees from 58 large organisations. The sample has more white-collar workers than the general population. Industry type and work role were included in models to adjust for these potential differences; however, extrapolation of these findings to the general employed population should be undertaken only where there is a clear match in the demographics of any sub-group. It should also be considered that only those at work during the data collection period responded. It could be that people on extended sick leave or out of the workforce are not represented. While it was not possible to adjust for the non-representativeness of those not in the work-force due to ill-health;

where possible, this study managed aspects of non-representativeness of the sample by including in analysis models all covariates that demonstrated a variation from the proportions seen in the Australian working population, for example sex and industry type. In addition, separate analyses were performed using the same data analysis methods on the two largest homogenous subsets of the data set to compare the consistency of these findings with those of the complete data set.

Other limitations include the self-reported nature of health conditions, the absence of some top burden of disease conditions such as kidney diseases, and the absence of some relevant work-related characteristics such as decision-making control. In addition, the survey was conducted from October 2004 to December 2005 and included one summer holiday season over the Christmas and New Year period in Australia. We were unable to control for any potential seasonal effects as many participants did not include the date the survey was completed. Nevertheless, many parts of Australia are tropical and sub-tropical, so the seasonal effects on illness are less pronounced compared with temperate climates. The response rate of 24.9% may be considered low by epidemiologic standards; however, the response rate is typical of the response rates achieved by employee administered health questionnaires in large organisations. [244] In addition, as previously shown, in regression analysis of response rate of the employers versus prevalence of psychological distress, there was no effect of response rate on prevalence estimates. [158] The sample size is not sufficient to explore profiles of characteristics for clusters of multi-morbidity or to explore associations between co-morbid health and productivity for the teacher and nurse subsets.

7.6 CONCLUSIONS

The research objectives outlines in Chapter One have been achieved as well as possible with a cross-sectional dataset. The following summary of key findings highlights keys research findings in relation to each objective

and other key findings. In addition, the significance of these findings and the implications for policy and future research will also be discussed.

7.6.1 Summary of Key Findings

Findings related to research objectives

Objective one explored the impact of a range of health conditions on workplace productivity using absenteeism and presenteeism as measures of productivity loss. This objective was achieved with following key findings reported: Some, but not all, health conditions have an impact on productivity loss. These impacts vary somewhat for absenteeism and presenteeism but certain conditions impact on both productivity measures. Some health conditions had a greater impact on productivity than co-morbidity of several health conditions at once. Psychological distress ranked highly with regard to impacting on both presenteeism and absenteeism. Obesity and fatigue, although not considered as high priority health conditions in Australia, were identified as high risks for productivity losses when co-morbid with psychological distress. These findings highlight the strong impact of mental health conditions on absenteeism and presenteeism. They also highlights the potential risk of inflated effect sizes of health-related productivity loss when relevant covariates are not included in models; such as the number of co-morbidities, work-related characteristics and treatment-seeking. In addition, they add to the body of evidence that presenteeism has a significant impact on productivity loss, often greater than that of absenteeism.

Objective two explored the impact of co-morbid psychological distress and other health conditions on workplace productivity using absenteeism and presenteeism as measures of productivity loss. This objective was achieved in two steps. Firstly by identifying health conditions associated with psychological distress, then exploring the association with absenteeism and presenteeism for each of these conditions when co-morbid with psychological distress. The following findings were found: All health conditions were associated with an increased risk of psychological distress.

Having a number of co-morbid health conditions was associated with an increased risk of psychological distress, as the number of health conditions increased the risk of psychological distress increased. All health conditions were associated with an increased risk of both absenteeism and presenteeism when co-morbid with psychological distress. For some conditions this was a greater than additive risk, suggesting the mediating role of psychological distress in the relationship between health and productivity. The impacts on presenteeism were greater than for absenteeism when co-morbid with psychological distress. This research raises the question of whether psychological distress is a potential mediating factor in lost productivity. Although with cross-sectional data we cannot conclusively answer this question; our findings highlight the need for further research into whether psychological distress, a treatable condition, may well exacerbate productivity losses. Given the existing evidence of a strong association between mental health, particularly depression, and other health conditions [14, 62, 67]; between depression and productivity loss [7, 166-168]; and the growing prevalence of psychological distress [26] the existing evidence that depression has been flagged as a mediating factor in sickness absence for other diseases [238], in work related disability for chronic back pain and arthritis [34], and in pain severity, [239] add to the body of evidence supporting this hypothesis. Further research with appropriate study designs are needed to more conclusively answer this research question.

Objective three explored the impact of each identified cluster of multi-morbid conditions; with and without co-morbid psychological distress, on work place productivity using absenteeism and presenteeism as measures productivity loss. This was achieved in two steps: identifying clusters of non-randomly occurring multi-morbid health conditions and then exploring the associations with absenteeism for these clusters of multi-morbid health conditions with and without co-morbid psychological distress. The following four clusters of non-randomly occurring health conditions were identified

through exploratory factor analysis. Factor one: arthritis, back/neck pain, migraine, other chronic pain; factor two: asthma, COPD, allergies; factor three: CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity; and factor four: irritable bowel syndrome, ulcer, and heartburn. The risk of absenteeism did not demonstrate any meaningful increased risk for factor one or factor four when co-morbid with psychological distress. However for factors two and three the increased risk was marked although not very large. For presenteeism the risks associated with all four factors were considerably greater when co-morbid with psychological distress compared to not being co-morbid with psychological distress. For factor one a three-fold increase; for factor two, a six-fold increase; for factor three a four-fold increase; and for factor four close to a three-fold increase. It should be noted that for all presenteeism models the confidence intervals are extremely wide although do not go below one. Even with the sample of over 78,000, there were not sufficient numbers to adequately model these multi-morbid clusters with more confined confidence intervals. More research is needed to better identify and understand clusters of multi-morbidity. This is particularly important due to rising health care costs associated with servicing an increasingly ageing population with complex health care needs. Health service providers need to better understand the complexity of the health status of consumers to ensure more strategic and tailored health care is provided.

Other key findings

Through analysis undertaken to achieve these objectives the following additional research findings were also uncovered. Differences in relative risks for absenteeism and presenteeism for some health conditions and for some working conditions demonstrate the importance of including both productivity outcome measures in analyses of health impacts on productivity. Demographic characteristics and working conditions impact on both productivity measures and therefore need to be considered in the exploration of health status impacts on productivity loss. Working conditions

and the number of co-morbidities had a strong impact on productivity, demonstrating the importance of including these factors in analyses of productivity loss associated with health conditions. The confounding variable “number of co-morbidities” had a higher impact on productivity than the majority of individual health conditions under investigation. Treatment-seeking behaviour impacts on productivity; but the impact varies for absenteeism and presenteeism. It is possible that early intervention may be associated with reducing productivity loss

7.6.2 Significance of Findings

This study addresses gaps in knowledge for Australia and internationally, using a large Australian working population sample to generate evidence of the impacts of a range of high priority chronic health conditions and risk factors on productivity loss. It provides empirical evidence of patterns of multi-morbidity identifying clusters of non-randomly occurring health conditions. It highlights the significance of both psychological distress and working conditions in the relationship between health and productivity for individual health conditions and clusters of multi-morbid health conditions. These findings can inform health promotion interventions and future research in health economics and public health.

7.6.3 Implications for Policy

In response to the global economic crisis, the Australian Productivity Commission has called on the Australian government to progress policy reforms that encourage best use of scarce capital and labour resources to boost productivity. This study highlights several issues relevant to workforce productivity for consideration. Productivity losses associated with low productivity are greater than those associated with absenteeism. Mental health factors, particularly psychological distress have the greatest impact on productivity losses both in terms of low productivity while at work (presenteeism) and absenteeism. All explored health conditions have a

significant association with psychological distress. It is possible that working conditions are instrumental in this relationship as considerable evidence indicates the relationship between working conditions and psychological distress; and in these models social gradient factors such income, sex, marital status were adjusted for. When co-morbid with psychological distress all health conditions and clusters of health conditions, had an increased risk of productivity losses, some demonstrating a greater than additive risk, suggesting a possible mediating role of psychological distress in productivity losses. Given the recent two-fold increase in psychological distress in Australia and the potential multi-directional relationship between health status, working conditions and psychological distress; these findings indicate increased strain on future productivity.

The number of co-morbidities was associated with an increased risk of both absenteeism and presenteeism. As the number of health conditions increased the risk increased. Similarly, as the number of co-morbid health conditions increased, the risk of having psychological distress also increased. Low rates of treatment-seeking behaviour were associated with reduced productivity losses (i.e. a protective effect), whereas high rates of treatment-seeking were associated with increased productivity losses indicating that early intervention of treatment supports productivity. Further research is needed.

Work-related characteristics such as being expected to work long hours (regardless of actual hours worked) was associated with productivity losses (both in absenteeism and presenteeism), indicating that hours expected are a proxy for job stress, which is well-demonstrated in literature to be associated with poor health and productivity decrements. Moderate rates of workplace accident had a slightly increased risk of absenteeism and higher rates of accidents had a reduced risk of absenteeism. Whereas for presenteeism, high rates of workplace accidents were associated with an

increased likelihood of high productivity; suggesting that productivity was occurring at the risk of workplace accidents. Further research is needed in this area.

Given the above findings, a policy to promote an increased uptake of opportunistic screening and early intervention of psychological distress in working-aged Australians attending primary health care settings could be warranted. Further to this, if Australia is to work smarter rather than harder in response to the global economic climate, a better understanding of the impacts of current Australian working conditions on worker productivity is needed, including the association between job demands, worker health and productivity.

7.6.4 Future Directions

A significant limitation of this study is that the sample is not representative of the Australian workforce. Further research is needed using a representative sample within the context of current Australian industrial relations legislation to explore the potential multi-directional relationship of health status, working conditions, and productivity.

Research investigating health and productivity should include adjusting for working conditions found in the literature to impact on productivity or health such as decision-making control, effort-reward balance and workplace bullying. Health related characteristics should also be included in models such as smoking status, quality of life, number of co-morbidities and treatment seeking behaviour. Also included should be factors associated with health inequalities including demographic characteristics, rurality, and Indigenous status.

The HPQ could be improved on by adding a validated utility instrument to measure overall health related quality of life such as the EQ5D (www.euroqol.org) or AQoL (www.besuco.monash.edu.au); and by adding

questions on: smoking status, rurality, socioeconomic status, race and cultural background. The HPQ also would benefit from a more comprehensive list of health conditions impacting on working populations, a more comprehensive list of working conditions recognised in the literature to impact on productivity or health such as decision-making control, effort-reward balance and workplace bullying; and further validation of the HPQ tool presenteeism measures. It would also benefit by a validated measure of staff turnover and recruitment costs to being developed and added to the HPQ as recommended by the expert panel convened to identify factors to include in measuring productivity losses. [77]

Further research is also required with a representative sample of Australians to obtain prevalence rates of clusters of non-randomly occurring multi-morbid health conditions, with a more comprehensive list of health conditions, to better understand the conditions included in clusters of multi-morbidity; the role of psychological distress in these clusters and their impacts on productivity. Including working-age Australians who are not currently in the workforce due to unemployment or illness would be important in this future research.

Psychological distress is a major issue affecting the health and productivity of Australian workers. Working conditions are having a negative impact on health and productivity of Australian workers. A multi-directional relationship between health, productivity and working conditions is likely.

APPENDICES

Appendix A: Literature Search Information

A1. Literature Search Strategy

The following methods were used to undertake this review of the literature: An initial preliminary search was conducted to get a feel for the literature. This involved the Medline database being explored extensively with a wide variety of search terms to identify literature relevant to this study including potential covariates. In addition, less rigorous explorations were conducted in CINAHL, Science Direct and Informit databases using the more refined search terms identified through the search of Medline. Australian Government websites were also explored to identify relevant grey literature. After this initial exploration of the literature, commonly referenced journals and authors were sourced more specifically. For example, contents list for recent years of the commonly referenced journals were explored, and searches for specific authors undertaken in these journals and in Medline. Further to this, the reference lists of papers of interest were explored to find additional papers of potential relevance.

A more systematic search was later conducted to ensure all articles relevant for comparison with study findings were identified using very broad search terms and a 20 year time frame in the following data bases Medline, CINAHL, and Science Direct. Figure 1 below describes the exclusion process and Appendix A describes search terms and results from each database. A large number of articles were flagged in these broader searches as potentially relevant to some aspect of the thesis. Studies meeting the criteria are summarized in Table one of Chapter one.

The critique of comparative literature focuses on studies that meet the following criteria:

- Published in the past 20 years (this was later reduced to 10 years for comparative studies based on the recommendation of the Chair of Examiners, see flow chart below).
- Available in English
- Available in full text

- A study population of working aged adults, preferably in the workforce
- quantitative study designs (excluding case studies and qualitative studies)
- Outcomes measures of absenteeism, presenteeism or both
- Studies that compare impacts on productivity (absenteeism, presenteeism or both) for a range of health conditions relevant to one of the research objectives, i.e. studies that compared a range of conditions in relation to: ii) individual health and productivity, ii) co-morbid psychological distress and productivity, or iii) multi-morbidity health clusters and productivity.

Preliminary searches involved using a broad range of exploratory search terms mostly in Medline. I did not keep records of numbers found in each of these many & varied searches. Some searches were to inform the background, rationale & methods rather than to identify comparative studies. From the preliminary searches I formulated key search terms to conduct a more systematic search, as described below, to identify relevant comparative studies. In addition I used information derived from the preliminary searches to identify key journals and authors then in key journals searched by author and through contents lists. I also searched reference lists of key papers, and searched relevant government websites.

Systematic search: Databases**:** Medline, CINAHL, Science Direct

Key terms:

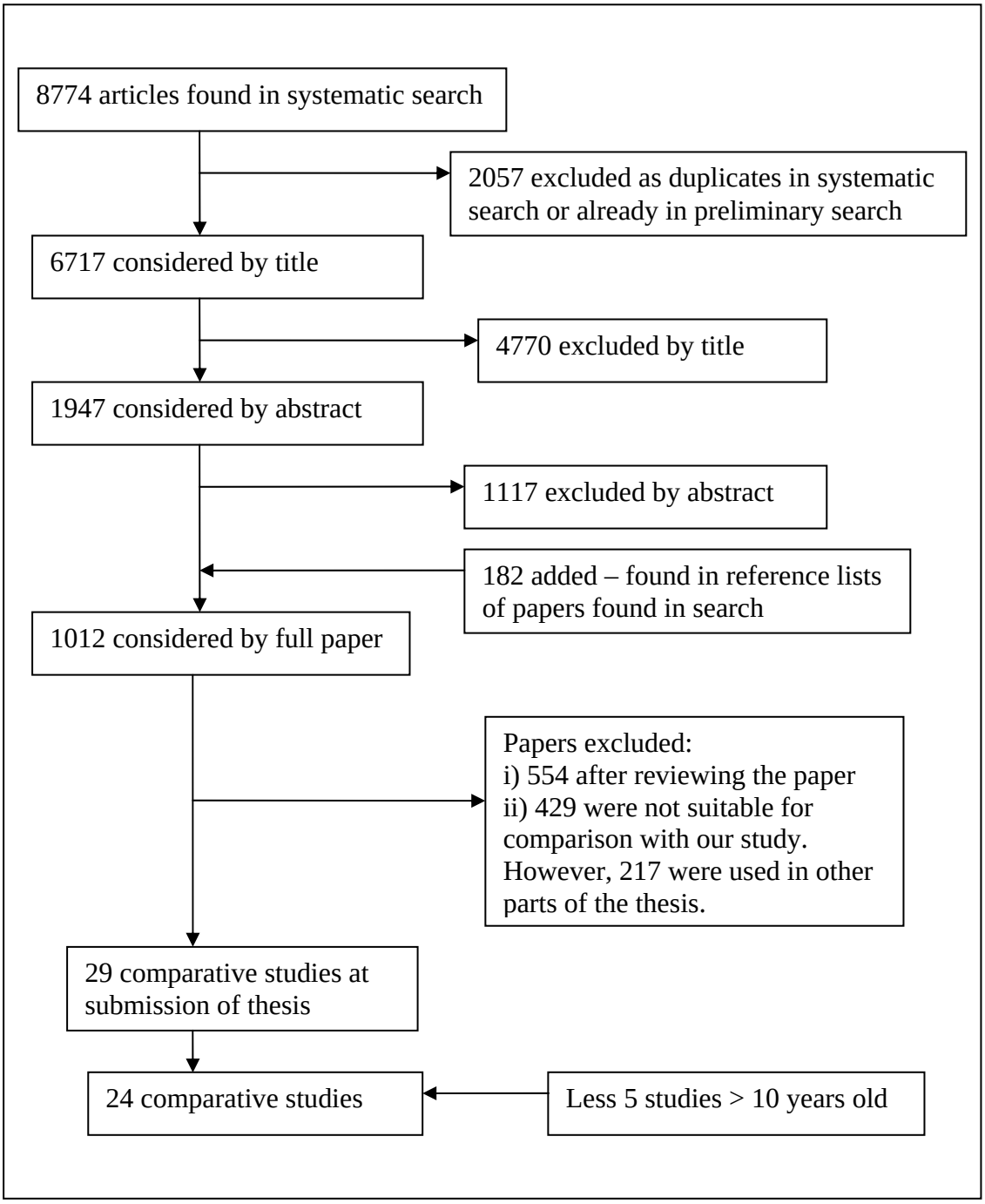
1. health and productivity / absenteeism / presenteeism
2. health and working conditions
3. working conditions and productivity/ absenteeism/ presenteeism
4. psychological distress / depression and health/ co-morbidity/ comorbidity/ multi-morbidity/ multimorbidity
5. co-multi-morbidity(as above) and productivity as above

Table A1: Description of Search Strategy and Results

Database	Key words	limits	Total number	Less duplicates in this set of searches
Medline (ovid/silverplatter)	Health & (productivity / absenteeism / presenteeism)	Human, Adult 19-64yrs, English, 1990-2008	2611	553
CINAHL (ovid/silverplatter)	Health & (productivity / absenteeism / presenteeism)	Human, Adult 19-64yrs, English, 1990-2008	829	
Science Direct	Health & (productivity / absenteeism / presenteeism)	English, 1990-2008	608	
Total topic 1			4048	3495
Medline (ovid/silverplatter)	health and working conditions	As in Medline above	557	116
CINAHL (ovid/silverplatter)	health and working conditions	As in CINAHL above	57	
Science Direct	health and working conditions	English, 1990-2008	483	
Total topic 2			1097	981
Medline (ovid/silverplatter)	working conditions and productivity etc	As in Medline above	153	40
CINAHL (ovid/silverplatter)	working conditions and productivity etc	As in CINAHL above	514	
Science Direct	working conditions and productivity etc	English, 1990-2008	60	
Total topic 3			727	687
Medline	psychological distress etc & health/ co-morbidity etc	Human, Adult 19-64yrs, English, 1990-2008	713	83
CINAHL	psychological distress etc & health/ co	Human, Adult 19-64yrs, English, 1990-2008	81	
Science Direct	psychological distress etc & health/ co	English, 1990-2008	1277	
Total topic 4			2132	2049
Comment	Medline search was 278522 then further limit by only core clinical journals and /or review articles and got 713. for CINAHL was 25,912 same extra limits now 81			
Medline	co-multi-morbidity etc & productivity etc	As in Medline above	593	137
CINAHL	co-multi-morbidity etc & productivity etc	As in CINAHL above	1085	
Science Direct	co-multi-morbidity etc &	English, 1990-2008	21	

Database	Key words	limits	Total number	Less duplicates in this set of searches
	productivity etc			
Total topic 5			1699	1562
Overall total 8774	All topics combined *(less duplicates in searches and existing database)*		2057	6717

Figure A1: Literature Search Exclusion Process Flow Chart



Appendix A2: Inclusion Criteria for Health Conditions Included in Models

Table A2: Rationale for inclusion and exclusion of available health conditions as conditions of interest for this study

Available Conditions	Aust Burden of Disease	Aust prevalence	Aust health priority	Aust chronic disease	count	Overall Aust priority	Top conditions productivity loss	Top conditions healthcare costs	Other reason	drop/keep
	[28]	[14]	[28] p3	[27]			[10, 11]	[10]		
Allergies		1			1	low	low	not on list		drop
Arthritis	1	1	1	1	4	high	low	low		keep
Asthma	1	1	1	1	4	high	med	not on list		Keep
Back/neck pain	1	1	1		3	high	high	high		keep
Cancer	1		1	1	3	high	low	med		keep
COPD/bronch				1	1	low	med	not on list		keep
CVD	1		1	1	3	high	low	high		keep
Depression	1	1	1	1	4	high	high	high		keep
Diabetes	1	1	1	1	4	high	low	not on list		keep
Fatigue/sleep					0	low	not on list	not on list	confounder	keep
Heartburn					0	low	not on list	not on list		drop
High cholesterol		1			1	risk factor	not on list	not on list	risk factor	keep
Hypertension		1			1	risk factor	high	High	risk factor	keep
Injuries	1	1	1	n/a	3	high	high	High		keep
Irritable bowel					0	low	not on list	not on list		drop
Migraine/headache		1			1	Low	med	not on list		keep
Obesity					0	risk factor	not on list	not on list	risk factor	keep
Osteoporosis				1	1	Low	not on list	not on list		drop
Substance use	1				1	risk factor	not on list	high	risk factor	keep
Ulcer					0	Low	not on list	not on list		drop
Urinary/bladder					0	Low	not on list	not on list		drop

Appendix B: **Annotated Bibliography**

B1. Health and Productivity Comparative studies

Eighteen studies have been found to date which compare impacts on productivity for a range of health conditions. Of these, fourteen are from the United States (USA) [3, 7-11, 74, 75, 88, 154, 159-162], one each from Australia [90], Canada [73], The Netherlands [70] and Sweden [89]. The following studies are grouped by country of origin.

Australian Study:

Musich et al. (2006) used a sample of 224 employees from one organisation to explore the impacts of heart problems, diabetes, cancer, bronchitis/emphysema, asthma, arthritis, allergies, and back pain on both presenteeism and absenteeism. The study adjusted for the number of co-morbidities in the analysis. Back pain, high stress, and life dissatisfaction were all associated with presenteeism. Diabetes, being overweight, and having poor perception of health were associated with absenteeism. Allergies demonstrated a similar non-significant trend. This study used a cross-sectional design. It had a very low sample size, which comprised of only one organisation so is not generalizable. It did however adjust for demographic characteristics and number of co-morbidities. [90]

US Studies:

- Kessler et al. (2001) describes findings from a general US population sample of 2,074 respondents aged from 25-54 years. The study explored impacts of health conditions on work impairment (a combination of days where employees were totally unable to carry out work or household duties and number of days where the respondent had to cut back on duties due to illness). The conditions explored were: arthritis, asthma, diabetes, high blood pressure, autoimmune disease, ulcers, cancer, heart disease, major depression, panic, generalised anxiety disorder, and substance dependence. The study adjusted for the number of co-

morbidities. Cancer was associated with the highest number of impairment days. Other conditions with high odds of impairment included ulcers, major depression, panic disorders, heart disease and high blood pressure. This cross-sectional study design used a small nationally representative population sample, so sample bias is not likely, however no discussion of whether appropriate proportions of specific industries and job roles were discussed or adjusted for. Demographic characteristics and the number of co-morbidities were included in models. [3]

- Another study by Kessler et al. (2008) uses data from 7,320 employees from one US Company. Only employees with 11 months of employee data on medical and pharmaceutical data were invited to complete a survey to identify impacts on absenteeism and presenteeism for a range of health conditions; however, only six conditions were prevalent enough to be included. These conditions were: fatigue, depression, anxiety, migraine, other headaches, obesity. The study reports that Depression had the largest effect on work performance. Several co-morbid conditions exacerbated the effect of depression but had no effect in the absence of depression. These were fatigue, sleep problems, anxiety; with the exception of migraine which had an independent effect on work loss regardless of co-morbid depression. Given the low proportion of some health conditions in the general population there may not be adequate power for less prevalent conditions. It did adjust for demographics and number of co-morbidities. [154]
- Loeppke et al. (2009) uses data from 51,648 employees from ten employers combined with medical and pharmaceutical claims data to explore health impacts on productivity for a range of health conditions: allergies, anxiety, arthritis, asthma, back/neck, bladder/urinary, bronchitis/ emphysema, congestive heart failure, COPD, coronary heart disease, depression, diabetes, fatigue, gastroesophageal reflux disease (GERD), headache, hypertension, irritable bowel, migraine, obesity, osteoporosis, other cancers, skin cancers, sleeping problems, and ulcers. They found that all chronic conditions were associated with productivity loss compared to those with no health conditions. The study used a cross-sectional survey and retrospective database medical claims data. It

has a large sample size; however, it is not clear whether the sample is representative of the working population but it does adjust for demographic characteristics and occupation. [75]

- Goetzel et al. (2003) aimed to describe the development and validation of a new health and productivity tool. The study explores the effects of 11 health conditions on work productivity (absenteeism and presenteeism) in a sample of 610 workers from the one organisation. These were: allergies, anxiety, arthritis, asthma, coronary heart disease, depression, diabetes, high stress, hypertension, migraine, respiratory infections and Alzheimer's. The health conditions with the greatest impact on absenteeism or presenteeism were allergic rhinitis, migraine, respiratory infections, high stress, arthritis, depression, hypertension, asthma, diabetes, and coronary heart disease. A small sample was used for this validations study that explored the impacts of a range of health conditions on absenteeism and presenteeism, only the proportion reporting either outcomes measure are reported for each health condition, no covariates were included in models. [162]
- Another study by Goetzel et al. (2003) uses data from 374,799 US employees from six US based companies to explore health conditions associated with the greatest cost to employers. The study used employee medical and pharmaceutical records to identify the most costly physical and mental health conditions. The most costly physical conditions were angina, hypertension, diabetes, lower back pain, COPD, non-specific back lain, sinusitis, and ear, nose and throat disorders. The most costly mental disorders were bipolar disorder, depression, depressive episode in bipolar disorder, neuroticism, personality and psychotic disorders, alcoholism, anxiety, schizophrenia, severe mania in bipolar disorder, non-specific neuroticism, personality non-psychotic disorders and psychosis. A retrospective cohort design was used in a large sample of employees however the sample was not representative for example, only 30% were women. No confounders were included in models. [10]
- Goetzel et al. (2004) investigated the costs associated with the top ten conditions common across a number of studies. The paper draws data from a multi-employer database of 374,799 US employees from six companies

described in the above study. It also synthesizes these data with data from several other productivity studies physical or mental health conditions with the greatest overall economic burden for either absenteeism or presenteeism. Only ten conditions were consistent across all studies, so only these explored. allergies, arthritis, asthma, any cancer, depression/sadness/mental illness, diabetes, heart disease, hypertension, migraine/headache, respiratory disorders. The total burden of illness was highest for hypertension ($392per employee per year), followed by heart disease ($368), depression and other mental illnesses ($348) and arthritis ($327). In most cases presenteeism costs were higher than medical costs and represented 18%-60% of all costs for the ten conditions. Depression had the highest percent productivity loss for absenteeism and second highest for presenteeism. Co-morbidities or other confounders were not reported in this study but may have been factored into some of the studies used in this meta-analysis. This study also used the same dataset as the study described above. [11]

- Ozminkowski et al. (2006) considered the impact of rheumatoid arthritis (RA) on medical expenditure, absenteeism and short term disability benefits, comparing a group with RA (n=4,490) and a group of matched controls without RA (n=4,208). Unadjusted cost of burden of disease including all costs was highest for arthritis, followed by bipolar disorder, COPD, renal failure, diabetes, lower back disorders, hypertension, heart disease, depression, cancer, and asthma. However, for costs associated with absenteeism alone, the raking of impact differed as follows: arthritis highest, followed by bipolar disorder, COPD, renal failure, diabetes, lower back disorder, hypertension, heart disease, depression and cancer. The study uses a retrospective design using the health and productivity. It does not report adjusting for any confounders. [161]
- Collins et al. (2005) explored the estimated costs of chronic health conditions among 7,410 workers from one US organisation found that 65% reported one or more chronic conditions. The list of conditions explored was: arthritis, asthma, back. Breathing, depression, diabetes, heart, migraine, stomach. All conditions studied the cost of presenteeism greatly exceeded the costs of absenteeism and medical treatment combined. Depression demonstrated the greatest impairment

costs followed by anxiety or emotional, migraine, breathing disorders, and back/neck pain. A comparison of respondents with non-respondents demonstrated that the study sample was not representative; also only one organisation was involved in the study so generalisability of the findings would not be possible. However, the modelling adjusted for some demographic characteristics, some working conditions and the number of co-morbidities. [88]

- Druss et al. (2000) used data from the health and employee files of one organisation to compare costs associated with absenteeism for depression and four other conditions: heart disease, diabetes, hypertension and back problems, adjusting for demographic and work characteristics. All four conditions were associated with absenteeism costs however depression was by far the greatest cost, with hypertension the second highest. [159]
- A study by Wang et al. (2003) investigated productivity loss in terms of both absenteeism and presenteeism for four occupation groups for the following health conditions: arthritis, asthma, chronic back / neck pain, cancer, COPD, or emphysema, depression, diabetes, anxiety, ulcers, heart disease, hypertension, and seasonal allergies. The study, which controlled for age, sex, education and occupation but not co-morbidities; reported more work performance loss from presenteeism than absenteeism. They reported that chronic conditions more consistently impacted on presenteeism than absenteeism. They reported conditions with significant effects as including arthritis, asthma, COPD - emphysema, depression, and chronic headaches. A cross-sectional design was used but only four occupation groups were recruited to this study and the sample size was small. The modelling did adjust for demographic characteristics and occupation. [7]
- Another study by Wang et al. (2004) used a sub-set of the above dataset (105 reservation agents and 181 customer service representatives) to explore moment in time work performance for people with major depression compared to people with other health conditions (arthritis, back pain, headache, allergies, high blood pressure, asthma). Major depression was the only condition significantly related to decrements in both task focus and productivity. A very small sample using only telephone service workers was used so the study findings are not

generalisable. There was no mention of adjusting for any confounders. [74] Boles et al. used a cross-sectional study design with a small sample of 2,264 employees of one company to obtain evidence of the relationship between health risks and productivity loss including self-reported impaired performance and health-related absence. They found that respondents with more risk factors reported more productivity loss however the health risk factors associated with presenteeism were different to those for absenteeism. [160]

- Merikangas et al. used a nationally representative household sample of 5,962 adults to estimate the effects of co-morbid mental and physical conditions on role impairment. As a first step they explored the impact on productivity for each of these conditions alone. Conditions having the greatest impact on productivity loss were (note only conditions of relevance to our study are reported here) COPD followed by cancer, back/neck problems, drug and alcohol abuse, depression, and arthritis. [8]

- Burton et al. (2004) uses data from 16,651 employees of a large financial services corporation to explore impacts of health conditions on work performance, specifically presenteeism. Health conditions explored were: allergies, arthritis, back pain, cancer, depression, diabetes, heart disease, heart burn, hypertension, irritable bowel, kidney disease, and menopause. The study adjusts for co-existing conditions and reports depression as impacting most significantly on presenteeism in domains of time management, interpersonal functioning, and overall output. Depression was highly associated with work limitations of time management, interpersonal and mental functioning and overall output. Both arthritis and lower back pain were associated with physical function limitations and mental/interpersonal limitations; and other conditions were associated with one or more of the four WLQ domains. Although a reasonable sample size, detection of effect for conditions with low prevalence rates may be difficult. This cross-sectional study used only one company so is not generalisable however it did adjust for demographic characteristics and co-morbidity in its limited sample. [9]

Sweden

- Aronsson et al. (2006) investigated sickness presenteeism in a sample of 3801 employed persons working at the time of the survey and found that one third of the sample had gone to work two or more times in the preceding year despite feeling sick. The main focus of the study was the correlation between working conditions and presenteeism. Analysis of specific illnesses and presenteeism were not reported in any detail so the complete list of potential health problems is not known. It is reported however, that having upper neck/back pain, fatigue and being slightly depressed were associated with increased risk of presenteeism. This stratified cross-sectional sample adjusted for demographic characteristics and some working conditions but not the number of co-morbidities. [89]

Netherlands:

Buist-Bouwman et al. (2005) used a stratified random sample for a cross-sectional study with 7,76 participants to assess co-morbidity between common physical and mental disorders and investigate the separate and joint effects on work loss. The chronic conditions were: fibromyalgia, arthritis, back pain, migraine, depression (12 months) and depression (lifetime). The study found that all health conditions except injury by accident were related to mood and anxiety disorders. Both physical and mental disorders were significantly related to work loss, mental disorders more so than physical. [70]

- Munce et al. (2007) used a very large sample of 9,238,154 individuals who reported at least one chronic pain condition who were absent from work due to illness in the previous week. The chronic conditions were: fibromyalgia, arthritis, back pain, migraine, depression (12 months) and depression (lifetime). The cross-sectional study, adjusting for demographic characteristics, found that 19% of the sample met the criteria for major depression compared to 8% of those non-absent individuals. The presence of depression represented a three-fold increased risk of absenteeism. [73]

B2. Co-morbid Psychological Distress and Productivity Comparative studies

Nine studies were found that explore the impacts of co-morbid depression on productivity. Four were from the USA, two from Canada, and one each from the Netherlands, Germany; and one European study that includes six European countries.

US studies:

- Druss et al. (2000) used data from the health and employee files of one organisation to compare absenteeism among other factors with depression and four other conditions: heart disease, diabetes, hypertension and back problems, adjusting for demographic and work characteristics. People with co-morbid depression had 1.7 greater costs and greater sickness absence. [159]
- Kessler et al. (2003) used a nationally representative household sample of 5877 respondents to assess current mental and physical disorders and role impairment. Only four disorders were of sufficient numbers to explore, these were hypertension, arthritis, asthma, and ulcers. These disorders were associated with significant role impairment in bivariate analysis but further analysis showed that these impairments were almost entirely confined to cases with co-morbid mental disorders. [177]
- Kessler et al. (2008) used a cross-sectional design of 7320 participants to present data on the comparative and interactive workplace costs of depression relative to other health conditions. Several co-morbid conditions exacerbated the effect of depression but had no effect in the absence of depression. These were fatigue, sleep problems, anxiety; with the exception of migraine which had an independent effect on work loss regardless of co-morbid depression. The study adjusted for some demographic characteristics, occupation and number of co-morbidities. [154]
- Egede (2007) used a cross-sectional design with a stratified random sample 30,801 participants from the national health interview survey including the CICI-SF to determine the prevalence and odds of major depression and the incremental effect of major depression on utilisation, lost productivity

(absenteeism) and functional disability. The study explored several conditions but combined them so no effect size can be attributed to an individual condition. These conditions were: diabetes, coronary artery disease, congestive heart failure, stroke, cerebro-vascular disease, COPD, and renal disease. The study adjusted for demographic characteristics and number of co-morbidities and found that the odds of depression are high among people with chronic medical conditions and are associated with significant lost productivity and functional disability. [176]

Canadian:

- Munce et al. (2007) used a very large nationally representative sample of 9,238,154 individuals who reported at least one chronic pain condition who were absent from work due to illness in the previous week. The chronic conditions were: fibromyalgia, arthritis, back pain, migraine, depression (12 months) and depression (lifetime). The cross-sectional study, adjusting for demographic characteristics, found that 19% of the sample met the criteria for major depression compared to 8% of those non-absent individuals. The presence of depression represented a three-fold increased risk of absenteeism. [73]
- Stein et al. (2006) explored work loss and functional disability to assess the relative and combined effect of depressive and chronic physical conditions on functional status and health care use. The conditions included were asthma, arthritis, back problems, COPD, heart disease, and diabetes. The cross-sectional study adjusted for demographic characteristics and the number of co-morbidities. They found that those with co-morbid depressive disorder had approximately a two-fold increased likelihood of functional disability and work absence compared to those with the condition and no co-morbid depression.[163]

Netherlands:

- Buist-Bouwman et al. (2005) used a stratified random sample for a cross-sectional study with 7076 participants to assess co-morbidity between common physical and mental disorders and investigate the separate and joint effects on work loss. The following conditions were included: asthma, migraine, chronic

back trouble, rheumatism, hypertension, digestive disorders, and accidental injury. Mental health conditions were: mood disorders, anxiety disorders and substance use disorders. All physical disorders except injury were all related to mood and anxiety disorders. All conditions except digestive and injury were significantly related to work loss when co-morbid with depression. The study found that all health conditions except injury by accident were related to mood and anxiety disorders. Both physical and mental disorders were significantly related to work loss, mental disorders more so than physical. Co-morbid mental and physical disorders lead to a mainly additive increase in work loss. [70]

Germany:

- Baune et al. (2007) explored the health-related quality of life, disability/work productivity, and health care utilisation in a variety of medical disorders with and without co-morbid major depressive disorder (MDD) in the general population of 4,184 community members aged 65 or less. They found that co-morbid MDD was strongly associated with lower full-time working status (37% with MDD vs 51% without MDD) and with significant increase in disability days (45%) in the presence of any medical disorder. [72]

Europe:

- Six European countries participated in this cross-sectional study comprising of 21,425 participants. The study explored the prevalence of painful physical symptoms in patients with major depression and found that one in two persons with major depression also reported painful symptoms and that this results in decreased productivity and lower rates of help-seeking. [64]

Appendix C: World Health Organisation Health and Productivity Questionnaire

SPACE FOR BARCODE

THE UNIVERSITY OF QUEENSLAND

The WORC Project

Valuing Healthy Employees

HAS: Health Appraisal Survey

Principal Researcher: Professor Harvey Whiteford[1,2]

Associate Researcher(s): Michael Hilton[1], Judith Sheridan[1], Catherine Cleary[1], Greg Simon[3], Ronald Kessler[4] and Philip Wang[4].

1 Queensland Centre for Mental Health Research; 2 The University of Queensland; 3 Group Health Cooperative, Seattle, USA; 4 Harvard Medical School, Boston, USA

Please take the time to read this information before you complete the attached questionnaire.

This survey, which takes between 15 and 20 minutes to complete, is part of a University of Queensland research study called 'The WORC Project – Valuing Healthy Employees'. This survey was developed by the World Health Organisation (WHO) as part of the WHO composite International Diagnostic Interview (copyright © 2001 WHO).

The physical and emotional health survey is being conducted as part of a large Australia wide research study about employee health in the workplace. The research is being conducted with full support of your employer. However, your responses are confidential and will in no way be communicated to your employer. Your answers to the questions are sent directly, to the research study staff. It is mandated by law that we (The WORC Project, University of Queensland) are not allowed to disclose your name or answers to your employer, representatives or affiliates of your employer or to any person not directly connected with the research. However, there is a small risk that this information could be obtained by unauthorised parties (For example, if an employee left a completed questionnaire lying around instead of putting it in the reply paid envelope).

All participants can receive feedback based on their responses to the survey questions, even if they take no further part in the study.

There is a chance that the answers you provide may identify potential health problems. If this happens, you may be asked to participate in the second phase of the study which is about encouraging people to seek advice for certain health problems. If you decide to be in the second phase of the study you may have to tell your insurance company if you apply for a new life or disability insurance policy or if you increase or reinstate an existing policy.

Participation in this study is voluntary. Refusal to complete this questionnaire will involve no discrimination, penalty or loss of benefits to which you are otherwise entitled from your employer or affect your present or future care by employer, your doctors or the participating hospitals.

If you have read the above information and consent to answering the questionnaire please complete and return your completed survey. If you would like to receive feedback about your responses, please fill in your name and address on the last sheet of the questionnaire and you will receive feedback by mail.

Please complete this questionnaire only if you are 18 years or older.

More comprehensive information can be found at http://www.worc.qcmhr.uq.edu.au

This study has been cleared by one of the human ethics committees of the University of Queensland in accordance with the National Health and Medical Research Council's guidelines. You are of course, free to discuss your participation in this study with project staff (contactable on (07) 3271-8658). If you would like to speak to an officer of the University not involved in the study, you may contact the Ethics Officer on (07) 3365 3924.

A. YOUR HEALTH

Survey Instructions

Please be sure to fill the response circle COMPLETELY. Use only BLACK or BLUE INK or DARK PENCIL to complete this survey.

Correct	*Incorrect*		
Yes	Yes	Yes	Yes
No	No	No	No

		Excellent	Very Good	Good	Fair	Poor
A1.	In general, how would you rate **your overall health** now?					
A2.	In general, how would you rate your overall **mental** health now?					

A3. Do you have any of the following conditions? If your answer is yes, please mark whether you **never**, **previously** or **currently** receive professional treatment. (Professional treatment is any treatment supervised by a health professional). If you are unsure if you have a condition, please mark the **NO** response option.

		NO, I don't have this condition	**YES**, but I never received professional treatment	**YES**, I previously received (but don't currently receive) professional treatment	**YES**, and I currently receive professional treatment
A3a.	Arthritis or rheumatism?				
A3b.	Chronic back/ neck pain?				
A3c.	Migraine headaches?				
A3d.	Other frequent or severe headaches?				
A3e.	Any other chronic pain?				
A3f.	High blood pressure or hypertension?				
A3g.	Congestive heart failure?				
A3h.	Coronary heart disease?				
A3i.	High blood cholesterol?				

A4. Do you have any of the following conditions? If your answer is yes, please mark whether you **never**, **previously** or **currently** receive professional treatment. (Professional treatment is any treatment supervised by a health professional). If you are unsure if you have a condition, please mark the **NO** response option.

		NO, I don't have this condition	**YES**, but I never received professional treatment	**YES**, I previously received (but don't currently receive) professional treatment	**YES**, and I currently receive professional treatment
A4a.	An ulcer in your stomach or intestine?				
A4b.	Irritable bowel disorder?				
A4c.	Chronic heartburn or oesophageal reflux?				
A4d.	Seasonal allergies or hay fever?				
A4e.	Asthma?				
A4f.	Chronic bronchitis or emphysema?				
A4g.	Chronic obstructive lung disease?				
A4h.	Urinary or bladder problems?				
A4i.	Diabetes?				
A4j.	Obesity?				
A4k.	Chronic sleeping problems?				
A4l.	Chronic fatigue or low energy?				
A4m.	Osteoporosis?				
A4n.	Skin cancer?				
A4o.	Any other kind of cancer?				
A4p.	Anxiety disorder?				
A4q.	Depression?				
A4r.	Any other emotional problems?				
A4s.	Substance problems (drugs or alcohol?)				

A5. During the **past 4 weeks** (28 days), how much were you bothered by each of the following conditions?

	Not at all	A little	Some	A lot
A5a. Feeling tired or having low energy?				
A5b. Trouble sleeping?				
A5c. Headaches?				
A5d. Back or neck pain?				
A5e. Pain in your arms, legs or joints (knees, hips etc.)?				
A5f. Muscle soreness?				
A5g. Watery eyes, runny nose, or stuffy head?				
A5h. Cough or sore throat?				
A5i. Fever, chills, or other cold/flu symptoms?				
A5j. Constipation, loose bowels, or diarrhoea?				
A5k. Nausea, gas or indigestion?				

A6. During the **past 4 weeks** (28 days), how much of the time did you feel...

	All of the time	Most of the time	Some of the time	A little of the time	None of the time
A6a. ...so sad nothing could cheer you up?					
A6b. ...nervous?					
A6c. ...restless or fidgety?					
A6d. ...hopeless?					
A6e. ...that everything was an effort?					
A6f. ...worthless?					

A7. (Women Only) During the **past 4 weeks** (28 days), were you pregnant?

- ◯ Yes
- ◯ No
- ◯ Not sure
- ◯ I am male

Survey Instructions

To record a response of "0 times", follow this example →	Number of times (000 - 365)	0 0 0
To record a response of "8 times", follow this example →	Number of times (000 - 365)	0 0 8
To record a response of "26 times", follow this example →	Number of times (000 - 365)	0 2 6

A8. In the **past 12 months**, did you have a work related accident, injury, or poisoning that required medical attention?

- ◯ Yes
- ◯ No ➜ Go to question A9

A8a. How many days of work did you miss in the **past 12 months** because of a work related accident, injury or poisoning? (If less than 1 day, enter 000.)

☐☐☐ Number of days (000 - 365)

A9. How many times did you see each of the following types of professionals in the **past 12 months**? Include only visits regarding your **own** health, not visits when you took someone else to be examined.
(Example: If you visited a dentist 2 times in the past year and an optometrist once, your answer to 9c would be 003)

		Number of times (000 - 365)
A9a.	A doctor, hospital, or clinic for a routine physical check-up or gynecological exam (not counting pregnancy related care)?	☐☐☐
A9b.	(Women Only) A doctor, hospital, or clinic for pregnancy related care? (If male, enter 000)	☐☐☐
A9c.	A dentist or optometrist for a routine check-up or exam?	☐☐☐
A9d.	A doctor, emergency room, or clinic for urgent care treatment (for example, because of new symptoms, an accident, or something else unexpected)?	☐☐☐
A9e.	A doctor, hospital, clinic, orthodontist, or ophthalmologist for scheduled treatment or surgery?	☐☐☐
A9f.	A psychiatrist, psychologist, or other mental health professional?	☐☐☐

A10. How many nights did you stay in a hospital during the **past 12 months** (not including nights associated with childbirth)?

☐☐☐ Number of nights (000 - 365)

A10a. (Women Only) How many nights did you stay in a hospital during the **past 12 months** for nights associated with childbirth? (If male, enter 000)

☐☐☐ Number of nights (000 - 365)

B. YOUR WORK

B1. Please choose the category that best describes your **main** job. If none of the categories fits you exactly, please respond with the closest category. **(Select only one.)**

- ◯ **Executive, administrator, or senior manager** (e.g., CEO, sales VP, plant manager)
- ◯ **Professional** (e.g., engineer, accountant, systems analyst, doctor, nurse, teacher)
- ◯ **Technical support** (e.g., lab technician, legal assistant, computer programmer)
- ◯ **Sales** (e.g., sales representative, stockbroker, retail sales)
- ◯ **Clerical and administrative support** (e.g., secretary, billing clerk, office supervisor)
- ◯ **Service occupation** (e.g., security officer, food office worker, janitor)
- ◯ **Precision production and crafts worker** (e.g., mechanic, carpenter, machinist)
- ◯ **Operator and labourer** (e.g., assembly line worker, truck driver, construction worker)

B1a. On the letter sent with this questionnaire, your employer lists certain job categories. There is a number next to each job category. Please choose the category that best describes your occupation. If none of the categories fits you exactly, please respond with the closest category to your experience (Select only **one**).

Category:

◯ 1	◯ 2	◯ 3	◯ 4	◯ 5	◯ 6	◯ 7	◯ 8	◯ 9	◯ 10
◯ 11	◯ 12	◯ 13	◯ 14	◯ 15	◯ 16	◯ 17	◯ 18	◯ 19	◯ 20

B1b. Are you an external contractor?

A contractor is a person that may work within an organisation but is paid by a different company / organisation. (for example, a cleaning firm that cleans buildings for a school.)

- ◯ Yes
- ◯ No

B1c. Please select which employee category you belong to (select only **one**):

- ◯ Full-time
- ◯ Part-time
- ◯ Casual

B2. How many people do you **personally** supervise on your job? (If more than 97, enter 97)

Number of people (00 - 97)

B3. About how many hours altogether did you work in the **past 7 days**? (If more than 97, enter 97)

Number of hours (00 - 97)

B4. How many hours does your employer **expect** you to work in a typical 7-day week?
(If it varies, estimate the average. If more than 97, enter 97)

Number of hours (00 - 97)

B5. Now please think of your work experiences over the **past 4 weeks** (28 days). In the spaces provided below, write the number of days you spent in each of the following work situations.

In the **past 28 days**, how many days did you...

		Number of days (00-28)
B5a.	...miss an **entire** work day because of problems with your physical or mental health? (Please include only days missed for your own health, not someone else's health.)	
B5b.	...miss an **entire** work day for any other reason (including vacation)?	
B5c.	...miss **part** of a work day because of problems with your physical or mental health? (Please include only days missed for your own health, not someone else's health.)	
B5d.	...miss **part** of a work day for any other reason (including vacation)?	

B6. About how many hours altogether did you work in the **past 4 weeks** (28 days)? (See examples below)

Number of hours in the past 4 weeks (28 days)

Examples for Calculating Hours Worked in the Past 4 Weeks

40 hours per week for 4 weeks = 160 hours
35 hours per week for 4 weeks = 140 hours
40 hours per week for 4 weeks with 2 8-hour days missed = 144 hours
40 hours per week for 4 weeks with 3 4-hour partial days missed= 148 hours
35 hours per week for 4 weeks with 2 8-hour days missed and 3 4-hour partial days missed= 112 hours

B7. Did you have any of the following experiences at work in the **past 4 weeks** (28 days)?

		Yes	No
B7a.	Any special work success or achievement?	⬭	⬭
B7b.	Any special work failure?	⬭	⬭
B7c.	An accident that caused either damage, work delay, a near miss, or safety risk?	⬭	⬭

B7d. If you answered "Yes" to any of the questions B7a, B7b, or B7c, please describe what happened.

B8. The next questions are about the time you spent during your hours at work in the **past 4 weeks** (28 days). Select the one response for each question that comes closest to your experience.

		All of the time	Most of the time	Some of the time	A little of the time	None of the time
B8a.	How often was your performance **higher** than most workers on your job?	⬭	⬭	⬭	⬭	⬭
B8b.	How often was your performance **lower** than most workers on your job?	⬭	⬭	⬭	⬭	⬭
B8c.	How often did you do no work at times when you were supposed to be working?	⬭	⬭	⬭	⬭	⬭
B8d.	How often did you find yourself not working as **carefully** as you should?	⬭	⬭	⬭	⬭	⬭
B8e.	How often was the **quality** of your work lower than it should have been?	⬭	⬭	⬭	⬭	⬭
B8f.	How often did you not concentrate enough on your work?	⬭	⬭	⬭	⬭	⬭
B8g.	How often did health problems limit the kind or amount of work you could do?	⬭	⬭	⬭	⬭	⬭

B9. On a scale of 0 to 10 where 0 is the worst job performance anyone could have at your job and 10 is the performance of a top worker, how would you rate the usual performance of **most** workers in a job similar to yours?

Worst Performance										Top Performance
0	1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

B10. Using the same 0-to-10 scale, how would you rate your **usual** job performance over the **past year or two**?

Worst Performance										Top Performance
0	1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

B11. Using the same 0-to-10 scale, how would you rate your **overall** performance on the days you worked during the **past 4 weeks**?

Worst Performance										Top Performance
0	1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

B12. How would you compare your overall job performance on the days you worked during the **past 4 weeks** (28 days) with the performance of most other workers who have a similar type of job? (Select only **one**.)

- ◯ You were **a lot better** than other workers
- ◯ You were **somewhat better** than other workers
- ◯ You were **a little better** than other workers
- ◯ You were about **average**
- ◯ You were **a little worse** than other workers
- ◯ You were **somewhat worse** than other workers
- ◯ You were **a lot worse** than other workers

C. DEMOGRAPHICS

C1. How old are you?

☐☐ Years old (00-99)

C2. Are you male or female?

- ◯ Male
- ◯ Female

C3. What is your current marital status?

- ◯ Married or cohabiting
- ◯ Separated
- ◯ Divorced
- ◯ Widowed
- ◯ Never Married

C4. How many children do you have?

- ◯ None
- ◯ One
- ◯ Two
- ◯ Three
- ◯ Four or more

C5. What is the highest grade or level of school that you have completed?

- ◯ **Did not** finish year 10
- ◯ Finished year 10
- ◯ Finished year 12
- ◯ Some tertiary education (University or Tafe)
- ◯ Degree Graduate
- ◯ Post Graduate Degree

C6. What is your height?

☐☐☐ cm (round to nearest cm)

C7. How much do you weigh?

☐☐☐ kg (round to the nearest kg)

C8. What is your postcode?

☐☐☐☐

C9. What is your annual income from your job, before taxes?

- ◯ $1 - $999
- ◯ $1,000 - $1,999
- ◯ $2,000 - $2,999
- ◯ $3,000 - $3,999
- ◯ $4,000 - $4,999
- ◯ $5,000 - $5,999
- ◯ $6,000 - $6,999
- ◯ $7,000 - $7,999
- ◯ $8,000 - $8,999
- ◯ $9,000 - $9,999
- ◯ $10,000 - $11,999
- ◯ $12,000 - $12,999
- ◯ $13,000 - $13,999
- ◯ $14,000 - $14,999
- ◯ $15,000 - $15,999
- ◯ $16,000 - $16,999
- ◯ $17,000 - $17,999
- ◯ $18,000 - $18,999
- ◯ $19,000 - $19,999
- ◯ $20,000 - $24,999
- ◯ $25,000 - $29,999
- ◯ $30,000 - $34,999
- ◯ $35,000 - $39,999
- ◯ $40,000 - $44,999
- ◯ $45,000 - $49,999
- ◯ $50,000 - $74,999
- ◯ $75,000 - $99,999
- ◯ $100,000 - $149,999
- ◯ $150,000 - $199,999
- ◯ $200,000 - $299,999
- ◯ $300,000 - $499,999
- ◯ $500,000 - $999,999
- ◯ $1,000,000 or more

C10. What date did you complete this survey?

☐☐ / ☐☐ / ☐☐

D. YOUR CONTACT DETAILS

There is a chance that the answers you provide may identify potential health problems. If you wish to receive feedback about your health form from the WORC Project please complete the section below in CAPITAL letters.

Your responses to this survey will be kept confidential and only researchers at the University of Queensland will see them. Your identity will remain anonymous and your answers will only be reported in the aggregate. Information on individuals will not be shared with your company

Title: ☐ Mr. ☐ Mrs. ☐ Ms. ☐ Miss. ☐ Dr. ☐ Prof. ☐ Other

First Name:

Last Name:

Postal Address:

Town/Suburb:

State Postcode

E. CONSENT

The WORC Project - valuing healthy employees would like your permission to contact you by telephone at home to ask you some more questions about your health. This phone call can take anywhere between 5 and 40 minutes. If you participate in the telephone health survey you will be paid $50 for your time. Not everyone who completes the questionnaire will be called.

Filling in your home phone number and/or your mobile number below indicates that you give us, the WORC Project, University of Queensland, permission to phone you at home to ask some more questions about your health for which you will receive $50. It also indicates that you have read and understood all the information about the WORC Project attached to this questionnaire. If you have any worries or concerns about the study, or would like more information please contact a study representative on (07) 3271 8658.

Title: ☐ Mr. ☐ Mrs. ☐ Ms. ☐ Miss. ☐ Dr. ☐ Prof. ☐ Other

First Name:

Last Name:

Company Name:

Home Telephone Number: ( ) **AND/OR** Mobile Number:

You may qualify for the next survey. Could you please provide a preferred calling time so that one of our Agents can call you as close as possible to your requested time. Note: Agents will be making these calls between the hours of

☐ 5.30pm - 9.30pm Monday to Friday ☐ 9am - 1pm Weekends ☐ 5pm - 9pm Weekends

Thank You! You have just completed the Queensland Health Appraisal Survey. We appreciate your interest and participation in the study, and we thank you for your time and patience.

Appendix D: Additional Tables

1. Demographic characteristics and Absenteeism (bi-variate)

Table D1. Results of bi-variate negative binomial logistic regression of DEMOGRAPHIC CHARACTERISTICS and ABSENTEEISM

Demographic Independent Variable	n	%	IRR	95% CIs	p value
AGE ¥	78,410				
18-29 years		17	1.0		
30-44 years		43	1.01	1.00-1.03	0.06
45-59 years		37	1.01	1.00-1.02	0.22
60-70 years		3	1.03	1.01-1.06	0.01
SEX	78,430				
Female		65	1.0		
Male		35	1.01	1.00-1.02	0.15
MARITAL STATUS	78,212				
Separated, divorced, widowed, never married		29	1.0		
Married or cohabitating		71	0.95	0.94-0.95	<0.001
NUMBER OF CHILDREN	78,209				
Nil		69	1.0		
1-3 children		28	1.09	1.08-1.10	<0.001
4 or more children		3	1.14	1.11-1.17	<0.001
EDUCATION LEVEL	78,430				
Did not complete high school		14	1.0		
Completed high school		10	0.99	0.97-1.00	0.12
Some college		27	1.01	1.00-1.03	0.10
Completed college or university		48	0.87	0.86-0.88	<0.001
ANNUAL WAGE β	76,778				
≤$29,999 pa		13	1.00		
$30,000-39,999 pa		14	1.29	1.26-1.31	<0.001
$40,000-49,999 pa		21	1.37	1.35-1.40	<0.001
$50,000-74,999 pa		36	1.33	1.31-1.36	<0.001
$75,000-99,999 pa		10	1.21	1.19-1.24	<0.001
≥$100,000 pa		7	1.04	1.02-1.07	<0.001

¥: only persons aged 18-70 included in analysis; β: excludes hourly rate < $7.50ph in case fortnightly income reported instead of annual income

2. Health related factors and absenteeism (bi-variate)

Table D2 Results of bi-variate negative binomial logistic regression of HEALTH CONDITION and ABSENTEEISM status

Health Related Independent Variable	n	%	IRR	95% CIs	P-value
ARTHRITIS	66,949				
no arthritis		96	1.00		
arthritis		4	1.53	1.43-1.62	<0.001
ASTHMA	67,786				
no asthma		94	1.00		
asthma		6	1.25	1.19-1.30	<0.001
BACK / NECK PAIN	71,800				
no back / neck pain		70	1.00		
back / neck pain		30	1.25	1.22-1.29	<0.001
CANCERS (excluding skin cancer)	77,014				
no cancers		97	1.00		
cancer / s		3	1.36	1.28-1.46	<0.001
CARDIOVASCULAR DISEASE	76,535				
no cardiovascular disease		99	1.00		
cardiovascular disease		1	1.17	1.03-1.32	0.01
COPD/BRONCHITIS/EMPHYSEMA	74,123				
no COPD / Bronchitis or emphysema		99.6	1.00		
COPD / Bronchitis or emphysema		0.4	1.57	1.33-1.86	<0.001
DIABETES	76,314				
no diabetes		98	1.00		
diabetes		2	1.17	1.09-1.26	<0.001
DRUG & ALCOHOL PROBLEMS	74,492				
no drug & alcohol problems		99.8	1.00		
drug & alcohol problems		0.2	1.75	1.38-2.22	<0.001
FATIGUE / SLEEP PROBLEMS	77,145				
no fatigue / sleep problems		99	1.00		
fatigue / sleep problems		1	1.41	1.24- 1.60	<0.001
HIGH BLOOD PRESSURE	73,108				
no high blood pressure		92	1.00		
high blood pressure		8	1.14	1.09-1.18	<0.001
HIGH CHOLESTEROL	70,781				
no high cholesterol		94	1.00		
cholesterol		6	1.11	1.06-1.16	<0.001
MIGRAINE/ SEVERE HEADACHES	72,685				
no migraine / severe headaches		90	1.00		
migraine / severe headaches		10	1.26	1.21-1.31	<0.001
OBESITY	73,780				
no obesity		89	1.00		
obesity		11	1.24	1.20-1.28	<0.001
PSYCHOLOGICAL DISTRESS	76,926				
no psychological distress		97	1.00		
psychological distress		3	1.60	1.51-1.69	<0.001
WORKPLACE INJURY	77,320				
no injury		93	1.00		
injury		7	1.47	1.41-1.52	<0.001
CO-MORBIDITY	77,661				
no health conditions		13	1.00		
1 health condition only		16	1.07	1.03-1.12	0.001
2-4 health conditions		41	1.24	1.20-1.29	<0.001

Health Related Independent Variable	n	%	IRR	95% CIs	P-value
5-7 health conditions		19	1.44	1.39-1.50	<0.001
8-10 health conditions		8	1.77	1.69-1.86	<0.001
11 or more health conditions		3	2.08	1.95-2.22	<0.001
TREATMENT-SEEKING	77,374				
no health services used in last 12 months		6	1.00		
1-3 health care services past 12 months		35	1.09	1.04-1.15	<0.001
4-9 health care services past 12 months		40	1.38	1.31-1.45	<0.001
10 or more services in past 12 months		20	2.09	1.99-2.20	<0.001
¥: only persons aged 18-70 included in analysis					

3. Working conditions and absenteeism (bi-variate)

Table D3. Results of bi-variate negative binomial logistic regression of WORKING CONDITIONS and ABSENTEEISM status

Work Related Independent Variable	n	%	IRR	95% CIs	p-value
OCCUPATION CATEGORY	78,430				
Manager		11	1.0		
Professional / technical		56	0.99	0.97-1.00	0.19
Sales		3	1.02	0.99-1.05	0.16
Clerical / service		27	1.15	1.13-1.17	<0.001
Trade / labour		3	1.12	1.09-1.16	<0.001
INDUSTRY TYPE	78,410				
Agriculture		2	1.0		
Communications		2	0.83	0.79-0.87	<0.001
Education		20	0.74	0.71-0.76	<0.001
Electricity / gas / water		2	1.04	1.00-1.09	0.05
Finance		15	0.84	0.81-0.86	<0.001
Government administration		22	1.13	1.09-1.16	<0.001
Health / community		30	0.90	0.87-0.92	<0.001
Manufacturing		3	0.67	0.64-0.69	<0.001
Media		2	0.97	0.93-1.02	0.20
Retail		1	0.81	0.77-0.86	<0.001
PRIVATE / PUBLIC SECTOR	78,410				
Federal government		10	1.0		
State government		59	0.72	0.71-0.73	<0.001
Local government		3	0.77	0.75-0.79	<0.001
Private		27	0.68	0.67-0.69	<0.001
ANNUAL WAGE β	76,778				
≤$29,999 pa		13	1.00		
$30,000-39,999 pa		14	1.29	1.26-1.31	<0.001
$40,000-49,999 pa		21	1.37	1.35-1.40	<0.001
$50,000-74,999 pa		36	1.33	1.31-1.36	<0.001
$75,000-99,999 pa		10	1.21	1.19-1.24	<0.001
≥$100,000 pa		7	1.04	1.02-1.07	<0.001
JOB SECURITY	78,183				
Part time or full time worker		97	1.0		

Work Related Independent Variable	n	%	IRR	95% CIs	p-value
Casual worker		3	0.72	0.70-0.74	<0.001
CONTRACTOR	78,252				
not a Contractor		98	1.0		
Contractor		2	0.80	0.77-0.83	<0.001
EMPLOYER RATE OF ACCIDENTS	78,430				
Less than 0.25 accidents per 100 workers		27	1.0		
>=0.25 <0.75 accidents per 100 workers		18	1.07	1.05-1.08	<0.001
>0.75 <1.5 accidents per 100 workers		18	1.23	1.21-1.24	<0.001
>=1.5 <3.0 accidents per 100 workers		6	0.94	0.92-0.96	<0.001
>=3 <5.0 accidents per 100 workers		16	0.76	0.75-0.77	<0.001
>=5 accidents per 100 workers		16	1.03	1.02-1.05	<0.001
HOURS WORKED IN PAST 7 DAYS	77,971				
(continuous variable)			0.981	0.9806-0.9812	<0.001
NUMBER OF STAFF SUPERVISING	77,630				
0 staff		57	1.0		
1-2 staff		12	0.97	0.96-0.98	<0.001
3-9 staff		14	0.94	0.93-0.95	<0.001
10-19 staff		6	0.94	0.92-0.96	<0.001
20 or more staff		11	0.81	0.80-0.82	<0.001
HOURS EXPECTED TO WORK	78,430				
≤35 hours per week		31	1.0		
>35 and ≤40 hours per week		56	1.19	1.18-1.21	<0.001
>40 and ≤50 hours per week		8	1.08	1.06-1.10	<0.001
>50 and ≤60 hours per week		3	1.06	1.03-1.09	<0.001
>60 hours per week		2	1.12	1.09-1.16	<0.001
β: excludes hourly rate < $7.50ph in case fortnightly income reported instead of annual income					

4. Individual health conditions and absenteeism (multivariate)

Table D4. Multivariate negative binomial logistic regression for each HEALTH CONDITION by ABSENTEEISM, WITH & WITHOUT ADJUSTING FOR TREATMENT-SEEKING BEHAVIOUR)

		Without treatment-seeking behaviour				With treatment-seeking behaviour			
	%	n	IRR	95% CIs	p-value	n	IRR	95% CIs	p-value
ARTHRITIS [r]		65,110				64,893			
no arthritis	96		1.00				1.00		
arthritis	4		1.13	1.06-1.20	<0.001		1.07	1.01-1.14	0.03
ASTHMA[r]		65,810				65,581			
no asthma	94		1.00				1.00		
asthma	6		1.05	1.00-1.09	0.05		1.02	0.98-1.07	0.30
BACK / NECK PAIN[r]		69,776				69,548			
no back / neck pain	70		1.00				1.00		
back / neck pain	30		1.03	1.00-1.06	0.03		1.02	0.99-1.05	0.12
CANCERS (excluding skin cancer)		74,825				74,567			
no cancers	97		1.00				1.00		
cancer/s	3		1.16	1.09-1.23	<0.001		1.11	1.04-1.17	0.001
CARDIOVASCULAR DISEASE		74,362				71,768			
no cardiovascular disease	99		1.00				1.00		
cardiovascular disease	1		1.07	0.95-1.20	0.27		0.89	0.83-0.96	0.002
COPD/BRONCHITIS/EMPHYSEMA[r]		72,015				74,106			
no COPD / Bronchitis / Emphysema	99.6		1.00				1.00		
COPD / Bronchitis or emphysema	0.4		1.34	1.14-1.57	<0.001		0.99	0.88-1.12	0.91
DIABETES		74,149				74,696			
no diabetes	98		1.00				1.00		
diabetes	2		0.95	0.88-1.02	0.15		0.89	0.83-0.96	0.002
DRUG & ALCOHOL PROBLEMS		72,355				72,114			
no drug & alcohol problems	99.8		1.00				1.00		
drug & alcohol problems	0.2		1.58	1.26-1.98	<0.001		1.41	1.13-1.77	0.003
FATIGUE / SLEEP PROBLEMS						70,791			
no fatigue / sleep problems	99		1.00				1.00		
fatigue / sleep problems	1						1.01	0.89-1.14	0.93
HIGH BLOOD PRESSURE		71,029				68,537			
no high blood pressure	92		1.00				1.00		
high blood pressure	8		0.97	0.93-1.01	0.18		0.94	0.90-0.97	0.001
HIGH CHOLESTEROL		68,772				70,378			
no high cholesterol	94		1.00				1.00		
cholesterol	6		0.97	0.93-1.02	0.23		0.93	0.89-0.98	0.01

		Without treatment-seeking behaviour				With treatment-seeking behaviour			
	%	n	IRR	95% CIs	p-value	n	IRR	95% CIs	p-value
MIGRAINE/SEVERE HEADACHES$^{\Upsilon}$		70,614				74,497			
no migraine / severe headaches	90		1.00				1.00		
migraine / severe headaches	10		1.02	0.98-1.06	0.29		1.01	0.97-1.05	0.65
OBESITY		71,756				75,002			
no obesity	89		1.00				1.00		
obesity	11		1.05	1.02-1.09	0.004		1.05	1.02-1.09	0.002
PSYCHOLOGICAL DISTRESS		74,753				73,895			
no psychological distress	97		1.00				1.00		
psychological distress	3		1.29	1.22-1.37	<0.001		1.22	1.04-1.43	0.02
WORKPLACE INJURIES		75,135				71,512			
no injuries	93		1.00				1.00		
injuries	7		1.28	1.23-1.33	<0.001		1.19	1.15-1.24	<0.001
CO-MORBIDITY		75,442				75,132			
no health conditions	13		1.00				1.00		
1 health condition only	16		1.09	1.05-1.14	<0.001		1.07	1.03-1.11	0.001
2-4 health conditions	41		1.23	1.19-1.27	<0.001		1.15	1.12-1.19	<0.001
5-7 health conditions	19		1.46	1.41-1.52	<0.001		1.29	1.24-1.34	<0.001
8-10 health conditions	8		1.74	1.66-1.82	<0.001		1.44	1.38-1.51	<0.001
11 or more health conditions	3		2.06	1.93-2.19	<0.001		1.62	1.52-1.72	<0.001

Adjusting for treatment-seeking behaviour, co-morbidity, median annual wage, industry type, public/private sector, occupation grade, contractor, number of staff supervising, number of work accidents per hundred workers for employer, age, education, sex, job security, hours worked in last week, marital status, number of children and number of hours expected to work by employer; Υ: number of children not significant at $p<0.05$.

5. Demographic characteristics and presenteeism (bi-variate)

Table D5. Results of bi-variate multinomial logistic regression of DEMOGRAPHIC CHARACTERISTICS and PRESENTEEISM (reference category average work performance)

			Low work performance			High work performance		
	n	%	RRR	95% CIs	p value	RRR	95% CIs	p value
AGE ¥	77,435							
18-29 years		17	1.00			1.00		
30-44 years		43	0.87	0.80-0.94	<0.001	1.31	1.20-1.43	<0.001
45-59 years		37	0.65	0.60-0.71	<0.001	2.15	1.99-2.34	<0.001
60-70 years		3	0.35	0.27-0.47	<0.001	3.40	2.99-3.88	<0.001
SEX	77,455							
Female		65	1.00			1.00		
Male		35	1.50	1.41-1.60	<0.001	0.62	0.59-0.66	<0.001
MARITAL STATUS	77,243							
Not married or cohabiting		29	1.00			1.00		
Married or cohabitating		71	0.71	0.67-0.76	<0.001	1.13	1.07-1.20	<0.001
NUMBER OF CHILDREN	77,247							
Nil		69	1.00			1.00		
1-3 children		28	1.21	1.13-1.29	<0.001	0.68	0.64-0.72	<0.001
4 or more children		3	1.35	1.13-1.61	<0.001	0.86	0.73-1.01	0.07
EDUCATION LEVEL	77,046							
Not complete high school		14	1.00			1.00		
Completed high school		10	1.18	1.03-1.34	0.01	0.54	0.49-0.59	<0.001
Some college		27	1.12	1.00-1.24	0.04	0.54	0.50-0.58	<0.001
Completed college/university		48	1.07	0.97-1.18	0.20	0.35	0.33-0.38	<0.001
ANNUAL WAGE β	75,848							
≤$29,999 pa		13	1.00			1.00		
$30,000-39,999 pa		14	1.42	1.23-1.63	<0.001	0.67	0.62-0.72	<0.001
$40,000-49,999 pa		21	1.67	1.47-1.90	<0.001	0.44	0.40-0.47	<0.001
$50,000-74,999 pa		36	1.57	1.39-1.77	<0.001	0.35	0.33-0.38	<0.001
$75,000-99,999 pa		10	1.72	1.49-1.99	<0.001	0.26	0.23-0.29	<0.001
≥$100,00 pa		8	1.52	1.30-1.79	<0.001	0.26	0.22-0.29	<0.001
¥: only persons aged 18-70 included in analysis								

6. Health related factors and presenteeism (bi-variate)

Table D6: Results of bi-variate multinomial logistic regression of HEALTH CONDITIONS and PRESENTEEISM status (reference category average productivity)

Health Related variables			Low productivity			High productivity		
	n	%	RRR	95% CIs	p-value	RRR	95% CIs	p-value
ARTHRITIS	66,756							
no arthritis		96	1.00			1.00		
arthritis		4	1.21	1.02-1.44	0.03	1.53	1.35-1.74	<0.001
ASTHMA	67,614							

Health Related variables			Low productivity			High productivity		
	n	%	RRR	95% CIs	p-value	RRR	95% CIs	p-value
no asthma		94	1.00			1.00		
asthma		6	1.23	1.09-1.40	<0.001	0.91	0.82-1.02	0.12
BACK / NECK PAIN	71,606							
no back / neck pain		70				1.00		
back / neck pain		30	1.32	1.23-1.41	0.003	0.92	0.87-0.97	0.003
CANCERS (excluding skin cancer)	76,801							
no cancers		97	1.00			1.00		
cancer/s		3	0.99	0.83-1.19	0.95	1.33	1.17-1.52	<0.001
CARDIOVASCULAR DISEASE	76,334							
no cardiovascular disease		99	1.00			1.00		
cardiovascular disease		1	1.65	1.22-2.21	<0.001	1.37	1.06-1.77	0.02
COPD/BRONCHITIS/EMPHYSEMA	73,921							
no COPD / Bronchitis/ Emphysema		99.6	1.00			1.00		
COPD / Bronchitis or emphysema		0.4	2.41	1.69-3.45	<0.001	1.41	0.98-2.02	0.06
DIABETES	76,112							
no diabetes		78	1.00			1.00		
diabetes		2	1.43	1.18-1.74	<0.001	1.19	1.01-1.41	0.04
DRUG & ALCOHOL PROBLEMS	74,283							
no drug & alcohol problems		99.8	1.00			1.00		
drug & alcohol problems		0.2	5.72	3.91-8.35	<0.001	0.36	0.13-0.99	<0.001
FATIGUE / SLEEP PROBLEMS	76,941							
no fatigue / sleep problems		99	1.00			1.00		
fatigue / sleep problems		1	2.94	2.29-3.78	<0.001	0.88	0.63-1.24	0.46
HIGH BLOOD PRESSURE	72,905							
no high blood pressure		92	1.00			1.00		
high blood pressure		8	0.97	0.86-1.10	0.64	1.32	1.21-1.43	<0.001
HIGH CHOLESTEROL	70,612							
no high cholesterol		94	1.00			1.00		
cholesterol		6	1.09	0.95-1.26	0.22	1.39	1.26-1.54	<0.001
MIGRAINE / SEVERE HEADACHES	72,493							
No migraine / severe headaches		90	1.00			1.00		
migraine / severe headaches		10	1.50	1.36-1.65	<0.001	0.96	0.88-1.05	0.42
OBESITY	73,586							
no obesity		89	1.00			1.00		
obesity		11	1.63	1.50-1.78	<0.001	0.92	0.85-1.00	0.07
PSYCHOLOGICAL DISTRESS	76,720							
no psychological distress		97	1.00			1.00		
psychological distress		3	6.72	6.11-7.39	<0.001	0.76	0.64-0.91	0.002
WORKPLACE INJURIES	77,101							
no injuries		93	1.00			1.00		
injuries		7	1.54	1.38-1.70	<0.001	1.18	1.07-1.29	0.001
CO-MORBIDITY	77,455							
no health conditions		13	1.00			1.00		
1 health condition only		16	1.16	1.00-1.35	0.05	0.87	0.79-0.95	0.002
2-4 health conditions		41	1.57	1.39-1.78	<0.001	0.86	0.80-0.93	<0.001
5-7 health conditions		19	2.33	2.05-2.66	<0.001	0.83	0.76-0.91	<0.001
8-10 health conditions		8	3.35	2.91-3.86	<0.001	0.81	0.72-0.91	<0.001
11 or more health conditions		3	4.62	3.93-5.44	<0.001	0.80	0.68-0.94	0.008
TREATMENT-SEEKING	77,145							
no health care services in last year		6	1.00			1.00		
1-3 health care services in last year		35	0.75	0.65-0.86	<0.001	0.85	0.76-0.95	0.003
4-9 health care services in last year		40	0.87	0.75-0.99	0.05	0.86	0.77-0.95	0.004
10 or more health services in last year		20	1.61	1.40-1.86	<0.001	0.83	0.74-0.93	0.002

7. Working conditions and presenteeism (bi-variate)

Table D7 Results of bi-variate multinomial logistic regression of WORKING CONDITIONS and PRESENTEEISM status (reference category: average productivity)

Work Related Variables			Low productivity			High productivity		
	n	%	RRR	95% CIs	p-value	RRR	95% CIs	p-value
OCCUPATION CATEGORY	77,455							
Manager		11	1.00			1.00		
Professional / technical		56	1.07	0.96-1.19	0.25	1.29	1.17-1.42	<0.001
Sales		3	1.74	1.47-2.06	<0.001	0.91	0.76-1.11	0.36
Clerical / service		27	1.14	1.02-1.28	0.02	1.96	1.78-2.17	<0.001
Trade / labour		3	1.42	1.16-1.74	<0.001	2.71	2.33-3.15	<0.001
INDUSTRY TYPE	77,435							
Agriculture		2	1.00			1.00		
Communications		2	1.05	0.82-1.35	0.70	0.96	0.72-1.29	0.81
Education		21	0.48	0.39-0.59	<0.001	1.88	1.52-2.32	<0.001
Electricity / gas / water		2	0.70	0.53-0.92	0.01	0.89	0.66-1.19	0.44
Finance		15	0.90	0.74-1.09	0.27	0.82	0.66-1.02	0.08
Government administration		22	0.87	0.71-1.05	0.14	1.03	0.83-1.28	0.79
Health / community		30	0.44	0.36-0.53	<0.001	1.66	1.35-2.05	<0.001
Manufacturing		3	0.74	0.58-0.95	0.17	0.92	0.70-1.20	0.52
Media		2	0.46	0.33-0.64	<0.001	1.19	0.90-1.58	0.23
Retail		1	0.60	0.42-9.85	0.004	0.71	0.49-1.04	0.08
PRIVATE/PUBLIC SECTOR	77,435							
Federal government		10	1.00			1.00		
State government		59	0.52	0.47-0.57	<0.001	1.88	1.70-2.08	<0.001
Local government		3	0.66	0.55-0.79	<0.001	1.31	1.11-1.56	0.002
Private		27	0.78	0.71-0.86	<0.001	1.09	0.97-1.21	0.14
ANNUAL WAGE β	75,848							
≤$29,999 pa		13	1.00			1.00		
$30,000-39,999 pa		14	1.42	1.23-1.63	<0.001	0.67	0.62-0.72	<0.001
$40,000-49,999 pa		21	1.67	1.47-1.90	<0.001	0.44	0.40-0.47	<0.001
$50,000-74,999 pa		36	1.57	1.39-1.77	<0.001	0.35	0.33-0.38	<0.001
$75,000-99,999 pa		10	1.72	1.49-1.99	<0.001	0.26	0.23-0.29	<0.001
≥$100,000 pa		8	1.52	1.30-1.79	<0.001	0.26	0.22-0.29	<0.001
JOB SECURITY	77,217							
Part time/ full time worker		97	1.00			1.00		
Casual worker		3	0.67	0.53-0.84	0.001	2.11	1.89-2.36	<0.001
CONTRACTOR	77,276							
not Contractor		98	1.00			1.00		
Contractor		2	1.07	0.87-1.32	0.54	0.87	0.72-1.04	0.13
RATE OF ACCIDENTS PER 100 WORKERS	77,455							
<0.25 accidents		27	1.00			1.00		

Work Related Variables			Low productivity			High productivity		
	n	%	RRR	95% CIs	p-value	RRR	95% CIs	p-value
≥0.25 <0.75 accidents		18	1.01	0.92-1.10	0.89	1.13	1.04-1.22	0.004
>0.75 <1.5 accidents		18	1.23	1.13-1.34	<0.001	0.87	0.79-0.95	0.001
≥1.5 <3.0 accidents		6	0.88	0.76-1.-2	0.08	1.10	0.97-.125	0.13
≥3 <5.0 accidents		16	0.64	0.57-0.72	<0.001	1.88	1.74-2.02	<0.001
≥5 accidents		16	0.48	0.42-0.54	<0.001	1.84	1.71-1.99	<0.001
HOURS WORKED IN PAST 7 DAYS	76,998							
(continuous variable)			0.995	0.993-0.997	<0.001	0.993	0.991-0.995	<0.001
NUMBER OF STAFF SUPERVISING	76,630							
0 staff		57	1.00			1.00		
1-2 staff		12	0.83	0.75-0.92	<0.001	0.97	0.90-1.05	0.46
3-9 staff		14	0.73	0.66-0.81	<0.001	0.81	0.75-0.88	<0.001
10-19 staff		6	0.76	0.66-0.87	<0.001	0.75	0.67-0.84	<0.001
20 or more staff		11	0.70	0.62-0.78	<0.001	0.97	0.89-1.05	0.41
HOURS EXPECTED TO WORK								
≤35 hours per week (pw)		31	1.00			1.00		
>35 and ≤40 hours pw		56	1.44	1.33-1.55	<0.001	0.67	0.64-0.71	<0.001
>40 and ≤50 hours pw		8	1.53	1.36-1.72	<0.001	0.57	0.52-0.64	<0.001
>50 and ≤60 hours pw		3	1.72	1.44-2.06	<0.001	0.75	0.64-0.88	<0.001
>60 hours per week		2	1.96	1.61-2.38	<0.001	1.14	0.98-.1.33	0.10
β: excludes hourly rate < $7.50ph in case fortnightly income reported instead of annual income								

8. Individual health conditions and presenteeism (multivariate)

Table D8: Results of multivariate multinomial regression for PRODUCTIVITY (Presenteeism) (Reference category moderate productivity); WITH AND WITHOUT ADJUSTING FOR TREATMENT-SEEKING BEHAVIOUR

		Without treatment-seeking behaviour considered							With treatment-seeking behaviour considered						
	%	n	Low Productivity			High Productivity			n	Low Productivity			High Productivity		
			RRR	95% CIs	p-value	RRR	95% CIs	p-value		RRR	95% CIs	p-value	RRR	95% CIs	p-value
ARTHRITIS ϒπ		63,835							63,627						
no arthritis	96		1.00			1.00				1.00			1.00		
arthritis	4		0.94	0.78-1.13	0.49	1.16	1.01-1.34	0.04		0.89	0.74-1.08	0.23	1.17	1.01-1.35	0.03
ASTHMA π		64,420							64,199						
no asthma	94		1.00			1.00				1.00			1.00		
asthma	6		0.81	0.71-0.93	0.002	1.05	0.93-1.19	0.43		0.79	0.69-0.90	0.001	1.06	0.94-1.20	0.35
BACK / NECK PAIN ϒ		68,289							68,069						
no back / neck pain	70		1.00			1.00				1.00			1.00		
back / neck pain	30		0.90	0.83-0.97	0.008	0.99	0.93-1.07	0.90		0.89	0.82-0.97	0.006	0.99	0.93-1.07	0.90
CANCERS - not skin cancer		73,211							72,858						
no cancers	97		1.00			1.00				1.00			1.00		
cancer/s	3		0.87	0.72-1.06	0.17	1.11	0.96-1.27	0.16		0.83	0.68-1.00	0.06	1.11	0.96-1.28	0.16
CARDIOVASCULAR DISEASE ϒ		72,767							72,523						
no cardiovascular disease	99		1.00			1.00				1.00			1.00		
cardiovascular disease	1		1.26	0.92-1.73	0.15	1.28	0.97-1.68	0.08		1.15	0.84-1.58	0.38	1.26	0.96-1.67	0.10
COPD/BRONCHITIS/EMPHYSEMA ϒ		70,591							70,353						
no COPD/Bronch/ Emph	99.6		1.00			1.00				1.00			1.00		
COPD / Bronch / Emph	0.4		1.55	1.06-2.26	0.02	1.32	0.90-1.94	0.15		1.43	0.98-2.10	0.06	1.21	0.81-1.81	0.35
DIABETES ϒπ		72,683							72,439						
no diabetes	78		1.00			1.00				1.00			1.00		
diabetes	2		1.00	0.81-1.22	0.97	1.20	1.00-1.43	0.05		0.92	0.75-1.13	0.43	1.19	1.00-1.43	0.06
DRUG & ALCOHOL (D&A) PROBLEMS ϒ		70,774							70,544						
no D & A problems	99.8		1.00			1.00				1.00			1.00		
drug & alcohol problems	0.2		2.49	1.66-3.75	<0.001	0.34	0.19-1.45	0.23		2.15	1.43-3.24	<0.001	0.55	0.20-1.50	0.24
FATIGUE / SLEEP PROBLEMS ϒ		73,473							73,224						
no fatigue/ sleep problems	99		1.00			1.00				1.00			1.00		
fatigue / sleep problems	1		1.46	1.12-1.92	0.006	0.95	0.66-1.36	0.77		1.36	1.03-1.78	0.03	0.98	0.68-1.40	0.91
HIGH BLOOD PRESSURE ϒπ		69,611							69,384						
no high blood pressure	92		1.00			1.00				1.00			1.00		

		Without treatment-seeking behaviour considered							With treatment-seeking behaviour considered						
	%	n	Low Productivity			High Productivity			n	Low Productivity			High Productivity		
			RRR	95% CIs	p-value	RRR	95% CIs	p-value		RRR	95% CIs	p-value	RRR	95% CIs	p-value
high blood pressure	8		0.82	0.72-0.94	0.004	1.12	1.01-1.23	0.03		0.79	0.69-0.91	0.001	1.11	1.01-1.23	0.03
HIGH CHOLESTEROL$^{\Upsilon}$		67,307							67,083						
no high cholesterol	94		1.00			1.00				1.00			1.00		
cholesterol	6		0.90	0.77-1.04	0.16	1.24	1.11-1.39	<0.001		0.87	0.75-1.01	0.08	1.25	1.12-1.40	<0.001
MIGRAINE/SEVERE HEADACHES$^{\Upsilon}\pi$		69,221							68,993						
no migraine / severe headaches	90		1.00			1.00				1.00			1.00		
migraine / severe headaches	10		0.91	0.82-1.02	0.11	1.06	0.96-1.18	0.24		0.90	0.80-1.00	0.06	1.07	0.96-1.18	0.23
OBESITY$^{\Upsilon}\pi$		70,354							70,119						
no obesity	89		1.00			1.00				1.00			1.00		
obesity	11		1.15	1.05-1.27	0.005	0.99	0.90-1.08	0.80		1.15	1.04-1.27	0.005	0.99	0.90-1.08	0.81
PSYCHOLOGICAL DISTRESS $^{\Upsilon}$		73,141							72,898						
no psychological distress	97		1.00			1.00				1.00			1.00		
psychological distress	3		4.54	4.09-5.05	<0.001	0.85	0.70-1.02	0.08		4.32	3.88-4.80	<0.001	0.85	0.70-1.02	0.08
WORKPLACE INJURIES$^{\Upsilon}$		73,525							73,415						
no injuries	93		1.00			1.00				1.00			1.00		
injuries	7		1.28	1.14-1.43	<0.001	1.13	1.02-1.25	0.02		1.18	1.05-1.32	0.005	1.14	1.03-1.26	0.01
CO-MORBIDITY$^{\Upsilon}$		73,816							73,568						
no health conditions	13		1.00			1.00				1.00		0.02	1.00		
1 health condition only	16		1.25	1.07-1.45	0.005	0.84	0.76-0.92	<0.001		1.23	1.05-1.43	0.008	0.84	0.76-0.93	<0.001
2-4 health conditions	41		1.79	1.57-2.04	<0.001	0.79	0.73-0.86	<0.001		1.70	1.49-1.94	<0.001	0.80	0.74-0.87	<0.001
5-7 health conditions	19		2.89	2.52-3.31	<0.001	0.67	0.61-0.74	<0.001		2.59	2.25-2.98	<0.001	0.69	0.62-0.76	<0.001
8-10 health conditions	8		4.31	3.71-5.01	<0.001	0.62	0.55-0.70	<0.001		3.63	3.11-4.24	<0.001	0.63	0.56-0.72	<0.001
11 or more health conditions	3		6.14	5.16-7.32	<0.001	0.59	0.50-0.70	<0.001		4.86	4.06-5.82	<0.001	0.60	0.51-0.72	<0.001

After adjusting for co-morbidity, age, sex, education, marital status, income, number of children, occupation, industry type, public/private sector, hourly wage, job security, contractor, hours worked in last week, number of staff supervising, number of work accidents per hundred workers for employer; Υ: number of children not significant at p<0.05; π: contractor not significant at p<0.05

9. Profile of characteristics associated with absenteeism

Table D9 Examples of Full models of Absenteeism (for psychological distress and drug & alcohol problems) (adjusting for demographic characteristics and working conditions)

	Psychological Distress n = 74,497			Drug & Alcohol Problems n = 72,114		
EXPLANATORY VARIABLES	IRR	95% CIs	P-value	IRR	95% CIs	p-value
HEALTH CONDITION OF INTEREST						
Health condition not present	1.00			1.00		
Health condition present	1.22	1.16-1.29	<0.001	1.42	1.13-1.77	0.003
CO-MORBIDITIES						
No health conditions	1.00			1.00		
1 health condition only	1.07	1.03-1.11	0.001	1.07	1.03-1.11	0.001
2-4 health conditions	1.15	1.11-1.19	<0.001	1.15	1.11-1.19	<0.001
5-7 health conditions	1.28	1.23-1.33	<0.001	1.29	1.24-1.34	<0.001
8-10 health conditions	1.41	1.35-1.48	<0.001	1.41	1.35-1.49	<0.001
11 or more health conditions	1.55	1.45-1.65	<0.001	1.60	1.50-1.72	<0.001
TREATMENT-SEEKING						
No health care services in last year	1.00			1.00		
1-3 health care services in last year	1.07	1.02-1.12	0.01	1.07	1.02-1.12	0.01
4-9 health care services in last year	1.28	1.22-1.34	<0.001	1.28	1.22-1.35	<0.001
10 or more health services in last year	1.69	1.60-1.78	<0.001	1.69	1.61-1.79	<0.001
AGE ¥						
18-29 years	1.00			1.00		
30-44 years	0.95	0.93-0.98	0.003	0.95	0.92-0.98	0.003
45-59 years	0.91	0.88-0.94	<0.001	0.90	0.87-0.94	<0.001
60-70 years	0.92	0.86-0.98	0.01	0.91	0.85-0.98	0.01
SEX						
Female	1.00			1.00		
Male	1.08	1.05-1.10	<0.001	1.08	1.05-1.10	<0.001
MARITAL STATUS						
Not married or co-habiting	1.00			1.00		
Married or cohabitating	0.98	0.95-1.00	0.04	0.97	0.95-1.00	0.02
NUMBER OF CHILDREN ϒ						
Nil	1.00			1.00		
1-3 children	-	-	-	-	-	-
4 or more children	-	-	-	-	-	-
EDUCATION LEVEL						
Did not complete high school	1.00			1.00		
Completed high school	0.95	0.91-0.99	0.02	0.94	0.90-0.99	0.01
Some college	0.96	0.93-0.99	0.02	0.95	0.92-0.98	0.01
Completed college or university	0.89	0.86-0.92	<0.001	0.88	0.85-0.91	<0.001
OCCUPATION CATEGORY						
Manager	1.00			1.00		
Professional / technical	0.98	0.94-1.02	0.25	0.98	0.94-1.02	0.31
Sales	1.04	0.97-1.12	0.25	1.06	0.99-1.14	0.09
Clerical / service	1.02	0.98-1.06	0.41	1.02	0.98-1.07	0.36
Trade / labour	1.09	1.01-1.18	0.03	1.10	1.01-1.19	0.02
INDUSTRY TYPE						
Agriculture	1.00			1.00		
Communications	1.05	0.92-1.20	0.50	1.05	0.91-1.20	0.51
Education	1.09	1.00-1.19	0.05	1.09	1.00-1.20	0.05
Electricity / gas / water	1.35	1.18-1.54	<0.001	1.36	1.19-1.56	<0.001
Finance	1.02	0.90-1.15	0.75	1.02	0.90-1.16	0.71
Government administration	0.96	0.88-1.05	0.37	0.97	0.89-1.06	0.54

	Psychological Distress n = 74,497			Drug & Alcohol Problems n = 72,114		
EXPLANATORY VARIABLES	IRR	95% CIs	P-value	IRR	95% CIs	p-value
Health / community	0.97	0.88-1.07	0.54	0.99	0.90-1.08	0.77
Manufacturing	0.90	0.79-1.03	0.12	0.90	0.79-1.03	0.12
Media	1.23	1.07-1.41	0.003	1.23	1.07-1.41	0.004
Retail	1.14	0.98-1.32	0.09	1.16	0.99-1.34	0.06
PRIVATE / PUBLIC SECTOR						
Federal government	1.00			1.00		
State government	0.96	0.92-1.00	0.08	0.96	0.92-1.01	0.11
Local government	0.92	0.84-1.01	0.07	0.92	0.84-1.01	0.08
Private	0.74	0.67-0.82	<0.001	0.74	0.67-0.82	<0.001
ANNUAL WAGE β						
≤$29,999 pa	1.00			1.00		
$30,000-39,999 pa	1.35	1.30-1.41	<0.001	1.35	1.29-1.41	<0.001
$40,000-49,999 pa	1.49	1.43-1.56	<0.001	1.50	1.43-1.56	<0.001
$50,000-74,999 pa	1.64	1.57-1.71	<0.001	1.65	1.58-1.72	<0.001
$75,000-99,999 pa	1.66	1.57-1.76	<0.001	1.68	1.58-1.78	<0.001
≥$100,000 pa	1.61	1.51-1.72	<0.001	1.62	1.52-1.74	<0.001
JOB SECURITY						
Part time or full time worker	1.00			1.00		
Casual worker	0.77	0.71-0.82	<0.001	0.76	0.71-0.82	<0.001
CONTRACTOR						
Not a Contractor	1.00			1.00		
Contractor	0.88	0.81-0.94	<0.001	0.86	0.80-0.93	<0.001
EMPLOYER RATE OF ACCIDENTS						
<0.25 accidents per 100 workers	1.00			1.00		
≥0.25 <0.75 accidents per 100 workers	1.04	1.00-1.08	0.08	1.04	1.00-1.08	0.07
≥0.75 <1.5 accidents per 100 workers	1.09	1.05-1.14	<0.001	1.10	1.05-1.14	<0.001
≥1.5 <3.0 accidents per 100 workers	0.89	0.83-0.96	0.003	0.88	0.82-0.95	0.001
≥3.0 <5.0 accidents per 100 workers	0.75	0.70-0.79	<0.001	0.75	0.71-0.79	<0.001
≥5 accidents per 100 workers	0.92	0.86-0.98	0.01	0.91	0.85-0.97	0.004
HOURS WORKED IN PAST 7 DAYS						
(Continuous variable)	0.978	0.972-0.972	<0.001	0.977	0.976-0.998	<0.001
NUMBER OF STAFF SUPERVISING ψ						
0 staff	1.00			1.00		
1-2 staff	-	-	-	-	-	-
3-9 staff	-	-	-	-	-	-
10-19 staff	-	-	-	-	-	-
20 or more staff	-	-	-	-	-	-
HOURS EXPECTED TO WORK						
≤35 hours per week	1.00			1.00		
>35 and ≤40 hours per week	1.26	1.23-1.30	<0.001	1.26	1.23-1.30	<0.001
>40 and ≤50 hours per week	1.38	1.32-1.45	<0.001	1.40	1.34-1.47	<0.001
>50 and ≤60 hours per week	1.58	1.47-1.69	<0.001	1.60	1.49-1.72	<0.001
>60 hours per week	1.72	1.59-1.87	<0.001	1.74	1.60-1.89	<0.001

¥: only persons aged 18-70 included in analysis; β: excludes hourly rate < $7.50ph in case fortnightly income reported instead of annual income; ϒ: kids not significant at p<0.05; ψ number supervised not significant at p<0.05

10. Profile of characteristics associated with presenteeism

Table D10 Examples of Full ADJUSTED models of Presenteeism (for psychological distress and drug & alcohol problems)

	Psychological Distress n= 72,898						Drug & Alcohol Problems n= 70,544					
	Low Productivity			High Productivity			Low Productivity			High Productivity		
EXPLANATORY VARIABLES	RRR	95% CIs	p-value	RRR	95% CIs	p-value	RRR	95% CIs	p-value	RRR	95% CIs	p-value
HEALTH CONDITION OF INTEREST												
Health condition not present	1.00						1.00					
Health condition present	4.32	3.88-4.80	<0.001	0.85	0.70-1.02	0.08	2.15	1.43-3.24	<0.001	0.55	0.20-1.50	0.240
CO-MORBIDITIES												
no health conditions	1.0						1.00					
1 health condition only	1.23	1.06-1.44	0.008	0.84	0.76-0.93	<0.001	1.21	1.04-1.41	0.02	0.84	0.76–0.92	0.001
2-4 health conditions	1.65	1.44-1.88	<0.001	0.80	0.74-0.87	<0.001	1.64	1.44-1.87	<0.001	0.80	0.74-0.87	<0.001
5-7 health conditions	2.26	1.97-2.61	<0.001	0.69	0.63-0.76	<0.001	2.44	2.12-2.81	<0.001	0.70	0.63-0.77	<0.001
8-10 health conditions	2.80	2.39-3.29	<0.001	0.64	0.56-0.73	<0.001	3.45	2.94-4.06	<0.001	0.64	0.56-0.73	<0.001
11 or more health conditions	3.24	2.68-3.92	<0.001	0.62	0.52-0.74	<0.001	4.35	3.59-5.29	<0.001	0.58	0.48-0.71	<0.001
TREATMENT-SEEKING												
No health care services in last year	1.00						1.00					
1-3 health care services in last year	0.82	0.71-0.96	0.01	0.82	0.73-0.92	0.001	0.83	0.70-0.97	0.02	0.83	0.73-0.93	0.002
4-9 health care services in last year	0.87	0.75-1.01	0.06	0.81	0.72-0.91	<0.001	0.90	0.77-1.05	0.19	0.82	0.73-0.92	0.001
10 or more health services in last year	1.24	1.06-1.45	0.007	0.81	0.71-0.92	0.001	1.35	1.14-1.59	<0.001	0.82	0.72-0.93	0.002
AGE ¥												
18-29 years	1.00						1.00					
30-44 years	0.88	0.80-0.96	0.007	1.35	1.23-1.49	<0.001	0.87	0.79-0.96	0.006	1.37	1.24-1.51	<0.001
45-59 years	0.65	0.59-0.73	<0.001	2.04	1.85-2.25	<0.001	0.62	0.56-0.70	<0.001	2.09	1.89-2.31	<0.001
60-70 years	0.37	0.27-0.50	<0.001	3.01	2.59-3.50	<0.001	0.31	0.23-0.43	<0.001	3.06	2.63-3.56	<0.001
SEX												
Female	1.00						1.00					
Male	1.61	1.49-1.74	<0.001	0.74	0.69-0.79	<0.001	1.59	1.47-1.72	<0.001	0.74	0.69-0.80	<0.001
MARITAL STATUS												
Not married or co-habiting	1.00						1.00					
Married or cohabitating	0.81	0.75-0.88	<0.001	1.06	1.00-1.13	0.06	0.80	0.74-0.86	<0.001	1.05	0.99-1.12	0.131
NUMBER OF CHILDREN ϒ												
Nil	1.00						1.00					
1-3 children	-	-					-	-	-			
4 or more children	-	-					-	-	-			
EDUCATION LEVEL ┼												

	Psychological Distress n= 72,898						Drug & Alcohol Problems n= 70,544					
	Low Productivity			High Productivity			Low Productivity			High Productivity		
EXPLANATORY VARIABLES	RRR	95% CIs	p-value	RRR	95% CIs	p-value	RRR	95% CIs	p-value	RRR	95% CIs	p-value
Did not complete high school	1.00						1.00					
Completed high school	1.00	0.87-1.15	0.96	0.77	0.70-0.85	<0.001	1.01	0.87-1.17	0.91	0.78	0.70-0.86	<0.001
Some college	0.94	0.84-1.06	0.34	0.75	0.69-0.81	<0.001	0.94	0.83-1.06	0.34	0.75	0.69-0.81	<0.001
Completed college or university	1.05	0.93-1.19	0.42	0.55	0.51-0.60	<0.001	1.04	0.92-1.19	0.54	0.55	0.51-0.61	<0.001
OCCUPATION CATEGORY												
Manager	1.00						1.00					
Professional / technical	1.19	1.05-1.34	0.006	1.01	0.90-1.13	0.87	1.24	1.09-1.41	0.001	1.01	0.91-1.13	0.808
Sales	1.34	1.10-1.63	0.004	0.82	0.66-1.02	0.08	1.43	1.16-1.75	0.001	0.84	0.68-1.05	0.118
Clerical / service	0.98	0.85-1.13	0.79	1.17	1.03-1.32	0.01	1.01	0.87-1.17	0.91	1.17	1.03-1.32	0.012
Trade / labour	1.28	1.00-1.63	0.05	1.60	1.33-1.93	<0.001	1.41	1.09-1.82	0.009	1.59	1.32-1.93	<0.001
INDUSTRY TYPE												
Agriculture	1.00						1.00					
Communications	0.71	0.46-1.08	0.10	1.17	0.81-1.69	0.40	0.70	0.45-1.08	0.11	1.19	0.82-1.72	0.358
Education	0.58	0.44-0.75	<0.001	1.32	1.02-1.70	0.03	0.57	0.43-0.75	<0.001	1.36	1.06-1.76	0.018
Electricity / gas / water	0.52	0.33-0.80	0.003	0.89	0.61-1.29	0.55	0.51	0.33-0.81	0.004	0.93	0.64-1.35	0.711
Finance	0.69	0.46-1.04	0.08	0.75	0.54-1.05	0.09	0.68	0.45-1.02	0.07	0.77	0.55-1.08	0.137
Government administration	0.67	0.53-0.85	0.001	1.05	0.82-1.35	0.69	0.66	0.52-0.84	0.001	1.07	0.83-1.37	0.618
Health / community	0.36	0.26-0.49	<0.001	1.21	0.93-1.58	0.15	0.34	0.25-0.47	<0.001	1.23	0.95-1.61	0.120
Manufacturing	0.61	0.40-0.93	0.02	0.74	0.52-1.06	0.10	0.56	0.36-0.86	0.009	0.76	0.53-1.09	0.134
Media	0.34	0.21-0.55	<0.001	1.24	0.86-1.78	0.25	0.32	0.19-0.52	<0.001	1.33	0.92-1.92	0.126
Retail	0.47	0.29-0.77	0.003	0.86	0.56-1.33	0.49	0.48	0.29-0.80	0.004	0.82	0.52-1.28	0.379
PRIVATE / PUBLIC SECTOR												
Federal government	1.00						1.00					
State government	0.75	0.65-0.86	<0.001	1.27	1.10-1.47	0.001	0.70	0.61-0.80	<0.001	1.29	1.11-1.49	0.001
Local government	1.31	0.95-1.80	0.10	0.91	0.70-1.17	0.45	1.25	0.90-1.74	0.18	0.92	0.71-1.18	0.502
Private	0.84	0.60 -1.20	0.34	1.48	1.16-1.88	0.001	0.85	0.59-1.21	0.36	1.46	1.15-1.87	0.002
ANNUAL WAGE β												
≤$29,999 pa	1.00						1.00					
$30,000-39,999 pa	1.25	1.06-1.46	0.006	0.73	0.66-0.80	<0.001	1.23	1.05-1.45	0.01	0.72	0.66-0.80	<0.001
$40,000-49,999 pa	1.32	1.14-1.54	<0.001	0.56	0.51-0.62	<0.001	1.33	1.14-1.56	<0.001	0.56	0.51-0.62	<0.001
$50,000-74,999 pa	1.40	1.20-1.64	<0.001	0.45	0.40-0.50	<0.001	1.36	1.16-1.60	<0.001	0.45	0.40-0.50	<0.001
$75,000-99,999 pa	1.55	1.28-1.88	<0.001	0.39	0.33-0.45	<0.001	1.48	1.22-1.80	<0.001	0.38	0.32-0.45	<0.001
≥$100,000 pa	1.53	1.23-1.90	<0.001	0.40	0.33-0.48	<0.001	1.43	1.14-1.79	0.002	0.39	0.32-0.47	<0.001

	Psychological Distress n= 72,898						Drug & Alcohol Problems n= 70,544					
	Low Productivity			High Productivity			Low Productivity			High Productivity		
EXPLANATORY VARIABLES	RRR	95% CIs	p-value	RRR	95% CIs	p-value	RRR	95% CIs	p-value	RRR	95% CIs	p-value
JOB SECURITY												
Part time or full time worker	1.00						1.00					
Casual worker	0.81	0.62-1.05	0.11	1.32	1.16-1.51	<0.001	0.78	0.60-1.03	0.09	1.31	1.15-1.50	<0.001
CONTRACTOR												
not a Contractor	1.00						1.00					
Contractor	0.79	0.63-0.99	0.05	1.05	0.85-1.28	0.67	0.75	0.58-0.96	0.02	1.04	0.85-1.28	0.69
EMPLOYER RATE OF ACCIDENTS												
<0.25 accidents per 100 workers	1.00						1.00					
≥0.25 <0.75 accidents per 100 workers	1.05	0.93-1.18	0.45	1.17	1.04-1.31	0.007	1.07	0.94-1.22	0.28	1.17	1.04-1.31	0.01
≥0.75 <1.5 accidents per 100 workers	0.96	0.85-1.09	0.55	1.09	0.96-1.25	0.17	0.97	0.85-1.10	0.63	1.08	0.94-1.23	0.26
≥1.5 <3.0 accidents per 100 workers	1.79	1.36-2.36	<0.001	1.00	0.83-1.21	0.99	1.85	1.40-2.46	<0.001	0.99	0.82-1.19	0.90
≥3.0 <5.0 accidents per 100 workers	0.93	0.75-1.14	0.47	1.34	1.16-1.54	<0.001	0.92	0.74-1.13	0.42	1.31	1.14-1.51	<0.001
≥5 accidents per 100 workers	1.05	0.81-1.37	0.71	1.25	1.07-1.47	0.005	1.06	0.81-1.39	0.68	1.23	1.05-1.44	0.01
HOURS WORKED IN PAST 7 DAYS												
(continuous variable)	0.982	0.979-0.985	<0.001	1.011	1.008-1.013	<0.001	0.982	0.980-0.985	<0.001	1.011	1.008-1.013	<0.001
NUMBER OF STAFF SUPERVISING												
0 staff	1.00						1.00					
1-2 staff	0.84	0.75-0.94	0.002	1.15	1.06-1.26	0.001	0.82	0.73-0.92	0.001	1.14	1.04-1.25	0.003
3-9 staff	0.77	0.69-0.86	<0.001	1.03	0.95-1.13	0.48	0.75	0.67-0.84	<0.001	1.04	0.95-1.14	0.35
10-19 staff	0.85	0.73-0.99	0.03	0.92	0.81-1.05	0.22	0.84	0.72-0.99	0.03	0.90	0.79-1.02	0.11
20 or more staff	0.85	0.74-0.97	0.02	1.05	0.95-1.15	0.38	0.86	0.75-0.99	0.04	1.03	0.94-1.14	0.51
HOURS EXPECTED TO WORK												
≤35 hours per week	1.00						1.00					
>35 and ≤40 hours per week	1.20	1.09-1.32	<0.001	1.08	1.01-1.16	0.04	1.18	1.07-1.31	0.001	1.09	1.01-1.18	0.02
>40 and ≤50 hours per week	1.34	1.16-1.55	<0.001	1.01	0.89-1.14	0.92	1.37	1.18-1.58	<0.001	1.02	0.90-1.16	0.77
>50 and ≤60 hours per week	1.59	1.29-1.97	<0.001	0.98	0.81-1.18	0.85	1.75	1.42-2.18	<0.001	0.98	0.81-1.19	0.87
>60 hours per week	2.06	1.64-2.60	<0.001	1.25	1.03-1.50	0.02	2.30	1.81-2.91	<0.001	1.24	1.02-1.50	0.03

¥: only persons aged 18-70 included; β: excludes hourly rate < $7.50ph; ϒ: number of children not significant at p<0.05;
┼ Education included as it impacted on high productivity

11. ABSENTEEISM: NURSES - Demographic characteristics

Table D11: Unadjusted negative binomial logistic regression of DEMOGRAPHIC CHARACTERISTICS and ABSENTEEISM, for NURSES subset

Demographic Independent Variable	n	%	IRR	95% CIs	p-value
AGE	14,952				
18-29 years		16.5	1.00		
30-44 years		42	1.03	0.95-1.11	0.54
45-59 years		37	1.15	1.06-1.25	0.001
60-70 years		4	1.18	1.02-1.37	0.03
SEX	14,962				
Female		81	1.00		
Male		19	1.04	0.97-1.11	0.32
MARITAL STATUS	14,914				
Separated, divorced, widowed, never married		29	1.00		
Married or cohabitating		71	0.99	0.93-1.04	0.61
NUMBER OF CHILDREN	14,930				
Nil		89	1.00		
1-3 children		10	0.93	0.85-1.00	0.06
4 or more children		1	0.76	0.60-0.96	0.02
EDUCATION LEVEL	14,879				
Did not complete high school		9	1.00		
Completed high school		7	0.90	0.78-1.04	0.16
Some college		20	0.89	0.80-1.00	0.04
Completed college or university		65	0.84	0.76-0.93	0.001
ANNUAL WAGE	14,550				
≤$29,999 pa		16	1.00		
$30,000-39,999 pa		16	1.19	1.08-1.31	<0.001
$40,000-49,999 pa		22	1.09	1.00-1.20	0.06
$50,000-74,999 pa		36	1.18	1.08-1.28	<0.001
$75,000-99,999 pa		4	1.04	0.89-1.21	0.60
≥$100,000 pa		5	1.02	0.89-1.18	0.75

12. ABSENTEEISM: NURSES – bi-variate health and absenteeism

Table D12: Unadjusted negative binomial logistic regression for HEALTH CONDITIONS associated with ABSENTEEISM, for NURSES subset

	n	%	IRR	95% CI	P value
ARTHRITIS	12,749				
no arthritis		96	1.00		
arthritis		4	1.82	1.58-2.11	<0.001

	n	%	IRR	95% CI	P value
ASTHMA	13,061				
no asthma		94	1.00		
asthma		6	1.28	1.13-1.44	<0.001
BACK / NECK PAIN	13,532				
no back / neck pain		68	1.00		
back / neck pain		32	1.20	1.13-1.28	<0.001
CANCERS (not skin)	14,829				
no cancers		96	1.00		
cancer / s		4	1.56	1.35-1.80	<0.001
CARDIOVASCULAR DISEASE	14,770				
no cardiovascular disease		99	1.00		
cardiovascular disease		1	1.27	0.93-1.74	0.13
COPD / BRONCHITIS / EMPHYSEMA	14,535				
no COPD / Bronchitis / Emphysema		99.7	1.00		
COPD / Bronchitis / Emphysema		0.3	1.42	0.85-2.36	0.18
DIABETES	14,703				
no diabetes		98	1.00		
diabetes		2	1.12	0.91-1.38	0.30
DRUG & ALCOHOL PROBLEMS	14,478				
no drug & alcohol problems		99.9	1.00		
drug & alcohol problems		0.1	1.77	0.80-3.92	0.16
FATIGUE / SLEEP PROBLEMS	14,845				
no fatigue / sleep problems		99	1.00		
fatigue / sleep problems		1	0.91	0.63-1.32	0.63
HIGH BLOOD PRESSURE	14,334				
no high blood pressure		92	1.00		
high blood pressure		8	1.32	1.19-1.47	<0.001
HIGH CHOLESTEROL	13,706				
no high cholesterol		95	1.00		
cholesterol		5	1.21	1.07-1.37	0.003
MIGRAINE / SEVERE HEADACHE	14,037				
no migraine / severe headaches		92	1.00		
migraine / severe headaches		8	1.13	1.02-1.26	0.02
OBESITY	14,192				
no obesity		88	1.00		
obesity		12	1.25	1.15-1.36	<0.001
PSYCHOLOGICAL DISTRESS	14,774				
no psychological distress		98	1.00		
psychological distress		2	1.47	1.22-1.77	<0.001
WORKPLACE INJURY	14,900				
no injury		92	1.00		
injury		8	1.36	1.24-1.50	<0.001
COMORBIDITY	14,962				
no health conditions		14	1.00		
1 health condition only		16	1.15	1.04-1.27	0.01
2-4 health conditions		41	1.33	1.22-1.45	<0.001
5-7 health conditions		19	1.53	1.39-1.69	<0.001
8-10 health conditions		7	1.85	1.63-2.09	<0.001
11 or more health conditions		3	2.13	1.79-2.54	<0.001

¥: only persons aged 18-70 included in analysis; ϒ: number of children not significant at <0.05; Ψ: number of staff supervised not significant at <0.05

13. ABSENTEEISM: NURSES – Multi-variate health and absenteeism

Table D13: Results of multivariate negative binomial logistic regressions for each HEALTH CONDITION by ABSENTEEISM for NURSES subset

ABSENTEEISM: TEACHERS – Multi-variate health and absenteeism

	Model n	%	IRR	95% CI	P value
ARTHRITIS	12,177				
no arthritis		96	1.00		
arthritis		4	1.16	1.00-1.34	0.05
ASTHMA	12,451				
no asthma		94	1.00		
asthma		6	1.07	0.95-1.21	0.95
BACK / NECK PAIN	12,929				
no back / neck pain		68	1.00		
back / neck pain		32	0.97	0.91-1.04	0.46
CANCERS (not skin)	14,161				
no cancers		96	1.00		
cancer / s		4	1.18	1.03-1.37	0.02
CARDIOVASCULAR DISEASE	14,104				
no cardiovascular disease		99	1.00		
cardiovascular disease		1	1.01	0.74-1.38	0.94
COPD / BRONCHITIS / EMPHYSEMA	13,881				
no COPD / Bronchitis / Emphysema		99.7	1.00		
COPD / Bronchitis / Emphysema		0.3	1.05	0.63-1.76	0.85
DIABETES	14,043				
no diabetes		98	1.00		
diabetes		2	0.73	0.59-0.89	0.002
DRUG & ALCOHOL PROBLEMS	13,822				
no drug & alcohol problems		99.89	1.00		
drug & alcohol problems		0.1	1.88	0.86-4.13	0.11
FATIGUE / SLEEP PROBLEMS	14,178				
no fatigue / sleep problems		99	1.00		
fatigue / sleep problems		1	0.60	0.41-0.87	0.01
HIGH BLOOD PRESSURE	13,696				
no high blood pressure		92	1.00		
high blood pressure		8	1.03	0.92-1.14	0.62
HIGH CHOLESTEROL	13,092				
no high cholesterol		95	1.00		
cholesterol		5	0.97	0.86-1.11	0.69
MIGRAINE / SEVERE HEADACHE	13,405				
no migraine / severe headaches		92	1.00		
migraine / severe headaches		8	0.95	0.85-1.07	0.40
OBESITY	13,570				
no obesity		88	1.00		
obesity		12	1.10	1.01-1.21	0.03
PSYCHOLOGICAL DISTRESS	14,110				
no psychological distress		98	1.00		
psychological distress		2	1.08	0.90-1.30	0.41
WORKPLACE INJURY	14,257				
no injury		92	1.00		
injury		8	1.11	1.01-1.22	0.04
COMORBIDITY	14,288				
no health conditions		14	1.00		
1 health condition only		16	1.18	1.07-1.30	0.001
2-4 health conditions		41	1.25	1.15-1.36	<0.001
5-7 health conditions		19	1.40	1.27-1.54	<0.001
8-10 health conditions		7	1.67	1.47-1.90	<0.001
11 or more health conditions		3	1.69	1.42-2.01	<0.001

Adjusting for treatment-seeking behaviour, co-morbidity, median annual wage, industry type, public/private sector, occupation grade, contractor, number of staff supervising, number of work accidents per hundred workers for employer, age, education, sex, job security, hours worked in last week, marital status, number of children and number of hours expected to work by employer; ¥: only persons aged 18-70 included in analysis; ϒ: number of children not significant at <0.05; Ψ: number of staff supervised not significant at <0.05

Table D14: Unadjusted negative binomial logistic regression of DEMOGRAPHIC CHARACTERISTICS and ABSENTEEISM, for TEACHERS subset

Demographic Independent Variable	n	%	IRR	95% CIs	p-value
AGE	12,340				
18-29 years		14	1.00		
30-44 years		37	1.08	0.99-1.18	0.08
45-59 years		46	1.08	1.00-1.18	0.06
60-70 years		3	1.08	0.91-1.29	0.38
SEX	12,342				
Female		78	1.00		
Male		22	1.08	1.01-1.15	0.02
MARITAL STATUS	12,303				
Separated, divorced, widowed, never married		25	1.00		
Married or cohabitating		75	0.96	0.90-1.03	0.27
NUMBER OF CHILDREN	12,322				
Nil		98	1.00		
1-3 children		1	1.56	1.25-1.96	<0.001
4 or more children		0.2	1.42	0.76-2.68	0.28
EDUCATION LEVEL	12,277				
Did not complete high school		4	1.00		
Completed high school		1	0.82	0.62-1.08	0.16
Some college		15	1.12	0.96-1.31	0.13
Completed college or university		20	1.13	0.98-1.30	0.09
ANNUAL WAGE	12,009				
≤$29,999 pa		17	1.00		
$30,000-39,999 pa		9	1.02	0.90-1.14	0.78
$40,000-49,999 pa		18	1.11	1.01-1.22	0.03
$50,000-74,999 pa		53	1.33	1.23-1.44	<0.001
$75,000-99,999 pa		3	1.23	1.02-1.49	0.03
≥$100,00 pa		0.2	1.51	0.75-3.06	0.25

15. ABSENTEEISM: TEACHERS – Bi-variate Health and Absenteeism

Table D15: Unadjusted negative binomial logistic regression for HEALTH CONDITIONS associated with ABSENTEEISM, for TEACHERS subset

	Unadjusted Association of Health Condition with ABSENTEEISM				
	n	%	IRR	95% CI	P value
ARTHRITIS	10,482				
no arthritis		96	1.00		
arthritis		4	1.36	1.17-1.58	<0.001
ASTHMA	10,783				
no asthma		92	1.00		
asthma		8	1.13	1.01-1.26	0.03

	Unadjusted Association of Health Condition with ABSENTEEISM				
	n	%	IRR	95% CI	P value
BACK / NECK PAIN	11,591				
no back / neck pain		69	1.00		
back / neck pain		31	1.31	1.24-1.40	<0.001
CANCERS (not skin)	12,256				
no cancers		96	1.00		
cancer / s		4	1.37	1.19-1.57	<0.001
CARDIOVASCULAR DISEASE	12,211				
no cardiovascular disease		99	1.00		
cardiovascular disease		1	1.13	0.81-1.58	0.47
COPD / BRONCHITIS / EMPHYSEMA	11,816				
no COPD / Bronchitis / Emphysema		99.6	1.00		
COPD / Bronchitis / Emphysema		0.4	2.25	1.47-3.44	<0.001
DIABETES	12,157				
no diabetes		98	1.00		
diabetes		2	1.31	1.07-1.61	0.01
DRUG & ALCOHOL PROBLEMS	11,985				
no drug & alcohol problems		99.9	1.00		
drug & alcohol problems		0.13	1.11	0.52-2.38	0.79
FATIGUE / SLEEP PROBLEMS	12,258				
no fatigue / sleep problems		99	1.00		
fatigue / sleep problems		1	1.80	1.28-2.52	0.001
HIGH BLOOD PRESSURE	11,675				
no high blood pressure		92	1.00		
high blood pressure		8	1.20	1.08-1.33	0.001
HIGH CHOLESTEROL	11,459				
no high cholesterol		95	1.00		
cholesterol		5	1.00	0.88-1.13	0.97
MIGRAINE / SEVERE HEADACHE	11,452				
no migraine / severe headaches		88	1.00		
migraine / severe headaches		12	1.28	1.18-1.40	<0.001
OBESITY	11,820				
no obesity		91	1.00		
obesity		9	1.27	1.16-1.40	<0.001
PSYCHOLOGICAL DISTRESS	12,265				
no psychological distress		97	1.00		
psychological distress		3	1.56	1.33-1.82	<0.001
WORKPLACE INJURY	12,258				
no injury		93	1.00		
injury		7	1.32	1.19-1.47	<0.001
COMORBIDITY	12,342				
no health conditions		13	1.00		
1 health condition only		15	0.99	0.89-1.10	0.80
2-4 health conditions		40	1.17	1.07-1.28	0.001
5-7 health conditions		20	1.43	1.29-1.57	<0.001
8-10 health conditions		8	1.63	1.44-1.84	<0.001
11 or more health conditions		4	2.11	1.80-2.48	<0.001

¥: only persons aged 18-70 included in analysis; ϒ: number of children not significant at <0.05; Ψ: number of staff not significant at <0.05; ∂: reference category are those without a combination of psychological distress and the condition of interest

16. ABSENTEEISM: TEACHERS – Multi-variate Health and Absenteeism

Table D16: Results of multivariate negative binomial logistic regressions for each HEALTH CONDITION by ABSENTEEISM for TEACHERS subset

	n	%	IRR	95% CI	P value
ARTHRITIS	10,016				
no arthritis		96	1.00		
arthritis		4	1.03	0.88-1.20	0.73
ASTHMA	10,293				
no asthma		92	1.00		
asthma		8	0.95	0.85-1.06	0.37
BACK / NECK PAIN	10,787				
no back / neck pain		69	1.00		
back / neck pain		31	1.09	1.01-1.16	0.02
CANCERS (not skin)	11,403				
no cancers		96	1.00		
cancer / s		4	1.18	1.03-1.36	0.02
CARDIOVASCULAR DISEASE	11,360				
no cardiovascular disease		99	1.00		
cardiovascular disease		1	0.86	0.61-1.21	0.39
COPD / BRONCHITIS / EMPHYSEMA	10,994				
no COPD / Bronchitis / Emphysema		99.6	1.00		
COPD / Bronchitis / Emphysema		0.4	1.09	0.71-1.67	0.70
DIABETES	11,308				
no diabetes		98	1.00		
diabetes		2	0.94	0.76-1.15	0.55
DRUG & ALCOHOL PROBLEMS	11,447				
no drug & alcohol problems		99.9	1.00		
drug & alcohol problems		0.1	0.77	0.36-1.62	0.49
FATIGUE / SLEEP PROBLEMS	11,404				
no fatigue / sleep problems		99	1.00		
fatigue / sleep problems		1	1.03	0.73-1.45	0.86
HIGH BLOOD PRESSURE	10,860				
no high blood pressure		92	1.00		
high blood pressure		8	0.95	0.85-1.06	0.34
HIGH CHOLESTEROL	10,659				
no high cholesterol		95	1.00		
cholesterol		5	0.78	0.68-0.89	<0.001
MIGRAINE / SEVERE HEADACHE	10,941				
no migraine / severe headaches		88	1.00		
migraine / severe headaches		12	1.03	0.94-1.13	0.50
OBESITY	10,987				
no obesity		91	1.00		
obesity		9	1.06	0.96-1.17	0.24
PSYCHOLOGICAL DISTRESS	11,413				
no psychological distress		97	1.00		
psychological distress		3	1.29	1.10-1.51	0.001
WORKPLACE INJURY	11,733				
no injury		93	1.00		
injury		7	1.14	1.03-1.27	0.01
COMORBIDITY	11,482				
no health conditions		13	1.00		
1 health condition only		15	0.99	0.89-1.10	0.84
2-4 health conditions		40	1.12	1.03-1.23	0.01
5-7 health conditions		20	1.34	1.21-1.48	<0.001

	n	%	IRR	95% CI	P value
8-10 health conditions		8	1.34	1.18-1.53	<0.001
11 or more health conditions		4	1.70	1.44-1.20	<0.001
Adjusting for treatment-seeking behaviour, co-morbidity, median annual wage, industry type, public/private sector, occupation grade, contractor, number of staff supervising, number of work accidents per hundred workers for employer, age, education, sex, job security, hours worked in last week, marital status, number of children and number of hours expected to work by employer; ¥: only persons aged 18-70 included in analysis; ϒ: number of children not significant at <0.05; Ψ: number of staff supervised not significant at <0.05					

17. PRESENTEEISM: NURSES- Demographic characteristics

Table D17: Unadjusted multivariate logistic regression of DEMOGRAPHIC CHARACTERISTICS and PRESENTEEISM for NURSES subset

Demographic Independent Variable	n	%	RRR	95% CIs	p-value
AGE	14,633				
18-29 years		167	1.00		
30-44 years		42	0.94	0.74-1.18	0.60
45-59 years		37	0.57	0.44-0.74	<0.001
60-70 years		4	0.24	0.10-0.54	0.001
SEX	14,643				
Female		81	1.00		
Male		19	1.81	1.49-2.12	<0.001
MARITAL STATUS	14,595				
Separated, divorced, widow, never married		29	1.00		
Married or cohabitating		71	0.74	0.61-0.89	0.002
NUMBER OF CHILDREN	14,613				
Nil		89	1.00		
1-3 children		10	1.44	1.11-1.87	0.01
4 or more children		1	1.74	0.88-3.43	0.11
EDUCATION LEVEL	14,564				
Did not complete high school		9	1.00		
Completed high school		7	1.22	0.66-2.27	0.52
Some college		20	1.78	1.09-2.90	0.02
Completed college or university		65	2.03	1.29-3.20	0.002
ANNUAL WAGE	14,251				
≤$29,999 pa		16	1.00		
$30,000-39,999 pa		16	1.17	0.83-1.64	0.38
$40,000-49,999 pa		22	1.10	0.80-1.52	0.57
$50,000-74,999 pa		36	1.25	0.93-1.69	0.13
$75,000-99,999 pa		4	1.13	0.68-1.89	0.64
≥$100,000 pa		5	1.22	0.77-1.93	0.40

18. PRESENTEEISM: NURSES- Bi-variate Health and Presenteeism

Table D18. Unadjusted multinomial logistic regression for HEALTH CONDITIONS associated with PRESENTEEISM, for NURSES subset

	%	n	RRR	95% CIs	p-value
ARTHRITIS		12,466			
no arthritis	96		1.00		
arthritis	4		1.64	1.09-2.47	0.02
ASTHMA		12,790			
no asthma	94		1.00		
asthma	6		1.36	0.94-1.97	0.10
BACK / NECK PAIN		13,234			
no back / neck pain	68		1.00		
back / neck pain	32		1.33	1.09-1.62	0.01
CANCERS (excluding skin cancer)		14,511			
no cancers	96		1.00		
cancer / s	4		0.78	0.44-1.36	0.38
CARDIOVASCULAR DISEASE		14,451			
no cardiovascular disease	99.3		1.00		
cardiovascular disease	0.7		1.76	0.77-4.05	0.18
COPD/ BRONCHITIS / EMPHYSEMA		14,222			
no COPD / Bronchitis / Emphysema	99.7		1.00		
COPD / Bronchitis or emphysema	0.3		1.85	0.44-7.78	0.40
DIABETES		14,388			
no diabetes	98		1.00		
diabetes	2		1.13	0.57-2.21	0.07
DRUG & ALCOHOL PROBLEMS		14,162			
no drug & alcohol problems	99		1.00		
drug & alcohol problems	1		6.00	1.72-20.95	0.01
FATIGUE / SLEEP PROBLEMS		14,525			
no fatigue / sleep problems	99.4		1.00		
fatigue / sleep problems	0.6		1.93	0.77-4.81	0.16
HIGH BLOOD PRESSURE		14,031			
no high blood pressure	92.		1.00		
high blood pressure	8		0.80	0.55-1.18	0.27
HIGH CHOLESTEROL		13,411			
no high cholesterol	95		1.00		
cholesterol	5		1.00	0.64-1.54	0.97
MIGRAINE/SEVERE/ HEADACHES		13,730			
no migraine / severe headaches	92		1.00		
migraine / severe headaches	8		1.12	0.80-1.57	0.51
OBESITY		13,896			
no obesity	88		1.00		
obesity	12		1.25	0.95-1.65	0.10
PSYCHOLOGICAL DISTRESS		14,456			
no psychological distress	98		1.00		
psychological distress	2		6.52	4.77-8.92	<0.001
WORKPLACE INJURIES		14,581			
no injuries	92		1.00		
injuries	8		1.26	0.93-1.71	0.13
CO-MORBIDITY		14,643			
no health conditions	15		1.00		

	%	n	RRR	95% CIs	p-value
1 health condition only	16		1.11	0.75-1.65	0.59
2-4 health conditions	41		1.41	1.01-1.95	0.04
5-7 health conditions	19		1.85	1.31-2.63	0.001
8-10 health conditions	7		2.61	1.75-3.89	<0.001
11 or more health conditions	3		3.93	2.48-6.24	<0.001
ϒ: number of children not significant at p<0.05; π: contractor not significant at p<0.05					

19. PRESENTEEISM: NURSES- Multi-variate Health and Presenteeism

Table D19: Multivariate multinomial regression for LOW PRODUCTIVITY (Presenteeism) for NURSES subset (Reference category moderate productivity, only low productivity reported)

	%	n	RRR	95% CIs	p-value
ARTHRITIS ±ψ		11,917			
no arthritis	96		1.00		
arthritis	4		1.46	0.93-2.31	0.10
ASTHMA ±ψ		12,199			
no asthma	94		1.00		
asthma	6		0.95	0.65-1.40	0.79
BACK / NECK PAIN ±ψ		12,647			
no back / neck pain	68		1.00		
back / neck pain	32		0.98	0.77-1.25	0.89
CANCERS (excluding skin cancer) ±		13,728			
no cancers	96		1.00		
cancer / s	4		0.79	0.44-1.40	0.41
CARDIOVASCULAR DISEASE±	0	13,673			
no cardiovascular disease	99.		1.00		
cardiovascular disease	1		1.64	0.69-3.87	0.26
COPD/ BRONCHITIS / EMPHYSEMA±		13,455			
no COPD / Bronchitis / Emphysema	99.7		1.00		
COPD / Bronchitis or emphysema	0.3		1.68	0.39-7.32	0.49
DIABETES ±		13,615			
no diabetes	98		1.00		
diabetes	2		0.81	0.40-1.63	0.55
DRUG & ALCOHOL PROBLEMS ±ψ		13,526			
no drug & alcohol problems	99.9		1.00		
drug & alcohol problems	0.1		1.59	0.34-7.43	0.56
FATIGUE / SLEEP PROBLEMS±		13,743			
no fatigue / sleep problems	99		1.00		
fatigue / sleep problems	1		0.90	0.34-2.37	0.84
HIGH BLOOD PRESSURE±		13,279			
no high blood pressure	92		1.00		
high blood pressure	8		0.75	0.49-1.13	0.17
HIGH CHOLESTEROL±		12,692			
no high cholesterol	88		1.00		
cholesterol	12		0.88	0.55-1.40	0.58
MIGRAINE / SEVERE HEADACHES±		13,113			
no migraine / severe headaches	92		1.00		
migraine / severe headaches	8		0.69	0.48-1.01	0.06
OBESITY±		13,170			
no obesity	88		1.00		
obesity	12		0.98	0.73-1.32	0.91
PSYCHOLOGICAL DISTRESS±		13,681			
no psychological distress	98		1.00		

	%	n	RRR	95% CIs	p-value
psychological distress	2		4.47	3.16-6.32	<0.001
WORKPLACE INJURIES±		13,823			
no injuries	92		1.00		
injuries	8		1.02	0.75-1.40	0.89
CO-MORBIDITY±		13,852			
no health conditions	14		1.00		
1 health condition only	16		1.25	0.83-1.87	0.29
2-4 health conditions	41		1.69	1.19-2.40	0.003
5-7 health conditions	19		2.48	1.70-3.62	<0.001
8-10 health conditions	7		3.49	2.26-5.40	<0.001
11 or more health conditions	3		5.44	3.27-9.05	<0.001
Adjusting for number of co-morbidities, treatment-seeking behaviour, age, sex, education, marital status, income, number of children, occupation, industry type, public/private sector, job security, contractor, hours worked in last week, supervisory role, rate of work accidents by employer, and hours expected to work per week ; ±: the following variables were not significant at <0.05: number of children, occupation, industry, job security, public/private sector, injuries; number of staff supervised					

20. PRESENTEEISM: TEACHERS – Demographic Characteristics

Table D20: Unadjusted multinomial logistic regression of DEMOGRAPHIC CHARACTERISTICS and PRESENTEEISM, for TEACHERS subset

Demographic Independent Variable	n	%	RRR	95% CIs	p-value
AGE	12,233				
18-29 years		14	1.00		
30-44 years		37	0.73	0.57-0.94	0.01
45-59 years		46	0.73	0.57-0.93	0.01
60-70 years		3	0.24	0.10-0.61	0.002
SEX	12,235				
Female		77	1.00		
Male		23	1.65	1.36-1.99	<0.001
MARITAL STATUS	12,196				
Separated, divorced, widowed, never married		25	1.00		
Married or cohabitating		75	0.69	0.56-0.83	<0.001
NUMBER OF CHILDREN	12,215				
Nil		98	1.00		
1-3 children		1	1.37	0.72-2.61	0.35
4 or more children		0.2	1.15	0.15-8.60	0.90
EDUCATION LEVEL	12,173				
Did not complete high school		4	1.00		
Completed high school		1	0.95	0.30-3.04	0.93
Some college		15	1.19	0.62-2.30	0.60
Completed college or university		80	1.57	0.85-2.88	0.15
ANNUAL WAGE	11,916				
≤$29,999 pa		17	1.00		

$30,000-39,999 pa		9	0.93	0.61-1.40	0.72
$40,000-49,999 pa		18	1.36	1.00-1.86	0.05
$50,000-74,999 pa		53	1.16	0.88-1.52	0.30
$75,000-99,999 pa		2	0.82	0.40-1.67	0.59
≥$100,000 pa		0.2	5.47	1.52-19.67	0.01

21. PRESENTEEISM: TEACHERS – bi-variate Health and Presenteeism

Table D21: Unadjusted multinomial logistic regression for HEALTH CONDITIONS associated with PRESENTEEISM, for TEACHERS subset

	%	n	RRR	95% CIs	p-value
ARTHRITIS		10,384			
no arthritis	96		1.00		
arthritis	4		.97	0.58-1.62	0.92
ASTHMA		10,685			
no asthma	92		1.00		
asthma	8		0.91	0.63-1.32	0.63
BACK / NECK PAIN		11,498			
no back / neck pain	69		1.00		
back / neck pain	31		1.47	1.22-1.78	<0.001
CANCERS (excluding skin cancer)		12,149			
no cancers	96		1.00		
cancer / s	4		1.45	0.97-2.17	0.07
CARDIOVASCULAR DISEASE		12,105			
no cardiovascular disease	99.3		1.00		
cardiovascular disease	0.7		1.28	0.47-3.54	0.63
COPD/BRONCHITIS/EMPHYSEMA		11,710			
no COPD / Bronchitis / Emphysema	99.6		1.00		
COPD / Bronchitis or emphysema	0.4		3.81	1.59-9.15	0.003
DIABETES		12,055			
no diabetes	98.2		1.00		
diabetes	1.8		1.53	0.86-2.71	0.14
DRUG & ALCOHOL PROBLEMS		11,880			
no drug & alcohol problems	99.9		1.00		
drug & alcohol problems	0.1		5.88	1.64-21.15	0.01
FATIGUE / SLEEP PROBLEMS		12,152			
no fatigue / sleep problems	99.4		1.00		
fatigue / sleep problems	0.6		2.73	1.30-5.73	0.01
HIGH BLOOD PRESSURE		11,572			
no high blood pressure	92		1.00		
high blood pressure	8		1.15	0.83-1.60	0.40
HIGH CHOLESTEROL		11,362			
no high cholesterol	89		1.00		
cholesterol	11		1.18	0.75-1.69	0.56
MIGRAINE / SEVERE HEADACHES		11,357			
no migraine / severe headaches	88		1.00		
migraine / severe headaches	12		1.38	1.07-1.78	0.01
OBESITY		11,720			
no obesity	91		1.00		
obesity	9		1.65	1.27-2.15	<0.001
PSYCHOLOGICAL DISTRESS		12,160			
no psychological distress	97		1.00		

	%	n	RRR	95% CIs	p-value
psychological distress	3		9.63	7.46-12.43	<0.001
WORKPLACE INJURIES		12,151			
no injuries	93		1.00		
injuries	7		1.48	1.10-2.00	0.01
CO-MORBIDITY		12,235			
no health conditions	13		1.00		
1 health condition only	15		1.10	0.70-1.73	0.70
2-4 health conditions	40		1.58	1.08-2.29	0.02
5-7 health conditions	20		2.49	1.70-3.65	<0.001
8-10 health conditions	8		4.08	2.72-6.13	<0.001
11 or more health conditions	4		4.77	3.01-7.58	<0.001

22. PRESENTEEISM: TEACHERS – Multi-variate Health and Presenteeism

Table D22. Multivariate multinomial logistic regression for LOW PRODUCTIVITY (Presenteeism) – for TEACHERS subset (Reference category moderate productivity, only low productivity reported)

	%	n	RRR	95% CIs	p-value
ARTHRITIS Ъ		9,684			
no arthritis	96		1.00		
arthritis	4		0.61	0.35-1.06	0.08
ASTHMA Ъ		9,934			
no asthma	92		1.00		
asthma	8		0.56	0.37-0.83	0.004
BACK / NECK PAIN Ъ		10,695			
no back / neck pain	69		1.00		
back / neck pain	31		0.96	0.76-1.20	0.70
CANCERS (excluding skin cancer) Ъ		11,299			
no cancers	96		1.00		
cancer / s	4		1.16	0.77-1.77	0.48
CARDIOVASCULAR DISEASE Ъ		11,256			
no cardiovascular disease	99.3		1.00		
cardiovascular disease	0.7		0.84	0.29-2.43	0.74
COPD/BRONCHITIS/EMPHYSEMA Ъ		10,891			
no COPD / Bronchitis / Emphysema	99.6		1.00		
COPD / Bronchitis or emphysema	0.4		2.12	0.84-5.37	0.11
DIABETES Ъ		11,208			
no diabetes	98		1.00		
diabetes	2		0.91	0.50-1.66	0.76
DRUG & ALCOHOL PROBLEMS Ъ		11,037			
no drug & alcohol problems	99.9		1.00		
drug & alcohol problems	0.1		2.70	0.64-11.30	0.17
FATIGUE / SLEEP PROBLEMS Ъ		11,300			
no fatigue / sleep problems	99.4		1.00		
fatigue / sleep problems	0.6		1.28	0.57-2.83	0.55
HIGH BLOOD PRESSURE Ъ		10,762			
no high blood pressure	92		1.00		
high blood pressure	8		1.00	0.70-1.42	0.96
HIGH CHOLESTEROL ЪΨ		10,848			
no high cholesterol	89		1.00		
cholesterol	11		0.84	0.54-1.30	0.44
MIGRAINE/SEVERE HEADACHES Ъ		10,562			
no migraine / severe headaches	88		1.00		
migraine / severe headaches	12		0.74	0.55-1.00	0.05

	%	n	RRR	95% CIs	p-value
OBESITY Ъ		10,908			
no obesity	91		1.00		
obesity	9		1.05	0.78-1.41	0.76
PSYCHOLOGICAL DISTRESS Ъ		11,308			
no psychological distress	97		1.00		
psychological distress	3		6.43	4.82-8.57	<0.001
WORKPLACE INJURIES Ъ		11,321			
no injuries	93		1.00		
injuries	7		1.07	0.77-1.49	0.69
CO-MORBIDITY Ъ		11,377			
no health conditions	13		1.00		
1 health condition only	15		1.19	0.74-1.90	0.72
2-4 health conditions	40		1.78	1.20-2.64	2.88
5-7 health conditions	20		2.89	1.91-4.36	5.05
8-10 health conditions	8		4.55	2.91-7.13	6.63
11 or more health conditions	4		5.58	3.36-9.26	6.65
Adjusting for number of co-morbidities, treatment-seeking behaviour, age, sex, education, marital status, income, number of children, occupation, industry type, public/private sector, job security, contractor, hours worked in last week, supervisory role, rate of work accidents by employer, and hours expected to work per week ; Ъ: The following variables have been dropped as not significant at p<0.05; number of children, contractor, occupation, industry, job security, public/private sector; Ψ: number of staff not significant at <0.05					

23. Demographic characteristics associated with psychological distress

Table D23: Results of bi-variate logistic regression of DEMOGRAPHIC CHARACTERISTICS and PSYCHOLOGICAL DISTRESS status

Demographic Independent Variable	n	No Psych Distress %	Psych distress %	Crude Odds Ratio	95% CIs	p-value
AGE ¥	77,823					
18-29 years		17.05	21.11	1.00		
30-44 years		42.75	45.62	0.86	0.78-0.95	0.004
45-59 years		37.10	31.70	0.69	0.62-0.77	<0.001
60-70 years		3.10	1.60	0.41	0.30-0.56	<0.001
SEX	77,841					
Female		65.07	34.93	1.00		
Male		67.22	32.80	0.91	0.84-0.99	0.02
MARITAL STATUS	77,626					
Separated, divorced, widowed, never married		28.24	40.05	1.00		
Married or cohabitating		71.76	59.95	0.59	0.54-0.64	<0.001
NUMBER OF CHILDREN	77,620					
Nil		69.60	66.80	1.00		
1-3 children		27.83	30.14	1.13	1.04-1.23	0.005
4 or more children		2.61	3.08	1.23	0.98-1.54	0.08
EDUCATION LEVEL	77,421					
Completed college or university		48.26	41.70	1.00		
Some college		27.20	29.90	1.27	1.16-1.40	<0.001

Completed high school		10.24	12.75	1.44	1.27-1.63	<0.001
Did not complete high school		14.43	15.71	1.27	1.13-1.42	<0.001
ANNUAL WAGE β	76,208					
≥$100,000 pa		6.80	4.65	1.00		
$75,000-99,999 pa		9.80	7.54	1.12	0.89-1.41	0.333
$50,000-74,999 pa		36.02	33.93	1.37	1.13-1.66	0.001
$40,000-49,999 pa		20.35	25.60	1.83	1.50-2.22	<0.001
$30,000-39,999 pa		13.83	15.70	1.65	1.34-2.03	<0.001
≤$29,999 pa		13.25	12.60	1.38	1.12-1.71	0.003
95% CIs = 95% confidence intervals; ¥: only persons aged 18-70 included; β: excludes hourly rate< $7.50ph in case fortnightly income reported instead of annual income						

24. Bi-variate Health conditions associated with psychological distress

Table D24: Unadjusted HEALTH CONDITIONS associated with PSYCHOLOGICAL DISTRESS

	n	%	OR	95% CI	P value
ARTHRITIS∂	67,085				
no arthritis		96	1.00		
arthritis		4	1.48	1.22-1.80	<0.001
ASTHMA∂	67,935				
no asthma		94	1.00		
asthma		6	1.47	1.26-1.70	<0.001
BACK / NECK PAIN∂	71,949				
no back / neck pain		70	1.00		
back / neck pain		30	1.93	1.77-2.10	<0.001
CANCERS (not skin) ∂	77,183				
no cancers		97	1.00		
cancer/s		3	1.37	1.13-1.67	0.002
CARDIOVASCULAR DISEASE∂	76,709				
no cardiovascular disease		99	1.00		
cardiovascular disease		1	2.18	1.59-2.99	<0.001
COPD / BRONCHITIS / EMPHYSEMA∂	74,288				
no COPD / Bronchitis / Emphysema		99.6	1.00		
COPD / Bronchitis / Emphysema		0.4	2.46	1.61-3.77	<0.001
DIABETES∂	76,489				
no diabetes		98	1.00		
diabetes		2	1.72	1.38-2.14	<0.001
DRUG & ALCOHOL PROBLEMS∂	74,656				
no drug & alcohol problems		99.8	1.00		
drug & alcohol problems		0.2	14.00	9.75-20.10	<0.001
FATIGUE / SLEEP PROBLEMS∂	77,322				
no fatigue / sleep problems		99	1.00		
fatigue / sleep problems		1	5.04	3.94-6.44	<0.001
HIGH BLOOD PRESSURE∂	73,259				
no high blood pressure		92	1.00		
high blood pressure		8	1.31	1.14-1.49	<0.001
HIGH CHOLESTEROL∂	70,932				
no high cholesterol		94	1.00		
cholesterol		6	1.27	1.08-1.50	0.003

	n	%	OR	95% CI	P value
MIGRAINE / SEVERE HEADACHE∂	72,836				
no migraine / severe headaches		90	1.00		
migraine / severe headaches		10	2.80	2.54-3.10	<0.001
OBESITY∂	73,939				
no obesity		89	1.00		
obesity		11	1.94	1.75-2.15	<0.001
WORKPLACE INJURY∂	77,490				
no injury		93	1.00		
injury		7	1.96	1.75-2.21	<0.001
COMORBIDITY∂	77,841				
no health conditions		13	1.00		
1 health condition only		16	1.23	0.90-1.68	0.19
2-4 health conditions		41	2.87	2.22-3.71	<0.001
5-7 health conditions		19	8.75	6.80-11.26	<0.001
8-10 health conditions		8	18.88	14.63-24.37	<0.001
11 or more health conditions		3	33.81	26.00-43.97	<0.001
∂: reference category are those without psychological distress and the condition of interest					

25. Co-morbid Psychological distress and absenteeism – bi-variate

Table 25: Unadjusted risk of Absenteeism for those with and without co-morbid psychological distress compared to the reference group that had neither the indexed health condition nor co-morbid psychological distress, using negative binomial logistic regression; reporting Incidence Rate Ratios (IRR)

		Without co-morbid PD		**With co-morbid PD**	
HEALTH CONDITION	**Model n**	**%**	**IRR (95%CIs)**	**%**	**IRR (95%CIs)**
Arthritis	64,888	3.5	1.40** (1.32-1.49)	0.2	2.24** (1.73-2.92)
Asthma	65,788	6.3	1.22** (1.17-1.28)	0.3	1.75** (1.43-2.14)
Back/neck pain	70,579	29.6	1.22** (1.19-1.25)	1.5	2.02** (1.85-2.21)
Cancers	74,514	3.1	1.27** (1.20-1.35)	0.14	2.36** (1.81-3.08)
COPD	71,750	0.4	1.51** (1.27-1.79)	0.03	2.80* (1.55-4.92)
CVD	74,002	0.8	1.17* (1.03-1.32)	0.06	2.14* (1.39-3.29)
Drug & Alcohol	72,227	3.0	1.74** (1.30-2.32)	0.5	2.24** (1.47-3.44)
Diabetes	73,853	2.0	1.18** (1.10-1.27)	0.12	1.60* (1.18-2.16)
Fatigue/sleep problems	74,630	0.6	1.48** (1.29-1.69)	.010	2.08** (1.51-2.87)
High Blood Pressure	71,009	8.1	1.14** (1.10-1.19)	0.3	1.82** (1.52-2.18)
High Cholesterol	68,637	5.7	1.10** (1.05-1.16)	0.2	1.87** (1.50-2.32)
Migraine/severe headache	70,881	9.1	1.22** (1.17-1.26)	0.7	1.94** (1.71-2.20)
Obesity	71,849	11.0	1.22** (1.18-1.27)	0.7	2.04** (1.79-2.32)
Workplace Injury	75,031	7.0	1.43** (1.37-1.49)	0.5	2.66*8 (2.29-3.09)
*: p<0.05; **: p<0.001; † trend <0.1					

26. Co-morbid Psychological distress and Presenteeism – bi-variate

Table 26: Unadjusted Relative Risk Ratio (RRR) of Presenteeism for those with and without co-morbid psychological distress compared to the reference group that had neither the indexed health condition nor co-morbid psychological distress. Using multinomial logistic regression, reporting relative risk ratios for low productivity compared to average productivity (high productivity not reported)

		Without co-morbid PD		With co-morbid PD	
HEALTH CONDITION	**Model n**	**%**	**RRR (95%CIs**	**%**	**RRR (95%CIs**
Arthritis	64,079	3.5	1.10 (0.90-1.33)	0.2	7.90** (5.21-11.97)
Asthma	64,970	6.3	1.22* (1.06-1.40)	0.3	5.91** (4.20-8.30)
Back/neck pain	69,701	29.6	1.22** (1.13-1.31)	1.5	7.83** (6.76-9.08)
Cancers	73,585	3.1	0.87 (0.70-1.08)	0.14	7.36** (4.78-11.34)
COPD	70,852	0.4	2.14** (1.41-3.24)	0.03	7.53** (2.92-19.43)
CVD	73,083	0.8	1.47 (1.04-2.07)	0.06	7.10** (3.54-14.22)
Drug & Alcohol	74,439	3.0	2.57** (2.25-2.94)	0.5	8.59** (6.81-10.84)
Diabetes	72,935	2.0	1.33* (1.06-1.65)	0.12	7.60** (4.72-12.22)
Fatigue/sleep problems	73,698	0.6	2.56** (1.89-3.46)	.010	8.80** (5.35-14.46)
High Blood Pressure	70,119	8.1	0.90 (0.79-1.04)	0.3	6.43** (4.75-8.69)
High Cholesterol	67,801	5.7	1.02 (0.87-1.19)	0.2	7.31** (5.13-10.41)
Migraine/severe headache	69,999	9.1	1.30** (1.16-1.45)	0.7	7.27** (5.94-8.90)
Obesity	70,967	11.0	1.60** (1.42-1.73)	0.7	7.68** (6.22-9.48)
Workplace Injury	74,086	7.0	1.35** (1.20-1.53)	0.5	9.46** (7.47-11.99)

*: p<0.05; **: p<0.001; † trend <0.1

27. Multi-morbidity and absenteeism – Bivariate health clusters with and without co-morbid psychological distress

Table D27: Results of bivariate negative binomial logistic regression of the association between each cluster of multi-morbid health conditions and Absenteeism

	Multi-morbid clusters without co-morbid Psychological Distress					Multi-morbid clusters with co-morbid Psychological Distress				
	n	%	IRR	95% CI	P value	n	%	IRR	95% CI	P value
Factor 1:										
No arthritis, back/neck pain, migraine, other chronic pain	38,922	99.9	1.00			38,474	99.9	1.00		
Arthritis, back/neck pain, migraine, other chronic pain	103	0.1	1.97	1.48-2.61	<0.001	13	0.04	2.41	1.73-3.38	<0.001
Factor 2:										
No asthma, COPD, allergies	41,895	99.9	1.00			41,433	99.9	1.00		
Asthma, COPD, allergies	66	0.1	1.76	1.23-2.51	0.002	4	0.01	2.71	1.83-4.01	<0.001
Factor 3:										
No CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity	52,604	100	1.00			52,081	100	1.00		
CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity	15	0	2.58	1.26-5.28	0.01	1	0	3.71	1.61-8.58	0.002
Factor 4:										
No irritable bowel syndrome, ulcer, heartburn	58,203	99.9	1.00			57,585	99.9	1.00		
Irritable bowel syndrome, ulcer, heartburn	108	0.01	1.70	1.29-2.23	<0.001	18	0.03	2.16	1.57-2.97	<0.001

28. Multi-morbidity Presenteeism - Bi-variate health clusters with and without co-morbid psychological distress

Table D28: Results of bivariate multinomial logistic regression of the association between each cluster of multi-morbid health conditions and Presenteeism

	Multi-morbid clusters without co-morbid Psychological Distress					Multi-morbid clusters with co-morbid Psychological Distress				
	n	%	RRR	95% CI	p value	n	%	RRR	95% CI	p value
Factor 1:										
No arthritis, back/neck pain, migraine, other chronic pain	38,475	99.9	1.00			38,030	99.9	1.00		
Arthritis, back/neck pain, migraine, other chronic pain	103	0.1	3.93	2.29-6.74	<0.001	13	0.04	17.62	8.24-37.64	<0.001
Factor 2:										
No asthma, COPD, allergies	41,337	99.9	1.00			40,878	99.9	1.00		
Asthma, COPD, allergies	66	0.1	5.23	2.81-9.74	<0.001	4	0.01	33.61	15.98-70.67	<0.001
Factor 3:										
No CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity	51,946	100	1.00			51,429	100	1.00		
CVD, diabetes, high cholesterol, fatigue, high blood pressure, obesity	15	0	13.63	4.73-39.32	<0.001	1	0	58.61	15.03-228.61	<0.001
Factor 4:										
No irritable bowel syndrome, ulcer, heartburn	57,481	99.9	1.00			56,869	99.9	1.00		
Irritable bowel syndrome, ulcer, heartburn	108	0.1	3.20	1.84-5.55	<0.001	18	0.03	12.44	5.33-29.00	<0.001

29. Examples of Full Models for Absenteeism and cluster 2 with and without co-morbid psychological distress

Table D29 Example of Full ADJUSTED models of ABSENTEEISM for cluster 2 (asthma, COPD, allergies) with and without co-morbid psychological distress

	Cluster 2 Without Psychological distress (n=38,846)			Cluster 2 With psychological distress (n=38,437)		
EXPLANATORY VARIABLES	IRR	95% CIs	p-value	IRR	95% CIs	p-value
HEALTH CLUSTER 2						
Health cluster 2 not present	1.00			1.00		
Health cluster 2 present	1.59	1.12-2.27	0.01	1.81	1.22-2.68	0.003
TREATMENT-SEEKING						
No health care services in last year	1.00			1.00		
1-3 health care services in last year	1.11	1.04-1.18	0.002	1.12	1.05-1.19	0.001
4-9 health care services in last year	1.34	1.26-1.43	<0.001	1.35	1.26-1.44	<0.001
10 or more health services in last year	1.86	1.74-1.99	<0.001	1.83	1.71-1.96	<0.001
AGE ¥						
18-29 years	1.00			1.00		
30-44 years	-	-	-	-	-	-
45-59 years	-	-	-	-	-	-
60-70 years	-	-	-	-	-	-
SEX						
Female	1.00			1.00		
Male	1.09	1.06-1.13	<0.001	1.10	1.06-1.14	<0.001
MARITAL STATUS						
Not married or co-habiting	1.00			1.00		
Married or cohabitating	0.95	0.92-0.98	0.002	0.95	0.92-0.98	0.004
NUMBER OF CHILDREN ϒ						
Nil	1.00			1.00		
1-3 children	-	-	-	-	-	-
4 or more children	-	-	-	-	-	-
EDUCATION LEVEL						
Did not complete high school	1.00			1.00		
Completed high school	0.99	0.94-1.06	0.87	1.00	0.94-1.06	1.00
Some college	0.99	0.94-1.04	0.72	1.00	0.95-1.05	0.88
Completed college or university	0.89	0.85-0.94	<0.001	0.89	0.85-0.94	<0.001
OCCUPATION CATEGORY						
Manager	1.00			1.00		
Professional / technical	1.03	0.98-1.09	0.24	1.03	0.98-1.09	0.23
Sales	1.04	0.94-1.15	0.44	1.03	0.92-1.14	0.64
Clerical / service	1.07	1.01-1.14	0.03	1.07	1.01-1.14	0.03
Trade / labour	1.16	1.05-1.29	0.01	1.15	1.04-1.28	0.01
INDUSTRY TYPE						
Agriculture	1.00			1.00		
Communications	1.01	0.83-1.22	0.92	1.02	0.84-1.24	0.84
Education	1.07	0.93-1.22	0.35	1.08	0.95-1.23	0.25
Electricity / gas / water	1.38	1.14-1.67	0.001	1.40	1.16-1.70	0.001
Finance	1.02	0.85-1.22	0.85	1.02	0.86-1.22	0.81
Government administration	0.98	0.87-1.11	0.81	0.99	0.88-1.12	0.88
Health / community	0.97	0.85-1.12	0.70	0.98	0.85-1.13	0.79
Manufacturing	0.89	0.74-1.08	0.25	0.91	0.75-1.10	0.33
Media	1.25	1.03-1.52	0.03	1.26	1.03-1.53	0.02
Retail	1.08	0.86-1.34	0.51	1.06	0.85-1.33	0.58
PRIVATE / PUBLIC SECTOR						

	Cluster 2 Without Psychological distress (n=38,846)			Cluster 2 With psychological distress (n=38,437)		
EXPLANATORY VARIABLES	IRR	95% CIs	p-value	IRR	95% CIs	p-value
Federal government	1.00			1.00		
State government	0.92	0.86-0.98	0.02	0.92	0.86-0.99	0.02
Local government	0.93	0.82-1.06	0.30	0.93	0.81-1.06	0.26
Private	0.73	0.63-0.83	<0.001	0.73	0.63-0.83	<0.001
ANNUAL WAGE β						
≤$29,999 pa	1.00			1.00		
$30,000-39,999 pa	1.37	1.29-1.46	<0.001	1.36	1.28-1.45	<0.001
$40,000-49,999 pa	1.50	1.42-1.60	<0.001	1.50	1.41-1.59	<0.001
$50,000-74,999 pa	1.63	1.53-1.74	<0.001	1.63	1.53-1.73	<0.001
$75,000-99,999 pa	1.61	1.48-1.74	<0.001	1.61	1.48-1.74	<0.001
≥$100,000 pa	1.54	1.40-1.68	<0.001	1.52	1.39-1.67	<0.001
JOB SECURITY						
Part time or full time worker	1.00			1.00		
Casual worker	0.79	0.72-0.87	<0.001	0.79	0.72-0.87	<0.001
CONTRACTOR						
not a Contractor	1.00			1.00		
Contractor	0.88	0.79-0.98	0.02	0.89	0.80-0.99	0.03
EMPLOYER RATE OF ACCIDENTS						
<0.25 accidents per 100 workers	1.00			1.00		
≥0.25 <0.75 accidents per 100 workers	1.00	0.94-1.06	0.93	0.99	0.93-1.05	0.73
≥0.75 <1.5 accidents per 100 workers	1.09	1.03-1.16	0.01	1.09	1.03-1.16	0.01
≥1.5 <3.0 accidents per 100 workers	0.94	0.84-1.04	0.22	0.93	0.84-1.04	0.19
≥3.0 <5.0 accidents per 100 workers	0.78	0.71-0.85	<0.001	0.77	0.71-0.84	<0.001
≥5 accidents per 100 workers	0.88	0.80-0.96	0.01	0.88	0.80-0.97	0.01
HOURS WORKED IN PAST 7 DAYS						
(continuous variable)	-	-	-	-	-	-
NUMBER OF STAFF SUPERVISING ψ						
0 staff	1.00			1.00		
1-2 staff	-	-	-	-	-	-
3-9 staff	-	-	-	-	-	-
10-19 staff	-	-	-	-	-	-
20 or more staff	-	-	-	-	-	-
HOURS EXPECTED TO WORK						
≤35 hours per week	1.00			1.00		
>35 and ≤40 hours per week	1.31	1.26-1.37	<0.001	1.31	1.25-1.37	<0.001
>40 and ≤50 hours per week	1.42	1.32-1.51	<0.001	1.41	1.32-1.50	<0.001
>50 and ≤60 hours per week	1.44	1.30-1.61	<0.001	1.45	1.30-1.61	<0.001
>60 hours per week	1.30	1.15-1.46	<0.001	1.29	1.14-1.45	<0.001

¥: only persons aged 18-70 included; β: excludes hourly rate < $7.50ph; ϒ: number of children not significant at p<0.05; ψ: number supervising not significant at P<0.05

30. Examples of full models of cluster 2 and Presenteeism - with and without co-morbid psychological distress, adjusting for demographic characteristics and working conditions

Table D32 Example of Full ADJUSTED models of PRESENTEEISM for cluster 2 (asthma, COPD, allergies) with and without co-morbid psychological distress, (Reference category moderate productivity, only low productivity reported)

	Cluster 2 Without Psychological distress (n=39,199)			Cluster 2 With psychological distress (n=38,784)		
EXPLANATORY VARIABLES	RRR	95% CIs	p-value	RRR	95% CIs	p-value
HEALTH CLUSTER 2						
Health cluster 2 not present	1.00			1.00		
Health cluster 2 present	3.48	1.75-6.93	<0.001	18.82	8.08-43.85	<0.001
TREATMENT-SEEKING						
No health care services in last year	1.00			1.00		
1-3 health care services in last year	0.83	0.69-1.02	0.07	0.85	0.70-1.04	0.12
4-9 health care services in last year	1.03	0.85-1.26	0.73	1.01	0.83-1.23	0.95
10 or more health services in last year	2.03	1.66-2.48	<0.001	1.73	1.41-2.12	<0.001
AGE ¥						
18-29 years	1.00			1.00		
30-44 years	0.94	0.82-1.07	0.32	0.92	0.81-1.05	0.24
45-59 years	0.75	0.64-0.87	<0.001	0.75	0.64-0.87	<0.001
60-70 years	0.31	0.20-0.48	<0.001	0.33	0.21-0.52	<0.001
SEX						
Female	1.00			1.00		
Male	1.61	1.45-1.79	<0.001	1.61	1.44-1.79	<0.001
MARITAL STATUS						
Not married or co-habiting	1.00			1.00		
Married or cohabitating	0.75	0.68-0.83	<0.001	0.80	0.72-0.89	<0.001
NUMBER OF CHILDREN ϒ						
Nil	1.00			1.00		
1-3 children	-	-	-	-	-	-
4 or more children	-	-	-	-	-	-
EDUCATION LEVEL						
Did not complete high school	1.00			1.00		
Completed high school	1.04	0.86-1.26	0.70	1.07	0.87-1.30	0.54
Some college	0.97	0.82-1.15	0.72	1.00	0.85-1.19	0.97
Completed college or university	1.02	0.85-1.21	0.86	1.06	0.88-1.26	0.55
OCCUPATION CATEGORY						
Manager	1.00			1.00		
Professional / technical	1.19	1.00-1.41	0.05	1.22	1.02-1.45	0.03
Sales	1.33	1.01-1.77	0.05	1.37	1.03-1.82	0.03
Clerical / service	1.02	0.84-1.25	0.85	1.04	0.85-1.28	0.69
Trade / labour	1.13	0.81-1.57	0.48	1.19	0.85-1.66	0.32
INDUSTRY TYPE						
Agriculture	1.00			1.00		
Communications	0.74	0.41-1.34	0.32	0.68	0.37-1.25	0.21
Education	0.60	0.41-0.88	0.01	0.58	0.39-0.85	0.01
Electricity / gas / water	0.57	0.31-1.06	0.07	0.52	0.28-0.96	0.04
Finance	0.70	0.40-1.25	0.23	0.65	0.36-1.16	0.15
Government administration	0.61	0.43-0.86	0.004	0.58	0.41-0.82	0.002
Health / community	0.34	0.22-0.53	<0.001	0.33	0.21-0.51	<0.001
Manufacturing	0.52	0.28-0.95	0.03	0.52	0.28-0.96	0.04
Media	0.34	0.17-0.66	0.001	0.32	1.16-0.64	0.001

	Cluster 2 Without Psychological distress (n=39,199)			Cluster 2 With psychological distress (n=38,784)		
EXPLANATORY VARIABLES	RRR	95% CIs	p-value	RRR	95% CIs	p-value
Retail	0.52	0.26-1.03	0.06	0.46	0.23-0.93	0.03
PRIVATE / PUBLIC SECTOR						
Federal government	1.00			1.00		
State government	0.66	0.54-0.80	<0.001	0.69	0.57-0.84	<0.001
Local government	1.40	0.89-2.18	0.14	1.45	0.92-2.29	0.11
Private	0.77	0.47-1.25	0.29	0.81	0.50-1.33	0.41
ANNUAL WAGE β						
≤$29,999 pa	1.00			1.00		
$30,000-39,999 pa	1.25	1.01-1.56	0.05	1.23	0.98-1.54	0.07
$40,000-49,999 pa	1.24	1.00-1.54	0.05	1.24	1.00-1.55	0.05
$50,000-74,999 pa	1.35	1.09-1.68	0.01	1.39	1.12-1.74	0.003
$75,000-99,999 pa	1.41	1.08-1.84	0.01	1.48	1.13-1.94	0.01
≥$100,000 pa	1.29	0.95-1.74	0.11	1.36	1.00-1.85	0.05
JOB SECURITY						
Part time or full time worker	1.00			1.00		
Casual worker	0.77	0.53-1.10	0.15	0.77	0.53-1.11	0.16
CONTRACTOR π						
not a Contractor	1.00			1.00		
Contractor	-	-	-	-	-	-
EMPLOYER RATE OF ACCIDENTS						
<0.25 accidents per 100 workers	1.00			1.00		
≥0.25 <0.75 accidents per 100 workers	1.12	0.94-1.33	0.20	1.13	0.95-1.35	0.17
≥0.75 <1.5 accidents per 100 workers	1.00	0.84-1.19	0.98	1.02	0.85-1.22	0.82
≥1.5 <3.0 accidents per 100 workers	2.12	1.43-3.15	<0.001	2.17	1.45-3.23	<0.001
≥3.0 <5.0 accidents per 100 workers	0.96	0.72-1.29	0.80	0.98	0.73-1.31	0.88
≥5 accidents per 100 workers	1.14	0.78-1.67	0.48	1.17	0.80-1.71	0.43
HOURS WORKED IN PAST 7 DAYS						
(continuous variable)	0.98	0.98-0.99	<0.001	0.98	0.98-0.99	<0.001
NUMBER OF STAFF SUPERVISING						
0 staff	1.00			1.00		
1-2 staff	0.82	0.70-0.96	0.01	0.81	0.69-0.95	0.01
3-9 staff	0.81	0.69-0.94	0.01	0.80	0.69-0.94	0.01
10-19 staff	0.81	0.65-1.00	0.06	0.81	0.66-1.01	0.07
20 or more staff	0.86	0.71-1.04	0.11	0.82	0.68-1.00	0.05
HOURS EXPECTED TO WORK						
≤35 hours per week	1.00			1.00		
>35 and ≤40 hours per week	1.20	1.05-1.38	0.01	1.17	1.02-1.35	0.03
>40 and ≤50 hours per week	1.46	1.19-1.78	<0.001	1.40	1.14-1.71	0.001
>50 and ≤60 hours per week	1.77	1.31-2.37	<0.001	1.62	1.20-2.19	0.002
>60 hours per week	3.21	2.40-4.31	<0.001	2.83	2.09-3.84	<0.001

Adjusting for number of co-morbidities, treatment-seeking behaviour, age, sex, education, marital status, income, number of children, occupation, industry type, public/private sector, job security, contractor, hours worked in last week, supervisory role, rate of work accidents by employer, and hours expected to work per week ; ¥: only persons aged 18-70 included; β: excludes hourly rate < $7.50ph; ϒ: number of children not significant at p<0.05; π: contractor not significant at P<0.05

References

1. Figueras, J., et al., *Health systems, health and wealth: Assessing the case for investing in health systems*. 2010, World Health Organisation European Ministerial Conference on Health Systems.
2. WHO European Ministerial Conference on Health Systems, *The economic costs of ill health in the WHO European Region*, in *WHO European Ministerial Conference on Health Systems. "Health systems, health and wealth"*. 2008: Tallinn, Estonia. p. 1-4.
3. Kessler, R., et al., *The Effect of Chronic Medical Conditions on Work Loss and Work Cutback.* Journal of Occupational and Environmental Medicine, 2001. **43**: p. 218-225.
4. Kessler, R., et al., *The World Health Organisation Health and Work Performance Questionnaire (HPQ).* Journal of Occupational and Environmental Medicine, 2003. **45**: p. 156-174.
5. Stewart, W.F., et al., *Lost Productive Work Time Costs From Health Conditions in the United States: Results from the American Productivity Audit.* Journal of Occupational and Environmental Medicine, 2003. **45**: p. 1234-1246.
6. Guthrie, R. and F. Meredith, *Long-term employee illness and frustration of the contract of employment.* Journal of Industrial Relations, 2007. **49**(1): p. 87-101.
7. Wang, P.S., et al., *Chronic medical conditions and work performance in the health and work performance questionnaire calibration.* Journal of Occupational and Environmental Medicine, 2003. **45**(12): p. 1303-1311.
8. Merikangas, K.R., et al., *The impact of comorbidity of mental and physical conditions on role disability in the US adult household population.* Arch Gen Psychiatry, 2007. **64**(10): p. 1180-8.
9. Burton, W., et al., *The association of medical conditions and presenteeism.* J Occup Environ Med, 2004. **46**: p. S38-S45.
10. Goetzel, R., et al., *The health and productivity cost burden of the "Top 10" physical and mental health conditions affecting six large US employers in 1999.* Journal of Occupational and Environmental Medicine, 2003. **45**(1): p. 5-14.
11. Goetzel, R., et al., *Health, Absence, Disability an presenteeism cost estimates of certain physical and mental health conditions affecting US employers.* Journal of Occupational and Environmental Medicine, 2004. **46**: p. 398-412.
12. Australian Government, *Potential Benefits of the National Reform Agenda: Report to the Council of Australian Governments: Overview*, P. Commission, Editor. 2006, Productivity Commission.
13. Australian Government, *Economic Implications of and Ageing Australia*, P. Commission, Editor. 2005, Productivity Commission.
14. Australian Institute of Health & Welfare, *Australia's Health 2006*, in *AIHW Cat No AUS73*, AIHW, Editor. 2006.
15. National Occupational Health & Safety Commission, *The NOHSC Symposium on the OHS implications of stress*, NOHSC, Editor. 2001, NOHSC.
16. Australian Safety and Compensation Council, *Work-related fatigue: Summary of recent indicative research*. 2006.
17. Isaac, J., *Reforming Australian Industrial Relations?* Journal of Industrial Relations, 2007. **49**(3): p. 410-435.
18. Strazdins, L., et al., *Job Strain, Job, Insecurity, and Health: Rethinking the Relationship.* Journal of Occupational Health Psychology, 2004. **9**(4): p. 296-305.

19. D'Souza, R.M.D., et al., *The health effects of jobs: status, working conditions, or both?* Australian and New Zealand Journal of Public Health, 2005. **29**(3): p. 222-228.
20. D'Souza, R.M.D., et al., *Work and health in a contemporary society: demands, control, and insecurity.* Journal of Epidemiology and Community Health, 2003. **57**: p. 849-854.
21. de Jonge, J., et al., *Job strain, effort-reward imbalance and employee well-being: a large-scale cross-sectional study.* Social Sciences and Medicine, 2000. **50**: p. 1317-1327.
22. Ferrie, J.E., et al., *Self-reported job insecurity and health in the Whitehall II study: potential explanations of the relationship.* Social Science & Medicine, 2005. **60**: p. 1593-1602.
23. Cheng, Y., et al., *Job insecurity and its association with health among employees in the Taiwanese general population.* Social Science and Medicine, 2005. **61**: p. 41-52.
24. Parslow, R.A., et al., *The impact of employee level and work stress on mental health and GP service use: an analysis of Australian government employees.* BMC Public Health, 2004. **4**(41).
25. Andrea, H., et al., *Health and psychosocial work characteristics of employees who did or did not consult the general practitioner in relation to work.* Int Arch Occup Environ Health, 2003. **76**(1): p. 69-74.
26. Australian Institute of Health & Welfare, *Australia's Health 2008*, AIHW, Editor. 2008.
27. Australian Institute of Health & Welfare, *Chronic disease and associated risk factors in Australia, 2006*, in *AIHW Cat. No. PHE 81*. 2006.
28. Begg, S., et al., *The burden of disease and injury in Australia 2003.* 2007.
29. National Preventative Health Taskforce, *Australia: the healthiest country by 2020: National Preventative Health Strategy - Overview*. 2009. p. 1-57.
30. Brenner, M.H. and A. Mooney, *Unemployment and health in the context of economic change.* Soc Sci Med, 1983. **17**(16): p. 1125-38.
31. Australian Government, *Men Not at work: An analysis of men outside the labour force*, P. Commission, Editor. 2007, Australian Government, Productivity Commission.
32. Laplagne, P., M. Glover, and A. Shomos, *Effects of health and education on labour force participation*, in *Staff Working Paper*, Australian Government Productivity Commission, Editor. 2007.
33. Zhang, X., X. Zhao, and A. Harris, *Chronic diseases and labour force participation in Australia.* J Health Econ, 2009. **28**(1): p. 91-108.
34. Waghorn, G., D. Chant, and C. Lloyd, *Labor force activity among Australians with musculoskeletal disorders comorbid with depression and anxiety disorders.* J Occup Rehabil, 2006. **16**(2): p. 241-52.
35. The Boston Consulting Group, *Improving Mental Health Outcomes in Victoria*. 2006. p. 1-84.
36. Waghorn, G. and C. Lloyd, *The employment of people with mental illness.* Australian e-Journal of the Advancement of Mental Health, 2005. **4**(2).
37. Waghorn, G. and D. Chant, *Labour force activity by people with depression and anxiety disorders: a population-level second-order analysis.* Acta Psychiatrica Scandeinavia, 2005. **112**: p. 415-424.
38. Zwerling, C., et al., *Workforce participation by persons with disabilities: the National Health Interview Survey Disability Supplement, 1994 to 1995.* J Occup Environ Med, 2002. **44**(4): p. 358-64.
39. Johannesson, M., *The willingness to pay for health changes, the human-capital approach and the external costs.* Health Policy, 1996. **36**: p. 231-244.
40. Liljas, B., *How to Calculate Indirect Costs in Economic Evaluations.* Pharmacoeconomics, 1998. **13**(1 Pt 1): p. 1-7.

41. Jacobson, L., *The family as producer of health - an extended grossman model.* Journal of Health Economics, 2000. **19**: p. 611-637.
42. Grossman, M., *Household production and health.* Review of Economics of the Household, 2003. **1**: p. 332-342.
43. Grossman, M., *The demand for health, 30 years later: a very personal and prospective reflection.* Journal of Health Economics, 2004. **23**: p. 629-636.
44. Grossman, M., *The demand for health after a decade.* Journal of Health Economics, 1982. **1**: p. 1-3.
45. Wagstaff, A., *The Demand for Health: some new empirical evidence.* Journal of Health Economics, 1986. **5**: p. 1985-233.
46. Grossman, M., *On the concept of health capital and the demand for health.* Journal of Policical Economy: p. 223-255.
47. Dardanoni, V. and A. Wagstaff, *Uncertainty, inequalities in health and the demand for health.* J Health Econ, 1987. **6**(4): p. 283-90.
48. Brouwer, W., et al., *Productivity costs before and after absence from work: as important as common?* Health Policy, 2002. **61**: p. 173-187.
49. Koopmanschap, M., et al., *Measuring Productivity Changes in Economic Evaluation: Setting the Research Agenda.* Pharmacoeconomics, 2005. **23**(1): p. 47-54.
50. Koopmanschap, M., et al., *The friction cost method of measuring indirect costs of disease.* Journal of Health Economics, 1995. **14**: p. 171-189.
51. Mooney, G., et al., *A Second Opinion: Cost-utiility analysis and varying preferences for health.* Health Policy, 1997. **41**: p. 201-205.
52. Brouwer, W., M. Koopmanschap, and F. Rutten, *Productivity costs measurements through quality of life? A reponse to the recommendation of the Washington Panel.* Health Econ, 1997. **6**: p. 253-259.
53. Johannesson, M. and D. Meltzer, *Some reflections on cost-effectiveness analysis.* Health Econ, 1998. **7**: p. 1-7.
54. Kessler, R.C., *Comorbidity*. International Encyclopedia of the Social & Behavioral Sciences, ed. N.J. Smelser and P.B. Baltes. 2001, Amsterdam, NY: Elsevier Science Ltd.
55. van den Akker, M., et al., *Marginal impact of psychosocial factors on multimorbidity: results of an explorative nested case-control study.* Social Science & Medicine, 2000. **50**(11): p. 1679-93.
56. van den Akker, M., et al., *Multimorbidity in general practice: prevalence, incidence, and determinants of co-occurring chronic and recurrent diseases.* J Clin Epidemiol, 1998. **51**(5): p. 367-75.
57. Fortin, M., et al., *Prevalence of multimorbidity among adults seen in family practice.* Annals of Family Medicine, 2005. **3**(May-June): p. 223.
58. van den Akker, M., et al., *Problems in determining occurrence rates of multimorbidity.* Journal of Clinical Epidemiology, 2001. **54**(7): p. 675-9.
59. Tong, B. and C. Stevenson, *Comorbidity of cardiovascular disease, diabetes and chronic kidney disease in Australia,* in *Cardiovascular Disease Series 28,* Australian Institute of Health & Welfare, Editor. 2007.
60. Australian Institute of Health & Welfare, *The relationship between overweight, obesity and cardiovascular disease,* in *Cardiovascular Disease Series Number 23*. 2004.
61. Britt, H., et al., *Prevalence and patterns of multimorbidity in Australia.* Medical Journal of Australia, 2008. **189**(2): p. 72-77.
62. Moussavi, S., et al., *Depression, chronic disease, and decrements in health: results from the World Health Surveys.* The Lancet, 2007. **370**(September 8): p. 851-858.

63. Crews, C.K., et al., *Podiatric problems are associated with worse health status in persons with severe mental illness.* General Hospital Psychiatry, 2004. **26**(3): p. 226-232.
64. Demyttenaere, K., et al., *Comorbid painful physical symptoms and depression: Prevalence, work loss, and help seeking.* Journal of Affective Disorders, 2006. **92**(2-3): p. 185-193.
65. Benton, T., J. Staab, and D.L. Evans, *Medical co-morbidity in depressive disorders.* Annals of Clinical Psychiatry, 2007. **19**(4): p. 289-303.
66. Fortin, M., et al., *Psychological Distress and Multimorbidity in Primary Care.* Annals of Family Medicine, 2006. **5**(September-October): p. 417-422.
67. Nuyen, J., et al., *Comorbidity was associated with neurologic and psychiatric diseases: a general practice-based controlled study.* Journal of Clinical Epidemiology, 2006. **59**(12): p. 1274-84.
68. Chapman, D., G. Perry, and T. Strine, *The vital link between chronic disease and depressive disorders.* Preventing Chronic Disease: Public Health Research, Practice, and Policy, 2005. **2**(1).
69. Fortin, M., et al., *Caring for body and soul: the importance of recognising and managing psychological distress in persons with multimorbidity.* International Journal of Psychiatry in Medicine, 2007. **37**(1): p. 1-9.
70. Buist-Bouwman, M.A., et al., *Comorbidity of physical and mental disorders and the effect on work-loss days.* Acta Psychiatr Scand, 2005. **111**(6): p. 436-43.
71. Pfaff, J., et al., *Medical morbidity and severity of depression in a large primary care sample of older Australians: the DEPS-GP project.* MJA, 2009. **190**(Suppliment): p. S75-S80.
72. Baune, B.T., I. Adrian, and F. Jacobi, *Medical disorders affect health outcome and general functioning depending on comorbid major depression in the general population.* Journal of Psychosomatic Research, 2007. **62**(2): p. 109-118.
73. Munce, S.E.P., et al., *The role of depression and chronic pain conditions in absenteeism: results from a national epidemiologic survey.* Journal of Occupational and Environmental Medicine, 2007. **49**(11): p. 1206-11.
74. Wang, P., et al., *Effects of major depression on moment-in-time work performance.* American Journal of Psychiatry, 2004. **161**(10): p. 1885-1891.
75. Loeppke, R., et al., *Health and Productivity as a Business Strategy: A Multi-employer Study.* Journal of Occupational & Environmental Medicine, 2009. **51**(4): p. 411-428.
76. Kessler, R., et al., *Using the World Health Organisation Health and Work Performance Questionnaire (HPQ) to evaluate the indirect workplace costs of illness.* Journal of Occupational and Environmental Medicine, 2004. **46**(6 suppl): p. S23.
77. Loeppke, R., et al., *Health-related workplace productivity measurement: general and migraine-specific recommendations from the ACOEM Expert Panel.* J Occup Environ Med, 2003. **45**(4): p. 349-59.
78. Virtanen, M., et al., *Sickness absence as a risk factor for job termination, unemployment, and disability pension among temproary and permanent employees.* Occupational and Environmental Medicine, 2006. **63**: p. 212-217.
79. Askildsen, J.E., E. Bratberg, and O.A. Nilsen, *Unemployment, labor force composition and sickness absence: a panel data study.* Health Economics, 2005. **14**: p. 1087-1101.
80. Whooley, M., et al., *Depressive Symptoms, Unemployment, and Loss of Income.* Archives of International Medicine, 2002. **2002**(162): p. 2614-2620.
81. Simon, G., et al., *Recovery from Depression, Work Productivity, and Health Care costs Among Primary Care Patients.* General Hospital of Psychiatry, 2000. **22**: p. 153-162.
82. Lerner, D., et al., *Unemployment, job retention, and productivity loss among employees with depression.* Psychiatric Services, 2004. **55**(12): p. 1371-1378.

83. Kessler, R.C., et al., *Individual and societal effects of mental disorders on earnings in the United States: results from the national comorbidity survey replication.* American Journal of Psychiatry, 2008. **165**(6): p. 703-11.
84. Vahtera, J., J. Pentti, and M. Kivimaki, *Sickness absence as a predictor of mortality among male and female employees.* 2004, 2004. **58**: p. 321-326.
85. Kivimaki, M., et al., *Working while ill as a risk factor for serious coronary events: The Whitehall II Study.* American Journal of Public Health, 2005. **95**(1): p. 98-102.
86. Dew, K., V. Keefe, and K. Small, *'Choosing' to work when sick: workplace presenteeism.* Soc Sci Med, 2005. **60**: p. 2273-2282.
87. Aronsson, G. and K. Gustafsson, *Sickness presenteeism: prevalence, attendance-pressure factors, and an outline of a model for research.* J Occup Environ Med, 2005. **47**: p. 958-966.
88. Collins, J.J., et al., *The assessment of chronic health conditions on work performance, absence, and total economic impact for employers.* J Occup Environ Med, 2005. **47**(6): p. 547-57.
89. Aronsson, G., K. Gustafsson, and M. Dallner, *Sick but yet at work. an empirical study of sickness presenteeism.* Journal of Epidemiology and Community Health, 2000. **54**: p. 502-509.
90. Musich, S., et al., *The association of two productivity measures with health risks and medical conditions in an Australian employee population.* Am J Health Promot, 2006. **20**(5): p. 353-63.
91. Prasad, M., et al., *A Review of Self-Reported Instruments Measuring Health-Related work Productivity.* Pharmacoeconomics, 2004. **22**(4): p. 225-244.
92. Lofland, J., L. Pizzi, and K. Frick, *A Review of Health-Related Workplace Productivity Loss Instruments.* Pharmacoeconomics, 2004. **22**(3): p. 165-184.
93. Australian Institute of Health and Welfare, *Risk Factors and participation in work*, Australian Institute of Health and Welfare, Editor. 2010, Australian Institute of Health and Welfare,: Canberra.
94. Harpole, L.H., et al., *Improving depression outcomes in older adults with comorbid medical illness.* General Hospital Psychiatry, 2005. **27**(1): p. 4-12.
95. Fortin, M., et al., *Relationship between multimorbidity and health-related quality of life of patients in primary care.* Quality of Life Research, 2006. **15**: p. 83-91.
96. Robinson, K., J. McBeth, and G. MacFarlaine, *Psychological distress and premature mortality in the general population - a prospective study.* Annals of Epidemiology, 2004. **14**: p. 467-472.
97. Muller-Tasch, T., et al., *Depression is a major determinant of quality of life in patients with chronic systolic heart failure in general practice.* Journal of Cardiac Failure, 2007. **13**(10): p. 818-824.
98. Fenn, H.H., et al., *Medical comorbidity and health-related quality of life in bipolar disorder across the adult age span.* Journal of Affective Disorders, 2005. **86**(1): p. 47-60.
99. Koopmans, G.T., M.C.H. Donker, and F.H.H. Rutten, *Length of hospital stay and health services use of medical inpatients with comorbid noncognitive mental disorders: a review of the literature.* General Hospital Psychiatry, 2005. **27**(1): p. 44-56.
100. DiMatteo, M., H. Lepper, and T. Croghan, *Depression is a risk factor for non-compliance with medical treatment.* Archives of Internal Medicine, 2000. **160**(July 24).
101. de Witte, H., *Job security and psychological well-being: Review of the literature and exploration of some unresolved issues.* European Journal of Work and Organisational Psychology, 1999. **8**(2): p. 155-177.

102. Ciechanowski, P.S., et al., *The relationship of depressive symptoms to symptom reporting, self-care and glucose control in diabetes.* General Hospital Psychiatry, 2003. **25**(4): p. 246-252.
103. Strine, T., et al., *Frequent mental distress status among adults with arthritis age 45 years and older, 2001.* Arthritis & Rheumatism, 2004. **51**(4): p. 533-537.
104. Parker, J. and G. Wright, *The implications of depression for pain and disability in rheumatoid arthritis.* The American College of Rheumatology, 1995. **8**(9): p. 279-283.
105. Thurston-Hicks, A., S. Paine, and M. Hollifield, *Rural Psychiatry - Functional impairment associated with psycholgocial distress and medical severity in rural primary care patients.* Psychiatric Services, 1998. **49**: p. 951-955.
106. Kannan, H., S. Thompson, and S.C. Bolge, *Economic and humanistic outcomes associated with comorbid type-2 diabetes, high cholesterol, and hypertension among individuals who are overweight or obese.* Journal of Occupational and Environmental Medicine, 2008. **50**(5): p. 542-9.
107. D'Souza, R.M.D., et al., *Work demands, job insecurity and sickness absence from work. How productive is the new flexible labour force?* Australian and New Zealand Journal of Public Health, 2006. **30**(3): p. 205-212.
108. Ala-Mursula, L., et al., *Employee worktime control moderates the effects of job strain and effort-reward imbalance on sickness absence: the 10-town study.* Journal of Epidemiology and Community Health, 2005. **59**: p. 851-857.
109. Nielsen, M.L., et al., *Psychosocial work environment predictors of short and long spells of registered sickness absence during a 2-year follow up.* J Occup Environ Med, 2006. **48**(6): p. 591-8.
110. Ala-Mursula, L., et al., *Employee control over working times: associations with subjective health and sickness absences.* J Epidemiol Community Health, 2002. **56**(4): p. 272-8.
111. Duijts, S.F.A., et al., *A meta-analysis of observational studies identifies predictors of sickness absence.* Journal of Clinical Epidemiology, 2007. **60**(11): p. 1105-1115.
112. Ala-Mursula, L., et al., *Long hours in paid domestic work and subsequent sickness absence: does control over daily working hours matter?* Occupational and Environmental Medicine, 2006. **63**: p. 608-616.
113. Head, J., et al., *Influence of change in psychosocial work characteristics on sickness absence: the Whitehall II Study.* Journal of Epidemiology and Community Health, 2006. **60**: p. 55-61.
114. Moreau, M., et al., *Occupational stress and incidence of sick leave in the Belgian workforce: the Belstress study.* J Epidemiol Community Health, 2004. **58**(6): p. 507-16.
115. Andrea, H., et al., *Health problems and psychosocial work environment as predictors of long term sickness absence in employees who visited the occupational physician and/or general practitioner in relation to work: a prospective study.* Journal of Environmental Medicine, 2003. **60**: p. 295-300.
116. Vaananen, A., et al., *Job characteristics, physical and psychological sympoms, and social support as entecedents of sickness absence among men and women in the private industrial sector.* Social Science and Medicine, 2003. **57**: p. 807-824.
117. Vahtera, J., et al., *Organisational downsizing, sickness absence, and mortality: 10-town prospective cohort study.* BMJ, 2004. **328**.
118. Lund, T., et al., *Psychosocial Work Environment Exposures as Risk Factors for Long-Term Sickness Absence Among Danish Employees: Results From DWECS/DREAM.* Journal of Occupational and Environmental Medicine, 2005. **47**: p. 1141-1147.

119. Melchor, M., et al., *Do psychosocial work factors and social relations exert independent effects on sickness absence? A six year prospective study of the GAZEL cohort.* Journal of Epidemiology and Community Health, 2003. **57**: p. 285-293.
120. Labriola, M., et al., *Multilevel analysis of workplace and individual risk factors for long-term sickness absence.* J Occup Environ Med, 2006. **48**(9): p. 923-9.
121. Vahtera, J., et al., *Effect of change in the psychosocial work environment on sickness absence: a seven year follow up of initially healthy employees.* Journal of Epidemiology and Community Health, 2000. **54**: p. 484-493.
122. Swaen, G.M.H., et al., *Psychosocial Work characteristics as Risk Factors for Being Injured in an Occupational Accident.* Journal of Occupational and Environmental Medicine, 2004. **46**(6): p. 521-527.
123. Niedhammer, I. and M. Chea, *Psychosocial factors at work and self reported health: comparative results of cross sectional and prospective analyses of the French GAZEL cohort.* Occup Environ Med, 2003. **60**(7): p. 509-15.
124. Iwasaki, K., M. Takahashi, and A. Nakata, *Health Problems due to Long working Hours in Japan: Working Hours, Workers' Compensation (Karoshi), and Preventative Measures.* Industrial Health, 2006. **44**: p. 537-540.
125. Bultmann, U., et al., *The relationship between psychosocial work characteristics and fatigue and psychological distress.* International Archives of Occupational and Environmental Health, 2002. **75**: p. 259-266.
126. Ferrie, J.E., et al., *Future uncertainty and socioeconomic inequalities in health: the Whitehall II study.* Social Science and Medicine, 2003. **57**: p. 637-646.
127. Bultmann, U., et al., *Psychological Distress, Fatigue and Long-Term Sickness Absence: Prospective Results From the Maastricht Cohort Study.* Journal of Environmental Medicine, 2005. **47**(9): p. 941-947.
128. Cheng, Y., Y.L. Guo, and W.Y. Yeh, *A national survey of psychosocial job stressors and their implications for health among working people in Taiwan.* Int Arch Occup Environ Health, 2001. **74**(7): p. 495-504.
129. Simon, G., et al., *Recovery from depression, work productivitry, and health care costs among primary care patients.* General Hospital Psychiatry, 2000. **22**: p. 153-162.
130. Pflanz, S., *Occupational Stress and Psychiatric Illness in the Military: Investigation of the Relationship between Occupational Stress and Mental Illness among Military Mental Health Patients.* Military Medicine, 2001. **166**(6): p. 457-462.
131. Shigemi, J., et al., *Effects of perceived job stress on mental health. A longitudinal survey in a Japanese electronics company.* European Journal of Epidemiology, 2000. **16**: p. 371-376.
132. Pflanz, S., *Work Stress in the Military: Prevalence, Causes, and Relationship to Emotional Health.* Military Medicine, 2002. **167**(11): p. 877-882.
133. Healy, C.M. and M.F. McKay, *Nursing stress: the effects of coping strategies and job satisfaction in a sample of Australian nurses.* J Adv Nurs, 2000. **31**(3): p. 681-8.
134. Chang, E.M., et al., *The relationships among workplace stressors, coping methods, demographic characteristics, and health in Australian nurses.* J Prof Nurs, 2006. **22**(1): p. 30-8.
135. Xianyu, Y. and V.A. Lambert, *Investigation of the relationships among workplace stressors, ways of coping, and the mental health of Chinese head nurses.* Nurs Health Sci, 2006. **8**(3): p. 147-55.
136. Stansfeld, S.A., et al., *Social support and psychiatric sickness absence: a prospective study of British civil servants.* Psychol Med, 1997. **27**(1): p. 35-48.

137. Sekine, M., et al., *Socioeconomic inequalities in physical and mental functioning fo Japanese civil servants: Explanations from work and family characteristics.* Soc Sci Med, 2006. **63**: p. 430-445.
138. Vahtera, J., et al., *Workplace as an origin of health inequalities.* Journal of Epidemiology and Community Health, 1999. **53**: p. 399-407.
139. Feeney, A., et al., *Socioeconomic and sex differentials in reason for sickness absence from the Whitehall II Study.* Journal of Occupational and Environmental Medicine, 1998. **55**: p. 91-98.
140. Evans, O. and A. Steptoe, *The contribution of gender-role orientation, work factors and home stressors to psychlogical well-being and sickness absence in male- and female-dominated occupational groups* Social Science & Medicine, 2002. **54**: p. 481-492.
141. Hemingway, H., et al., *Sickness absence from back pain, psychosocial work characteristics and employment grade among office workers.* Scand J Work Environ Health, 1997. **23**(2): p. 121-9.
142. Carter, K.N., et al., *What is the association between wealth and mental health?* J Epidemiol Community Health, 2009. **63**(3): p. 221-6.
143. Tang, K.K., D. Petrie, and D.S. Rao, *Measuring health inequality with realization of potential life years (RePLY).* Health Econ, 2009. **18 Suppl 1**: p. S55-75.
144. Lahelma, E., et al., *Multiple measures of socioeconomic circumstances and common mental disorders.* Soc Sci Med, 2006. **63**(5): p. 1383-99.
145. Hunter, P., *Wealth and health. Will the global credit crunch cause a health crunch in the most affected countries?* EMBO Rep, 2009. **10**(8): p. 820-2.
146. Labonte, R., *The global financial crisis and health: scaling up our effort.* Can J Public Health, 2009. **100**(3): p. 173-5.
147. Hesdorffer, D.C. and P. Lee, *Health, wealth, and culture as predominant factors in psychosocial morbidity.* Epilepsy Behav, 2009. **15 Suppl 1**: p. S36-40.
148. Taylor, L., *Poverty, wealth, and health, or getting the dosage right.* Br Med J, 1975. **4**(5990): p. 207-11.
149. Queensland University of Technology, *Socioeconomic determinants of health: towards a national research program and a policy and intervention agenda*, C.D.o.H.a. Ageing, Editor. 1999, Commonwealth Department of Health and Ageing,: Canberra.
150. Navarro, V., *What we mean by social determinants of health.* Int J Health Serv, 2009. **39**(3): p. 423-41.
151. Marmot, M., et al., *Social inequalities in health: next questions and converging evidence.* Social Science Medicine, 1997. **44**(6): p. 901-910.
152. Singh-Manoux, A. and M. Marmot, *Role of socialization in explaining social inequalities in health.* Social Science & Medicine, 2004. **60**: p. 2129-2133.
153. Stansfeld, S.A., et al., *Work characteristics predict psychiatric disorder: prospective results from the Whitehall II Study.* Occupational & Environmental Medicine, 1999. **56**(5): p. 302-307.
154. Kessler, R., et al., *Comparative and interactive effects of depression relative to other health problems on work performance in the workforce of a large employer.* Journal of Occupational and Environmental Medicine, 2008. **50**(7): p. 809-16.
155. Waghorn, G. and D. Chant, *Receiving treatment and labor force activity in a community survey of people with anxiety and affective disorders.* Journal of Occupational Rehabilitation, 2007. **17**(4): p. 623-40.

156. Druss, B.G. and S.A. von Esenwein, *Improving general medical care for persons with mental and addictive disorders: systematic review.* General Hospital Psychiatry, 2006. **28**(2): p. 145-153.
157. Lim, D., K. Sanderson, and G. Andrews, *Lost Productivity Among Full-Time Workers with Mental Disorders.* The Journal of Mental Health Policy and Economics, 2000. **3**: p. 139-146.
158. Hilton, M., et al., *Prevalence of psychological distress in employees and associated occupational risk factors.* Journal of Occupational and Environmental Medicine, 2008. **50**(7): p. 747-757.
159. Druss, B., R. Rosenheck, and W. Sledge, *Health and Disability Costs of Depressive Illness in a Major U.S. Corporation.* American Journal of Psychiatry, 2000. **157**: p. 1274-1278.
160. Boles, M., B. Pelletier, and W. Lynch, *The Relationship Between Health Risks and Work Productivity.* Journal of Environmental Medicine, 2004. **46**(7): p. 737-745.
161. Ozminkowski, R.J., et al., *The impact of rheumatoid arthritis on medical expenditures, absenteeism, and short-term disability benefits.* Journal of Occupational and Environmental Medicine, 2006. **48**(2): p. 135-48.
162. Goetzel, R.Z., R.J. Ozminkowski, and S.R. Long, *Development and reliability analysis of the Work Productivity Short Inventory (WPSI) instrument measuring employee health and productivity.* Journal of Occupational and Environmental Medicine, 2003. **45**(7): p. 743-62.
163. Stein, M., et al., *Does comorbid depressive illness magnify the impact of chronic physical illness? A population-based perpective.* Psychological Medicine, 2006. **36**: p. 587-596.
164. Marshall, K.L. and F.P. Deane, *General practitioners' detection and management of patients with a dual diagnosis: implications for education and training.* Drug Alcohol Rev, 2004. **23**(4): p. 455-62.
165. Slade, T., et al., *2007 National Survey of Mental Health and Wellbeing: methods and key findings.* Aust N Z J Psychiatry, 2009. **43**(7): p. 594-605.
166. Simon, G., et al., *Depression and Work Productivity: The Comparative Costs of Treatment Versus Nontreatment.* Journal of Occupational and Environmental Medicine, 2001. **43**: p. 2-9.
167. Laitinen-Krispijn, S. and R.V. Bijl, *Mental disorders and employee sickness absence: the NEMESIS study. Netherlands Mental Health Survey and Incidence Study.* Social Psychiatry and Psychiatric Epidemiology, 2000. **35**(2): p. 71-7.
168. Simon, G., *Social and economic burden of mood disorders.* Society of Biological Psychiatry, 2003. **54**: p. 208-215.
169. Wan, J.J., et al., *Mental illness as an independent risk factor for unintentional injury and injury recidivsm.* The Journal of Trauma Injury, Infection, and Critical Care, 2006. **61**(6): p. 1299-1304.
170. Cameron, C.M., et al., *Mental health: a cause or consequence of injury? A population-based matched cohort study.* BMC Public Health, 2006. **6**: p. 114.
171. Cameron, C.M., et al., *Differences in prevalence of pre-existing morbidity between injured and non-injured populations.* Bull World Health Organ, 2005. **83**(5): p. 345-52.
172. Lavigne, J.E., et al., *Reductions in Individual Work Productivity Associated with Type 2 Diabetes Mellitus.* Journal of Pharmacoeconomics, 2003. **21**(15): p. 1123-1134.
173. Li, X., M.A.M. Gignac, and A.H. Anis, *The Indirect Costs of Arthritis Resulting From Unemployment, Reduced Performance, and Occupational Changes While at Work.* Medical Care, 2006. **44**(4): p. 304-310.

174. Lamb, C.E., et al., *Economic impact of workplace productivity losses due to allergic rhinitis compared with select medical conditions in the United States from an employer perspective.* Curr Med Res Opin, 2006. **22**(6): p. 1203-10.
175. Conti, D. and W. Burton, *The economic impact of depression in a workplace.* JOM, 1994. **36**(9): p. 983-988.
176. Egede, L.E., *Major depression in individuals with chronic medical disorders: prevalence, correlates and association with health resource utilization, lost productivity and functional disability.* General Hospital Psychiatry, 2007. **29**(5): p. 409-16.
177. Kessler, R., et al., *Comorbid mental disorders account for the role impairment of commonly occuring chronic physical disorders: results from the National Comorbidity Survey.* Journal of Occupational and Environmental Medicine, 2003. **45**(12): p. 1257.
178. Nuttall, M., J. van der Meulen, and M. Emberton, *Charlson scores based on ICD-10 administrative data were valid in assessing comorbidity in patients undergoing urological cancer surgery.* J Clin Epidemiol, 2006. **59**(3): p. 265-73.
179. Fortin, M., et al., *Comparative assessment of three different indices of multimorbidity for studies on health-related quality of life.* Health and Quality of Life Outcomes 2005. **3**(74).
180. Hudon, C., M. Fortin, and A. Vanasse, *Cumulative Illness Rating Scale was a relaible and valid index in a family practice context.* Journal of Clinical Epidemiology 2005. **58**: p. 603-608.
181. Saltman, D., G. Sayer, and S. Whicker, *Co-morbidity in general practice.* Postgraduate Medical Journal, 2005. **81**(957): p. 474-80.
182. Taylor, B. and J. Barling, *Identifying sources and effects of carer fatigue and burnout for mental health nurses: a qualitative approach.* International Journal of Mental Health Nursing, 2004. **13**: p. 117-125.
183. Benavides, F.G., et al., *How do types of employment relate to health indicators? Findings from the Second European survey on Working Conditions* Journal of Epidemiology and Community Health, 2000. **54**: p. 494-501.
184. Jansen, N.W., et al., *Antecedents and consequences of work-family conflict: a prospective cohort study.* J Occup Environ Med, 2003. **45**(5): p. 479-91.
185. Mino, Y., et al., *Perceived job stress and mental health in precision machine workers of Japan: a 2 year cohort study.* Occup Environ Med, 1999. **56**(1): p. 41-5.
186. Bultmann, U., et al., *Psychosocial work characteristics as risk factors for the onset of fatigue and psychological distress: prospective results from the Maastricht Cohort Study.* Psychol Med, 2002. **32**(2): p. 333-45.
187. Kawakami, N., T. Haratani, and S. Araki, *Job strain and arterial blood pressure, serum cholesterol, and smoking as risk factors for coronary heart disease in Japan.* Int Arch Occup Environ Health, 1998. **71**(6): p. 429-32.
188. Sluiter, J., *High-demand jobs: age-related diversity in work ability?* Applied Ergonomics, 2006. **37**: p. 429-440.
189. Eriksen, W., D. Bruusgaard, and S. Knardahl, *Work factors as predictors of sickness absence: a three month prospective study of nurses' aides.* Occup Environ Med, 2003. **60**(4): p. 271-8.
190. Fukuoka, Y., et al., *Do Japanese workers who experience an acute myocardial infarction believe their prolonged working hours are a cause?* International Journal of Cardiology, 2005. **100**: p. 29-35.
191. de Lange, A.H., et al., *Effects of stable and changing demand-control histories on worker health.* Scand J Work Environ Health, 2002. **28**(2): p. 94-108.

192. Kivimaki, M., et al., *Factors underlying the effect of organisational downsing on health of employees: longitudinal cohort study.* British Medical Journal, 2000. **320**: p. 971-975.
193. Vaananen, A., et al., *Role clarity, fairness, and organizational climate as predictors of sickness absence.* Scandinavian Journal of Public Health, 2004. **32**: p. 426-434.
194. Voss, M., B. Floderus, and F. Diderichsen, *How do job characteristics, family situation, domestic work, and lifestyle factors relate to sickness absence? A study based on Sweden Post.* J Occup Environ Med, 2004. **46**(11): p. 1134-43.
195. Jansen, N.W., et al., *Work-family conflict as a risk factor for sickness absence.* Occup Environ Med, 2006. **63**(7): p. 488-94.
196. Kivimaki, M., M. Elovainio, and J. Vahtera, *Workplace bullying and sickness absence in hospital staff.* Journal of Occupational and Environmental Medicine, 2000. **57**: p. 656-660.
197. Kessler, R., et al., *Short screening scales to monitor population prevalences and trends in non-specific psychological distress.* Psychological Medicine, 2002. **32**: p. 959-976.
198. Hennekens, C. and S. Buring, *Epidemiology in Medicine*. 1987, Philidelphia: Lippincott Williams & wilkins.
199. Australian Bureau of Statistics, *Year book Australia, 2008*, A.B.o. Statistics, Editor. 2008, Australian Government: Canberra.
200. Kessler, R., et al., *Screening for Serious Mental Illness in the General Population.* Archives of General Psychiatry, 2003. **60**: p. 184-189.
201. Australian Government, *Nursing and midwifery labour force 2008*, A.I.o.H.a. Welfare, Editor. 2010.
202. Australian Government, *Labour Force Participation of Women Over 45*, P. Commission, Editor. 2010.
203. Muthen, L. and B. Muthen, *MPlus: Statistical analysis with latent variables: Users Guide (v5)*. 2007, Los angeles: Muthen & Muthen.
204. Burton, W.N., et al., *The Role of Health Risk Factors and Disease on Worker Productivity.* Journal of Environmental Medicine, 1999. **41**(10): p. 863-877.
205. Hertz, R.P., et al., *The impact of obesity on work limitations and cardiovascular risk factors in the U.S. workforce.* J Occup Environ Med, 2004. **46**(12): p. 1196-203.
206. Arena, V.C., et al., *The impact of body mass index on short-term disability in the workplace.* J Occup Environ Med, 2006. **48**(11): p. 1118-24.
207. Ricci, J.A., et al., *Pain exacerbation as a major source of lost productive time in US workers with arthritis.* Arthritis Rheum, 2005. **53**(5): p. 673-81.
208. Stang, P.E., et al., *Mental and physical comorbid conditions and days in role among persons with arthritis.* Psychosom Med, 2006. **68**(1): p. 152-8.
209. Tsutsumi, A. and N. Kawakami, *A review of empirical studies on the model of effort-reward imbalance at work: reducing occupational stress by implementing a new theory.* Social Science & Medicine, 2004. **59**(11): p. 2335-2359.
210. Head, J., et al., *Effort-reward imbalance and relational injustice at work predict sickness absence: The Whitehall II study.* Journal of Psychosomatic Research, 2007. **63**(4): p. 433-440.
211. Ahola, K., et al., *Contribution of burnout to the association between job strain and depression: the Health 2000 Study.* Journal of Occupational and Environmental Medicine, 2006. **48**(10): p. 1023-1030.
212. Ylipaavalniemi, J., et al., *Psychosocial work characteristics and incidence of newly diagnosed depression: a prospective cohort study of three different models.* Social Science & Medicine, 2005. **61**(1): p. 111-122.

213. Munce, S.E.P., et al., *The role of work stress as a moderating variable in the chronic pain and depression association.* Journal of Psychosomatic Research, 2006. **61**(5): p. 653-660.
214. Bakker, A.B., et al., *Job demands and job resources as predictors of absence duration and frequency.* Journal of Vocational Behavior, 2003. **62**(2): p. 341-356.
215. Camerino, D., et al., *Factors affecting work ability in day and shift-working nurses.* Chronobiology International, 2008. **25**(2): p. 425-42.
216. Hansen, C.D. and J.H. Andersen, *Going ill to work - what personal circumstances, attitudes and work-related factors are associated with sickness presenteeism?* Social Science & Medicine, 2008. **67**(6): p. 956-64.
217. Elstad, J.I. and M. Vabo, *Job stress, sickness absence and sickness presenteeism in Nordic elderly care.* Scandinavian Journal of Public Health, 2008. **36**(5): p. 467-74.
218. Virtanen, M., et al., *Job Strain and Psychologic Distress: Influence on Sickness Absence Among Finnish Employees.* American Journal of Preventive Medicine, 2007. **33**(3): p. 182-187.
219. Kim, M.-H., et al., *Is precarious employment damaging to self-rated health? Results of propensity score matching methods, using longitudinal data in South Korea.* Social Science & Medicine, 2008. **67**(12): p. 1982-1994.
220. Guadalupe, M., *The hidden costs of fixed term contracts: the impact on work accidents.* Labour Economics, 2003. **10**(3): p. 339-357.
221. Virtanen, P., et al., *Economy and job contract as contexts of sickness absence practices: revisiting locality and habitus.* Social Science & Medicine, 2004. **58**(7): p. 1219-29.
222. Virtanen, M., et al., *From insecure to secure employment: changes in work, health, health related behaviours, and sickness absence.* Occupational and Environmental Medicine, 2003. **60**(12): p. 948-53.
223. Hemingway, H., et al., *Social and Psychosocial Influences on Inflammatory Markers and Vascular Function in Civil Servants (The Whitehall II Study).* The American Journal of Cardiology, 2003. **92**: p. 984-987.
224. Elovainio, M., et al., *Organizational Justice and Sleeping Problems: The Whitehall II Study.* Psychosomatic Medicine, 2009. **71**: p. 334-340.
225. Kumari, M., J. Head, and M. Marmot, *Prospective Study of Social and Other Risk Factors for Incidence of Type 2 Diabetes in the Whitehall II Study.* Archives of Internal Medicine, 2009. **164**: p. 1873-1880.
226. Akbaraly, T.N., et al., *Association between metabolic syndrome and depressive symptoms in middle-aged adults: Results from the Whitehall II study.* Diabetes Care, 2009. **32**(3): p. 499-504.
227. Wilhelm, K., et al., *Prevalence and correlates of DSM-IV major depression in an Australian national survey.* Journal of Affective Disorders, 2003. **75**: p. 155-162.
228. Kessler, R., et al., *Depression In The Workplace: Effects On Short-Term Disability.* Health Affairs, 1999(September/October): p. 163-171.
229. Souetre, E., H. Lozet, and I. Cimarosti, *Predicting factors for absenteeism in patients with major depressive disorders.* European Journal of Epidemiology, 1996. **13**: p. 87-93.
230. Lerner, D., et al., *The clinical and occupational correlates of work productivity loss among employed patients with depression.* Journal of Occupational and Environmental Medicine, 2004. **46**(6): p. S46-S55.
231. Australian Government National Preventative Health Taskforce, *Australia: The healthiest country by 2020 - National Preventative Health Strategy - the roadmap for action*, N.P.H. Taskforce, Editor. 2009, Australian Department of Health and Ageing: Canberra, ACT. p. 3-307.

232. Kivimaki, M., et al., *Increased sickness absence in diabetic employees: what is the role of co-morbid conditions?* Diabetic Medicine, 2007. **24**(9): p. 1043-8.
233. Ricci, J.A. and E. Chee, *Lost productive time associated with excess weight in the U.S. workforce.* J Occup Environ Med, 2005. **47**(12): p. 1227-34.
234. Hickie, I.B., et al., *Comorbidity of common mental disorders and alcohol or other substance misuse in Australian general practice.* Med J Aust, 2001. **175 Suppl**: p. S31-6.
235. Philip, P., et al., *Insomniac complaints interfere with quality of life but not with absenteeism: respective role of depression and organic comorbidity.* Sleep Medicine, 2006. **7**: p. 585-591.
236. Huibers, M.J., et al., *Predicting the two-year course of unexplained fatigue and the onset of long-term sickness absence in fatigued employees: results from the Maastricht Cohort Study.* J Occup Environ Med, 2004. **46**(10): p. 1041-7.
237. Nakata, A., et al., *Association of sickness absence with poor sleep and depressive symptoms in shift workers.* Chronobiol Int, 2004. **21**(6): p. 899-912.
238. Savikko, A., K. Alexanderson, and G. Hensing, *Do mental health problems increase sickness absence due to othe diseases.* Journal of Scial Psychiatric Epidemiology, 2001. **36**: p. 310-316.
239. Naughton, F., P. Ashworth, and S. Skevington, *Does sleep quality predict pain-related disability in chronic pain patients? THe mediating role of depression and pain severity.* Pain, 2007. **127**: p. 243-252.
240. Sundararajan, V., et al., *New ICD-10 version of the Charlson comorbidity index predicted in-hospital mortality.* J Clin Epidemiol, 2004. **57**(12): p. 1288-94.
241. Rius, C., et al., *An adaptation of Charlson comorbidity index predicted subsequent mortality in a health survey.* J Clin Epidemiol, 2004. **57**(4): p. 403-8.
242. Harse, J.D. and C.D. Holman, *Charlson's Index was a poor predictor of quality of life outcomes in a study of patients following joint replacement surgery.* J Clin Epidemiol, 2005. **58**(11): p. 1142-9.
243. Groll, D.L., et al., *The development of a comorbidity index with physical function as the outcome.* J Clin Epidemiol, 2005. **58**(6): p. 595-602.
244. Wang, P.S., et al., *Telephone screening, outreach, and care management for depressed workers and impact on clinical and work productivity outcomes: a randomized controlled trial.* JAMA, 2007. **298**(12): p. 1401-11.