The health and economic benefits of reducing disease risk factors

Research Report

July 2009

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ACKNOWLEDGEMENTS

We thank the following experts for providing advice on disease risk factors and data analysis methods: Michael Flood; Melanie Heenan; Kim Webster; Brian Vandenberg; Jane Potter and Shelley Maher from VicHealth; Professor Tony Worsley, University of Wollongong; Cate Burns and Caryl Nowson from Deakin University; Kylie Lindorff from the VicHealth Centre for Tobacco Control; Professor Robin Room, AERF Centre for Alcohol Social Research, Turning Point Alcohol and Drug Centre; Professor Theo Vos at the University of Queensland; as well as several health experts at the National Stroke Research Institute.

This report has been prepared by staff at Deakin University and the National Stroke Research Institute.

Funding was provided by VicHealth following a competitive tender application.

INVESTING IN PREVENTION

“How much is it worth?” This is a frequently asked question in the context of preventative health and health promotion. It seeks to measure the monetary benefits of these public health approaches and it rightly influences major decisions about how we spend our limited budgets.

However well-justified, this query can be challenging to answer because preventative health’s many benefits can’t always be assessed in mere dollar terms. Many regard the quality of life that accompanies good health, for example, as being valuable beyond measure.

But this new report, *The Health and Economic Benefits of Reducing Disease Risk Factors,* tackles this challenge head on. It estimates the ‘health status’, ‘economic’ and ‘financial’ benefits of reducing the prevalence of the six behavioural risk factors that contribute to chronic diseases affecting millions of Australians. These major risk factors concern obesity, alcohol, smoking, exercise, diet and domestic violence.

Importantly, this research maps new territory by developing a model for estimating the benefits of our home-based work and leisure. These are areas that have eluded traditional economic analysis but which we increasingly recognise are important to maintaining our work-life balance.

The findings show that increasing physical activity creates more household productivity and leisure time than reductions in alcohol consumption which have a greater influence on workforce productivity.

This report adds to the growing body of evidence that backs greater investment in preventative health. It provides a wealth of information that can help us to make informed decisions about which areas deliver the greatest value when developing policies, funding programs and infrastructure, and initiating research.

As the report highlights, we are all beneficiaries when it comes to reducing the prevalence of these six behavioural risk factors. We all have a stake in using this research to make better choices, as individuals, businesses, governments and communities.

Todd Harper
Chief Executive Officer
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ACRONYMS AND DEFINITIONS

Glossary of abbreviations

Acronym	Meaning
ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
BoD	Burden of Disease
BMI	Body Mass Index
COPD	Chronic Obstructive Pulmonary Disease
CURF	Confidentialised Unit Record File
DALY	Disability Adjusted Life Years
DTF	Department of Treasury and Finance
DCIS	Disease Costs and Impact Study
FCA	Friction Cost Approach
GDP	Gross Domestic Product
HCA	Human Capital Approach
IPV	Intimate Partner Violence
LL	Lower Limit of a range of values
NHMRC	National Health and Medical Research Council
NPV	Net Present Value
NHS	National Health Survey
OECD	Organization for Economic Cooperation and Development
PAF	Population Attributable Risk Fraction
RADL	Remote Access Data Library
RR	Relative Risk
SEIFA	Socio-Economic Indexes For Areas
UI	Uncertainty Interval
UL	Upper Limit of a range of values
VicHealth	Victorian Health Promotion Foundation
WHO	World Health Organization

Definition of key terms

Term	Meaning
Arcadian ideal	Countries comparable to Australia, where the prevalence of a risk factor is lower.
Attributable burden	The estimated effects on population health, economic and financial outcomes of a risk factor at current prevalence estimates.
Avoidable burden	The estimated net change in population health, economic and financial parameters (reported savings arising from mortality, morbidity, absenteeism, participation rates) if feasible reductions in risk factor prevalence could be achieved
Cost offsets	These are made up of reductions in the costs of future health care delivery (for example, hospital admissions, General Practitioner visits, pharmaceuticals and allied health services) which can be avoided by reductions in the number of cases of disease. Cost offsets are the estimated resources consumed in the diagnosis, treatment and care of preventable events that could become available for other uses. These can be considered as 'opportunity costs'. However, ***such estimates are only indicative of financial savings and should be interpreted with caution because they are not estimates of immediately realisable financial savings***.
Disability Adjusted Life Year	The Disability Adjusted Life Year is a summary measure of population health that captures the effects of premature mortality and morbidity associated with disease and injury.
Discount Rate	A 3% discount rate was applied to ensure future costs and benefits were expressed in the net present value. See *Net present value.*
Economic benefits	Measures of economic gain estimated in this project were decreases in short and long-term absenteeism, decrease in premature retirements and increases in household production (e.g. shopping, cleaning and child care) and leisure activities, associated with changes in disease incidence and deaths, over a time period.
Feasible reduction	A reduction in risk factor prevalence that is consistent with the current evidence for that risk factor within Australia and overseas.
Financial benefits	The valuation in dollar terms of the estimated *economic benefits*. The potential opportunity cost savings that include a value for health sector offsets, productivity impacts in terms of household and workforce participation, taxation, recruitment and training costs and leisure time. ***These are not estimates of immediately realisable cash savings.***
Friction Cost Approach	In the context of productivity, the friction cost method determines the costs to employers of losing workers due to illness and conversely the savings to employers from health improvements, as well as lost individual income during the friction period. The friction period is the time it takes to recruit and train a new worker from the ranks of the unemployed to replace the lost worker who has either died or is unable to work due to illness (Koopmanschap et al. 1995).
Health gains	Quantified as the incident (new) cases of disease and deaths that could be prevented and the potential *Disability Adjusted Life Years* that could be averted (saved), over a time period, from reductions in the prevalence of a risk factor.
Health sector costs	The cost associated with: hospital care (admitted and non-admitted); aged care homes; out-of-hospital medical services; pharmaceuticals (prescription and over-the-counter drugs); other professional services (e.g. optometry); dental services; and research.

Definition of key terms continued

Term	Meaning
Health sector offsets	These are made up of reductions in the costs of future health care delivery (for example, hospital admissions, General Practitioner visits, pharmaceuticals and allied health services) which can be avoided by reductions in the number of cases of disease. Cost offsets are the estimated resources consumed in the diagnosis, treatment and care of preventable events that could become available for other uses. These can be considered as 'opportunity costs'. However, ***such estimates are only indicative of financial savings and should be interpreted with caution because they are not estimates of immediately realisable financial savings***.
Household production	The non-paid hours of time allocated to household duties of cooking, shopping, cleaning, maintenance etc. This is often referred to in the literature as non-market based production, since it is not traded in the usual way as a marketable item.
Human Capital Approach	In the context of productivity, the human capital method is based on estimated output losses from cessation or reduction of production due to morbidity and mortality; or conversely, from gains made in human capital (both in terms of workforce participation and productivity increases) due to investments in health care (Sapsford and Tzannatos 1993). This is valued as gross employee earnings in the case of the paid workforce.
Ideal target	The feasible risk factor prevalence reduction target. This ideal target was established: by selecting a country comparable to Australia with a lower risk factor prevalence (Arcadian ideal); or according to expert opinion, current guidelines and/or relevant literature.
Net present value	The value of benefits (income or health benefits), which are expected to be received in the future, at a specified reference year (2008 in this analysis), taking the time value of returns into account (discounted by 3% in this project).
Not in the labour force	Individuals not currently active in, or looking for, employment. For example, students / retirees.
Opportunity cost	Opportunity costs are defined as the value of time or any other 'input' in its highest value alternative use. Therefore, opportunity costs represent the lost benefit of not selecting the next best alternative use of the resource inputs.
Population Attributable Risk Fraction	The proportion by which the incidence rate of a disease could be reduced over a time period, if the risk factor was to reach a theoretical minimum, assuming causation between risk factor and disease.
Preferred conservative estimate	Estimates calculated using the Friction Cost Approach, as opposed to the Human Capital Approach, are the preferred conservative estimates for valuing productivity costs in this study. As a number of assumptions needed to be made for modelling to occur, the FCA is preferred as it represents a more conservative estimate of the production gain likely to follow a reduction in risk behaviour.
Productivity gains/losses	Reflect changes in workforce participation and absenteeism associated with health status
Progressive target	The mid-point between the current prevalence of a risk factor and the ideal target prevalence for risk factor reduction. For example, the current prevalence of tobacco smoking in Australia is 23%, the ideal prevalence target is 15% and therefore, the progressive target is 19%.

Definition of key terms continued

Term	Meaning
Reference year	The year used for determination and valuation of costs, benefits and population health impact.
Replacement costs	Valued at the average hourly rates for commercially available domestic services and child care. See *household production.*
Socio-Economic Indexes For Areas	This suite of indexes ranks geographic areas across Australia in terms of their socio-economic characteristics (from most disadvantaged to least disadvantaged) on the basis of several factors which include education, income and others (Australian Bureau of Statistics 2008a).
Standard drink	A standard drink is equal to 10g (12.5ml) of alcohol (National Health and Medical Research Council 2001).
Threshold analysis	An analytic method used to provide evidence for priority setting and policy decisions, including resource allocation and research priority decisions. It is employed in decision contexts when some information is available, but other important variables are missing.
Workforce participants	People working part-time, full time or looking for work.

Definitions of risk factors used in this project as per the 2004-05 National Health Survey (Australian Bureau of Statistics 2006)

Alcohol consumption	Long term high risk alcohol consumption: Greater than 75ml of alcohol consumed per day for men, and greater than 50ml of alcohol consumed per day for women.
	Long term low risk alcohol consumption: Less than 50ml of alcohol consumed per day for men, and less than 25ml of alcohol consumed per day for women.
High body mass index	Obese or overweight: BMI greater than 25, based on self-reported height and weight.
	Normal weight: BMI less than 25, based on self-reported height and weight (including underweight).
Inadequate fruit and vegetable consumption	Inadequate fruit and vegetable consumption: Consumption below the recommended minimum of 2 serves fruit and 5 serves vegetables daily.
	Adequate consumption: Consumption at or above the recommended minimum of 2 serves fruit and 5 serves vegetables daily.
Intimate partner violence	High psychological distress has been used as a proxy for current exposure to intimate partner violence: High or very high levels of psychological distress (score 22-50 on the Kessler Psychological Distress Scale -10).
	Moderate psychological distress has been used as a proxy for past exposure to intimate partner violence: Moderate levels of psychological distress (score 10-21 on the Kessler Psychological Distress Scale -10).
Physical inactivity	Inactive: Sedentary or low activity level.
	Active: Moderate to high activity level.
Tobacco smoking	Current smokers: Persons who smoke tobacco on a regular or irregular daily basis.
	Ex-smokers: Persons who no longer smoke on a regular or irregular basis.

EXECUTIVE SUMMARY

VicHealth commissioned Deakin Health Economics (DHE) to undertake this research project into the economic benefits of reducing disease risk factors in mid 2008. DHE and the National Stroke Research Institute formed a partnership to complete this project. Six potentially modifiable risk factors were nominated for assessment: intimate partner violence (IPV), high risk alcohol consumption, inadequate fruit and vegetable consumption, physical inactivity, tobacco smoking and high body mass index (BMI). The research was completed in 2008 and the reports finalised, following review, in early 2009.

Research Objective:

More specifically, the objective was to estimate the ‘health status’, ‘economic’ and ‘financial’ benefits of reducing the prevalence of the six behavioural risk factors. The ‘health status’ benefits were measured as changes in the incidence of disease, deaths and Disability Adjusted Life Years (DALYs) associated with fewer people having the risk factor. The ‘economic’ benefits were measured as changes in workforce participation rates, absenteeism and early retirement from the workforce, as well as days of increased household and leisure activities that could be associated with improvements in health status. The ‘financial’ benefits were defined in this project as the dollar value of the estimated economic benefits and represent *opportunity cost savings* rather than immediately realisable cash savings. For example, resources currently used in the treatment of diseases that may no longer occur in future, may become available for other purposes in society.

The beneficiaries of these ‘health status’, ‘economic’ and ‘financial’ benefits are made up of individuals, businesses and government. Government should benefit through future savings in health care expenditure on treatments for preventable disease, through increased taxation transfers from higher individual incomes and through fewer welfare payments. Businesses should benefit from reduced absenteeism from work and from less recruitment and training costs associated with replacing staff that die or retire prematurely from ill health. Individuals should benefit from increases in income, from reduced absenteeism from work or time spent out of role at home and from increased quality of life from reduced levels of ill health.

Research Methods:

The research methods used to estimate the potential benefits were:

- A detailed literature review on each risk factor to provide the theoretical background and context for assumptions and estimates used in the prevalence scenarios modelled;
- Regular consultation with external and independent experts through an Advisory Committee convened by the Victorian Health Promotion Foundation (VicHealth);
- Direct attainment and use of databases from the Australian Bureau of Statistics (ABS) and the 2003 Australian Burden of Disease (BoD) Study to ensure consistent national data inputs for each risk factor;
- Redevelopment of existing workforce productivity decision analytic models prepared as part of an earlier research project completed for the Victorian Department of Treasury and Finance;
- Use of both the Human Capital Approach (HCA) and the Friction Cost Approach (FCA) to estimate production gains/losses in the general economy;
- Development of new decision analytic models for the estimation of household production and leisure time costs;
- Use of probabilistic multivariable uncertainty analyses to improve the precision and reliability of primary outcome variables and provide 95% uncertainty intervals (refer section 2.8);
- Adjustment for the joint effects of multiple risk factors, since it is more common for people to report two or more risk factors than one risk factor; and
- The analysis was limited to the prevention of new cases of disease attributable to the six risk factors over the lifetime of the 2008 population.

The risk factor prevalence scenarios were modelled separately for each risk factor using best available evidence to inform decisions on what constituted realistic and feasible reductions. However, the decision on what constituted ‘best available’ evidence, varied between the risk factors. In the estimations for alcohol, tobacco and IPV it was agreed that the feasible reductions should be modelled against attainment of prevalence levels observed in a comparable country (referred to as an 'Arcadian' ideal). In contrast, for inadequate consumption of fruit and vegetables, high BMI and physical inactivity, a consensus approach informed by best available evidence was preferred. For these risk factors, the Advisory Committee agreed that international comparisons were too problematic, mainly due to country specific socio-economic and cultural variations. Irrespective of which approach was used to provide the basis of the 'feasible' reduction in risk factor prevalence targets, systematic methods and data sources were applied to ensure comparability. The systematic approach also facilitated correction for co-morbidities across risk factors.

Overview of Results:

Overall, large potential opportunity cost savings from the avoidable disease burden are possible if we achieve the 'feasible' reductions in the prevalence of the nominated risk factors. Over the lifetime of the 2008 Australian adult population, opportunity cost savings were conservatively estimated to be $2,334 million (using FCA) or $3,057 million (using HCA). The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects (see column with mean estimates in Table 1).

Table 1 Financial outcomes of all risk factors if ideal targets achieved, corrected for joint effects

All 6 risk factors		**95% Uncertainty Interval**	
$ millions	**Mean**	**LL**	**UL**
Financial Outcomes FCA			
Production gains/(losses)	473	(2)	1,155
Recruitment/training costs	79	n/a	n/a
Leisure based production	110	(361)	602
Home based production	248	(69)	568
Total production FCA	***830***	***(109)***	***1,843***
Health sector offsets	1,504	1,504	1,504
Total Opportunity Cost Savings FCA	**2,334**	**1,395**	**3,347**
Taxation effects FCA	78	(45)	244
Financial Outcomes HCA			
Production gains/(losses)	1,196	(648)	3,070
Leisure based production	110	(361)	602
Home based production	248	(69)	568
Total production HCA	***1,553***	***(435)***	***3,569***
Health sector offsets	1,504	1,504	1,504
Total Opportunity Cost Savings HCA	**3,057**	**1,069**	**5,073**
Taxation effects HCA	(22)	(323)	289

Notes: The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals as both the components and the total are run as independent distributions. These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. Values are net present value using a 3% discount rate. Numbers in brackets ( ) indicate the possibility of losses resulting from achieving the target, rather than gains.

The upper and lower limits of the uncertainty interval indicate the range of possible values that these estimates might be. The wider the interval the larger the degree of uncertainty there is around the estimates. The presence of negative numbers at the lower limit indicates there is some chance (albeit small) of a financial loss occurring.

For individual risk factors, the relative value of potential opportunity cost savings varied. This reflected the difference in prevalence of the risk factors; the age and gender distributions of the population with the risk factor; the size of the realistic targets selected; the impact of the risk factor on health status and the quality of the data to inform differences between individuals with and without the risk factor of interest, such as number of days off work from ill health. The largest potential opportunity cost savings estimated using FCA, could be gained from reductions in alcohol consumption, followed by reductions in tobacco smoking, IPV, physical inactivity, BMI and lastly from increases in the consumption of fruit and vegetables (Table 2).

Table 2 Total potential opportunity cost savings if 'ideal' risk factor target reductions achieved

	Uncorrected individual risk factors ($ millions)						Combined risk factors
	IPV	**High risk alcohol**	**Inadequate F & V**	**Physical inactivity**	**Tobacco smoking**	**High BMI**	**Corrected for JE**
Total production FCA	333	435	21	162	415	82	830
Health sector offsets	38	789	71	96	491	90	1,504
Total opportunity cost savings - FCA	**371**	**1,225**	**92**	**258**	**906**	**173**	**2,334**
Total production HCA	678	(1,532)	161	288	2,942	174	1,553
Health sector offsets	38	789	71	96	491	90	1,504
Total opportunity cost savings - HCA	**716**	**(743)**	**232**	**384**	**3,433**	**264**	**3,057**

Notes: FCA: Friction Cost Approach for valuing workforce production gains/ (losses); HCA Human Capital Approach to valuing workforce production gains/(losses). IPV: Intimate Partner Violence; F&V: Fruit and Vegetables; BMI: Body Mass Index; JE: Joint Effects. Values are net present value using a 3% discount rate.

While the opportunity cost savings for each individual risk factor can be compared to each other in size, they cannot be simply added together to determine the overall potential savings. This would lead to a serious overestimation of benefits. If several analyses were added together it could appear as if more than 100% of the burden for any one disease or injury was being accounted for by the risk factors in combination. This is illustrated in Table 2 where the potential opportunity costs savings results for the combined risk factors are provided.

The total economic and health status benefits of achieving the ideal targets (with adjustment for joint effects) are presented in Table 3. The largest potential savings in terms of lost days prevented are estimated to occur in the workforce, followed by home based production and leisure time. Where uncertainty was able to be estimated, it clearly indicates the precision of the estimates as well as the possibility of losses occurring. The chance of loss associated with a number of particular factors, including data quality, and risk factor by risk factor is detailed in individual risk factor chapters.

Table 3 Economic and health status outcomes of all risk factors corrected for joint effects if ideal targets achieved

All 6 risk factors	Ideal reduction		
	Corrected for joint effects		
		95% Uncertainty interval	
	Mean (‘000s)	**LL (‘000s)**	**UL (‘000s)**
Health status and economic outcomes			
Per annum			
Disability Adjusted Life Years	95	n/a	n/a
Incidence of disease	161	n/a	n/a
Mortality	6	n/a	n/a
Lifetime			
Leisure (days)	529	(1,195)	2,233
Absenteeism (days)	5,050	n/a	n/a
Days out of home based production role (days)	626	(173)	1,433
Early retirement (persons)	1	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality were calculated for all age groups. Leisure and home based production were calculated for persons aged 15+ years. Absenteeism and early retirement were calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate.

The spread of the potential health benefits in DALYs from avoidable disease related to each of the risk factors was consistent with the potential total production gains in Table 2. That is, the greatest health gains in DALYs could be achieved from reducing high risk alcohol consumption and tobacco smoking. This is because alcohol consumption and tobacco smoking are associated with a larger number of fatal and non-fatal diseases compared to the other risk factors. Individual risk factor chapters in this report provide further detail on the absolute health benefits.

The proportionate gains in household production, leisure time, workforce participation, health expenditure and fewer incident cases of disease and deaths did vary amongst each of the risk factors (Table 4). For example, achieving the ideal feasible reduction in physical inactivity prevalence would create more household productivity and leisure time than reductions in alcohol consumption which, in turn, had a greater influence on workforce productivity. These findings reflect the differences in workforce status, age and gender distributions in each of the populations at risk.

Table 4 Total workforce, household and leisure production gains/losses if ideal targets achieved

	Uncorrected individual risk factors ($ millions)						Combined risk factors
	IPV	**High risk alcohol**	**Inadequate F & V**	**Physical inactivity**	**Tobacco smoking**	**High BMI**	**Corrected for JE**
Production gains/(losses) (FCA)	88	427	7	12	285	6	473
Leisure based production	98	(12)	8	79	(18)	37	110
Home based production	147	21	7	71	147	39	248
Total production - FCA	**333**	**435**	**21**	**162**	**415**	**82**	**830**

Notes: FCA: Friction Cost Approach for valuing workforce production gains/(losses); IPV: Intimate Partner Violence; F&V: Fruit and Vegetables; BMI: Body Mass Index; JE: Joint Effects. Values are net present value using a 3% discount rate.

Discussion:

This research provides a wealth of new information to inform policy decisions on public health strategies to prevent chronic disease in Australia. The key messages are: i) that the potential benefits of reducing risk factor prevalence are substantial; ii) that the gains vary by risk factor and reduction target considered; and iii) that further research is required to reduce the uncertainty surrounding the estimates.

The main strengths of the research reported here are the consistent methods and data sources applied, including comprehensive assessment by age, gender and workforce status to account for variations within each risk factor population. There are a number of major assumptions to note. The first was our current reliance on the accuracy of self-reported cross sectional data to identify the association between the presence of risk factors and the amount of time and its use away from work due to ill health. Assuming causality between risk factors, illness, absenteeism and workforce participation in the absence of rigorous longitudinal data, means that our results must be regarded as broadly indicative, rather than authoritative, until further testing and validation of causal relationships can be completed.

A second major assumption was the adoption of an incidence based approach to the measurement of health benefits (i.e. looking at new cases avoided, but not health benefits among people who were already ill). This approach was necessary to complete the research in the time available for the project, but biases the estimates in a conservative direction. Offsetting this bias, was the omission of any time lag effects in the modelling between the reduction in the prevalence of a risk factor, the assumed reversal of the elevated risk of disease and consequential reductions in the incidence of diseases associated with that risk factor. The omission of time lags biases the results in an optimistic direction and means we are unable to specify exactly when the benefits will be realised.

A fourth major assumption was our preference for the adoption of the FCA, rather than HCA, as the preferred method for measuring workforce production gains and losses. We present estimates, however, using both the HCA and FCA, as the adoption of one approach rather than the other has a dramatic effect upon the results and there are valid arguments for adopting both methods. The essence of our position is that the FCA is more suitable for answering the research question we were charged with – that is, *for estimating production gains/losses in the general economy*. For this question it was important to us to take into account the fact that businesses will adjust to short term and long term absences. Further, we argue that the HCA is more suited to answering a different research question – that is, placing a monetary value on human life, where the total forgone income stream due to premature death provides a sensible floor estimate (refer section 2.4.5).

In addition to these assumptions, it should be noted that there is a paucity of effectiveness evidence for specific interventions to adequately inform judgements about feasible reductions in prevalence of many risk factors. Future research in this area is an important way forward if we are to have better evidence for prioritising specific interventions to achieve risk factor prevalence reductions and to support further modelling for health promotion.

Finally, we recommend that caution in the interpretation of the presented ‘opportunity cost savings’ is necessary for three main reasons. Firstly, these benefits will only be achieved by the adoption of effective interventions that will certainly have implementation costs attached to them. Inclusion of intervention costs was not a part of our brief for this analysis and we have assumed that effective interventions exist to achieve the target reductions in prevalence of the risk factors. One might argue that the large potential opportunity cost savings we found could enable the upfront investment in suitable prevention interventions. Secondly, we have assessed the benefits as occurring over the future lifetime of the 2008 population. The estimates we present are particularly conservative in that they represent the benefits for a single population group. Similar benefits would be expected in subsequent cohorts if the same magnitudes of risk factor reductions could be achieved in future years. However, the prevalence of each risk factor would fall in each future year. Thirdly, the opportunity cost savings are not estimates of immediately realisable financial savings, but rather estimates of resources reflecting current practice that could be available for other purposes. In the health context, they are estimates of resources devoted to the treatment of preventable disease that could be released for other activities. A number of steps would be required, for example, to close/restructure nursing wards if hospital services for cardiovascular disease or cancer were reduced. Therefore, the results presented are broadly indicative of potential financial savings.

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PART A

METHODOLOGY

1.0 INTRODUCTION

Reducing disease risk factors, even by small amounts, can have a major impact on improving health status and productivity in the general economy. Despite this, only 2.5% of Australia's health budget is allocated to public health, with the remainder spent on care and treatment services (Australian Institute of Health and Welfare 2008). Because budgets for health promotion are likely to remain constrained, it is important to identify the potential health status, economic and financial gains from effective public health and health promotion strategies. Knowledge about where potential returns are likely to be the largest can assist policymakers in making difficult choices, particularly when combined with evidence-based information on the efficacy and cost of interventions that will achieve the potential gains.

To make appropriate investment choices, decision making processes are needed and may include formal priority setting evaluation methods. A detailed description of priority setting evaluation methods is beyond the scope of this report. In brief, priority setting evaluation methods can be used to enable the best choices of where to direct limited resources to achieve social welfare and health outcome objectives for society. Qualitative and quantitative methods or a mixture of both with varying levels of rigor can be used. Health economics forms a fundamental part of modern decision making in health care and technical approaches include an assessment of the benefits and costs of each choice within an environment of scarce resources. Efficiency occurs when we can maximise benefit from the available resources (Mooney 1992). Nevertheless, it is recognized that quantitative analysis of efficiency is just one input for priority setting processes. Therefore, the information provided by health economics analyses needs to be evaluated against other social goals. In other words, trade-offs need to be made which consider both the value of choices in terms of potential economic and health benefits obtained, but also the 'societal value' of such choices. This is to ensure that the ultimate end allocation of resources reflects the preference of the populace and/or its representatives in government, as well as the socio-cultural setting (Hutubessy et al. 2003). In the absence of strong evidence for effective interventions to base priority setting analyses, more descriptive modelling can be applied. In this project, we focused on providing evidence to assist decision making by quantifying the effects of reducing the prevalence of six predetermined risk factors according to each of the major potential beneficiaries.

There are three major beneficiaries of reducing risk factor prevalence, viz: government, business and individuals. Government should benefit through future savings in health care expenditure on treatments for preventable disease, through increased taxation transfers from higher individual incomes and through fewer welfare payments. Businesses should benefit from reduced absenteeism from work and less recruitment and training costs associated with replacing staff that die or retire prematurely due to ill health. Individuals should benefit from increases in income, reduced absenteeism from work (or time spent out of role at home) and increased quality of life from reduced levels of ill health.

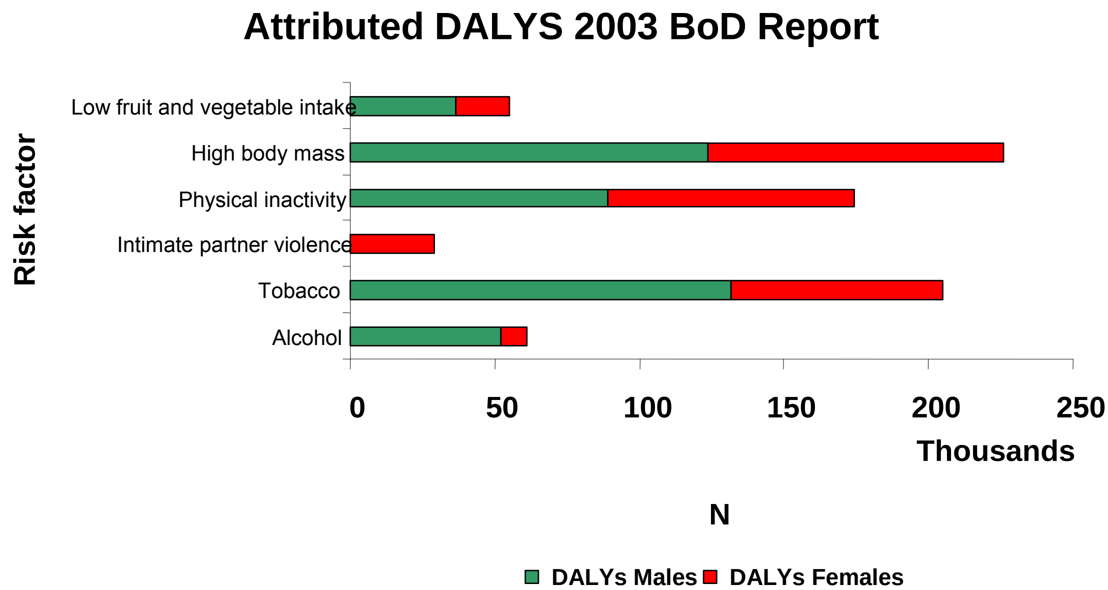
VicHealth commissioned Deakin Health Economics (DHE) to undertake this research project into the economic benefits of reducing disease risk factors in mid 2008. DHE and the National Stroke Research Institute formed a partnership to complete this project. Six potentially modifiable risk factors were nominated for assessment: intimate partner violence (IPV), high risk alcohol consumption, inadequate fruit and vegetable consumption, physical inactivity, tobacco smoking and high body mass index (BMI).

Aims of the project:

More specifically, the aims of the project were to estimate the ‘health status’, ‘economic’ and ‘financial’ benefits of reducing the prevalence of the six nominated behavioural risk factors. The ‘health status’ benefits were measured as changes in the incidence of disease, deaths and Disability Adjusted Life Years (DALYs) associated with the risk factor reduction. The ‘economic’ benefits were measured as changes in workforce participation rates, absenteeism and early retirement from the workforce, as well as days of increased household and leisure activities that could be associated with improvements in health status. The terms ‘productivity’ and ‘production’ in this report are used interchangeably and refer to the potential for both production gains, or on occasions, production losses. The ‘financial’ benefits were defined in this project as the dollar value of the estimated economic benefits and represent opportunity cost savings rather than immediately realisable cash savings.

Figure 1 provides evidence from the 2003 BoD study on the magnitude of the disease burden that is associated with each of the nominated risk factors in Australia. This was accomplished by developing population simulation models and applying threshold analysis principles to determine the potential lifetime benefits of the 2008 Australian adult cohort (aged 15 years and over). The simulation models for people in the workforce were enhanced from previous work undertaken by Deakin Health Economics for the Victorian Department of Treasury and Finance (Magnus et al. 2008). Because these earlier models did not include estimates of lost leisure and household production associated with diseases attributable to the risk factors of interest, additional models required development. It was also acknowledged that many of the risk factors contribute to several of the same diseases and therefore methods to correct for the joint effects of these risk factors were established. ***The focus of the project was to scope the potential size and distribution of health status, economic and financial gains arising from health promotion activities that reduce the prevalence of risk factors and not on conducting economic evaluations of specific interventions***. The project was monitored by an Advisory Committee consisting of public health experts (refer page ii Project Contributors).

Figure 1 Total Disability Adjusted Life Years attributed to the risk factors of interest in this project by gender



Source: Adapted from Begg et al (2007). DALYs: Disability Adjusted Life Years; N: Number.

1.1 Structure of the research report

This report has been structured in two parts. In Part A, the description of the common methods and data sources used is provided. In Part B, the background literature review and analytic results for each risk factor of interest is given in a contained chapter. These are followed by a summary of the main findings, correction for joint effects of risk factors and discussion chapter which were developed to bring the major findings from each risk factor chapter into a broader health promotion context.

2.0 METHODOLOGY

The following section outlines the common methods and data sources used to undertake the analyses for each of the risk factors of interest.

2.1 Primary research question

To estimate the potential health status, economic and financial gains of feasible reductions in the prevalence of IPV; high risk alcohol consumption; inadequate fruit and vegetable consumption; physical inactivity; tobacco smoking; and high BMI.

2.2 Role of the Advisory Committee and expert consultation

An Advisory Committee, Chaired by the Chief Executive Officer of VicHealth (Todd Harper), was convened for this project and met formally on three occasions during the seven month project period. A broad range of experts from both government and non-government sectors were appointed with backgrounds in health economics, health promotion and/or policy. The Advisory Committee provided early input to the project in terms of ratifying the study methods and the project scope. In addition, feedback on the literature reviews was provided, in particular for estimates of disease prevalence and potential feasible reductions in risk factor prevalence. Between meetings, correspondence including feedback on the reports was received via email and/or telephone.

2.3 Literature reviews

Literature reviews for each of the six risk factors were undertaken. The evidence obtained was used to provide the theoretical background and context for assumptions and decisions, and to identify estimates needed for the modelling. To undertake the literature search we used the electronic database Medline (1950-2008) and also searched relevant websites including the World Health Organisation (WHO), Organisation for Economic Cooperation and Development (OECD), VicHealth and the Australian Government Department of Health and Ageing. Reference lists of relevant publications were also reviewed. In addition, the public health experts on the Advisory Committee were consulted and suggested many important references.

The literature reviews for each risk factor are presented in the relevant risk factor chapters in Part B. We relied heavily on the *2003 Australian Burden of Disease* (BoD) study files (Begg et al. 2007) to determine the health status and economic benefits (refer section 2.4.1). Therefore, each chapter includes a definition and a brief summary of the relevant findings from the *2003 Australian BoD* study (Begg et al. 2007), estimates of prevalence and the influence of other factors, including socioeconomic status, and the major health outcomes associated with each risk factor. Two central goals of the literature review were to: a) establish the scope for a potentially meaningful and ***'feasible reduction'*** in the prevalence of each risk factor; and b) identify any published ***cost-of-illness estimates*** attributable to each risk factor to determine the ***potential for gains in health sector costs***. In this way, ***'what if' scenario modelling*** to simulate the potential health status, economic and financial benefits (both within and outside the health sector) could be undertaken. The underlying principle was to estimate the effects on our stated economic and financial parameters given current risk factor prevalence estimates (referred to as the ***attributable burden***) and determine the ***net change in these parameters*** if feasible reductions (expressed as a proportion of the ***avoidable burden***) in risk factor prevalence could be achieved.

2.3.1 Determining what is a feasible reduction for risk factor prevalence

Identifying a feasible reduction in prevalence for the six nominated risk factors was based initially on reviewing the literature to determine the scope for risk reversibility and the potential magnitude of reductions achievable from evidence of effective interventions, nationally and/or internationally. However, this task proved to be difficult since little useful information was obtained for our risk factors of interest from the search strategies used. Most studies identified were cross-sectional rather than longitudinal, and there was great heterogeneity in the type of interventions and target populations. We noted that reductions in risk factor prevalence were rarely reported as an outcome measure, and generalisability to the Australian setting was often questionable.

Together with the Advisory Committee, it was agreed that in the absence of reliable data, a more consistent approach might be to investigate prevalence levels of risk factors in other comparable countries. For comparable countries where the prevalence of the risk factors was lower, these could then be used as feasible targets (or ‘Arcadian’ ideals) for Australia. Once these Arcadian ideals were established, we could model different levels of progression (e.g. 25%, 50%, 75% and 100% reduction to the Arcadian ideal). We found that there was more extensive information on prevalence in other countries than on reductions brought about by intervention programs, but this approach was also not without its problems. Firstly, it required finding a country that was broadly comparable with Australia (e.g. comparing alcohol consumption in Australia and Iran makes little sense given differences in culture, legislation, availability, etc.). Secondly, estimates of prevalence needed to be comparable in terms of how and when they were measured. Lastly, temporal trends in risk factor prevalence and growth needed to be balanced against the potential for achieving reductions. For example, the prevalence of obesity and overweight (high BMI) is increasing rapidly in many populations for a variety of reasons, including cultural and socioeconomic factors, and thus even modest reductions offered by choosing an Arcadian ideal could be considered unrealistic.

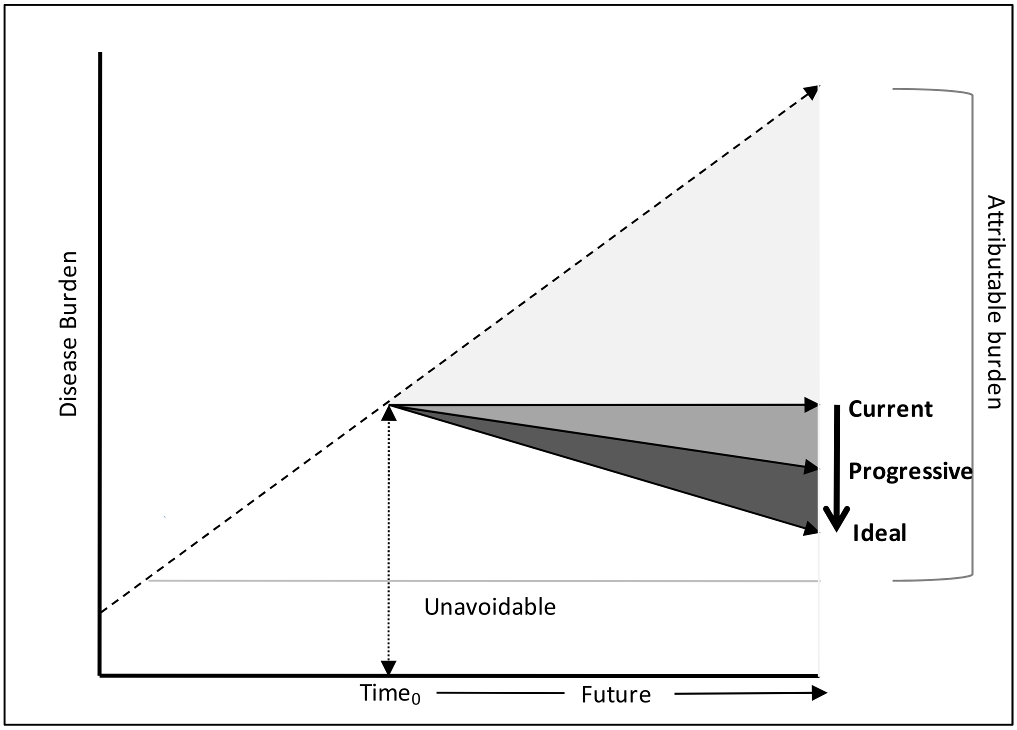
The final selection of feasible reductions in prevalence for each risk factor was the result of extensive discussions between the project staff, the Advisory Committee, VicHealth staff and external experts. Thus, the selections combine not only relevant information from the prevention literature and prevalence levels in other countries, but also expert opinion and relevant risk factor targets and guidelines. The overarching consideration was always “what is feasible?” For example, if an Arcadian ideal was considered unachievable in the current Australian climate, then a more conservative estimate was made. From these estimates, absolute differences between current prevalence estimates and a feasible reduction in the prevalence of each risk factor were determined and applied in our analytic models. It was agreed to simulate what might be achieved if we were to accomplish half (progressive goal) and all (longer-term goal) of the feasible risk factor prevalence reduction. A summary of the selected feasible reductions for each risk factor are provided in Table 5. Greater detail for the choice of comparator is given in each of the relevant chapters.

Table 5 Final decisions for the feasible reductions for each risk factor

Risk factor	Method	Attributable		Change		Reference Source
		Australia	Comparator	Ideal	Progressive	
Intimate partner violence (prevalence %)	Arcadian ideal	27	Denmark: 22	↓5	↓2.5	Johnson et al. (2008)
High risk alcohol consumption (litres/capita/year)	Arcadian ideal	9.8	Norway: 6.4	↓3.4	↓1.7	Organization for Economic Cooperation and Development (2008)
Tobacco smoking (prevalence %)	Arcadian ideal	23	California: 15	↓8	↓4	Behavioral Risk Factor Surveillance System (2008)
Physical inactivity (prevalence %)	Evidence based consensus	70	60	↓10	↓5	Katzmarzyk et al.(2000)
Inadequate fruit and vegetable consumption (grams/day/person)	Evidence based consensus	503	675	↑172	↑86	External consultation and Australian guidelines.
High body mass index (prevalence %)	Evidence based consensus	27	24	↓3	↓1.5	Dutch intervention study; external consultation; National Preventative Health Taskforce

Conceptual measurement of the potential impact of reductions in risk factor prevalence on the health, economic and financial burden in a population is presented in Figure 2. We argue that DALY burden, health sector costs and production gains/losses will all be altered in a similar way, if change was to occur in the population. In the absence of any change, the burden attributable to risk factors may be expected to rise as the population increases and ages. If we were to measure change from the current position (Time 0 or baseline) into the future without incorporating future disease or population trends, we can estimate the impact of change on important outcomes.

Figure 2 Estimation of the change in attributable burden of a risk factor due to a reduction in prevalence



Source: Adapted from (Begg et al. 2007).

2.3.2 Determining the magnitude of health sector costs associated with the risk factors of interest

The literature reviews for the cost-of-illness estimates for the risk factors of interest provided limited and incomparable estimates of health sector costs. Inconsistencies included different definitions, inclusions, exclusions, assumptions, unit prices, time periods and methodology. A summary of the available data is provided in the relevant risk factor chapters in Part B.

To maintain consistent methodology throughout the project, we used the best available source of health sector costing data for Australia to establish health sector benefits. The Disease Costs and

Impact Study (DCIS) files for 2000-01 created using BoD nomenclature for disease groups, for the distribution of Australian health care expenditure were used (Australian Institute of Health and Welfare 2002). The files that were made available to us were based on disease groupings rather than risk factors. Following the BoD work, where disease burden (DALYs) are attributed back to each of the risk factors of interest, we were able to back calculate the attributable portion of total health sector costs associated with the risk factors. Although not a perfect approach, this method offered greater consistency, reliability and internal validity for this project. Further details are provided in section 2.7.

2.4 Estimation of health status and economic benefits

The following sections describe how the health status and economic benefits were modelled. To estimate the economic benefits from greater productivity, we required assessments of: cost offsets or opportunity cost savings from reductions in the cost of future health care delivery; productivity (within the paid labour force); leisure time; and home based production. Health status benefits were assessed in terms of reductions in incident cases of disease, DALYs and deaths. Each of the six risk factors was evaluated in a consistent way. The population was selected, the eligible population was determined, the avoidable risk was estimated and the potentially achievable economic and financial gains of health promotion and disease prevention strategies was estimated. From this analysis, the health, economic and financial benefits were calculated using multivariable probabilistic uncertainty analysis (refer section 2.8).

We consider our findings to be conservative. The total potential benefits from the reductions in prevalence of risk factors have been underestimated in this project since we only considered the incident cases of diseases that would be reduced by prevention strategies for our risk factors. In reality, prevalent cases of cardiovascular disease and stroke would also be likely to benefit from becoming physically active, eating more fruit and vegetables, losing weight and/or quitting smoking. This is because the risk of a recurrent cardiovascular event can be great, for example the risk of a recurrent stroke is about 8% 12 months after a first-ever stroke (Hardie et al. 2004). However, inclusion of prevalent cases in our modelling would have added an extra level of complexity given that disease prevalence estimates are often based on less reliable data than on incident cases and not all of the diseases would result in recurrent events. In addition, we would also have required a second level assessment on the nature of the interventions that could be adopted to estimate the likely reductions in recurrent events possible. Therefore, only incident cases of disease were considered and results presented are conservative.

2.4.1 Data sources

In this project there were several data sources used. The most appropriate and recent data for Australia were obtained. A particular consideration was the ability to use data that were consistent for each of the risk factors and outcomes of interest. This was to ensure a systematic and comparable approach. We used: a) the 2003 Australian BoD Excel files (Microsoft Office) for our risk factors of interest; b) the full DALY BoD files for health status estimates; and c) the DCIS files created using BoD nomenclature for distribution of Australian health care expenditure. These files were provided to the project team in Excel format via Professor Theo Vos (University of Queensland), a co-investigator for the Australian BoD study.

We also obtained the most recent National Health Survey (NHS) data (2004-05) directly from the ABS, as well as the 2006 Time Use Survey (directly downloaded from the ABS website as an Excel file). Labour force participation and current prices for average wages were obtained directly from the ABS and/or published government pay scale summaries. Further details about these source data are provided in the relevant sections below.

2.4.2 Estimates directly derived from the National Health Survey database

Demographic data and information on the nominated health risk factors, employment status, and health-related actions were obtained from the NHS 2004-05 Confidentialised Unit Record Files (CURF), with the approval of the Australian Statistician. The Basic CURF data, provided on CD ROM, were used to conduct analyses relating to the impact of risk factors on ***absenteeism*** from work due to illness and ***days of reduced activity*** for those not in the labour force. The Basic and Expanded CURF data were accessed online, through the Remote Access Data Laboratory (RADL), to conduct additional analyses by population-based quintiles of the Index of Relative

Socioeconomic Disadvantage and to estimate mean ages within risk factor categories (Australian Bureau of Statistics 2006).

Characteristics of the Australian population were estimated from the CURF data (Table 6), which were collected from a representative sample of Australian State and Territory populations, with weights (expansion factors) assigned to individual responder's records consistent with the sampling strategy (Australian Bureau of Statistics 2006). Survey participant privacy was protected by the inclusion of replicate-weight variables, used with the jackknife replication procedure to produce point and variance estimates (StataCorp 2007a). Software used was Stata/IC Version 10.0 for Windows (StataCorp 2007b). Stata analytical programming code used for this project is provided in Appendix 1 and Appendix 2.

Table 6 Basic and Expanded National Health Survey 2004-05 CURF Variables used for this analysis

Characteristic	CURF variable name	CURF variable description	Variables used in this analysis	Variable code	Comparator category description
Risk factors					
Intimate partner violence	MNKESSLR	Age 18+ years	ANXDEPRS	1	Low psychological distress
		Mental wellbeing indicated by categories of the Kessler Psychological Distress Scale -10.		2	Moderate psychological distress
				3	High or very high psychological distress
		High or very high levels of psychological distress: score 22-50		4	NA
			ANXDEPRSm		
		Low or moderate levels of psychological distress: score 10-21		0	Low or moderate psychological distress
				1	High or very high psychological distress
Alcohol	AL2K7DAY	Age 18+ years	HIALCRSK	0	No or low alcohol risk
		Alcohol types and quantities consumed on number of days in the previous week converted to average millilitres alcohol over 7 days; Risk categories based on NHMRC risk levels for harm in the long term.		1	High or medium alcohol risk
			HIHIALCRSK (excludes medium risk)	0	No or low alcohol risk
				1	High alcohol risk
		High risk: Males > 75 ml; Females > 50 ml.	LOALCRSK	0	High or medium alcohol risk
				1	No or low alcohol risk
		No/ Low risk: Males ≤ 50 ml; Females ≤ 25 ml.			

NHMRC: National Health and Medical Research Council

Table 6 cont.

Characteristic	CURF variable name	CURF variable description	Variables used in this analysis	Variable code	Comparator category description
Risk factors					
Poor nutrition		Age 15+ years	DIETRSK	0	Adequate fruit and vegetables
		Daily serves of fruit and vegetables:		1	Inadequate fruit and vegetables
	DIETQ2	Vegetables (75 grams):		2	Not applicable
		Cooked vegetables – half cup			
		Salad vegetables – one cup	HIDIETRSK	0	Adequate fruit and vegetables
	DIETQ3	Fruit :		1	Inadequate fruit and vegetables
		One medium or two small pieces fresh fruit (150 grams)			
		Dried fruit (50 grams)			
		National dietary guidelines recommend a minimum of 2 serves fruit and 5 serves vegetables daily			
Physical inactivity	EXLEVEL	Age 15+ years	EXCSRSK	0	Moderate to High exercise level
		Score derived from frequency, duration and intensity of exercise undertaken for recreation, sport or fitness, or walking for transport .		1	Sedentary or Low exercise level
				2	Not applicable or unknown
			HIEXCSRSK	0	Moderate to High exercise level
				1	Sedentary or Low exercise level
		Sedentary or low activity level <1600			
		Moderate to high activity level ≥ 1600			
Smoking	SMKREGLR	Age 18+ years	SMKRSK	0	Never smoked regularly
		Smoking of tobacco, including manufactured and roll-your-own cigarettes, cigars, pipes. Regular smoking defined as 1 or more per day		1	Current ir/regular smoker
				2	Ex regular smoker
				3	Not applicable
			CURSMKRSK	0	Never smoked regularly or Ex-smoker
				1	Current ir/regular smoker

Table 6 cont.

Characteristic	CURF variable name	CURF variable description	Variables used in this analysis	Variable code	Comparator category description
Risk factors					
High body mass index (BMI)	BMBMICAT	Age 15+ years BMI derived from self-reported height and weight. Normal or underweight: BMI < 25 Overweight or obese: BMI ≥ 25 NB 3.35% underweight included in Normal	BMIRSKOVB	0 1 2	Normal BMI <= 24.99 Obese or Overweight BMI >= 25 Not applicable or unknown
			HIBMIRSKOVB	0 1	Normal BMI <= 24.99 Obese or Overweight BMI >= 25
			HIBMIRSKOB (excludes overweight)	0 1	Normal BMI <= 24.99 Obese BMI >=30
Multiple risk factors			RF2more	0 1	0 or 1 risk factor 2 to 6 risk factors
Demography					
Age category	AGECB	5 year age groups 0-84, age 85 and over coded as 85	AGE15over	1 2… 10 11	15-19 20-24…. 60-64 65+ years
			LFAGECAT15	0 1 2	<15 15-64 65+ years
			LFAGECAT01	0 1	15-64 65+ years
Age in years	*AGECX	Age in years 15 - 85 Note: age 85 and over coded as 85	AGECX	N/A	N/A

BMI: Body Mass Index

Table 6 cont.

Characteristic	CURF variable name	CURF variable description	Variables used in this analysis	Variable code	Comparator category description
Gender	SEX	1 Male 2 Female	GENDER	1 0	Male Female
			MALE	1 0	Male Female
			FEMALE	1 0	Female Male
Labour Force status	EMPSTABC	Age 15+ years Employed full-time or part-time Unemployed seeking work Not in Labour Force	Analysis included 15-64 years		
			LFEMPSTAT	1 2 3 4	Employed full-time Employed part-time Unemployed, seeking FT or PT work Not in labour force or N/A
			LFEMPFPUST	0 1	Unemployed, seeking FT or PT work Employed full-time or part-time
			NLFORCE	0 1	Employed full/part-time or Unemployed Not in labour force
SEIFA Index of Relative Socioeconomic Disadvantage	*CDDISWT	Population-weighted deciles of Index of Relative Socioeconomic Disadvantage at household Census District level	SDISPWT5	1 2 3 4 5	First quintile: most disadvantaged Second quintile Third quintile Fourth quintile Fifth quintile: least disadvantaged

Table 6 cont.

Characteristic	CURF variable name	CURF variable description	Variables used in this analysis	Variable code	Comparator category description
Health-related actions					
Days off work - Absenteeism	WRKOFFQ2	Employed persons 15-64 years Days (more than half) away from work due to own illness	ABSNTWI	0	No absence from work
				1	Days absent from work due to own illness
				2	N/A
			ABSNTWIm		
				0	No absence from work
				1	Days absent from work due to own illness
	WSILLNCF	Number of days off work due to own illness (0-14)	DOFFWKIL14	N/A	N/A
Days of reduced activity	OTHREDAC	Not in Labour Force with days of reduced activity	REDACTI	0	No reduced activity due to own illness
				1	Days reduced activity due to own illness
			REDACTIm	2	NA (or 14 days off work)
	REDANCF	Number of days of reduced activity	DREDACT14	0	No reduced activity due to own illness
				1	Days reduced activity due to own illness
				N/A	N/A

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006). CURF: Confidentialised Unit Record Files; NHS: National Health Survey; SEIFA: Socio-Economic Indexes for Areas *Expanded CURF.

2.4.3 The population, reference year and time horizon

The nominated ***reference year*** was ***2008***. Where we were required to use data from an earlier period, we adjusted these to accord with the population or prices for 2008. For example, we have used the latest Australian BoD study which has compiled the attributable burden associated with the risk factors of interest, in terms of incident cases, deaths and DALYs for 2003 (Begg et al. 2007). These were applied to the 2008 population by substituting 2003 ABS age and gender specific population data in the BoD spreadsheets for the 2008 population ABS data. We simulated benefits of risk factor prevalence reductions for the one reference year. However, the ***time horizon for benefits was based on a lifetime perspective for that 2008 population cohort***.

2.4.4 Use of Threshold Analysis for risk factors

Threshold analysis is a useful decision aid that can be undertaken in various ways to assist policy makers with important decisions, including resource allocation and research priority decisions. It can be used in a very general way, for example, to scope out the likely size or distribution of a key parameter; or in a more direct way, to assist with specific decisions (such as to invest or disinvest in a program). Threshold analysis is usually employed in decision contexts when some information is available, but other important variables are missing.

Threshold analysis was used in our estimations, combining available information and sensible judgements about credible values for missing data (i.e. the estimates for 'feasible' reductions in risk factor prevalence). First, the total disease burden was assessed and then the portion of the disease burden attributable to each risk factor was determined. The BoD study (Begg et al. 2007) was relied on heavily for these estimates. The ***attributable*** portion of the disease burden set the upper limit of health gain that would be possible following the theoretical elimination of a risk factor from the population. Using a combination of judgement and reference to the prevention literature, we estimated the ***avoidable*** portion of the disease burden by applying an 'ideal' feasible reduction in prevalence or at least getting half way (progressive target) to that goal. These estimates of reductions in mortality, incidence and DALYs were used to generate the likely production gains and health sector cost offsets. When used in a decision-making context to assist with priority setting, a common rule of thumb is that effective interventions that cost less than this level of production gain would constitute a net benefit to society. For example, if production gains and health sector cost offsets sum to $1 million then an intervention which is likely to cost less than $1 million would be considered cost-effective when compared to that threshold value.

The analysis set out in subsequent chapters for each of the risk factors, constitutes initial steps in the direction of using threshold analysis to inform the debate about the potential benefits of health promotion strategies. Used in a scoping role, the potential size and distribution of production gains available from the reduction of risk factors is useful for policy discussions, even where detailed cost-effectiveness information relating to specific interventions is unavailable. When applied to a number of risk factors in a systematic way, threshold analyses can provide decision-makers with an assessment of the potential contribution of each risk factor, as well as equity implications if you have information on who gains by age and gender, socioeconomic status, etc.

Using the threshold analysis approach, the potential production gains can be estimated if some proportion of the incident cases of disease is assumed to be preventable. The value of threshold analysis in the current context is that decision-makers will gain an idea of what proportion of a risk factor needs to be prevented before sizable gains in production effects can be anticipated. As empirically-based prevention intervention effects become available in the future, both in terms of costs and benefits, these can then be compared to results from the earlier preliminary estimates from threshold analysis.

2.4.5 Workforce productivity gains/losses

In this report we have adopted the term productivity gains/losses to reflect changes in workforce participation and absenteeism associated with health status. There are two main techniques which have been most frequently used in economic evaluation to measure and value productivity gains and losses: the Human Capital Approach (HCA) and the Friction Cost Approach (FCA). In brief, HCA counts all future income lost from an individual who leaves the workforce due to death and disability, whereas the FCA assumes individual will be replaced after a specified period and thus productivity losses to society will be less. However, there is still debate in the literature about which method is preferable, see Koopmanschap and Rutten (1996) and Liljas (1998) for two alternative views. The HCA is still the dominant methodology utilised to measure productivity costs in much of the published cost of illness studies, despite its limitations. However, the FCA has been used more frequently in recent studies.

The choice of HCA or FCA is not trivial. The adoption of one approach rather than the other has a dramatic effect upon the results and it is therefore important to revisit the conceptual underpinning of these approaches and the interpretation which can be attached to each. The discussion in the following three paragraphs was provided to the team by Professor Jeff Richardson (a member of the project Advisory Committee) and we are very appreciative of his input. While we take a slightly different position, we felt it important to fully report Professor Richardson’s advice.

> “HCA is the loss of production that occurs because a person is disabled or dead and is estimated on the assumption that the person would otherwise be fully employed. FCA assumes that if a person is out of the workforce then they will be, in part, replaced and, upon the assumptions used here this results in between 66 and 90 percent of the lost labour being replaced. Selecting between the HCA and FCA depends upon a counterfactual assumption, viz, what would happen to the employed labour force if a person was not dead or disabled. This counterfactual can never be verified. In the short term the assumption of the FCA is probably more plausible. It is feasible for other workers to work overtime and make up for people who are temporarily lost from the workforce. In the longer term and especially in the case of a young worker this assumption is less plausible in the case of mortality. If a large number of people do not die and the workforce is increased substantially it is implausible that unemployment will permanently rise by between 66 and 90 percent of this number. Macroeconomic policy or the operation of the market would be expected to absorb the additional labour and return unemployment to the so called ‘natural rate of unemployment’. This implies that the HCA is a more accurate reflection of the long term impact upon GDP and that the cumulative effect of health policies upon production will be somewhere between the two

> estimates. There is an alternative way of looking at these two estimates which is, perhaps, clearer. The HCA *estimates* the potential loss of production that would occur if unemployment remained at its 'natural rate' and other workers were not forced to work overtime or more intensively (imposing a cost in the form of lost leisure and – unrecorded – reductions in domestic production). The FCA estimate represents a lower estimate of what will, in fact, occur.
>
> At a deeper level production costs are of interest because the value of production is supposed to be related to the benefits that people obtain, as measured by their willingness to pay in a free market. Thus 'the economic benefits of reducing disease risk factors' – the topic of this report – are in principle, the human benefits obtained from reducing disease risk factors. But the important omission from this type of study is that the 'cost' – loss of wellbeing – from the death of an individual may not be correctly incorporated. An alternative justification of the HCA (indeed, the original justification) is that the 'economic cost' of a lost human life (i.e. the loss of benefits in the sense mentioned above), is equal to the market value of what that person would have consumed plus the market value of what others would have consumed because of this individual's efforts, (i.e. the market value of that person's production [domestic plus workforce]). Interpreted in this way, the HCA provides a better estimate of the 'economic cost'- that is, the human cost attributable to economic factors of the loss of production.'
>
> Interpreting the two estimates as potential and minimum economic losses therefore clarifies the differences and explains why the two estimates are so disparate."

In our view, part of the debate about HCA and FCA reflects the fact that the two methods can be used to answer two quite different research questions and that their relative merit varies according to the question being addressed. One question is to place a monetary value on human life, where the HCA provides a sensible floor estimate (logically, people should be prepared to pay at least their potential income to avoid death). The second question (our issue here) is to place a monetary value on productivity effects in the general economy (where the HCA has problems due to over-estimation and FCA has stronger claims). Considering the controversial nature of productivity gains/losses, both the HCA and the FCA were used and reported in this project (refer section 9.1). Further details about both methods are outlined below.

2.4.5.1 Human Capital Approach

Essentially the HCA determines "the present value of the additional stream of life income for individuals as a result of a health care programme" (Sculpher 2001).

The HCA is based on estimated output losses from cessation or reduction of production due to morbidity and mortality; or conversely, from gains made in human capital (both in terms of workforce participation and productivity increases) due to investments in health care (Sapsford and Tzannatos 1993). This is estimated from gross employee earnings in the case of the paid workforce (which involves various assumptions about the relationship between employee wages and production) and from the imputed value of unperformed household tasks for those not in the paid workforce (Hodgson and Meiners 1982). The values of other non market activities, such as leisure, study, housework, etc can be included under production costs, but do not appear in economic indices such as GDP. Therefore, these non-market activities are often excluded in the calculation of HCA estimates due to the difficulty of measuring and defining such costs. This method also excludes other psychosocial costs of illness such as pain, suffering and stress etc, which impact on quality of life. The current study includes an estimate for the non market activities of household and leisure productivity effects which are explained later (refer section 2.6). Intangibles such as pain and suffering are not costed.

An important assumption of the HCA method is that there is near full employment (Canadian Agency for Drugs and Technologies in Health 2006). While this assumption has been the main criticism of this method in the literature (Koopmanschap and Rutten 1994), the current Australian labour market may be close to meeting this assumption (due to low unemployment rates refer http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/6202.0). Secondly, this approach faces the difficulty of forecasting future rates of unemployment, growth and productivity over the remaining normal working lifetime of the prematurely dead/retired (Collins and Lapsley 1996), which cannot be accurately predicted.

In computing productivity impacts with HCA we use a methodology based on the DCIS, see Mathers et al. (1998). This methodology is based on usual HCA techniques and is simple to implement. The only issue is that DCIS is largely a descriptive study outlining the health sector costs of diseases rather than individual risk factors. In contrast, our project is an evaluation of various scenarios representing levels of risk factor prevalence in the Australian population. The techniques for counting and valuing the primary components of the HCA are the same. The only difference is that the incremental difference between productivity effects with and without a health promotion strategy that changes the prevalence of the risk factors needs to be determined. ***This procedure involves the determination of two sets of costs***:

- Mortality costs due to premature death;
- Morbidity costs due to illness, resulting in
    - absenteeism (i.e. taking time off work and household production/leisure activities) to attend medical and allied health professionals appointments
    - premature retirement.

We have not attempted to include the circumstance whereby people may be at work, but are less productive because of ill health.

The major assumptions behind the determination of production gains/losses of health interventions using the HCA are set out below. Not only does the current prevalence level in the population vary by risk factor, but also the workforce participation rate differs between people with different risk factors. For example ex-smokers (male) have a participation rate which is 19% lower than current smokers, whereas females with high psychological distress (such as those who have been exposed to intimate partner violence) have a participation rate of 53%, which is 8% lower than females with moderate levels of psychological distress. Thus, the scope for improving the productivity of the workforce pool will vary according to which risk factor is being considered. Details are set out in Part B of this report.

2.4.5.1.1 Mortality Costs

Mortality costs refer to lost production which has occurred as a result of premature death. Work related production losses due to premature mortality attributable to a risk factor are calculated for each death occurring at ages between 15 and 65. This is done by multiplying the years of life lost up to age 65 by the workforce participation rate and the average annual earnings for males and females separately. The relevant workforce participation rates of persons exposed to a risk factor are used. The main data sources include:

- Empirical estimates based on disease surveys – usually cross-sectional surveys. Examples include the NHS and the National Survey of Mental Health and Well-Being, as well as other disease or risk factor surveys; and
- Recourse to expert opinion if empirical estimates are unavailable.

2.4.5.1.2 Morbidity Costs

Morbidity costs refer to time which is lost from production, because the person is unfit for work, or is required to take time off work associated with ill health (e.g. to attend medical appointments) or leaves the workforce prematurely and permanently due to ill health (e.g. because of a serious non-fatal stroke).

Ideally, the opportunity cost of the time spent pursuing or receiving treatment by the relevant target population should be measured. If an individual is a worker substituting time at work for time spent receiving treatment, then the opportunity cost is his/her hourly wage. If the time component of treatment is large and differing wage rates are used (e.g. average wages for females are less than for males), the use of the relevant wage rates of the affected target population may lead to differences in the total production costs analysis. This can create equity issues that may be considered unacceptable in our society (Luce et al. 1996). Furthermore, issues such as the timing of appointments (during work time versus after hours) can incur disparate unit prices (leisure time is usually valued less than work time) (Cesario 1976). Due to lack of adequate data, we assumed that medical appointments occurred during work time. We used age and gender based wage rates for all analyses of the impact of change in risk factor prevalence.

In summary, the following parameters were required using the HCA, to calculate the likely production benefits associated with the feasible reductions in the prevalence of risk factors modelled in this project (a summary of the assumptions is also provided in section 2.5.3):

- Incremental numbers of lives saved and years of life up to retirement age saved, by the intervention (compared to doing nothing) by age and sex (to calculate mortality costs);
- Workforce participation rates of the population exposed to the risk factor and the unexposed comparator group (by age and sex);
- Gross and net average annual salary for premature deaths prevented by an intervention that leads to a reduction in prevalence of the risk factor (by age and sex);
- Quantity and length of short term absences from the workplace (by age and sex);
- Gross and net average annual salary of the exposed and unexposed comparator group population (by age and sex) who experience absences from work due to morbidity;
- The potential for compensation mechanisms at work (replacing an absent worker with a current worker, no worker, or an agency worker at higher rates) were incorporated by multiplying gross average salary by a factor (wage multiplier) which was varied in the uncertainty analysis between 0.275 and 1.3; and
- The proportion of absences covered by leave entitlements, which is assumed to be zero.

2.4.5.2 Friction Cost Approach

The proponents of the FCA argue that it provides a more realistic estimate of true market-based production costs by only including costs associated with the “friction” period. The friction period is the time it takes to recruit and train a new worker from the ranks of the unemployed to replace the lost worker who has either died or is unable to work due to illness (Koopmanschap et al. 1995). Proponents of this method argue that there are no production losses evident after a new worker is trained to replace the lost worker. In essence the friction method determines the costs to employers of losing workers due to illness and conversely the savings to employers from health improvements, as well as lost individual income during the friction period. The FCA has been recommended as the methodology of choice by a number of international bodies including the Canadian Agency for Drugs and Technologies In Health (2006).

However, the biggest drawback of this methodology is that it requires extensive data to estimate accurately the losses in the friction period, as these can vary widely across and within industry sectors. Furthermore, recruitment and training costs can vary significantly and are often not publicly available for use in economic evaluations. It is mainly for this reason that this method has not been widely adopted. Some of the data requirements are similar to the HCA; particularly with respect to the incremental numbers of people returned to work (in terms of both reduced mortality and morbidity) and labour force participation rates, wage rates and productivity levels. The only additional data requirements are the estimation of the friction period and associated recruitment and training costs.

It is noted that the Australian economy is operating at near full employment (http://www.abs.gov.au/AUSSTATS/abs@.nsf/mf/6202.0), and that some workers may not have been replaced when they die or retire. The additional data requirements to determine the FCA include:

- Key industries in which the target exposed populations are employed (from descriptive surveys or evaluation literature);
- Frictional periods of the industries (labour economics sources); and
- Employer costs (sourced from either published labour economic surveys/studies or expert opinion).

Finally, for illnesses which involve only short absences from work, both methods will produce similar results. However, for chronic diseases and/or diseases with high mortality, the two methods HCA and FCA produce quite different results.

A summary of the assumptions used in this project to calculate production gains applying the FCA is provided in section 2.5.3.

2.5 The Production Gains Model for people participating in the workforce

This section outlines the application of a mathematical model developed in Excel (Microsoft, Corp, 2003) to simulate the 'what if scenarios' as part of a threshold analysis related to people in the workforce. The model estimates the potential impact on workforce productivity gains/losses, and taxation effects in the Australian economy if reductions in risk factor prevalence were to be achieved. ***In this model, it is not necessary to specify an actual prevention intervention***. The model has been named the ***Production Gains Model***.

A separate Production Gains Model was developed for each of the risk factors of interest. Three workforce benefits were modelled which arise from a change in the prevalence of a risk factor. These included reduced premature mortality, reduced premature retirement and reduced short term absences. These benefits could be expected to occur (under certain assumptions outlined in detail later) if the exposed or 'at-risk' group changed their workforce behaviour and experience, now and in future, to match that of the workforce participation and absenteeism rates of the (comparator) persons in the Australian population.

The model follows a theoretical cohort of Australians who are participating in the workforce. Workforce participation is defined as people working part time, full time or looking for work. The model follows the cohort through time, until they retire upon reaching 65 years of age, estimating the production gains/losses and taxation effects of the health benefits that accrue during working years of life. The health benefits from a reduction in the prevalence of the risk factor include reduced deaths and reduced incident cases of diseases that are associated with exposure to the risk factor. Time lags between reduction in prevalence of risk factors and fewer deaths or incident cases of disease are acknowledged, but not incorporated in the modelling undertaken for this project (due to time constraints). 'Presenteeism' was also not included, that is a measure and valuation of persons at work, but less productive because of ill health. The real health benefits associated with any health promotion strategy or prevention intervention will depend on the breadth and effectiveness of the intervention, the age and gender of the persons who participate, and the reversibility of the excess risk associated with the risk factor. Such detailed analyses were beyond the scope of this project.

The dollar values of the measured workforce benefits were derived using the HCA and FCA outlined above.

2.5.1 Production Gains Model inputs

The model required considerable data inputs from a range of Australian and other data sources, along with a number of assumptions that are outlined in some detail. A complete list of inputs, their sources and the specification of uncertainty around the estimates is provided in Table 7.

Data on the workforce status (employed full time/part time, unemployed, not in the workforce) and absenteeism rates (over a fourteen day period) for the exposed and unexposed (comparator) Australian population are sourced from the NHS of 2004-05 (Australian Bureau of Statistics 2006). Average earnings and the number of days worked by part time workers are sourced from regularly generated labour-market surveys (Australian Bureau of Statistics 2007a). Data on the 2008 Australian population are sourced from the ABS (Australian Bureau of Statistics 2005).

To account for potential work place behaviour in response to short term absences, a wage multiplier is incorporated to more accurately reflect the value of production lost to short term absences. There is some overseas evidence that compensatory behaviour in the workplace by employees on their return to work and/or by colleagues in response to short term absences may occur (Koopmanschap and Rutten 1996; Pauly et al. 2002; Jacob-Tacken et al. 2005; Nicholson et al. 2006). The presence of compensation mechanisms in the workplace is likely to be dependent on factors such as the skill set of the absentee and his colleagues, the team based nature of the work, time sensitivity of deadlines and spare staff capacity in the workplace. In the absence of data on the nature of the industry in which the intervention participants work, we applied the likelihood of compensatory mechanisms when measuring the value of all short term absences. Longer term absences, valued using the FCA, also incorporated the possibility of compensatory behaviour, since the friction period was relatively short being set at three months.

Estimates of the number of beneficiaries from reductions in exposure to risk factors were sourced from the most recent Australian BoD study which attributes a number of deaths and DALYs to each risk factor of interest separately. The age and sex distribution of DALYs and deaths attributed to a risk factor have been used to estimate the likely age/sex distribution of incident cases of disease that can be attributed to the risk factor. An unspecified intervention was assumed to be able to potentially avoid all the attributed deaths and incidence of disease or some proportion of the attributed deaths and incidence, referred to as ‘avoidable’. The proportion described as avoidable is a matter of judgement described in section 2.3.1.

The marginal income tax rates applying in 2008 sourced from the Australian Taxation Office were used to determine the taxation effects on estimates of change in gross wages due to an intervention. An estimate of recruitment and training costs was taken from the outsourced Human Resources consultant to the Department of Treasury and Finance (personal communication, Craig Michaels DTF 2007).

Table 7 Technical parameters, source of data and uncertainty distribution

Data Item	***Source***	***Values***	***Distribution***	***Comments***
Unexposed Australian workforce participation rate	NHS 2004-05	Mean , n	Binomial	By 10 age groups and sex.
Risk factor specific exposed workforce participation rate	NHS 2004-05	Mean , n	Binomial	By 10 age groups and sex.
Unexposed Australian absenteeism rate	NHS 2004-05	Mean , SE	Normal	By 10 age groups and sex. Number of days away from work in the last 2 working weeks.
Risk factor specific exposed absenteeism rate	NHS 2004-05	Mean , SE	Normal	By 10 age groups and sex. Number of days away from work in the last 2 working weeks.
Days worked in a year at full-time status	Assumed	240	N/A	5 days for 48 weeks
Days worked in a year at part-time status	ABS 6310.0 Aug 2003 table 7. Weekly earnings in main job - by hours paid for in main job.	52% work 60 days 31% work 147 days 17% work 192 days	Cumulative	Assuming an 8 hour day and 48 weeks/year worked.
Wage multiplier	Pauly Nicholson, Koopmanschap	0.275 to 1.3	Uniform	Applied to reflect compensation mechanisms in workplaces.
Hiring and Training costs	Dept Treasury and Finance Human Resources Contractor	15 to 20% of gross wage for persons < 35 years. 35 to 50% of gross wage for persons > 35 years	Uniform	2007 proportions applied to 2008 wage rates. Higher rates apply to higher wages

Table 7 cont.

Data Item	Source	Values	Distribution	Comments
Australian average weekly earnings	ABS 6310.0 August 2008	Mean , SE	Normal	By 10 age groups and sex.
Real Wages Growth	Dept Treasury and Finance internal document	0.016	N/A	Introduced to yield consistent comparisons with other DTF projects
Friction Period (months)	Koopmanschap	3, 6	N/A	Varied in sensitivity analysis.
Discount rates		0, 0.035, 0.05, 0.7	N/A	Varied in sensitivity analysis.
Retirement age		65	N/A	Assumed
Employment status full time and part time of risk factor exposed population	NHS 2004-05	Mean SE	Normal	By 10 age groups and sex.
Unexposed Australian workforce employment status full time and part time	NHS 2004-05	Mean SE	Normal	By 10 age groups and sex.
Diseased or risk factor exposed population benefiting from an intervention	Burden of disease study 2003	Risk factor specific	N/A	By 10 age groups and sex.
Deaths averted by an intervention	Burden of disease study 2003	Risk factor specific	N/A	By 10 age groups and sex.

NHS: National Health Survey; SE: standard error; n: sample size; N/A: not applicable; fnight: fortnight; ABS: Australian Bureau of Statistics.

2.5.2 Production Gains Model simulations

The Production Gains Model was developed to calculate the net present value (NPV) of lost production that would be averted if people exposed to a risk factor were to modify their behaviour (that is, by eliminating exposure to the risk factor and thereby avoid the negative health effects of illness in future). For example, people who quit smoking may avoid future premature mortality and permanent early departure from the workforce (i.e. reduced participation in the workforce due to long term ill health), as well as experiencing fewer short term absences (days off work in a year) due to smoking-related ill health. All calculations in the model were created using age and sex specific data. Production effects were valued in real prices for the reference year (2008) after incorporating a wages growth factor of 0.016 per annum.

The model measures the difference in the surveyed workplace behaviours of the sub-population of people potentially benefiting from reduced risk factor exposure (e.g. current smokers) compared to the surveyed workplace behaviours of the unexposed (comparator) Australian smoking population (eg ex-smokers) in the year 2008 on the following parameters:

- the workforce participation rate: (employed and unemployed)/total civilian population; and
- the absenteeism rate (days off work in the last two weeks, converted to an annual rate).

The measured differences are converted to time away from the workplace and valued at the relevant current and future age and sex-specific wage rates, as the people grow older, to ascertain the future gross wages gained/lost if death and disease incidence can be avoided. A 3% discounting rate was used for future benefits (those occurring beyond the 2008 reference year).

2.5.2.1 Short term absences

The short term absences potentially avoided by a preventive health intervention conducted in 2008 or over a longer period, were measured as the difference in reported days off work that would occur if the exposed sub-population were to take days off work at the rate of the unexposed (comparator) Australians. We found that absenteeism rates at most ages were generally higher among exposed and diseased sub-populations compared to the unexposed (comparator) Australians. Where this was not the case in some sex/age groups and sub-populations (e.g. high risk consumers of alcohol), no adjustments to the NHS survey data were made. It is possible that under- or over-reporting of short term absences are present in the 2004-05 NHS data, but the extent is unknown and, therefore, we did not make any adjustments.

The model is designed to randomly select a value of absenteeism from the distribution of potential values for the age/sex specific exposed group (as specified by the mean and standard deviation) and calculates the difference from a randomly selected value of absenteeism from the distribution of potential values for the age/sex specific unexposed (comparator) Australian population.

The difference in absenteeism rate converts to work days gained/lost after multiplying by the number of working days in a year (240 for full time workers; a range of values for part time workers) and were weighted by the proportion of the exposed sub population in full time and part time work in 2004/5. The range of number of days worked per annum for part time employees was estimated using the distribution of number of hours worked in the main job, taken from the ***ABS 6310.0, Aug 2003, Table 7. Weekly earnings in main job - by hours paid for in main job*** (Australian Bureau of Statistics 2003). We assumed an 8 hour working day and 48 weeks worked per year.

The difference in days off work in each future year due to the intervention, were calculated at the relevant future age specific rates as an annual stream until the worker reaches 65 years of age (i.e. following the cohort of beneficiaries through time). The reduced days off work during the remaining working life of each beneficiary were converted to years. These gains/losses due to short term absences were valued under both the HCA and the FCA, in the same way. The age/sex specific participation rate and gross annual wage was adjusted by the wage multiplier to account for compensatory workplace behaviour and multiplied by the total of years gained/lost and multiplied by the number of people at each age who were estimated to benefit from the intervention in 2008.

2.5.2.2 Long term absences due to premature death

The first type of long term workplace absence potentially avoided by a health intervention in 2008 or a longer period, comprise the premature deaths that will be avoided in current and future years among persons up to the age of 65, due to the reduction in the excess mortality risk of the exposed sub-population, when they change their risk behaviour. For example, the risk of mortality at all ages is higher for smokers than non-smokers and ex-smokers (Bertram et al. 2007). The young have most to gain by quitting smoking.

Deaths avoided after the age of 65 were not considered as workplace productivity gains in this project. The expected time lag to the avoided deaths was determined by the distribution of mortality risk in the exposed population and varied with each risk factor. For example, the change in mortality risk among young depressed persons was quite immediate while the change in mortality risk associated with smoking was more distant. Many of the avoided deaths due to behaviour change at each age were expected to occur beyond retirement age and were therefore not included in the production gains estimates. The number of deaths avoided and their distribution across ages and time are risk factor and intervention specific. Thus considerable modelling dependent on such factors like intervention effectiveness and reach of the intervention across the population at risk is required. Since no interventions in this project were specifically considered, the time lag to deaths averted could not be modelled. Instead, we present a descriptive analysis of likely benefits regardless of disease specific time-lags.

While both the HCA and FCA count deaths in the same way, different monetary values to a lost working life are assigned. Using the HCA, long term absences were valued at the NPV of the current and future gross wages stream using age specific workforce participation rates and wage rates, until the deceased employees would have reached retirement age. Using the FCA, long term absences were valued as a fraction of the current year only, at current gross wage and workforce participation rates, adjusted by the wage multiplier, on the understanding that the employee would be replaced and compensation mechanisms may occur. A base friction period of 3 months was used in the production gains/losses model (Koopmanschap et al. 1995), which was varied to 6 months in the sensitivity analysis.

2.5.2.3 Long term absences of permanent withdrawal from the workplace due to ill health

The second type of long term absence that is potentially avoided by a health intervention arises because of permanent premature retirement from the workforce due to ill health. These longer term absences were estimated (incorporating a number of assumptions outlined later), by using the difference between workforce participation rates of sub-groups exposed to risk factors and the participation rates of unexposed (comparator) Australians. The participation rate difference assessed at each age was multiplied by the number of survivors benefiting from the intervention (that is, incidence of disease averted) to estimate the number of people who would not be leaving the workforce permanently early.

Long term absences for morbidity were valued differently depending on the HCA and FCA. Using the HCA long term absence was valued at the NPV of the current and future gross wages stream using age specific workforce participation rates and wage rates, until employees would have reached retirement age. Using the FCA, long term absences were valued as a fraction of the current year only, at current gross wage and workforce participation rates, adjusted by the wage multiplier, on the understanding that the employee would shortly be replaced and compensation mechanisms may occur. A base friction period of 3 months was used in the production gains/losses model (Koopmanschap et al. 1995) which was varied to 6 months in the sensitivity analysis.

2.5.2.4 Taxation effects

Total taxation gains/losses for short-term absences were calculated for HCA and FCA, by converting days of absence averted to years, by age and sex for the individuals that benefited from a reduction in the prevalence of each of the risk factors. The taxation gains/losses were measured for each of the remaining work force years at the appropriate age and gender wage rate and applying the 2008 taxation rates, sourced from the Australian Taxation Office. Using the HCA, longer term taxation was valued as the NPV of the current and future tax payable based on the future income stream of the people who benefited from the intervention, (deaths or prematurely retired due to ill health), ignoring the impact of potential compensation mechanisms. Using the FCA, the taxation effects of long term absences were determined by applying the 2008 taxation rates to gross annual wages earned in the friction period (multiplying by participation rates and the wage multiplier since compensatory behaviour in the workplace may occur). If the friction period was three months, one-quarter of an equivalent year’s tax was included; if the friction period was six months, half an equivalent year’s tax was included in the calculation. By calculating the tax effects this way, we assume the taxation impact occurs the instant the employee retires prematurely, and that no employee sickness benefits are paid. We acknowledge that data on the proportion of employees covered by long term sickness benefits would be needed to refine this aspect of the model.

2.5.3 Assumptions for the Production Gains Model

The following lists a number of important assumptions that have been required:

- Forty eight weeks are worked per year.
- Retirement age is 65 for both men and women.
- Short term absences from the workplace are caused by ill health.
- A reduction in ill health will lead to fewer short term absences, other factors remaining equal.
- Short term absences cover visits to both health professionals and hospital stays.
- People with risk factors who change their behaviour or exposure to the risk factor will reduce their rate of short term absences to the same level as those Australians who do not have the risk factor of interest in 2008. These time delays to risk reduction and benefits are not incorporated into the model.
- Workforce participation rates are related to health status.
- An improvement in health status will lead to higher workforce participation, other factors remaining equal.
- Any reduction in leisure time among workers making up for absences (themselves or others) is excluded from the study.
- Wages are expressed in real terms with 0.016 real growth per annum incorporated.
- The current wage rates and structure across age and gender will be maintained into the future.
- Current taxation rates remain constant until all beneficiaries of any health intervention reach retirement age or death.
- Taxation effects occur as soon as an employee retires prematurely.
- Training and recruitment costs are a percentage estimate of gross wages which rises in parallel with wage rates.

- Self report data from the NHS is sufficiently valid and reliable on exposure to risk factors of interest to the project.
- Presenteeism (being present at work but working at less than full productivity) is ignored.
- The presence of multiple risk factors in employees has not been incorporated. Each risk factor has been evaluated in isolation.
- The age and sex specific participation rates and absenteeism rates of NHS 2004-05 are assumed representative of future years while the 2008 population cohort ages to 65.
- Disease epidemiology does not incorporate any future trends.

2.5.4 Production Gains Model Outputs

We report for each scenario tested, the HCA and the FCA point estimates of production gains expected from a reduction in risk factor prevalence, broken down by age and sex. The production gains are separated into mortality and morbidity components. The taxation effects are reported by age and sex. For each of the production gains model output results we report the 95% uncertainty interval (refer section 2.8). The reported 95% uncertainty interval around the estimated mean value indicates that we are 95% certain that all of the assumptions above and estimates in data methods have been taken into account in this interval. In other words, this provides a likely upper and lower limit for each output variable.

2.5.4.1 Summary of the strengths and limitations of the data sources and assumptions incorporated in the Production Gains Model

- Longitudinal cohort data would be the best data to use in this analysis, as we are estimating the impact on workforce behaviour of reduction/elimination of risk factors in the working age population. This data may become available in future as Australian cohort studies (e.g. in cancer) publish long term data. In the absence of such longitudinal cohort data we have relied on the most recent cross sectional NHS which includes an examination of the workforce status and work place behaviours of Australians, and allows us to compare sub populations that have disease or risk factors, with other Australians who do not have such exposures. Data captured in the NHS is self-reported and not verified. This may lead to an overstatement or understatement of the work place behaviour differences in sub populations used in this analysis, compared to the (comparator) Australians. Many health conditions are poorly understood or recognized by the general population - diabetes and obesity in particular are known to be underreported (Vos and Begg 1999) as are the behavioural risk factors of smoking and alcohol use. It is difficult to know the direction of the bias this may have introduced to the calculation of production gains.

- The number of people included in the NHS, within age groups varied by sub-population examined and could introduce volatility to estimates of workplace behaviour.
- We have assumed the surveyed workplace behaviours of 18 and 19 year olds with risk factors, was representative of all persons aged 15 to 19 since persons under the age of 18 were not surveyed about the risk factors of interest.
- Estimates of the taxation effects are likely to be overstated to the extent that people continue to earn their usual salary while on sick leave for some extended period.

2.6 The Household Production and Leisure Time Model

In this project it was considered important to capture all aspects of productivity and not just the productivity of those participating in the workforce. This required the creation of a new model developed in Excel (Microsoft Corp) that could be linked to the other analytical models and source files used in this project. Unlike the Production Gains Model, the Household Production and Leisure Time Model was developed to estimate the impact of each of the risk factors of interest in one workbook. ***Two sources of ABS data were used as inputs to this model: the 2006 Time Use Survey (for identification of time allocation across activities of interest) and the NHS 2004-05 (for identification of time lost due to ill health among people with and without the risk factors of interest)***.

The most appropriate economic methods for quantifying and valuing household production and leisure time remain an area of continued debate (Drummond and McGuire 2001). Potential limitations include the fact that individuals may also perform overlapping activities because of time constraints, such as watching television while minding a child or cooking while listening to a radio. Floro and Miles (2003) have reported estimates of overlapping time spent for males and females for the labour market, household work and leisure activities. The authors provided this evidence using sub-sample data from the 1992 National Australian Time Use Survey. In brief, about one third of every activity involves at least one other simultaneous activity (Floro and Miles 2003). Therefore, it can be difficult to estimate precisely the quantity of household production and leisure time.

The definitions and methods used in this project for quantifying household production and leisure time are provided below. A summary of the assumptions are listed in section 2.6.6

2.6.1 Definition of household production

Household or home based production refers to the hours of time spent performing non-paid household duties such as cooking, shopping, cleaning, child care and maintenance. This is often referred to in the literature as non-market based production, since it is not traded in the usual way as a marketable item. The value of increased home based production available because of improved health is difficult to quantify directly in dollar terms, because the hours of increased household production are not usually assessed in studies of the effectiveness of preventive health interventions. Therefore, we were required to make a number of assumptions to estimate the value of household production which are described in the following sections.

2.6.2 Methods for measuring and valuing changes in household production

We sourced the average daily hours of participation in household activities from the 2006 Time Use Survey (Australian Bureau of Statistics 2008b). In this project, household production was based on three major activity classification groups within the 2006 Time Use Survey. These included **domestic activities** (mainly based on housework activities such as food preparation, cleaning, ironing, home and car maintenance), **childcare activities** (includes physical and emotional care for children under the age of 15 years), and **voluntary work and care** (such as physical and emotional caring activities for adults, unpaid work and assisting family and friends) (Australian Bureau of Statistics 2008c). Use of these categories leads to conservative estimates because they exclude personal care (sleeping, washing, etc); employment related activities (time spent in both paid and unpaid work or searching for work); education and training activities; and purchasing goods and services. The average time per day spent in household production was measured and valued at ***'replacement cost'*** by identifying a range of average hourly rates for commercially available domestic services and child care from appropriate sources. Each classification level provides three options for a basic hourly rate (e.g. based on years of experience). The most likely value was selected as the mid range basic hourly rate for each classification and the low and high values were the lowest and highest rate available for that classification band. These low and high values were used in the uncertainty analysis (refer section 2.8). These unit prices are provided in Table 8.

Table 8 Summary of unit prices used to estimate household production

Household production		**Uncertainty Ranges**	
Unit Prices*	**Hourly rate**	**Low**	**High**
Child care			
Unqualified	$15.24	$14.65	$15.79
Qualified (certificate III level)	$17.38	$16.78	$19.95
Domestic Services			
General services (gardening/ housekeeping, laundry)	$16.13	$15.72	$17.29
Food services (cook)	$16.40	$15.72	$16.53
Technical, clinical, personal care (nurse attendant/ personal care worker)	$16.40	$15.72	$16.99

*Sources of unit prices: Pay Scale Summaries- Victorian (2005) Award AP840807-FED and Health and Allied Health Private Sector Vic Consolidated Award 1998 [AP783872-FED] (note these pay scale summaries provide current 2008 prices).

2.6.3 Definition of Leisure time

Leisure time is a term used to describe healthy time available for non work-related activities in pursuit of leisure goals. This may include both active and passive leisure. In this project, leisure time was based on two major activity classification groups within the 2006 Time Use Survey (Australian Bureau of Statistics 2008b). These comprised **social and community interaction** activities (for example attending concerts, sports events, participating in religious ceremonies and attending meetings as part of community participation) and **recreation and leisure** activities (such as playing sport, participating in games and hobbies, reading and watching television, as well as relaxation time, thinking, smoking and drinking alcohol).

2.6.4 Methods for measuring and valuing changes in leisure time

The value of increased leisure time available because of improved health is difficult to quantify directly in dollar terms, because the hours of increased leisure available due to improved health, are not usually assessed in studies of the effectiveness of preventive health interventions. In this project, the value of increased leisure time was determined using the ***'opportunity cost method'***. Leisure time was valued by applying one third of the average weekly earnings for males and females reported by the ABS for 2008 (Jacobs and Fassbender 1998). There is empirical evidence from certain types of behaviour that is inconsistent with the standard model of the labour-leisure trade-off at the market wage. Cesario (1976) demonstrated that choice of mode of transport by commuters indicated that the opportunity cost of time was perhaps only one-third of the market wage. The practice of using a shadow price of time of one-third of the wage rate has become common in recreation demand analysis (Shaw and Feather 1999). Others recommend a lower value of 25% (Jacobs and Fassbender 1998). It is acknowledged that the value of leisure time may differ for a number of reasons, such as when leisure time is scarce an individual may value it more. In this project we have chosen to use a common conservative estimate because of the population approach taken.

The average weekly earnings were divided by 38 to provide an average hourly rate. To obtain an overall cost for leisure time one third of ***the hourly rate was then multiplied by the net difference in the annual number of hours of leisure time lost due to ill health for persons with and without the risk factor***. The usual method of measuring the value of labour time depends upon the marginal labour/leisure trade-off. It is likely that as leisure decreases its value rises and the one third of the wage rate estimate is likely to be a conservative estimate of the average as distinct from marginal value of leisure.

To accommodate uncertainty in the unit prices applied, a pragmatic approach of varying the unit prices by as low as 25% and up to 50% of the average weekly earnings were used. The average weekly earnings utilised were the reported seasonally adjusted estimates based on ordinary time earnings (Australian Bureau of Statistics 2008d). Table 9 provides a summary of the unit costs applied for valuing leisure time in this project.

Table 9 Unit prices for valuing leisure time

Leisure time Unit Prices	Hourly rate	Uncertainty Ranges Low	Uncertainty Ranges High
Average weekly earnings			
% applied	33%	25%	50%
Males	$10.44	$7.84	$15.68
Females	$8.79	$6.60	$13.20

Source: ABS 6302.0 TABLE 2. Average Weekly Earnings, Australia (Dollars) - Seasonally Adjusted weekly adult ordinary times earnings Feb 2008.

2.6.5 Methods for attributing the value of household production and leisure time to risk factors: the Household Production and Leisure Time model

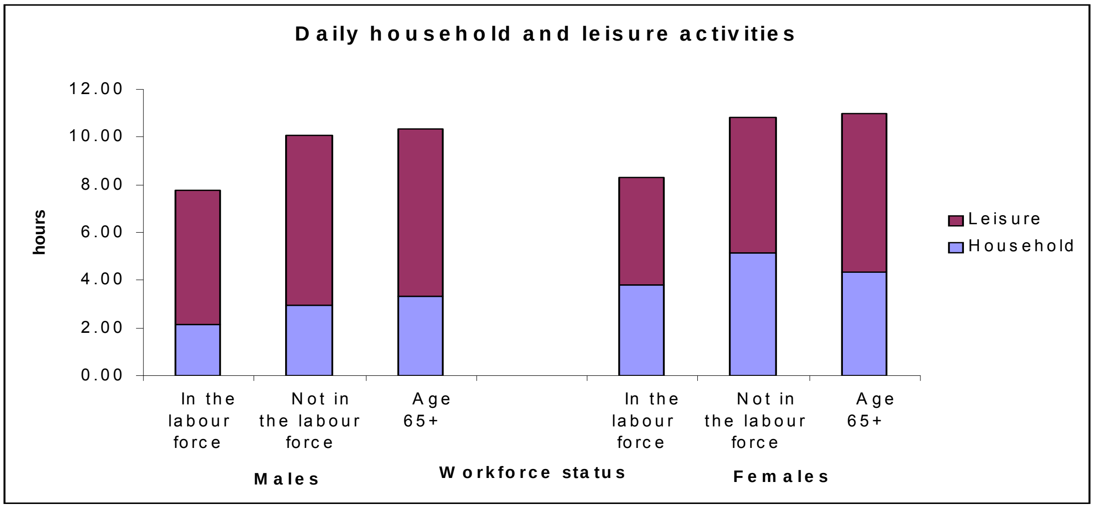
Data from the ABS Time Use Survey 2006 was not provided by risk factor status. Instead, we used the average time spent in the activities of interest for males and females according to workforce status and for persons aged 65 years or more. That is, the value of household production and leisure time attributable to the risk factors of interest were estimated for those in the workforce, as well as those not in the workforce and for people aged 65 or more who were considered to be retired. This is because each of these groups will have different amounts of time for household and leisure activities (Figure 3 and Figure 4). These estimates of leisure and household production **hours per day** were then applied to the surveyed **days of absenteeism due to illness and days out of role due to illness** data from the NHS 2004-05 for people in different risk factor exposure categories. That is, we determined the net difference in the calculated average days per year lost from absenteeism and/or reduced activity from ill health for people with and without the risk factors of interest, multiplied these days by the average hours per day spent undertaking household production and leisure activities (according to workforce status). The net difference in days of household production and leisure time between those persons with and without the risk factors was finally valued at the relevant average unit prices (Figure 5).

To estimate the ***change in lifetime household production and leisure dollars*** the annual household production and leisure activities dollars (of each risk factor) was finally multiplied by the remaining average years of life of the gender based three groups (working, not in the labour force and over 65 years of age) and discounted back to 2008 at 3%. The remaining average years of life were determined by subtracting the average age of each of the three groups from the life expectancy taken from the 2004-2006 Australian cohort life table (Australian Bureau of Statistics 2007b). The different ages of the risk factor groups and the reported life expectancy for each of these mean ages provided the uncertainty distribution which was entered to the @RISK modelling. As most people have more than one risk factor, we adopted the lowest estimate of life expectancy to provide the uncertainty range (uniform distribution between average life expectancy and lowest life expectancy expected based on individual risk factors).

Figure 3 Schematic of time allocation over work, household production and leisure by workforce status

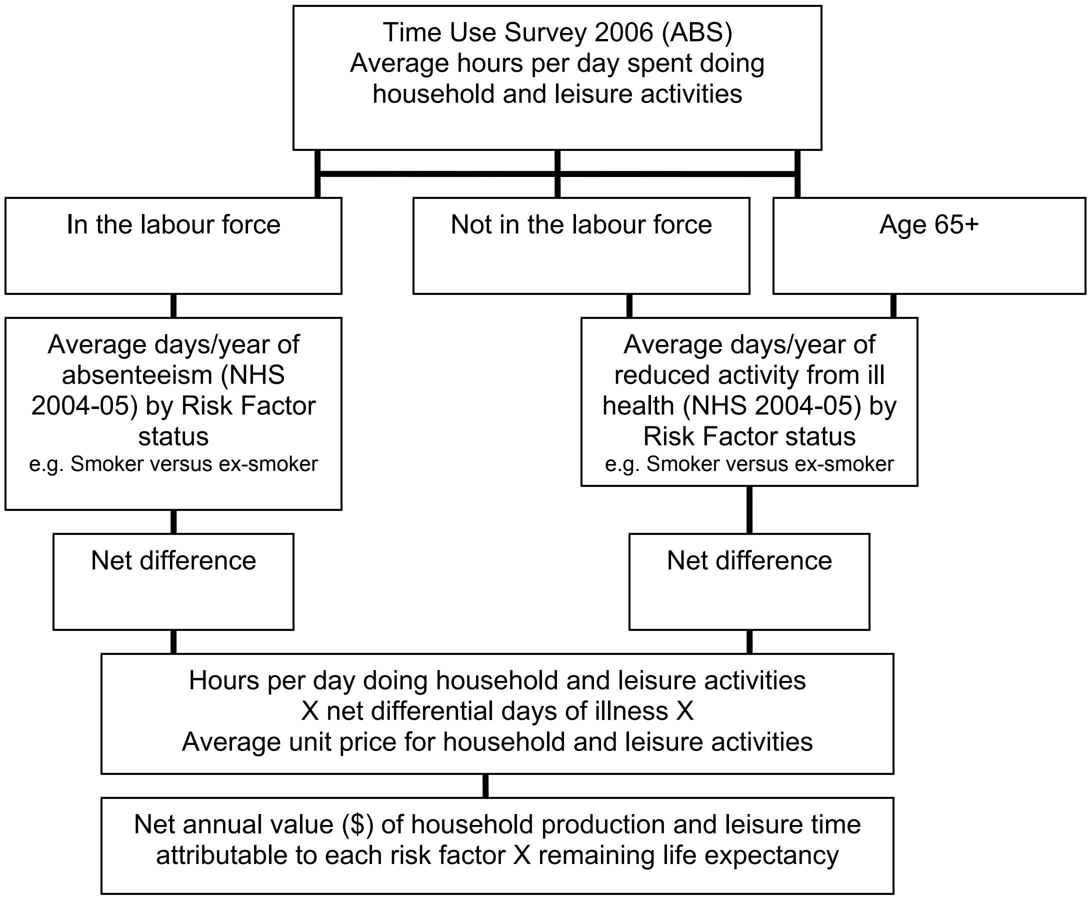
<table>
<tr><th>Participating in Workforce</th><th>Not Participating in Workforce</th></tr>
<tr><td>WORK</td><td rowspan="2">Household production</td></tr>
<tr><td>Household production</td></tr>
<tr><td>Leisure</td><td>Leisure</td></tr>
</table>

Figure 4 Average hours per day undertaking household production and leisure activities by gender and workforce status



Source: Adapted from How Australians Use Their Time (41530DO001) (Australian Bureau of Statistics 2008b).

Figure 5 Schematic of data sources and methods for estimating the lifetime value of household production and leisure time



NHS: National Health Survey ABS: Australian Bureau of Statistics.

A summary of the input parameters (net difference in days per year and the dollar value of these days in terms of household production and leisure time) for each of the risk factors is given in Table 10. These data highlight that, ***in some cases, people without a risk factor participate less in household and leisure time than those with a risk factor*** (see Figure 6 and Figure 7). In the analyses, these data were combined for each of the three labour force categories to provide an overall estimate of attributable household production and leisure costs for males and females by risk factor category Figure 8 and Figure 9). The issue of greater participation for some labour force groups with the risk factor of interest were overrun by the magnitude of the lesser participation in other labour force categories. The exceptions were males with high risk alcohol consumption and male current smokers. In both instances, the negative overall values were dominated by those not in the labour force. The implication is that ex-smokers have more reduced days of activity as do low risk alcohol consumers who are not working. This might be a plausible assertion and, in part, be explained by some of these people not in the workforce or over 65 years of age already being unwell and thus not working because of health effects, which has also resulted in them becoming an ex-smoker or reducing their alcohol consumption. For example, people who consumed alcohol at levels associated with high risk may avoid leisure time activities where they would be encouraged to consume alcohol. Unfortunately, more detail about these cases is unavailable because the best available data for this project were cross-sectional (from two separate sources) rather than longitudinal. This highlights an area for more research. Nevertheless, when the estimates are summed for males and females for both household production and leisure time, ***overall, there is a large attributable cost associated with smoking and high risk alcohol consumption risk factors***, which could be reversible (see individual risk factor chapters).

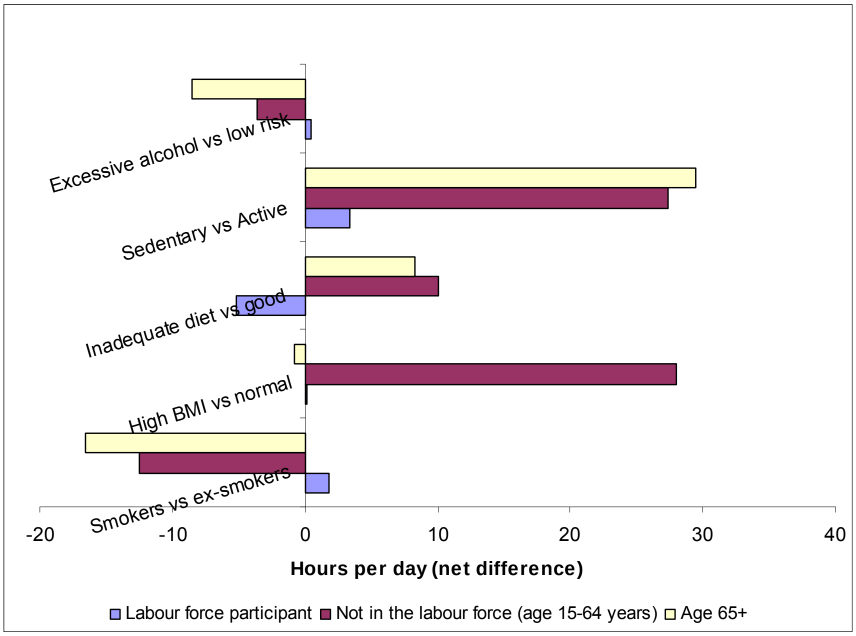
In summary, we have used conservative approaches to quantify and value household production and leisure time applying the best available Australian data. More specific details about the results derived for each risk factor are given in the relevant risk factor chapters in Part B.

Table 10 Summary of input parameters calculated for each risk factor group to estimate average household production and leisure time values

Net difference between those with and without risk factor	Smokers vs ex-smokers		High BMI vs normal		Hi psych distress vs moderate distress	Inadequate consumption vs Adequate consumption		Sedentary vs Active		High risk alcohol vs low risk	
	Male	Female	Male	Female	Female	Male	Female	Male	Female	Male	Female
Labour force participants											
Days**	1.9	5.1	0.2	4.7	14.9	-5.1	-0.5	3.4	3.2	0.5	2.4
Household production value***	$66	$316	$7	$292	$933	-$183	-$33	$122	$201	$17	$149
Leisure time value***	$117	$218	$12	$201	$642	-$325	-$23	$215	$139	$31	$102
Not in the labour force (age 15-64 yrs)											
Days**	-12.4	17.7	28	14.5	40.8	10.1	-6.4	27.4	16.1	-3.6	5.2
Household production value***	-$605	$1,494	$1,360	$1,223	$3,437	$489	-$540	$1,332	$1,358	-$173	$435
Leisure time value ***	-$1,000	$960	$2,249	$786	$2,209	$809	-$347	$2,202	$873	-$287	$279
Age 65+											
Days**	-16.5	-21.8	-0.8	9.3	35.8	8.2	8.8	29.5	26.5	-8.6	2.9
Household production value***	-$904	-$1,554	-$44	$662	$2,553	$450	$626	$1,610	$1,895	-$468	$208
Leisure time value***	-$1,313	-$1,379	-$64	$587	$2,267	$654	$555	$2,340	$1,682	-$680	$185

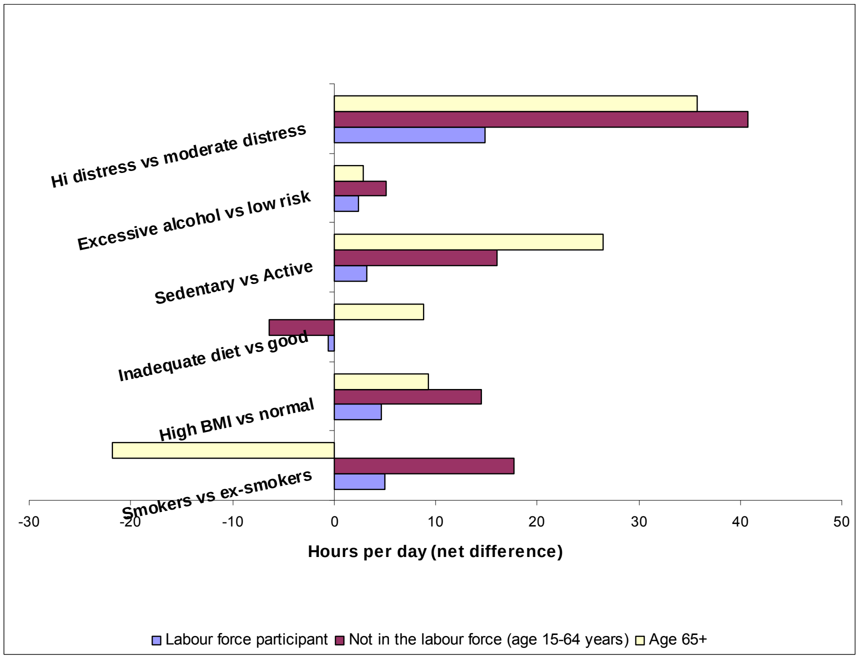
*Used as a surrogate from the National Health Survey 2004-05 (Australian Bureau of Statistics 2006) for the effects of intimate partner violence in females; **days rounded to 1 decimal place; ***rounded to whole $

Figure 6 Net differences in reported absenteeism or days of reduced activity from ill health in males by labour force and risk factor status



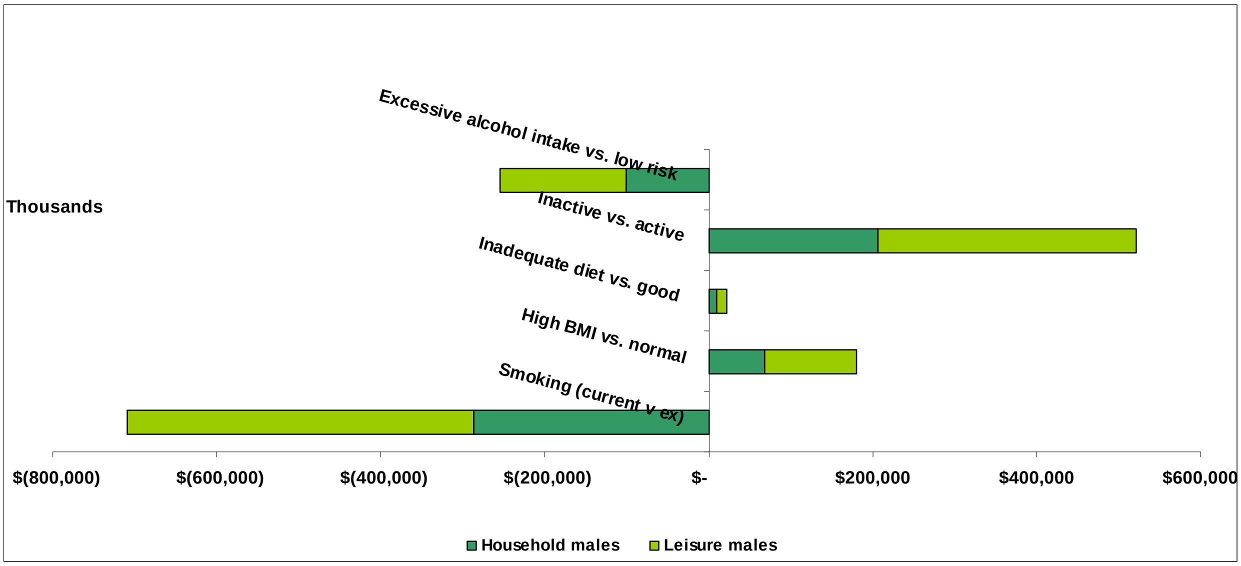
Source: Adapted from data National Health Survey 2004-05 (Australian Bureau of Statistics 2006) and the 2006 Time Use Survey (Australian Bureau of Statistics 2008b).

Figure 7 Net differences in reported absenteeism or days of reduced activity from ill health in females by labour force and risk factor status



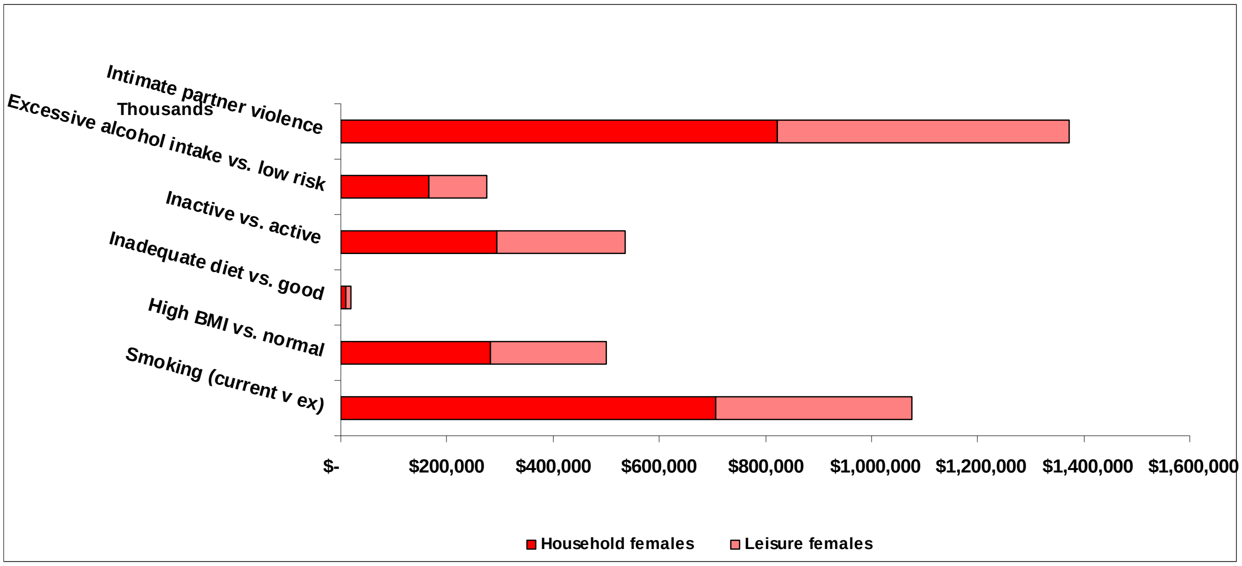
Source: Adapted from data National Health Survey 2004-05 (Australian Bureau of Statistics 2006) and the 2006 Time Use Survey (Australian Bureau of Statistics 2008b).

Figure 8 Net differences in attributable household production and leisure time costs by risk factor for males



Source: Adapted from data National Health Survey 2004-05 (Australian Bureau of Statistics 2006) and the 2006 Time Use Survey (Australian Bureau of Statistics 2008b).

Figure 9 Net differences in attributable household production and leisure time costs by risk factor for females



Source: Adapted from data National Health Survey 2004-05 (Australian Bureau of Statistics 2006) and the 2006 Time Use Survey (Australian Bureau of Statistics 2008b).

2.6.6 Assumptions for the Household Production and Leisure Model

The following lists a number of important assumptions used in the Household Production and Leisure model:

- Average hours per day in household and leisure activities was obtained from the 2006 Time Use Survey (Australian Bureau of Statistics 2008b) and accepted as representative for people with the risk factors of interest since most Australians have one or more of our risk factors of interest irrespective of workforce status (refer section 9).
    - Household time defined as undertaking childcare; domestic activities (such as cleaning and food preparation); and voluntary work and care (e.g. unpaid care of friends and family) activities. Leisure time defined as undertaking social and community interactions as well as recreation and leisure tasks.
    - Personal care (including sleeping), employment or self education related activities and making household purchases were not included.
    - The amount of time dedicated to household and leisure activities varies according to gender and workforce status (i.e. working, not in the labour force and retired) and health status.
- An improvement in health status will lead to greater participation in household and leisure activities, other factors remaining equal.
- Household time can be valued according to the average market price of replacement household and childcare services.
- Leisure time can be valued by applying one third of the average weekly earnings for males and females.
- Retirement age is 65 for both men and women.
- People with risk factors who change their behaviour or exposure to the risk factor will increase their participation in household and leisure tasks to the same level as those who do not have the risk factor of interest.
- Time delays to achieve risk reduction and benefits are not incorporated into the model. That is, in 2008 it is assumed that those people who no longer have the risk factor will not acquire the diseases associated with that risk factor over the rest of their lifetime.

- Current household and leisure time participation by gender and workforce status is representative of future activity.
- Self report data from the NHS is sufficiently valid and reliable for exposure to risk factors; days of reduced activity and absenteeism from work of interest to the project.
- The presence of multiple risk factors has not been incorporated. Each risk factor has been evaluated in isolation.
- Benefits determined for the rest-of-life for the 2008 cohort based on current life expectancy estimates for males and females.
- Disease epidemiology does not incorporate any future trends.
- Uncertainty ranges for point estimates based on standard errors for the Time Use Survey data and NHS 2004-05; life expectancy estimates for various average ages for people who have the risk factors of interest; and the range of employment classification levels used for replacement costs are valid.

2.7 Co-morbidity correction methods

Co-morbidity arises when two or more conditions occur simultaneously in an individual. Independent co-morbidity is when the probability of having two or more conditions simultaneously equals the product of the probabilities for having each of the conditions (Begg et al. 2007). In contrast, dependent co-morbidity is when the probability of having two or more diseases is greater than the product of the probabilities for each disease. In this latter instance, there are common causal pathways, such as multiple risk factors causing the same disease or the presence of one disease may increase the risk of another in the same population (Begg et al. 2007). Therefore, when making assessments of the impact of individual risk factors on disease or financial outcomes there is a potential for ‘double counting’. That is, if estimates of disease burden due to several risk factors are added together it can appear that more than 100% of the total burden of any one disease is being accounted for by the risk factors in combination (Begg et al. 2007).

The usual method for estimating the excess risk of disease from exposure to a risk factor is to calculate the population attributable risk fraction (PAF). These are usually based on evidence from studies where relative risk (RR) estimates for disease have been reliably calculated for people exposed and not exposed to single risk factors (as far as possible). The formula requires the lowest possible level of risk in a population which has been referred to as the 'theoretical minimum' (Begg et al. 2007). The PAF is the proportion by which the incidence rate of a disease could be reduced if the risk factor was to reach the theoretical minimum. Some degree of risk reversibility is assumed.

The PAF is expressed as:

$$\textbf{PAF} = \frac{\textbf{Prevalence Exposure (RR disease - 1)}}{\textbf{Prevalence Exposure (RR disease - 1) +1}}$$

To avoid overestimating potential benefits from reducing multiple risk factors, techniques for more appropriately attributing outcomes to risk factors have been developed. The 2003 Australian BoD study outlines a mechanism for correcting for joint risk factor attribution, based on work done by WHO (Ezzati 2004). The purpose of joint attribution methods is to enable an aggregate estimate of the likely effect of reductions in multiple risk factors. In brief, a formula known as the ***joint population attributable risk fraction*** (joint PAF) is used. This formula is based on the assumption that health risks are biologically independent and uncorrelated (although it is acknowledged that this is not always the case). This assumption allows the joint PAF for *n* number of risks to be expressed as:

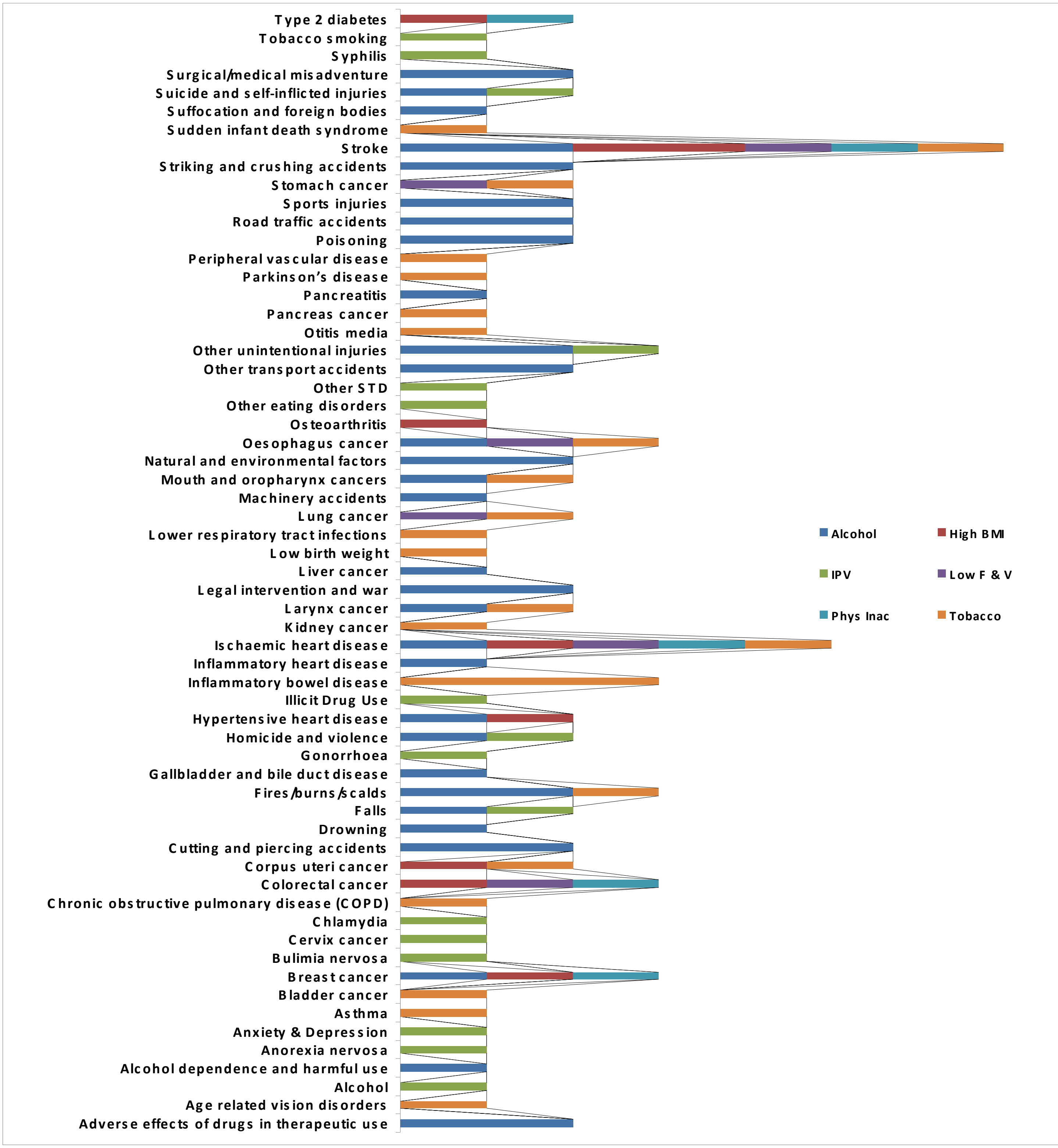
$$\text{joint PAF} = 1 - \prod_{i=1}^{n}(1 - PAF_i)$$

where PAF_i is the PAF of the individual risk factors (Begg et al. 2007).

2.7.1 Method for joint attribution to correct for co-morbidities

The risk factor calculation and summary files generated for the 2003 Australian BoD study were provided for use in this project. Within the 2003 BoD study, PAFs were estimated for each of the risk factors for males and females by age group. From these files, we were able to establish the scope of diseases attributable to each risk factor and also identify the significant overlap in disease causation (Figure 10). The joint effects correction methods were applied in Excel to estimate the total health, economic and financial outcomes that could be attributed to the six risk factors in combination. The 'unshared' absolute DALYs and health expenditure costs were also included in the total estimates for each risk factor. Health expenditure arising due to risk factors was nominated as one of the important financial outcomes for this project. The use of data from the DCIS ensured a consistent disease-based approach with the BoD method of joint attribution of DALYs (refer section 2.3.2).

Figure 10 Schematic diagram of the breadth and overlap of diseases associated with each risk factor (adapted from 2003 Burden of Disease study files)



Another important consideration was to acknowledge the relationship between behavioural risk factors (considered to be distal risk factors in the causal chain) and biomedical risk factors (considered as proximal risk factors). In the casual pathway for disease, for example cardiovascular disease, a risk factor such as physical inactivity will be less influential once the data have been corrected for proximal risk factors (which precede disease development in the casual chain) such as blood pressure. In other words, there is evidence to demonstrate that there is some attenuation of the health effects after adjustment for the more proximal factors. This attenuation provides evidence that some of the hazard of the more distal factors operates by increasing levels of proximal risk in factors (Begg et al. 2007). The attenuation varies among studies, but is consistently less than one-half of the excess risk (that is, RR - 1) of the more distal factors. Therefore, an upper bound of 50% was used in the 2003 BoD study as the proportion of the excess risk for distal risk factors that were considered to be mediated through proximal factors that were also among the risks being analysed (Begg et al. 2007). In this project, where risk factors were considered to have interactions for the disease outcomes we applied the sample principle. That is, we applied a 50% attribution correction factor to the individual PAFs prior to calculating the joint PAF. For each disease associated with the nominated risk factors the total number of DALYS or total amount of health expenditure was multiplied by the estimated joint PAF (calculated by applying the joint effects PAF formula which incorporates the individual PAFs for each risk factor) for each gender and age group.

The diseases associated with combinations of the risk factors fall into four large disease groups: cancers, cardiovascular disease, diabetes and injuries. The summary results with and without the joint effects correction are provided in Table 11. While 28% of the total DALY burden in Australia has been attributed to the six individual risk factors of interest, once the correction of joint effects has been applied, only 16% of the total DALY burden is attributed to the six risk factors in combination. In contrast while 9% of the total health expenditure in Australia can be attributed to the six individual risk factors of interest, once the correction of joint effects has been applied, 9% of the total health expenditure remains attributed to the six risk factors in combination. This highlights the fact that diseases that generate DALYs do not necessarily lead to proportionate health expenditure. The clearest example of this is maternity services which incur health sector costs but very few DALYs. The health expenditure does not fall after the application of joint effects correction also because there are some diseases which generate large health expenditures (eg chronic airways disease, mental disorders and neurological conditions) that do not share the causal pathways of multiple risk factors and thus are not significantly reduced in the joint effects correction process.

Through this method, we estimated the proportion of the uncorrected attributed health, economic and financial outcomes of interest that were attributable once joint effects were taken into account. These benefits amounted to 57% of the health status outcomes (DALYs), and 95% of the health sector costs. We applied these proportions to each of the feasible reductions in the risk factor prevalence collectively to avoid overestimation of the potential benefits to society. More details of the findings are provided in chapter 9.

Table 11 Summary of joint effects correction applied to DALYs and health sector costs

Joint effects (JE) correction	DALYS ‘000s	COSTS* $millions
Total national estimate 2008	2,633	62,108
Attributed (uncorrected for JE)	750	5,583
Cancers (JE corrected)	76	214
Cardiovascular disease (JE corrected)	158	1,045
Diabetes (JE corrected)	69	369
Injuries (JE corrected)	15	320
Attributed (JE corrected)**	430	5,329
% corrected of Total	16%	9%
% corrected of Uncorrected	57%	95%
% uncorrected of Total	28%	9%

*Health Expenditure 2000-01 (Australian Institute of Health and Welfare 2002) adjusted to 2008 prices (total health price index 100/80.74); JE: Joint Effects.

**Includes other diseases associated with risk factors.

2.8 Uncertainty analyses

In this study, multivariable probabilistic uncertainty analyses was undertaken using @RISK software version 4.5 (Palisade Corporation 2005). Uncertainty analysis was undertaken using a range of possible values whenever a piece of information was not known exactly. Simulated point estimates (minimum 4,000 iterations or until convergence was met) was used to estimate a mean, median and 95% uncertainty interval for each of the economic and financial outcome measures.

Simulation modelling techniques (with Monte Carlo sampling) using @RISK software are used to allow the presentation of an uncertainty range around the estimates of productivity gains/losses, the taxation effects and the household and leisure gains (Palisade Corporation 2005). This approach is recommended by the Canadian Coordinating Office for Health Technology Assessment and is also mentioned as one of a number of methods of exploring uncertainty in the 1996 US Consensus Panel on Cost-Effectiveness in Health and Medicine (Gold et al. 1996; Palisade Corporation 2005; Canadian Agency for Drugs and Technologies in Health 2006).

The probability distributions around the input variables were based on survey standard errors, survey proportions, or taken from the literature. The range of parameter values were taken from surveyed data, quoted in or calculated from the literature or from expert advice. In addition to enabling the presentation of the uncertainty surrounding results, @RISK analysis can be used to identify the input parameters with the greatest influence on the uncertainty surrounding the final results. It would be these input parameters that need to be prioritised in future research if greater accuracy of results (i.e. narrower ranges) is considered desirable.

As the uncertainty analysis executes within our models, values of a parameter from the distribution of potential values for the age/sex specific exposed group are randomly selected and the difference from a randomly selected value of the same parameter from the distribution of potential values for the age/sex specific unexposed (comparator) group is calculated. The models are iterated in this way 4,000 times generating a range of likely outcomes, from which the median and the 95% uncertainty interval (UI) are reported. Since exposure status (for example smoking, high risk alcohol consumption or being obese) is the only change occurring, it would be unreasonable to allow the model to choose a high parameter value for the exposed group to compare with a low value selected at random from the unexposed (comparator group) distribution of the same parameter and vice versa. To prevent this occurrence, (which could lead to unrealistic results), the distributions of selected parameters are correlated. Absenteeism rates and participation rates pertaining to the unexposed (comparator) population and the exposed population of each risk factor are the only parameters that are correlated within the production gains model. In the household and leisure model the correlated variables are the hours of household production and the hours of leisure, which it is argued would be similarly affected by days of illness in any member of the population, whether they were working, not working or retired. Unit prices have also been correlated since movements up and down could be expected to similarly affect all prices in the economy.

Simulation results from @RISK can be provided highlighting graphically the likely distribution of the outputs of interest, and the most important inputs contributing to the uncertainty in the results under multiple scenarios. These reports are available from the authors upon request.

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PART B

RISK FACTOR CHAPTERS & DISCUSSION

3.0 INTIMATE PARTNER VIOLENCE

Summary of consensus decision for analytic modelling:

Current prevalence (Australian Population 2008)

Progressive target ↓2.5%

Ideal (realistic) target ↓ 5%

3.1 Executive summary

Main findings from the literature review

- Consistent with the 2003 Australian Burden of Disease (BoD) report, analysis of intimate partner violence (IPV) was only attempted for females in this project. Begg et al (2007) explain that there is currently insufficient evidence available indicating the prevalence and risk of IPV amongst males, but it is unlikely to be zero.
- In any one year, approximately 4% of Australian women have been reported to experience IPV, with the highest prevalence in younger women.
- IPV contributes 1.1% to the total disease burden in women in Australia, with depression and anxiety the major contributors of disease burden (63%) associated with IPV.
- Many primary and secondary prevention strategies have been initiated, but very few have evaluated reductions in IPV prevalence or cost-benefit.
- Investigators who conducted a recent international survey reported IPV prevalence of 27% in Australia and a prevalence of 22% in Denmark. The Advisory Committee of this project agreed that the latter figure represented a realistic target for Australia.

Research findings from this project

We modelled health status, economic and financial benefits based on the prevalence of the risk factor of interest in the 2008 Australian population. These benefits will not occur instantaneously, and the results are provided to inform decision making regarding the importance of disease prevention. In reality, risk reversal after the cessation of a risk behavior can take some time to occur and hence the estimated benefits will not be realized immediately but over some period of years instead. For example, recovery from depression can take several years and may be interspersed with periods of relapse. Putting this issue of time lags to one side, at a population level, if the prevalence of IPV was to be decreased important opportunity cost savings from the reduction of illnesses associated with this risk factor could be achieved. These are outlined below.

- If the prevalence of IPV was eliminated from the Australian community then potential opportunity cost savings of $207 million in health sector costs and $1,801 million in production and leisure costs could be realised (assessed using the Friction Cost Approach - FCA) over time.
- We found that if IPV prevalence could be reduced from 27% to 22% (ideal target):
    - Potential opportunity cost savings of $38 million in health sector costs and $333 million in production and leisure costs could be realised (FCA) over time
    - The 34,000 annual new cases of IPV related illness could be reduced by 6,000
    - The 435 annual deaths attributed to IPV could be reduced over time by 74
    - The 29,000 Disability Adjusted Life Years (DALYs) could be reduced by 5,000
- If IPV prevalence could be reduced from 27% to 24.5% (progressive target):
    - Potential opportunity cost savings of $19 million in health sector costs and $166 million in production and leisure costs could be realised (FCA) over time
    - Annual new cases of IPV related illness could be reduced by 3,000
    - Deaths attributed to IPV could be reduced by 37
    - DALYs could be reduced over time by 3,000

3.2 Definition

The *International Violence Against Women Survey* (IVAWS) defined IPV as women who had a current or former intimate partner and had experienced violence from that partner during their lifetime (Johnson et al. 2008). A detailed definition is offered by VicHealth (2004), '*Intimate partner violence, sometimes referred to as domestic violence, family violence or relationship violence, refers to violence occurring between people who are, or were formerly, in an intimate relationship. Intimate partner violence can occur on a continuum of economic, psychological and emotional abuse, through to physical and sexual violence*'.

The NHS 2004-05 does not measure IPV directly. Therefore, we used psychological distress as a reasonable proxy for IPV in this project because the major illnesses associated with IPV are depression and anxiety. Drawing on the literature, and taking into account available source data, IPV was defined as follows:

Intimate partner violence	High psychological distress has been used as a proxy for current exposure to intimate partner violence: High or very high levels of psychological distress (score 22-50 on the Kessler Psychological Distress Scale -10).
	Moderate psychological distress has been used as a proxy for past exposure to intimate partner violence: Moderate levels of psychological distress (score 10-21 on the Kessler Psychological Distress Scale -10).

If a woman ceases to be exposed to current IPV, we have modelled that she will change from a high level of psychological distress to a moderate level since she remains exposed to lifetime (past) IPV.

3.3 Summary of current literature and best available data

3.3.1 Prevalence data

Prevalence estimates in the current study were based on data from the 2003 BoD report (Begg et al. 2007); see Table 12).

Table 12 Australian women who have ever suffered violence from current or former partner

Age	15-29	30-44	45-59	60-69	70-79	80+
% of women	15%	22%	21%	10%	10%	10%

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

Data from the ABS Personal Safety Survey (2006a) showed that 2% of women experienced violence by a current partner and 15% of women experienced violence by a previous partner, although this sample included never-partnered women. A recent survey that used more inclusive definitions indicated that 27% of women who had a current or former intimate partner had experienced violence from a partner during their lifetime (Johnson et al. 2008).

In Victoria, IPV contributes 3% to the total disease burden in women and 9% in women aged 15-44. In this younger age group, it is the leading contributor to death, disability and illness, being responsible for more disease burden than many well-known risk factors, such as high blood pressure, smoking and obesity (VicHealth 2004).

3.3.2 Socioeconomic status

Age is consistently identified as a major predictor, with younger women more likely to experience IPV. The predictive value of socioeconomic status is less clear. Some researchers have found an inverse association between women's educational attainment and the risk of domestic violence (Craven 1997). Others have found higher levels of violence reported by women with higher educational attainment (Australian Bureau of Statistics 1996). A number of studies have indicated that women living in poverty are disproportionately affected by IPV (Krug et al. 2002), but most of these studies were conducted in developing countries.

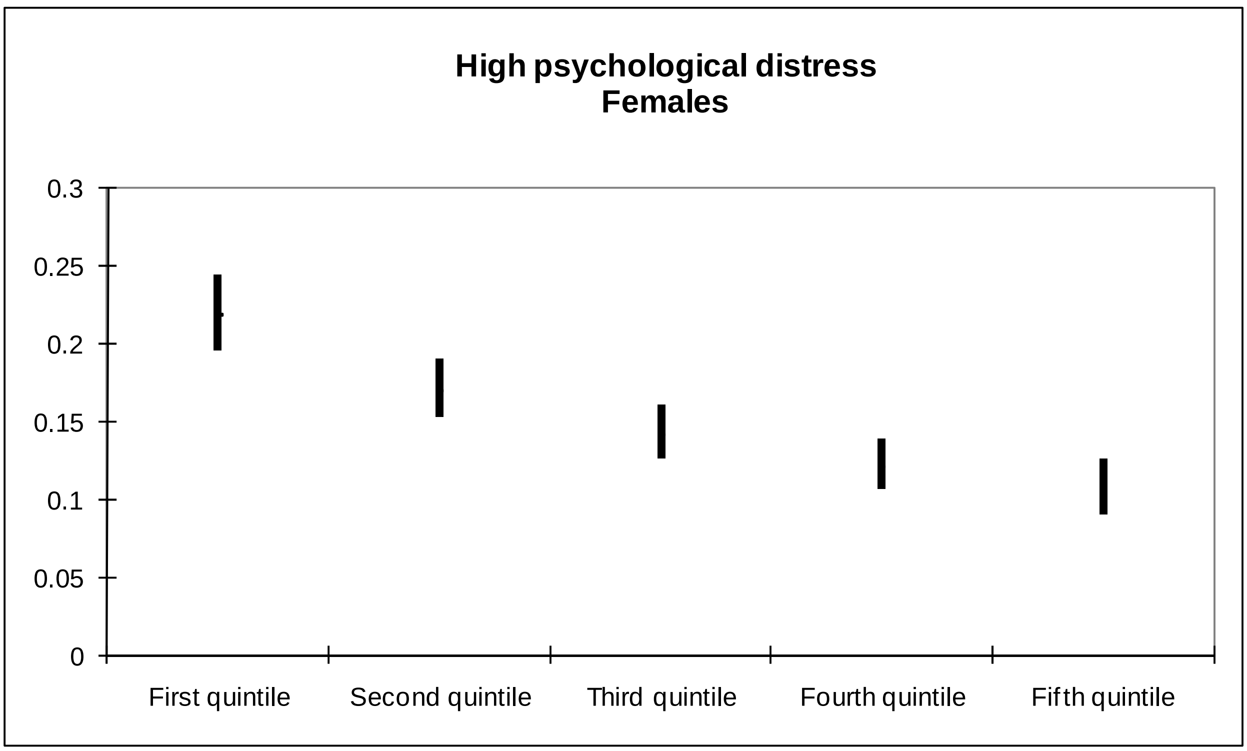
Australian data have drawn inconsistent findings. Mouzos and Makkai (2004) indicated that IPV is not related to a woman's educational attainment, labour force participation or combined household income. However, investigators using NSW data suggested that the incidence of domestic assault in an area is linked to economic and social disadvantage (People 2005). Therefore, the exact relationship between this disadvantage and domestic assault remains unclear.

SEIFA indices are summary measures of a number of variables that represent different aspects of relative socio-economic disadvantage and/or advantage in a geographic area (Australian Bureau of Statistics 2008). In the current study, ***SEIFA quintiles obtained from data in the NHS 2004-05*** were used to illustrate differences in socioeconomic status among people with and without the risk factor of interest.

The proportion of females in each socioeconomic quintile who reported high levels of psychological distress is presented in Figure 11 and Table 13. Females in lower socioeconomic groups were more likely to report high distress levels compared to females in higher socioeconomic groups. We found that 21.8% of females reported high distress levels in the lowest socioeconomic group compared to only 10.7% in the highest socioeconomic group.

While this suggests that there may be benefit in accounting for socioeconomic status in the design of preventive programs, in order to target women more likely to report IPV, this finding is inconsistent with aforementioned literature. This may be due to our use of psychological distress as a proxy for current exposure to IPV and suggests the need for further research to consider the complexity of the relationship between socioeconomic factors and IPV.

Figure 11 Proportion of women in each socioeconomic quintile who report high levels of psychological distress



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006b).

Table 13 Proportion of women in each socioeconomic quintile who report high levels of psychological distress

		95% Confidence Interval	
	Mean	**Lower Limit**	**Upper Limit**
Females			
First quintile	0.218	0.195	0.243
Second quintile	0.17	0.152	0.19
Third quintile	0.142	0.126	0.16
Fourth quintile	0.121	0.106	0.138
Fifth quintile	0.107	0.09	0.126

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006b).

3.3.3 International comparisons

There have been several attempts to make meaningful international comparisons in rates of IPV, including Krug et al.'s (2002) WHO report, Garcia-Moreno et al.'s (2005) multi-country WHO report and Schröttle et al.'s (2006) European study. The best and most recent attempt to compare IPV across countries was the *International Violence Against Women Survey* (IVAWS). One of the main aims of the IVAWS was to facilitate international comparisons by using very similar measurement tools and techniques to establish prevalence in each participating country. Johnson et al. (2008) reported data for Australia and eight other countries. Prevalence of IPV was highest in Mozambique (40%) and lowest in Hong Kong (9%), with other countries ranking in between: Czech Republic (37%), Costa Rica (36%), Australia (27%), Denmark (22%), Poland (16%), Philippines (10%) and Switzerland (10%).

3.3.4 Health outcomes

Authors of the 2003 BoD report (Begg et al. 2007) estimated that 1.1% of the overall health burden in Australian women can be attributed to IPV (age <45: 4.8%, 45-64: 2.8%, >64: 0.3%). In terms of DALYs lost, the most prominent contributors to health burden are depression and anxiety (63%), suicide and self-inflicted injuries (11%), lung cancer (5%), homicide and violence (4%) and Chronic Obstructive Airways Disease (COPD) (4%). In Victoria, the largest contributors to the health burden of IPV are depression (33%), anxiety (26%), suicide (13%) and tobacco use (10%) (VicHealth 2004). Poor mental health is a major part of the burden, with shock, fear and feelings of numbness common psychological responses to IPV (Krug et al. 2002). Hegarty et al. (2004) reported a five-fold increased risk of depression, even after other confounding factors were considered. A study of patients attending a Brisbane hospital emergency department provided evidence that women reporting IPV were nine times more likely to report having harmed themselves or having recently thought of doing so than women who had never experienced violence (Roberts 2007). Mouzos (1999) demonstrated that, during the 1990s, 57% of deaths in women resulting from violence or homicide were perpetrated by an intimate partner. Injuries to the eyes, ears, head, neck, breasts and abdomen are common in women who attend hospital for treatment (Campbell 2002). There are also indirect links to poorer health outcomes. Women exposed to IPV are more likely to smoke and to have alcohol problems, and are also more likely to use non-prescription drugs, amphetamines and solvents (Roberts et al. 1998; Golding 1999).

3.3.5 Other economic cost estimates

For comparison purposes we include the most recent cost data from a reputable source, but reiterate the point that costing studies of disease or risk factors are often incomparable due to the different definitions and assumptions applied. The cost estimates provided in the current study have been consistently and comparably estimated across all the risk factors considered.

During the 1980s and 1990s, Australia was at the forefront of research into the economic costs of domestic violence, with studies being undertaken in Queensland, NSW, Tasmania and the Northern Territory (Laing and Bobic 2002). The most recent Australian attempt to quantify the economic cost of IPV was a report prepared for the Office of the Status of Women (Access Economics 2004). The authors used a ‘prevalence’ approach to capture all annual costs of domestic violence and its consequences. It included many indirect and more intangible costs, allocating costs to seven categories: (1) pain, suffering and premature mortality; (2) health care costs; (3) production related costs; (4) consumption related costs; (5) second generation costs; (6) administrative and other costs; and (7) transfer costs. The total number of victims of domestic violence in Australia in 2002-03 was estimated at 408,100, of which 87% were females. The total annual cost was estimated to be $8.1 billion, with $3.5 billion arising from pain, suffering and premature mortality. The next largest contributor at $2.6 billion was consumption costs, of which the biggest component was lost household economies of scale (domestic violence victims are less likely to be living in a partner relationship). The largest cost burden ($4.0 billion) was borne by the victims, followed by the community ($1.2 billion). The lifetime cost of domestic violence was estimated to be $224,470 per victim experiencing domestic violence in 2002-03.

The American study of Laurence and Spalter-Roth (1996) included many direct and indirect costs and estimated that annual victim losses from domestic violence were US$67 billion. Other studies from the US (Max et al. 2004; Brown et al. 2008) have also estimated the cost of IPV, but were confined to direct medical costs and to the 12 months post-victimisation. Max et al. (2004) estimated an annual cost of US$8.3 billion, while the estimate of Brown et al. (2008) ranged from US$2.3 to US$7 billion depending on the method used.

No Australian study has attempted a cost-effectiveness or cost-benefit analysis of an intervention program for IPV. One US study (Chanley et al. 2001) used a cost-benefit analysis to estimate the social benefits of providing domestic violence shelter services in Kingman, Arizona. Total costs included operational, social justice and productivity costs, while benefits were quantified using information obtained on injuries averted and mental health benefits. Even using the lower estimate of social benefits and the upper estimate of costs, there was a net benefit of almost US$3.5 million.

3.3.6 Prevention

It is generally agreed that IPV is best addressed in the context of a human rights, legal and health framework and through the development of multi-level strategies across sectors (Krug et al. 2002; Office of Women's Policy 2002). Many programs and campaigns have been initiated, including *Partnerships Against Domestic Violence* (2003) which was Government funded and ran from 1997 in two 3-year, $25 million stages. The meta-evaluation report from PADV categorised the aims of prevention into four areas: community awareness, community action, individual action and prevention. The two specific examples of prevention programs outlined in this report were the *Freedom from Fear* campaign in Western Australia and the *It's Against the*

Rules campaign in New South Wales (NSW). The *Freedom from Fea*r campaign included mass media advertising, media and public relations activities, a men's domestic violence 24-hour helpline and funding of programs for at-risk men, victims and children. *It's Against the Rules* also used advertising resources and a public relations strategy, with regional and local implementation, to increase the unacceptability of violence against women and encourage men to have a broader understanding of violence and its effects. Preliminary results were somewhat positive: men reported that they were more knowledgeable about domestic violence and more confident in speaking about violence against women.

A national media campaign run in June 2004, *Violence Against Women. Australia Says No*, had a major impact in raising awareness of domestic violence and generated more than 44,000 calls to the Helpline. The campaign targeted 16 to 39 year olds and consisted of television, magazine, cinema, indigenous and ethnic press and convenience advertising. The campaign was supported by a 24 hour a day, seven days a week dedicated Helpline, which provided a counselling and referral service not only for victims of domestic violence or sexual assault, but for all Australians who were concerned about the issues surrounding violence against women. Funding under the Women's Safety Agenda for the campaign and Helpline was $36 million over four years.

One important aspect of secondary prevention is to adopt a framework which allows women and children to remain safely in their homes on leaving a violent relationship. The key elements identified by Edwards (2004) were: removal of the violent partner from the home; keeping them out of the home over time; provision of immediate and longer term safety for the woman and her children; and the prevention of further violence. Another secondary prevention measure is to improve the legal system. In 2007, the first of five new courts opened in Perth with the aim of reducing family violence. This followed the success of the first dedicated Family Violence Court in Joondalup in 2000. Offenders who have pleaded guilty in a Magistrate's Court, and agree to take part in the Family Violence Court, will need to complete rehabilitation programs which are designed to address their violent behaviour.

There have been no attempts to estimate the reduction in prevalence of domestic violence as a result of these preventive measures, or to estimate the reversal of risk of illness associated with

IPV that accompanies a drop in prevalence. Recent work from the WHO (Harvey et al. 2007) emphasised the need for better evaluation of the effectiveness of prevention programs. The evidence base for primary prevention approaches suffers from several deficits (Dahlberg and Butchart 2005):

- few outcome evaluations;
- few systematic evaluations of the same program over time;
- weak design, with evaluation only of change in knowledge and attitudes using short follow-up and no comparison group. Very few attempts to measure the impact of interventions on actual rates of IPV.

There are some exceptions. Studies in Australia and Sweden have demonstrated that closing bottle shops on certain days did reduce domestic violence incidents (although it was noted that reducing alcohol consumption alone would not eliminate violence). Markowitz (2000) estimated that a 1% increase in the price of alcohol would decrease IPV against women by 5%. Two randomised studies of interventions in South Africa also yielded promising results. The Stepping Stones program (Jewkes et al. 2007) used participatory learning approaches to build healthier, more gender-equitable relationships and documented a reduction in men's reported physical or sexual IPV incidents. The IMAGE study (Pronyk et al. 2006) used microfinance as a prevention tool to address economic vulnerability, combined with mandatory training on gender, HIV, domestic violence and life skills. Experience of IPV was reduced by 55% in the intervention group. A similar reduction was documented in the CEDOVIP study in Uganda (CEDOVIP http://www.raisingvoices.org/cedovip.php). Evaluations of other violence prevention activities are currently underway and will be very useful in informing future resource allocation decisions.

To guide future prevention work, VicHealth recently released *Preventing violence before it occurs* as a framework for implementing a comprehensive approach to preventing violence against women (VicHealth 2007).

3.4 Determination of the feasible reductions for IPV prevalence

As the literature on prevention did not identify readily usable estimates for feasible reductions, prevalence rates of IPV from other countries were consulted (refer methods in Part A section 2.3.1). Comparing across countries also has difficulties: some prevalence estimates are based on all women; others are based on only those women who have ever had a partner; and others are based on women who currently have a partner. Furthermore, studies differ in their definition of intimate partner (husband, de facto, cohabiting partner, boyfriend) and also in their definition of what constitutes violence. Using data from the IVAWS study overcomes many of these issues, although there were still important differences between participating countries, including sample size, age distribution of respondents, response rate and method of interview. Of the countries with lower prevalence estimates than Australia (at 27%), Poland, Philippines and Hong Kong were ruled out as comparators for being too socio-culturally different. Although broadly comparable, Switzerland had a prevalence of only 10% which seemed rather low and too ambitious a target for Australia. Denmark, with a prevalence of 22%, was selected as the most appropriate comparator.

Prevalence of IPV by current or former partners among ever-partnered women:

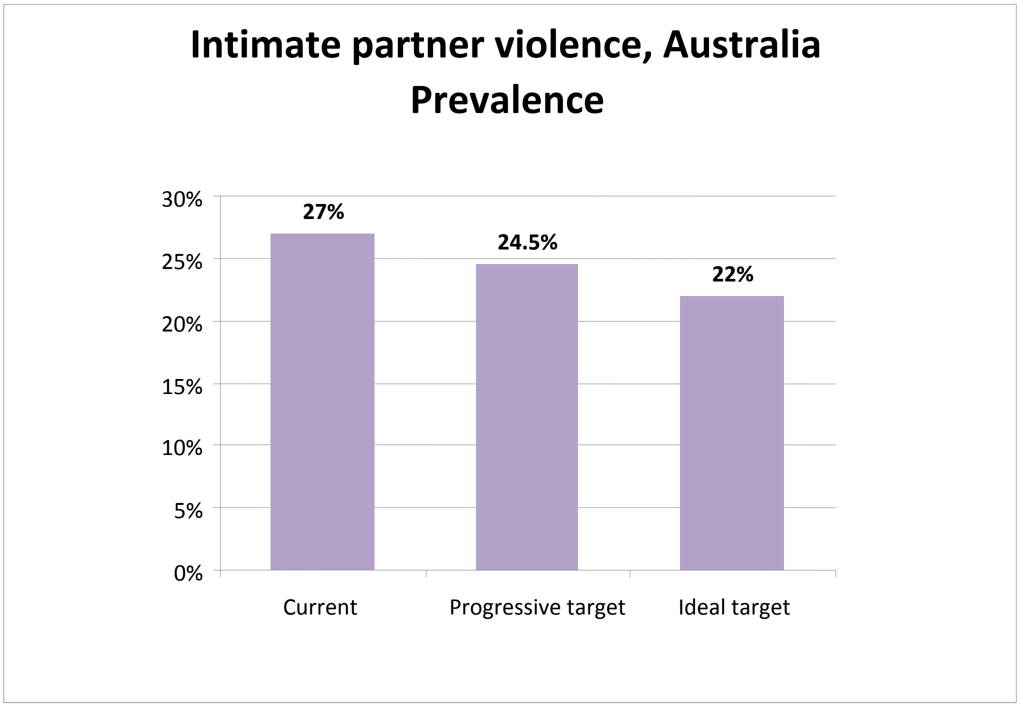
- Australian estimate: 27%.
- Danish estimate: 22%.

Proposed prevalence levels to be modelled (appear in Figure 12):

- Current – 27%.
- Ideal – 22%.
- Progressive – 24.5%.

We have calculated an absolute 2.5% and 5% reduction in prevalence of IPV to produce the estimates of avoidable burden (health status, economic and financial). It has been assumed that a decrease in prevalence of IPV is achieved by reducing incident cases in the coming years. The net difference between the current (attributable) and avoidable burden is reported.

Figure 12 Comparison of current and target prevalence of IPV



3.5 Economic and financial benefits of reduced IPV prevalence

The following sections provide the results for the IPV analysis undertaken using the systematic methods outlined in Part A. Firstly, the 2008 population characteristics are presented followed by estimates for the potential health status, economic and financial outcomes obtained from reducing the prevalence of this risk factor.

3.5.1 Population characteristics of comparator groups

Based on the data from the NHS 2004-05the following population characteristics were estimated for the 2008 reference population according to age, gender and work force status (Table 14).

Table 14 Females with high psychological distress compared to females with moderate levels of distress

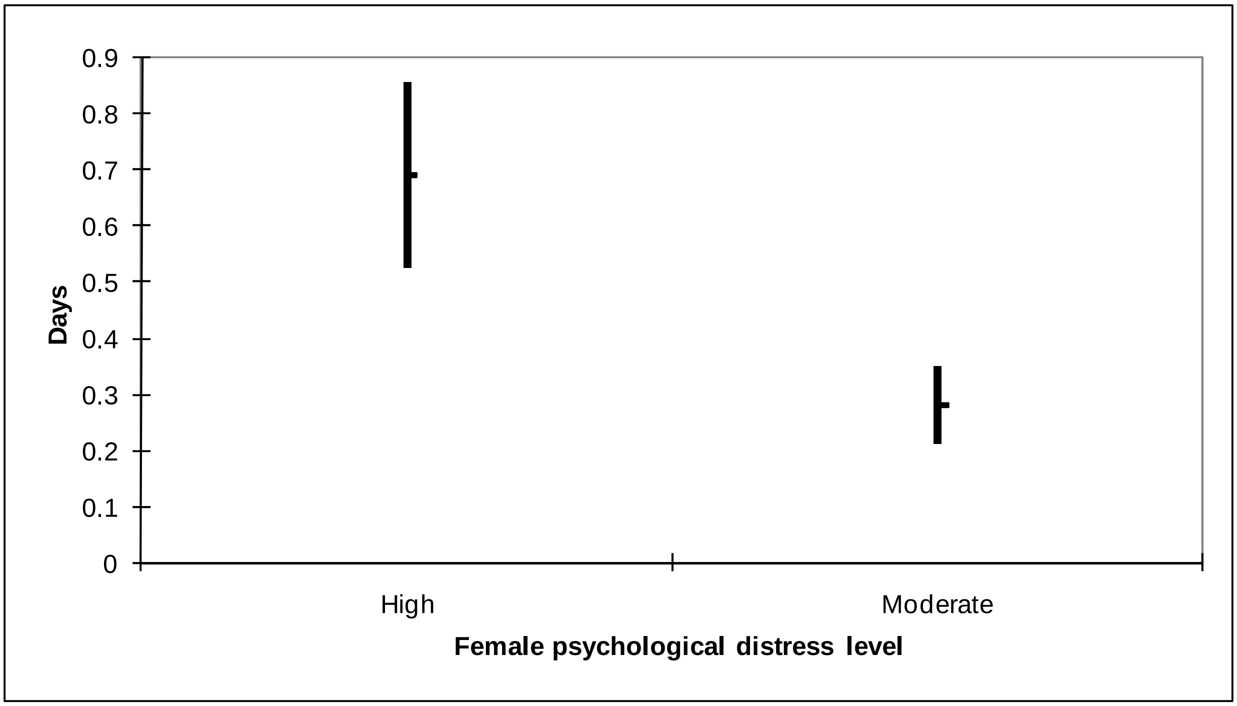
Females:	High or very high distress	Moderate distress
Age summary		
Age 15-64 y N (95% CI)	989,848 (927,959 – 1,051,738)	1,636,652 (1,556,018 – 1,717,285)
Age 65+ y N (95% CI)	153,190 (132,009 – 174,372)	300,836 (265,299 – 336,372)
Age 15+ y Mean (95% CI)	43.8 (42.7 - 44.9)	43.5 (42.8 – 44.2)
In Labour Force (15+ years)*		
% (95% CI)	53% (50% - 57%)	62% (59% - 64%)
Mean days off work (95% CI)	0.69 (0.52 – 0.85)	0.28 (0.21 – 0.35)
Not in Labour Force		
% (95% CI)	47% (43% - 50%)	39% (36% - 41%)
Mean days of reduced activity: 15-64 y (95% CI)	3.03 (2.54 - 3.53)	1.47 (1.15 – 1.79)
Aged 65+ years		
% (95% CI)	13.4% (11.7% - 15.3%)	15.5% (13.9% – 17.3%)
Mean days of reduced activity (95% CI)	3.62 (2.70 - 4.55)	2.25 (1.75 – 2.75)

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006b); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years

Absenteeism from paid work – overall

The number of days taken off work in a 10-day working period by females with high levels of psychological distress compared to females with moderate levels of distress is presented in Figure 13 and Table 15. The number of days taken off work by females who reported a high level of psychological distress (0.687) was significantly higher and more than doubled those who reported moderate distress levels (0.279).

Figure 13 Days taken off work in a 10-day working period by females with high levels of psychological distress compared to females with moderate levels of distress



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006b).

Table 15 Days taken off work by females with high levels of psychological distress compared to females with moderate levels of distress

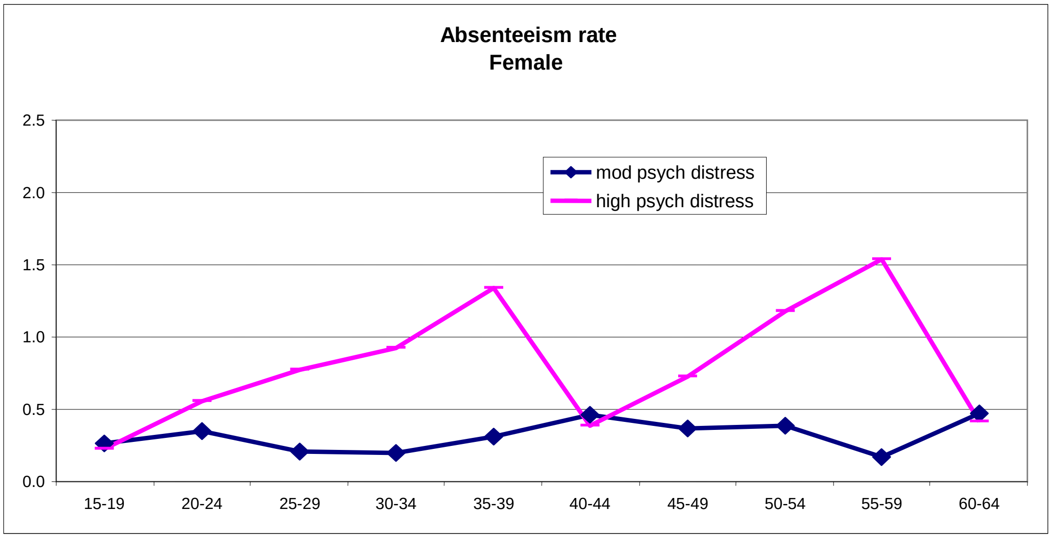
	Mean	Lower Limit	Upper Limit
Females			
High distress	0.687	0.523	0.852
Moderate distress	0.279	0.21	0.348

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006b).

Absenteeism from paid work – by age

Absenteeism rates for women with high psychological distress compared to those with moderate psychological distress are presented by age in Figure 14. Women who reported high levels of psychological distress tended to have higher absenteeism rates at all ages than women who reported moderate levels of psychological distress, with the possible exceptions of the age groups 15-19, 40-44 and 60-64 years.

Figure 14 Absenteeism rates of women with high levels of psychological distress compared to women with moderate levels of distress by age

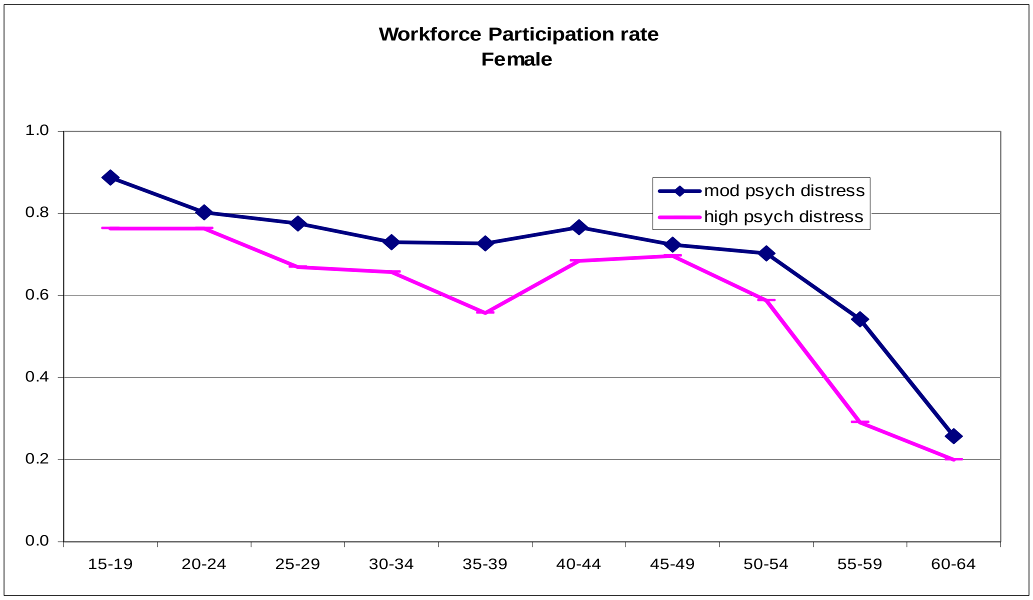


Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006b).

Workforce participation – by age

Workforce participation rates of women with high levels of psychological distress compared to women with moderate levels of distress by age are presented in Figure 15. Women who reported high levels of psychological distress had lower workforce participation rates at all ages than women who reported moderate levels of psychological distress.

Figure 15 Workforce participation rates of women with high levels of psychological distress compared to women with moderate levels of distress by age



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006b).

3.5.2 Health status and economic gains/losses

The health status and economic gains presented include health gains of potential reduction of DALYs, reduced incidence of IPV-related illness and reduced mortality from IPV. The economic gains evaluated also include potential reductions in days of absenteeism from paid employment, reductions in lost days of home based production and reductions in lost days of leisure time; all due to IPV-related illness. The mean and 95% uncertainty interval for outcomes able to be modelled as distributions with uncertainty are presented in Table 16.

3.5.2.1 Current losses (attributed economic burden)

Health status estimates were calculated according to the benefits arising when a change from the attributable (27%) to the ideal (22%) or progressive (24.5%) target level was modelled, based on 2003 BoD incidence and deaths data. Currently, we can attribute 34,000 new cases of IPV-related illness, just under 440 deaths and 29,000 DALYs annually to IPV at past and current levels. Over the working lifetime of the female working-age population we estimated there were

8.4 million working days lost and 2,800 early retirements due to IPV. Over the lifetime of all adult females we estimated that there were 2 million days lost because of ill health that would have been used for household production, and 2.3 million days of lost leisure due to IPV-related illness. If we were able to eliminate IPV entirely from the population, each of these losses would disappear over time.

3.5.2.2 Realistic target reductions in prevalence

If the prevalence of IPV was reduced nationally to 22% some of the attributed economic burden described above would potentially no longer occur. We estimated the new cases of IPV-related illness would fall by 6,000; deaths would reduce by 74; and DALYs by 5,000 each year. Over the working lifetime of the working-age population we estimated there would be 1.56 million fewer working days lost and just under 520 early retirements due to IPV that would potentially not occur. Over the lifetime of all adult women we estimated there would be 370,000 fewer days lost to illness that would have been used for household production, and 428,000 fewer days of lost leisure due to IPV-related illness that would potentially not occur.

3.5.2.3 Progressive target reduction in prevalence

If the prevalence of IPV was reduced nationally to only 24.5% some (a smaller proportion) of the attributed economic burden described above would potentially no longer occur. We estimated the new cases of IPV-related illness would fall by 3,000, deaths would fall by just under 40 and there would be 3,000 fewer DALYs annually. Over the working lifetime of the working-age females there would be 782,000 fewer working days lost and just under 260 early retirements due to IPV that would potentially not occur. Over the lifetime of all adult women we estimated that there would be 185,000 fewer days lost to illness that would have been used for household production, and 214,000 fewer days of lost leisure due to IPV-related illness that would potentially not occur.

Table 16 Health status and economic outcomes uncorrected for joint effects

Intimate Partner Violence	**Attributable at current levels of prevalence** ***uncorrected for joint effects***		
		95% Confidence Interval	
	Mean ('000s)	**LL ('000s)**	**UL ('000s)**
Health status and economic outcomes			
Per annum			
DALYs	29	n/a	n/a
Incidence of IPV related illness	34	n/a	n/a
Mortality	0.44	n/a	n/a
Lifetime			
Leisure (days)	2,314	1,598	3,067
Absenteeism (days)	8,441	n/a	n/a
Days out of home based production role (days)	2,003	1,400	2,651
Early retirement (persons)	3	n/a	n/a
	Ideal target reduction		
Health status and economic outcomes			
Per annum			
DALYs	5	n/a	n/a
Incidence of IPV related illness	6	n/a	n/a
Mortality	0.07	n/a	n/a
Lifetime			
Leisure (days)	428	296	568
Absenteeism (days)	1,563	n/a	n/a
Days out of home based production role (days)	371	259	491
Early retirement (persons)	0.52	n/a	n/a
	Progressive target reduction		
Health status and economic outcomes			
Per annum			
DALYs	3	n/a	n/a
Incidence of IPV related illness	3	n/a	n/a
Mortality	0.04	n/a	n/a
Lifetime			
Leisure (days)	214	148	284
Absenteeism (days)	782	n/a	n/a
Days out of home based production role (days)	185	130	245
Early retirement (persons)	0.26	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

3.5.3 Financial gains/losses

The potential opportunity cost savings which benefit the health sector, individuals, business and government are presented in Table 17 and Figure 16.

3.5.3.1 Health sector costs associated with IPV

IPV (past and present) is associated with almost $207 million of health sector costs that we estimate could be prevented at some point in the life time of women in 2008. This can be expected to be reduced by $38 million or $19 million if IPV prevalence is reduced as described above to 22% or 24.5%, respectively.

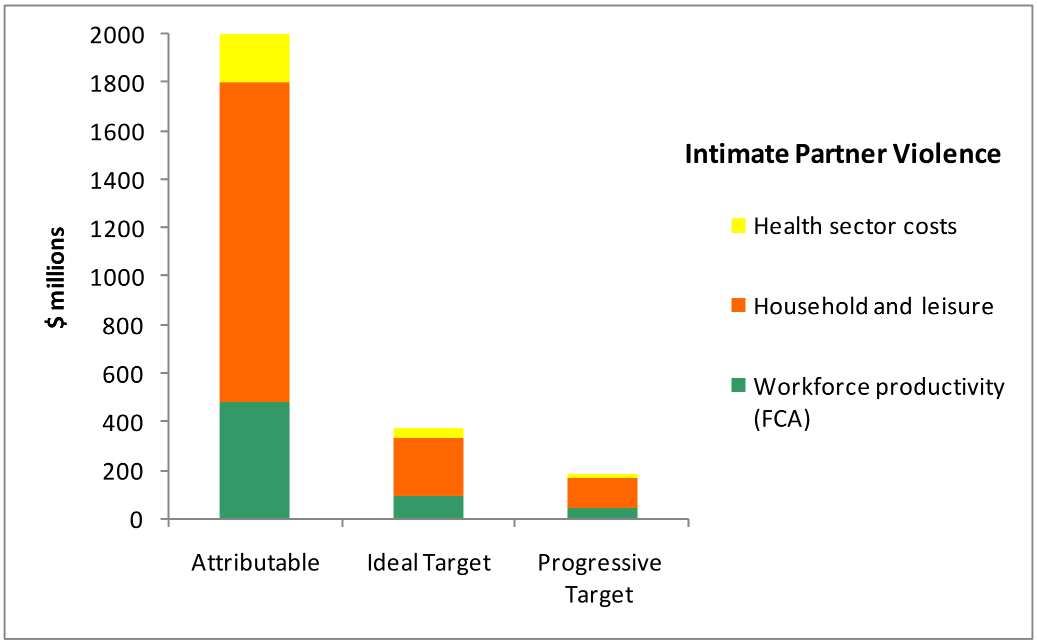
3.5.3.2 Gains to individuals and business

The total opportunity cost savings from production gains (working, household activities and leisure) that could potentially be achieved if IPV was eliminated from the population sum to $3,665 million using the HCA or $1,801 million using the more realistic FCA. The fewer deaths and incidence of IPV-related illness which would arise from reduced prevalence of IPV (at 22%) could be expected to lead to total production gains of $678 million (HCA) or $333 million (FCA). If the progressive target was achieved, total production gains of $338 million (HCA) or $166 million (FCA) might be realised. The FCA method identifies recruitment and training costs of $32 million as being attributable to the current IPV burden. It is estimated that these costs could be reduced by $6 million if the ideal reduction in IPV prevalence was achieved; or by $3 million if the progressive target reduction in IPV prevalence was achieved. The lost household production was $792 million given the current prevalence of IPV and can be expected to be reduced by $147 million or by $73 million at prevalence of 22% or 24.5%, respectively. An estimated net leisure loss of $528 million at current IPV prevalence can be expected to be reduced by $98 million or by $49 million at target IPV prevalence of 22% or 24.5%, respectively.

3.5.3.3 Taxation Gains to Government

If there are higher individual wages earned by people through not becoming ill or retiring early from the workforce then greater taxation revenue could be expected to follow. At the current lifetime prevalence of IPV (27%), the taxation forgone due to lost incomes is estimated at $308 million (HCA) or $88 million (FCA). These will change by $57 million or $28 million (HCA) if the lower prevalence targets were reached (ideal or progressive target respectively). The taxation foregone will be reduced by lesser amounts of $16 million or $8 million (FCA) if the lower prevalence targets are reached (ideal or progressive target respectively).

Figure 16 Total potential opportunity cost savings from reductions in intimate partner violence



FCA: Friction Cost Approach (preferred conservative estimate).

Table 17 Financial outcomes uncorrected for joint effects

Intimate Partner Violence	Attributable at current levels of prevalence *uncorrected for joint effects*		
		95% Confidence Interval	
Financial Outcomes	**Mean ($mill)**	**LL ($mill)**	**UL ($mill)**
Health sector costs	207	n/a	n/a
Production Costs HCA	2,345	1,375	3,383
Production Costs FCA	481	162	1,030
Recruitment and training costs	32	n/a	n/a
Leisure based production	528	330	779
Home based production	792	551	1,051
Total production HCA	***3,665***	***2,590***	***4,795***
Total production FCA	***1,801***	***1,243***	***2,515***
Taxation effects HCA	308	163	475
Taxation effects FCA	88	25	198
	Ideal target reduction		
Financial Outcomes			
Health sector costs	38	n/a	n/a
Production Costs HCA	434	253	621
Production Costs FCA	88	29	185
Recruitment and training costs	6	n/a	n/a
Leisure based production	98	61	144
Home based production	147	102	195
Total production HCA	***678***	***480***	***884***
Total production FCA	***333***	***227***	***461***
Taxation effects HCA	57	29	87
Taxation effects FCA	16	4	36
	Progressive target reduction		
Financial Outcomes			
Health sector costs	19	n/a	n/a
Production Costs HCA	216	126	310
Production Costs FCA	44	15	93
Recruitment and training costs	3	n/a	n/a
Leisure based production	49	31	72
Home based production	73	51	97
Total production HCA	***338***	***239***	***441***
Total production FCA	***166***	***114***	***228***
Taxation effects HCA	28	15	43
Taxation effects FCA	8	2	18

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate.

3.5.4 Discussion

The largest potential saving arising from reduced lifetime prevalence of IPV will potentially occur in home based production, followed by leisure and income to individuals, the health sector, government and business respectively.

Past exposure to IPV is most influential in determining the current health burden, health sector costs and production and leisure costs and is not amenable to prevention efforts. Past exposure can be ameliorated through current health services. If women cease to be exposed to current IPV, we have modelled that they will change from a high level of psychological distress to a moderate level since they remain exposed to lifetime (past) IPV. We have modelled conservatively and consistently with other risk factors that only current levels of IPV are amenable to preventive interventions and thus, gradually over time, the lifetime prevalence of IPV can be expected to fall by addressing incident cases.

Compared to previous Australian literature (refer section 3.3.5), the cost estimates associated with IPV reported by Access Economics (2004) were higher compared to those reported in the current study. Several methodological differences between the current study and the work undertaken by Access Economics explain these differences. For example, Access Economics based estimates on the prevalence of domestic violence, experienced by both women and men, and included additional cost categories which were beyond the scope of the current study. In contrast, current study estimates were based on incident cases of illness associated with IPV for women only, due to the uncertainty around the risk of IPV for males. While study results are not directly comparable due to fundamental methodological differences, both studies provide a valuable contribution to the literature regarding the potential economic benefits of reducing IPV in Australia.

Since people are not questioned in the NHS on the issue of IPV, we relied on surveyed levels of psychological distress amongst females as a proxy. The BoD studies have identified that depression and anxieties are the largest components of illness attributable to IPV. The Kessler 10 score used in the NHS adequately captured depression and anxieties in the general population for this study.

We have not controlled for other risk factors or socioeconomic status in the analysis that may influence production and leisure effects. Most persons surveyed reported more than one of the risk factors of interest to this study (refer section 9).

In conclusion, at a population level, if the prevalence of IPV was to be decreased important opportunity cost savings from the reduction of illnesses associated with this risk factor could be achieved.

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4.0 HIGH RISK ALCOHOL CONSUMPTION

Summary of consensus decision for analytic modelling:

Current prevalence (Australian Population 2008) → Progressive target ↓1.7 litres per capita → Ideal (realistic) target ↓3.4 litres per capita

4.1 Executive summary

Main findings from the literature review

- In Australia, 13% of adults drink alcohol at a risky or 'high risk' level long term (based on their estimated average daily consumption of alcohol during the previous week).
- Annually, Australians drink more litres of alcohol per capita (9.8) than Americans (8.4), Canadians (8.0), Swedes (6.6) and Norwegians (6.4).
- Alcohol contributed a net 2.3% to the overall health burden in Australia, with alcohol dependence (39%), suicide and self-inflicted injuries (14%), and road traffic accidents (13%) the major consequences.
- Brief alcohol interventions in primary care can reduce alcohol consumption by around 10% (approximately 4standard drinks of alcohol per week), but other interventions have not demonstrated long-term change.

Research findings from this project

Risk reversal after the cessation of the risk behavior takes some time to occur and hence the estimated economic benefits will be realized not immediately, but over some period of years instead. At a population level, if 'high risk' alcohol consumption were to be decreased for the 2008 Australian adult cohort modelled, important opportunity cost savings from the reduction of diseases associated with this risk factor could be achieved. These benefits are summarised below.

- Potential opportunity cost savings of $2,275 million in health sector costs and $1,224 million in production and leisure costs could be realised Friction Cost Approach (FCA) over time, if all attributed deaths and incident cases of alcohol related disease did not occur.

- We found that if the litres of alcohol consumed nationally was reduced from 9.8 litres/capita to 6.4 litres/capita (ideal target):
  - Potential opportunity cost savings of $789 million in health sector costs and $435 million in production and leisure costs could be realised (FCA) over time
  - The 282,000 annual new cases of alcohol-related disease could be reduced over time 98,000
  - The 1,000 annual deaths attributed to alcohol consumption could be reduced over time by 380
  - The 61,000 Disability Adjusted Life Years (DALYs) could be reduced over time by 21,000
- If the litres of alcohol consumed nationally was reduced from 9.8 litres/capita to 8.1 litres/capita (progressive target) there would be:
  - Potential opportunity cost savings of $395 million in health sector costs and $224 million in production and leisure costs could be realised (FCA) over time
  - Annual new cases of alcohol-related disease could be reduced by 49,000
  - Annual deaths attributed to alcohol consumption could be reduced by 188
  - DALYs could be reduced overtime by 11,000

High risk alcohol consumption over the long term has been linked to several diseases including cancers, alcohol dependence, etc. Past and current prevalence of ‘high risk’ alcohol consumption are related to the current burden of alcohol-related disease and any reductions in the prevalence of ‘high risk’ alcohol consumption in the future will be reflected in health, economic and financial gains in the future. Gains in some conditions are experienced reasonably soon after reducing drinking, but reductions of risk of cancers occur more slowly.

The consumption of alcohol at moderate levels has also been linked to positive health benefits (prevention of cardiovascular disease among mature aged persons) (Begg et al. 2007). The extent and even the existence of such benefits remain controversial (Jackson et al. 2005; Fillmore et al. 2006). In terms of population health, heart disease and stroke are the most important of these potential benefits. Nearly all the potential benefits are confined to males over the age of 45 and women past menopause, and can be gained with a drinking pattern of as little as one drink every second day. Since alternative means of preventing heart and vascular disease are available, the clinical consensus is that people need not take up or maintain drinking for health benefits (National Health and Medical Research Council 2007).

The economic and financial gains have been modelled based on a change in litres of national annual alcohol consumption. The current national level of alcohol consumption is 9.8 litres per capita (estimated among adults over 15 years). The optimistic goal is modelled as a reduction to 6.4 litres per capita based on the annual consumption per capita in Norway and the progressive target modelled as a reduction to 8.1 litres per capita. The scenarios selected are **not** the same as the potential elimination or specific reductions in **long term 'high risk' alcohol consumption.** Instead the modelling of a general reduction in litres of consumption has lead to some reductions in the potential benefits of alcohol consumption as well as the reductions in harm. We present the **net** benefits (benefits gained – benefits lost) of reductions in alcohol consumption which are sometimes negative due to the potential loss of health benefits particularly in the moderate elderly drinkers.

4.2 Definition

The term alcohol is used to refer to ethyl alcohol (ethanol), which is present in greater or lesser quantities in various drinks intended for human consumption. The point at which alcohol consumption becomes harmful is difficult to define given that studies have demonstrated some protective health effects of moderate alcohol consumption. In line with English et al. (1995) and NHMRC (1992) guidelines, the average number of standard drinks per day was used to classify alcohol consumption: abstainer (0-0.25), low (0.26-4 for men; 0.26-2 for women), hazardous (4.01-6 for men; 2.01-4 for women) and harmful (>6 for men; >4 for women). A standard drink is equal to 10g (12.5ml) of alcohol (National Health and Medical Research Council 2001).

Drawing on this literature, and taking into account available source data, alcohol consumption was categorised as follows:

Alcohol consumption	Long term high risk alcohol consumption: Greater than 75ml of alcohol consumed per day for men, and greater than 50ml of alcohol consumed per day for women. Long term low risk alcohol consumption: Less than 75ml of alcohol consumed per day for men, and less than 50ml of alcohol consumed per day for women.

4.3 Summary of current literature and best available data

4.3.1 Prevalence data

Data from the NHS 2004-05 (Australian Bureau of Statistics 2006) indicated that 13% of adults drank alcohol at a risky or 'high risk' level (>4 standard drinks per day for men, >2 standard drinks per day for women; based on their estimated average daily consumption of alcohol during the previous week). Prevalence of risky drinking was higher in middle age groups for both males and females; refer Table 18 and Table 19.

Table 18 Categories of alcohol consumption in Australian men

Age	18-24	25-34	35-44	45-54	55-64	65-74	75 and over
Did not consume/low risk (%)	84.6	84.3	84	81.7	82.4	88.5	95.1
Risky/high risk (%)	15.4	15.7	16	18.3	17.6	11.5	4.9

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 19 Categories of alcohol consumption in Australian women

Age	18-24	25-34	35-44	45-54	55-64	65-74	75 and over
Did not consume/low risk (%)	87.5	89.2	86.8	87	86.6	90.7	94.4
Risky/high risk (%)	12.5	10.8	13.2	13	13.4	9.3	5.6

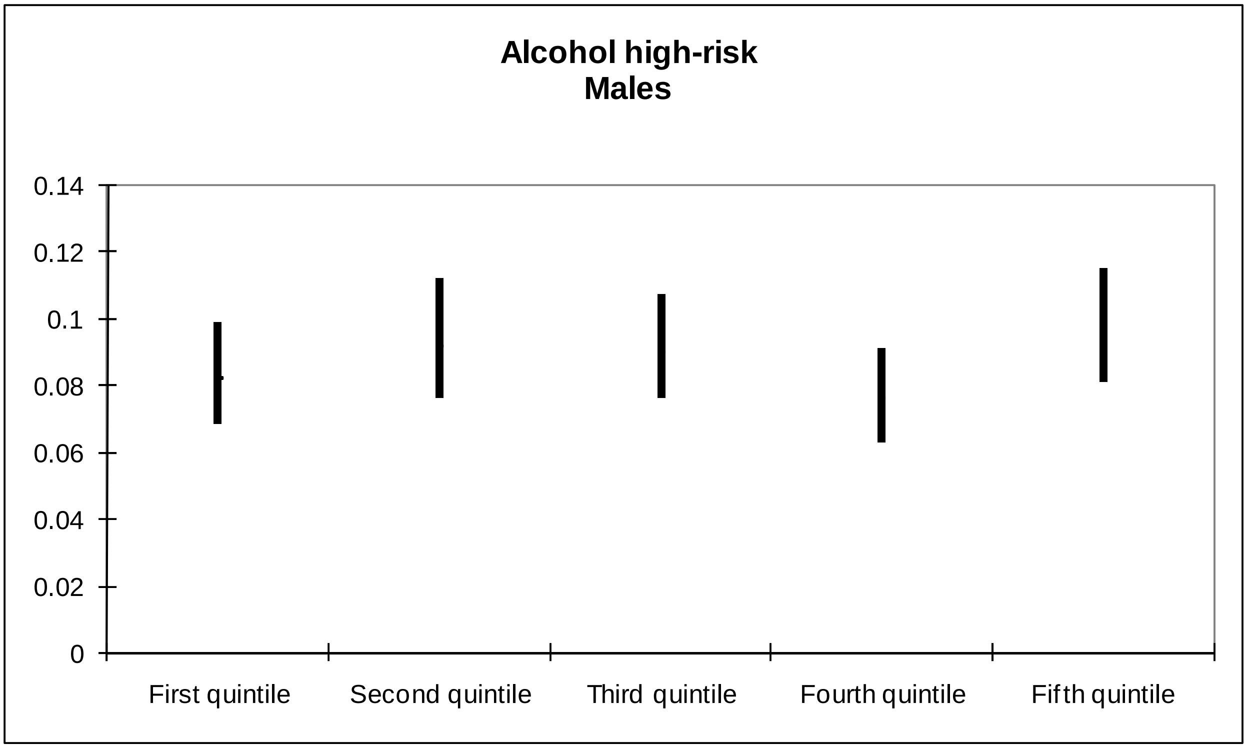
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

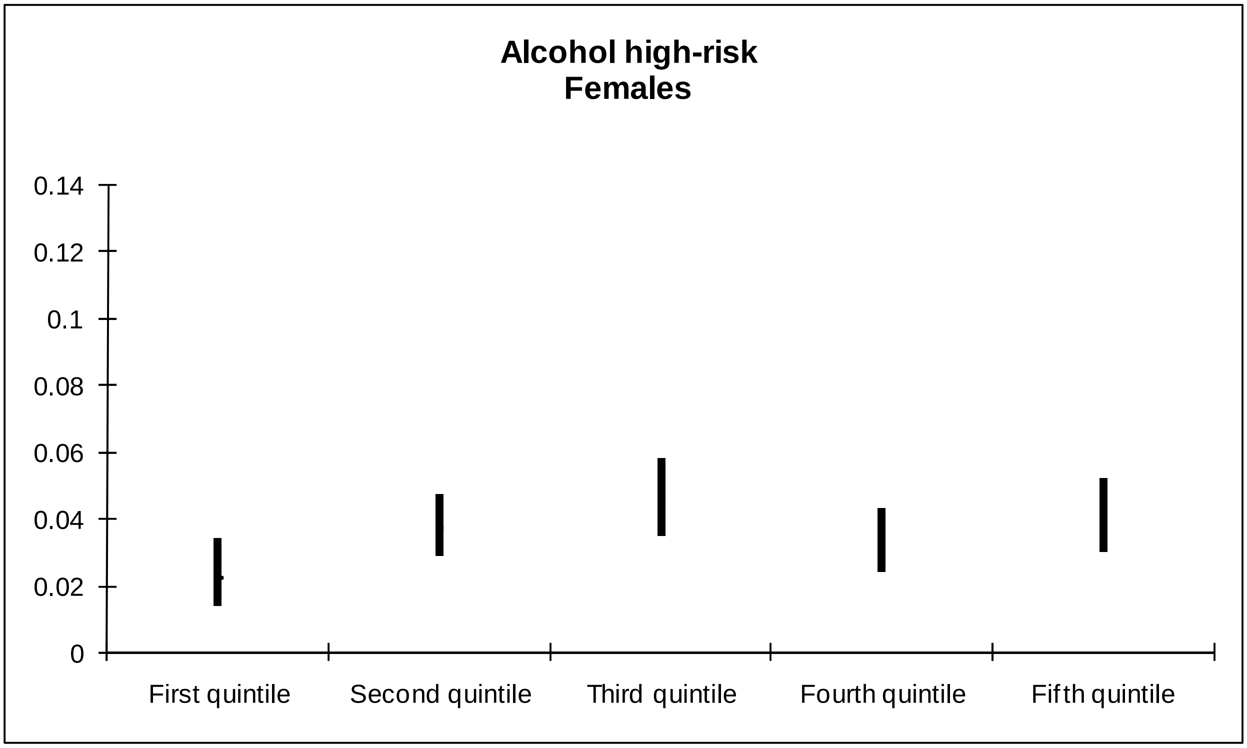
4.3.2 Socioeconomic status

The proportion of persons in each socioeconomic quintile who self report as 'high risk' alcohol consumers in the NHS 2004-05 is presented in Figure 17 and Table 20. The first quintile represents the one-fifth of Australians who are most disadvantaged and the fifth quintile represents the one-fifth of Australians who are least disadvantaged. A similar proportion of persons who report 'high risk' drinking are observed within each socioeconomic quintile for both females and males. There are no significant differences in the proportion of people reporting 'high risk' alcohol consumption across the quintiles.

To ensure long term 'high risk' alcohol consumers are broadly targeted by preventive interventions, this relationship with socioeconomic status suggests population-based strategies would be equally appropriate as targeted approaches.

Figure 17 Proportion in each socioeconomic quintile who report high risk alcohol consumption by gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 20 Proportion of Australian adults in each socioeconomic quintile who report high risk alcohol consumption by gender

	Mean	Lower Limit	Upper Limit
Males			
First quintile	0.082	0.068	0.099
Second quintile	0.092	0.076	0.112
Third quintile	0.09	0.076	0.107
Fourth quintile	0.076	0.063	0.091
Fifth quintile	0.096	0.081	0.115
Females			
First quintile	0.022	0.014	0.034
Second quintile	0.037	0.029	0.047
Third quintile	0.045	0.035	0.058
Fourth quintile	0.032	0.024	0.043
Fifth quintile	0.039	0.03	0.052

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

4.3.3 International comparisons

In 2005, statistics indicated that number of litres of alcohol consumed per capita (over the age of 15) was 9.8 in Australia (Organization for Economic Cooperation and Development 2008). Lower amounts were found in several other OECD countries, including the United States (8.4), Canada (8.0), Sweden (6.6) and Norway (6.4). In terms of the percentage of the population who were heavy drinkers, Australia (men: 6.7%, women: 7.2%) had higher rates than Norway (men: 3.0%, women: 5.2%), Israel (men: 5.9%, women: 4.7%) and the United States (men: 6.4%, women: 5.0%) (World Health Organization 2004).

4.3.4 Health outcomes

Authors of the 2003 BoD report (Begg et al. 2007) revealed that alcohol contributed a net 2.3% to the overall health burden in Australia. Of this, a net 3.8% can be attributed to alcohol in men (harmful: 4.9%, beneficial: -1.1%) and a net 0.7% can be attributed to alcohol in women (harmful: 1.6%, beneficial: -0.9%). In terms of DALYs, the most prominent contributors to health burden are alcohol dependence (39%), suicide and self-inflicted injuries (14%), road traffic accidents (13%), oesophagus cancer (5%) and breast cancer (5%). In terms of DALYs that may be averted from alcohol consumption, the most prominent contributors to health benefit are ischemic heart disease (77%) and stroke (22%).

Drinking alcohol heavily over a period of time can increase the risk of developing cirrhosis of the liver, cognitive problems, dementia and alcohol dependence (National Health and Medical Research Council 2001). High risk consumption has also been associated with oral, throat and oesophageal cancer (Australian Institute of Health and Welfare 2005) and breast cancer in women (Ridolfo and Stevenson 2001). In addition, injury rates are several times higher in risky drinkers as compared to low-risk drinkers (Australian Bureau of Statistics 2006). Alcohol is also a major cause of mortality. Following from tobacco smoking, alcohol is the largest cause of drug-related deaths (Australian Institute of Health and Welfare 2005), being the main cause of death on Australian roads (Ridolfo and Stevenson 2001) and a major contributor to death from liver disease and mental disorders.

4.3.5 Other economic cost estimates

For comparison purposes we include the most recent cost data from a reputable source, but reiterate the point that costing studies of disease or risk factors are often incomparable due to the different definitions and assumptions applied. The cost estimates provided in the current study have been consistently and comparably estimated across all the risk factors considered.

The estimated cost to the Australian community of alcohol misuse in 2004-05, including associated crime and violence, treatment costs, loss of productivity and premature death, was estimated to be $15.3 billion (Collins and Lapsley 2008). Tangible costs were $10.8 billion, including net labour costs ($3.5 billion), total healthcare ($2.0 billion), road accidents ($2.2 billion) and crime ($1.4 billion). Intangible costs were $4.5 billion, consisting of loss of life ($4.1 billion) and pain and suffering from road accidents ($0.4 billion). The estimation technique used has been labelled the demographic approach, with costs defined as "the value of the net resources that in a given year are unavailable to the community for consumption or investment purposes as a result of the effects of past and present drug abuse, plus the intangible costs imposed by this abuse". The counterfactual situation that is compared to the actual 2004-05 drug abuse situation is one in which there has been no drug abuse for an extended period of time. The Collins and Lapsley study estimates the social costs that were borne in 2004-05 that resulted from all drug abuse in 2004-05 and in previous years.

4.3.6 Prevention

A recent review and meta-analysis of 22 randomised controlled trials of brief alcohol interventions in primary care populations indicated that they can be successful in reducing alcohol consumption (Kaner et al. 2007). Participants receiving an intervention had lower alcohol consumption than controls at follow-up of one year or longer, with a mean difference between groups of 38 grams per week (95% CI: 23-54). This equates to a reduction of approximately 4 standard drinks of alcohol per week, which is considerable given that participants across the trials consumed an average of 310 grams of alcohol per week. Intervention benefit was stronger in men (57 grams per week reduction) than in women (10 grams per week reduction).

In several areas of interest, investigations into the effectiveness of alcohol interventions have produced more equivocal results. In a review of eight community-based alcohol prevention initiatives, Gorman and Speer (1996) concluded that while such programs could increase awareness and knowledge of harms, there was little evidence to indicate they changed people's behaviour. A Cochrane review of primary prevention for alcohol misuse in young people found that 20 of the 56 included studies were ineffective (Foxcroft et al. 2002). Others were partially effective, but the diversity of settings and approaches to prevention precluded a formal meta-analysis. Only the Iowa Strengthening Families Program provided evidence that robust reductions in alcohol initiation behaviours in young people, with rate differences between intervention and control groups of 30-60% at 1- and 2-year follow-up (Spoth et al. 1999).

A review of community-based initiatives restricting alcohol availability in remote Australia identified reductions in consumption (d'Abbs and Togni 1999). These reductions ranged from 0.2% in Derby to 3% in Tennant Creek to 7% in Halls Creek and even up to 60-80% in Curtin Springs, where the restrictions were comprehensive. Another Australian initiative – the Northern Territory's Living With Alcohol Program – also yielded substantial reductions in per capita consumption and in harmful consumption (Stockwell et al. 2001).

Several reports profiling prevention initiatives targeting 'high risk' alcohol consumption have been published. For further reading on this topic, refer to Babor et al. (2003); Loxley et al. (2004); National Drug Research Institute (2007).

4.4 Determination of the feasible reductions for alcohol consumption

As the literature review did not identify any readily usable estimates for feasible reductions, prevalence rates for alcohol consumption from other countries were consulted (refer methods in Part A section 2.3.1). Norway was chosen as the best comparator as it has a history of government regulation and pricing policies aimed at reducing alcohol consumption, and is a developed country like Australia. In terms of consumption, 2005 statistics (Organization for Economic Cooperation and Development 2008) indicated that number of litres of alcohol consumed annually per capita (over the age of 15) was 9.8 in Australia, which was higher than the amount consumed in Norway (6.4). These data on litres per capita are consistent with the 2003 BoD (Begg et al. 2007).

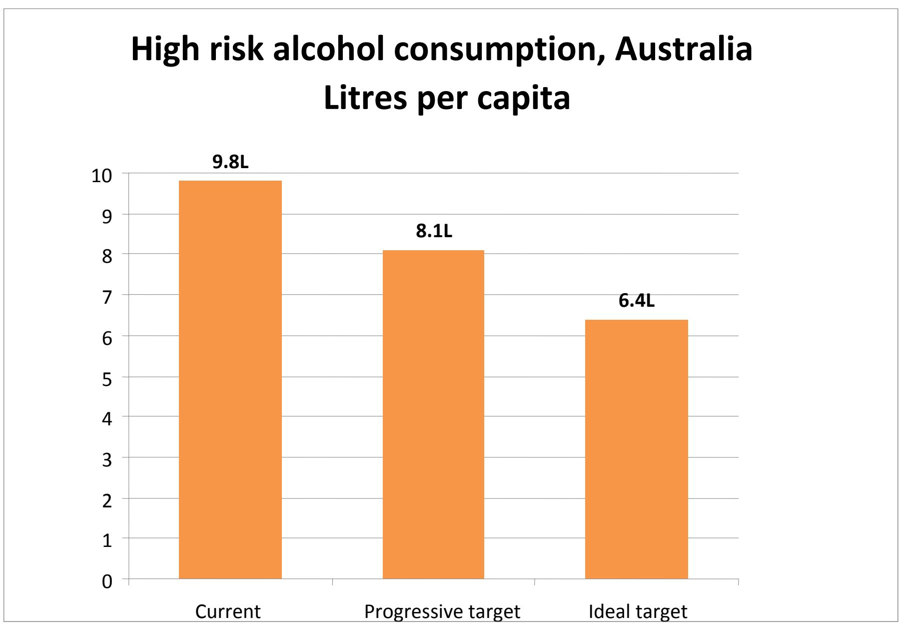
Number of litres of alcohol consumed per capita:

- Australian estimate: 9.8.
- Norwegian estimate: 6.4.

Proposed levels to be modelled (appear in Figure 18):
Current – 9.8.
Ideal – 6.4.
Progressive – 8.1.

The net difference between the current (attributable) and avoidable burden will be reported.

Figure 18 Comparison of current and target litres of alcohol consumed annually per capita



4.5 Economic and financial benefits of reduced high risk alcohol consumption

The following sections provide the results for the 'high risk' alcohol consumption analysis undertaken using the systematic methods outlined in Part A. Firstly, the 2008 population characteristics are presented followed by estimates for the potential health status, economic and financial outcomes obtained from reducing the prevalence of this risk factor.

4.5.1 Population characteristics of comparator groups

Based on the data from the NHS 2004-05 the following population characteristics were estimated for the 2008 reference population according to age, gender and work force status (Table 21 and Table 22).

Table 21 Males who consume alcohol at levels associated with high risk compared to males who consume alcohol at levels associated with low risk

Males:	High risk alcohol consumption	Low risk alcohol consumption
Age summary		
Age 15-64 y N (95% CI)	548,967 (504,066 - 593,867)	5,159,965 (5,085,129 -5,234,801)
Age 65+ y N (95% CI)	42,640 (30,065 – 55,216)	1,009,718 (990,008 – 1,029,427)
Age 15+ y Mean (95% CI)	42.6 (41.4 - 43.8)	45.3 (45.1 - 45.5)
In Labour Force (15+ years)*		
% (95% CI)	82% (79% - 85%)	75% (74% - 76%)
Mean days off work (95% CI)	0.32 (0.16 – 0.48)	0.31 (0.25 -0.37)
Not in Labour Force		
% (95% CI)	18% (16% - 21%)	25% (24% - 26%)
Mean days of reduced activity: 15-64 y (95% CI)	1.72 (0.75 - 2.70)	1.86 (1.53 - 2.20)
Aged 65+ years		
% (95% CI)	7.2% (5.5% - 9.5%)	16.4% (16.0% -16.7%)
Mean days of reduced activity (95% CI)	0.89 (0.21 - 1.57)	1.22 (0.97 - 1.47)

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years.

Table 22 Females who consume alcohol at levels associated with high risk compared to females who consume alcohol at levels associated with low risk

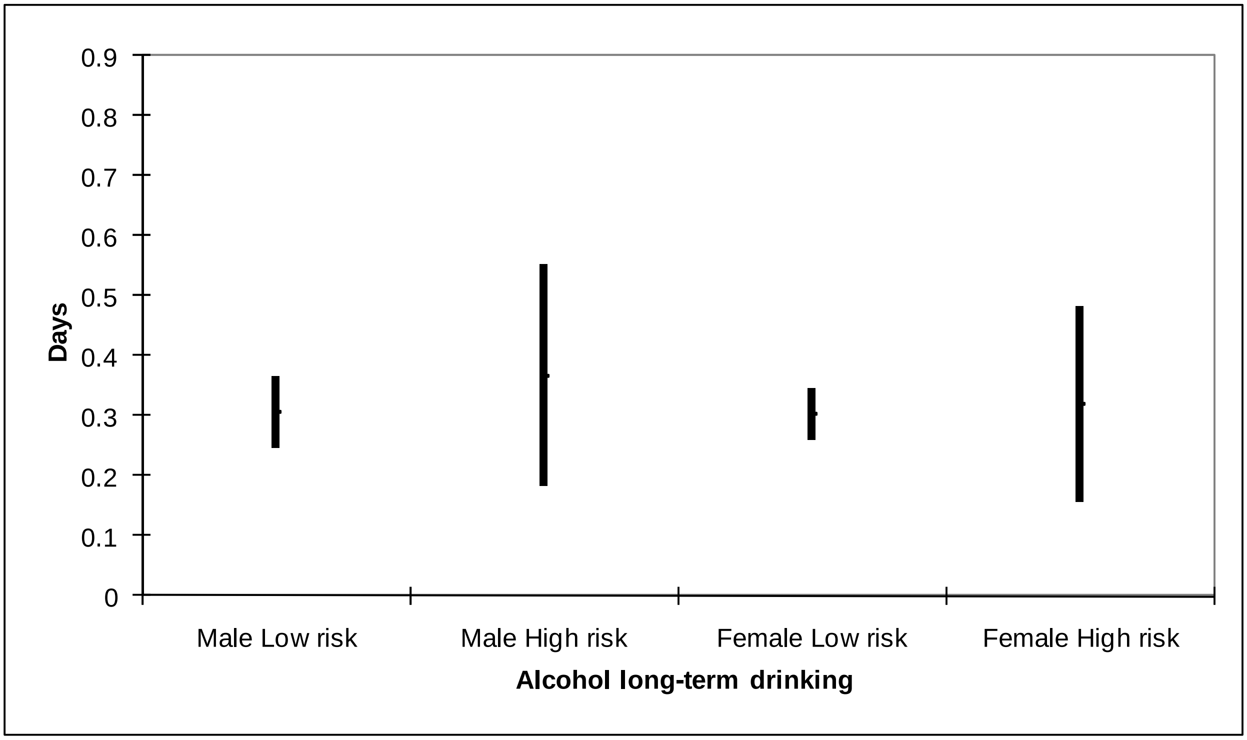
Females:	High risk alcohol consumption	Low risk alcohol consumption
Age summary		
Age 15-64 y N (95% CI)	215,942 (188,952 – 242,931)	5,412,604 (5,348,433 – 5,476,774)
Age 65+ y N (95% CI)	25,977 (15,428 – 36,525)	1,182,647 (1,159,920 – 1,205,374)
Age 15+ y Mean (95% CI)	43.5 (41.4 - 45.6)	46.1 (45.9 - 46.3)
In Labour Force (15+ years)*		
% (95% CI)	69% (63% - 75%)	58% (57% - 59%)
Mean days off work (95% CI)	0.37 (0.18 – 0.55)	0.30 (0.26 – 0.35)
Not in Labour Force		
% (95% CI)	31% (25% - 38%)	42% (41% - 43%)
Mean days of reduced activity: 15-64 y (95% CI)	1.59 (0.65 - 2.54)	1.40 (1.24 - 1.55)
Aged 65+ years		
% (95% CI)	10.7% (7.1% - 15.9%)	17.9% (17.6% - 18.3%)
Mean days of reduced activity (95% CI)	1.64 (-0.62 - 3.89)	1.52 (1.32 - 1.73)

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years

Absenteeism from paid work – overall

The number of days taken off work in a 10-day working period by persons who consume alcohol at levels associated with ‘high risk’ compared to persons who consume alcohol at levels associated with low risk by gender is presented in Figure 19 and Table 23. A similar number of days were taken off by persons who report consuming alcohol at levels associated with ‘high risk’ compared to persons who report consuming alcohol at levels associated with low risk, with no significant difference between the two groups. The wider confidence intervals for persons who consume alcohol at ‘high risk’ levels were due to smaller numbers of persons reporting consuming alcohol at ‘high risk’ levels in both genders.

Figure 19 Days taken off work in a 10-day working period by persons who consume alcohol at levels associated with high risk compared to persons who consume alcohol at levels associated with low risk by gender



Source: 2004-05 National Health Survey (Australian Bureau of Statistics 2006).

Table 23 Days taken off work by persons who consume alcohol at levels associated with high risk compared to persons who consume alcohol at levels associated with low risk by gender

	Mean	Lower Limit	Upper Limit
Males			
Low risk	0.306	0.246	0.366
High risk	0.368	0.182	0.554
Females			
Low risk	0.303	0.259	0.347
High risk	0.32	0.157	0.483

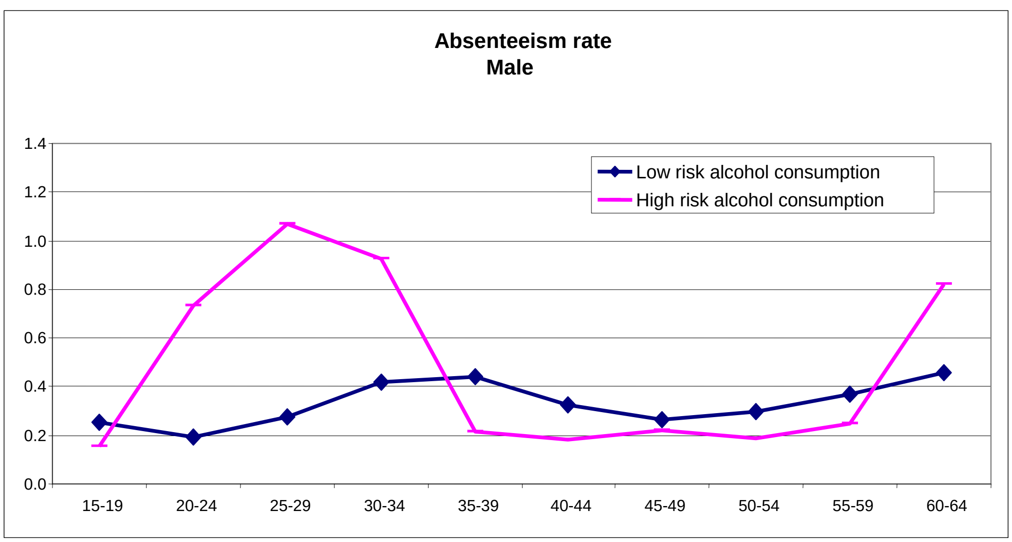
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

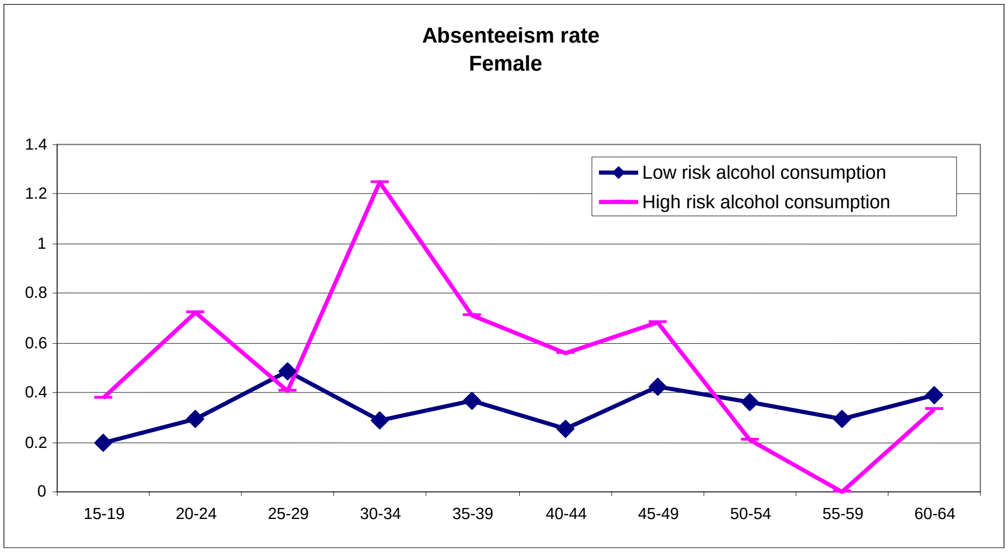
Absenteeism from paid work – by age and gender

Absenteeism rates for persons who consume alcohol at levels associated with 'high risk' compared to persons who consume alcohol at levels associated with low risk by age and gender are presented in Figure 20. The differences at each age and gender were used in the estimation of workforce productivity effects, even though the difference may not have reached statistical significance. This is detailed in section 2.

The rate of absenteeism for persons who reported consuming alcohol at levels associated with 'high risk' intake compared to those who report consuming alcohol at levels associated with 'low risk' varied greatly over the age groups, for both males and females. Males who reported consuming alcohol at levels associated with 'high risk', overall, took more days off work than males who reported consuming alcohol at levels associated with low risk. This was especially notable in the younger males aged 20-34 and 60-64 year olds. Females who reported consuming alcohol at levels associated with 'high risk' took more days off work than females who reported consuming alcohol at levels associated with 'low risk'. However, females above the age of 50 were an exception, with those consuming alcohol at 'high risk' levels taking fewer days off.

Figure 20 Absenteeism rates of persons who consume alcohol at levels associated with high risk compared to persons who consume alcohol at levels associated with low risk by age and gender





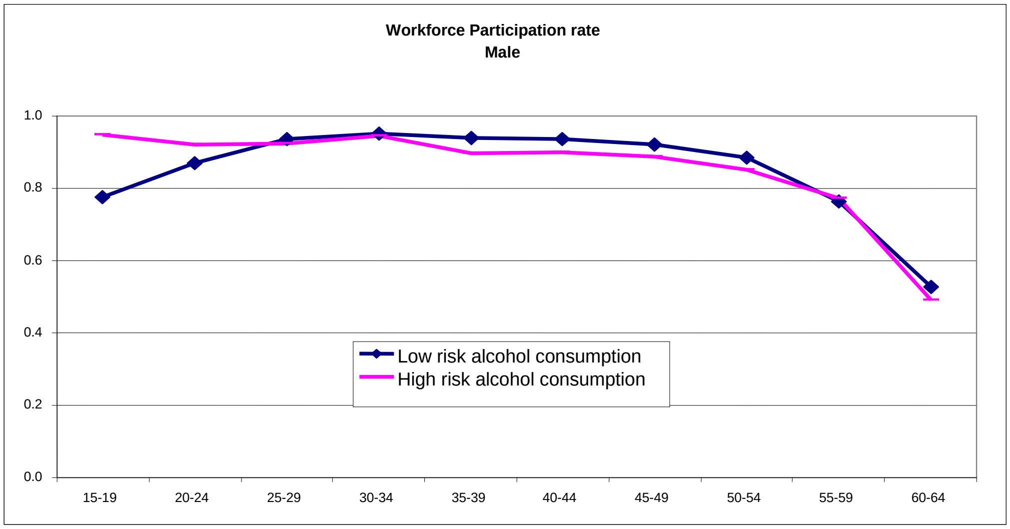
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

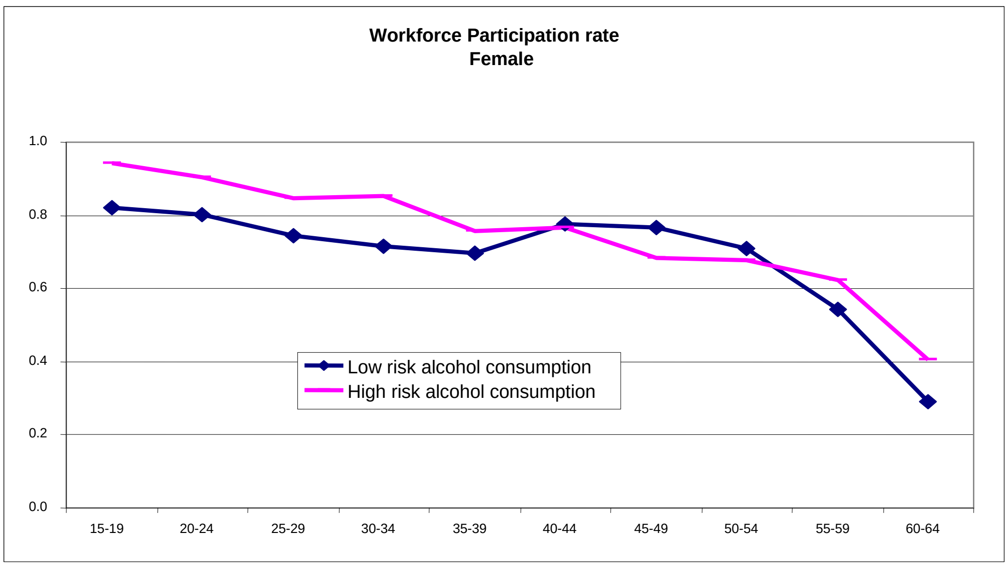
Workforce participation – by age and gender

Workforce participation rates for persons who consumed alcohol at levels associated with 'high risk' compared to persons who consumed alcohol at levels associated with 'low risk' by age and gender are presented in Figure 21. The differences at each age and by gender were used in the estimation of workforce productivity effects, even though the difference may not have reached statistical significance. This is detailed in section 2.

In most age groups, males who reported consuming alcohol at levels associated with 'high risk' participated in the workforce at a slightly lower rate compared to males who reported consuming alcohol at levels associated with low risk. Exceptions included males below the age of 24 years and in the age group 55-59, where workforce participation was slightly higher for those who consumed alcohol at 'high risk' levels. In contrast, females in most age groups who reported consuming alcohol at levels associated with 'high risk' participated in the workforce at a higher rate than females who reported consuming alcohol at levels associated with 'low risk'. Exceptions included females aged 45-49 and 50-54 years, where workforce participation was slightly lower than for those who consumed alcohol at 'high risk' levels.

Figure 21 Workforce participation rates of persons who consume alcohol at levels associated with high risk compared to persons who consume alcohol at levels associated with low risk by age and gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

4.5.2 Health status and economic gains/losses

The health status and economic gains presented include net health gains of potential reduction of DALYs, reduced incidence of alcohol-related disease and reduced mortality from alcohol-related disease. The economic gains evaluated also include potential net reductions in days of absenteeism from paid employment, net reductions in lost days of home based production and net reductions in lost days of leisure time; all due to alcohol-related disease. The mean and 95%

uncertainty interval for outcomes able to be modelled as distributions with uncertainty are presented in Table 24.

4.5.2.1 Current losses (attributed economic burden)

Currently we can attribute 282,000 new cases of alcohol-related disease, 1,000 deaths and 61,000 DALYs annually to alcohol consumption at past and current levels. Over the working lifetime of the working-age population we estimated there were 14.4 million working days lost due to past alcohol consumption. However, we found that there may be an improvement in early retirements. The negative retirements estimated occur because both males and females who consumed alcohol at 'high risk' levels reported higher participation rates at most ages than persons reporting alcohol consumption at 'low risk' levels. Over the lifetime of all adults we estimated there were 162,000 days lost because of ill health that could have been used for household production, and -94,000 days of lost leisure due to alcohol-related illness. The negative count of leisure days occurs because people who reported consuming alcohol at 'low risk' have more days of lost leisure due to illness than do current 'high risk' alcohol consumers, so if we were to increase 'low risk' alcohol consumption there would potentially be more days of leisure lost rather than fewer. If we were able to eliminate 'high risk' alcohol consumption entirely from the population, each of these losses would disappear over time.

4.5.2.2 Realistic target reductions in alcohol consumption

If national alcohol consumption was reduced to 6.4 litres/capita, from 9.8 litres/capita some of the attributed net economic burden described above would potentially no longer occur. We estimated the new cases of alcohol-related disease would fall by 98,000; deaths would reduce by 380; and DALYs by 21,000 each year. Over the working lifetime of the working-age population we estimated there would be 5 million fewer working days lost and just under -1,500 early retirements due to alcohol consumption that would potentially not occur. Over the lifetime of all adults we estimated there would be 54,000 fewer days lost to illness that would have been used for household production, and -28,000 fewer days of lost leisure due to alcohol-related illness that would potentially not occur. See explanation of negative results above.

4.5.2.3 Progressive target reduction in alcohol consumption

If national alcohol consumption was reduced to 8.1 litres/capita from 9.8 litres/capita some (a smaller proportion) of the attributed net economic burden described above would potentially no longer occur. We estimated the new cases of alcohol-related disease would fall by 49,000, deaths would fall by 188 and there would be 11,000 fewer DALYs annually. Over the working lifetime of the working-age population there would be 2.5 million fewer working days lost and over -700 early retirements due to alcohol consumption that would potentially not occur. Over the lifetime of all adults we estimate there would be 27,000 fewer days lost to illness that would have been used for household production, and -14,000 fewer days of lost leisure due to alcohol-related illness that would potentially not occur. See explanation of negative results above.

Table 24 Health status and economic outcomes uncorrected for joint effects

High risk alcohol consumption	Attributable at current levels of prevalence Uncorrected for joint effects		
		95% Confidence Interval	
	Mean ('000s)	LL ('000s)	UL ('000s)
Health status and economic outcomes			
Per annum			
DALYs	61	n/a	n/a
Incidence of disease	282	n/a	n/a
Mortality	1	n/a	n/a
Lifetime			
Leisure (days)	(94)	(12,818)	12,482
Absenteeism (days)	14,417	n/a	n/a
Days out of home based production role (days)	162	(6,445)	6,724
Early retirement (persons)	(4)	n/a	n/a
	Ideal target reduction		
Health status and economic outcomes			
Per annum			
DALYs	21	n/a	n/a
Incidence of disease	98	n/a	n/a
Mortality	0.38	n/a	n/a
Lifetime			
Leisure (days)	(28)	(2,906)	2,778
Absenteeism (days)	5,002	n/a	n/a
Days out of home based production role (days)	54	(1,252)	1,341
Early retirement (persons)	(1)	n/a	n/a
	Progressive target reduction		
Health status and economic outcomes			
Per annum			
DALYs	11	n/a	n/a
Incidence of disease	49	n/a	n/a
Mortality	0.19	n/a	n/a
Lifetime			
Leisure (days)	(14)	(1,453)	1,389
Absenteeism (days)	2,501	n/a	n/a
Days out of home based production role (days)	27	(626)	670
Early retirement (persons)	(1)	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

4.5.3 Financial gains/losses

The potential opportunity cost savings which benefit the health sector, individuals, business and government are presented in Table 25 and Figure 22.

4.5.3.1 Health sector costs associated with alcohol consumption

Alcohol consumption (past and present) is associated with $2,275 million of health sector costs that we estimate could be prevented at some point in the life time of males and females in 2008. This can be expected to be reduced by $789 million or $395 million if alcohol consumption is reduced nationally as described above to 6.4 or 8.1 litres/day respectively.

4.5.3.2 Gains to individuals and business

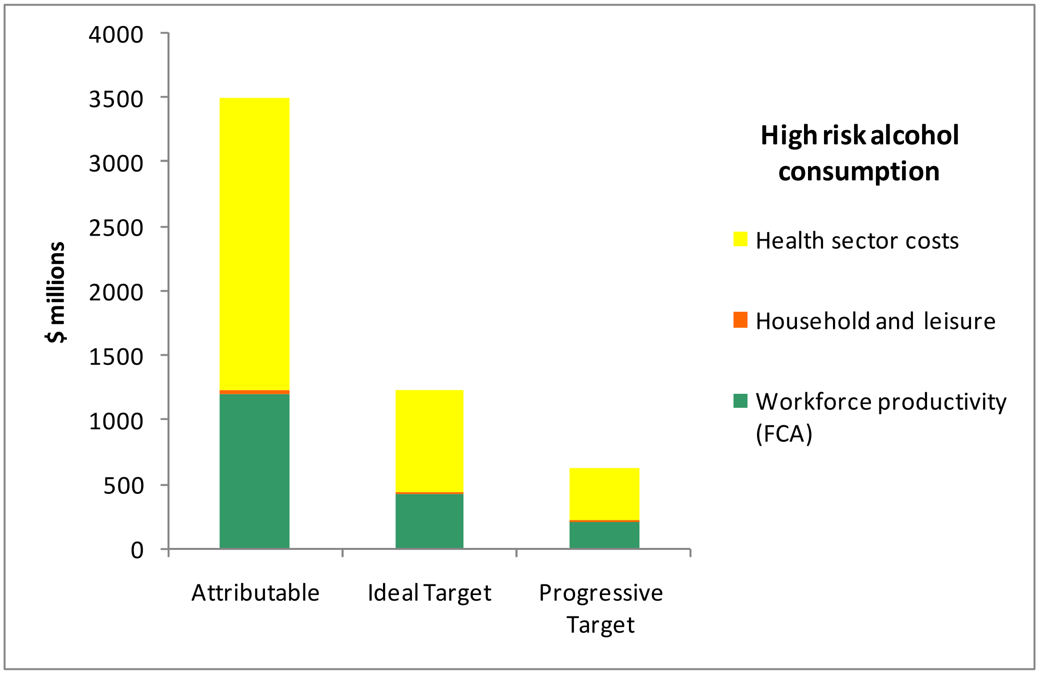
The total opportunity cost savings from production gains (working, household activities and leisure) that could be achieved if all attributed deaths and incident cases of alcohol related disease did not occur are estimated at -$4,482 million using the HCA or $1,224 million using the more realistic FCA. The fewer deaths and incidence of alcohol-related disease which would arise from reduced consumption (at 6.4 litres) could be expected to lead to total production gains of -1,532 million (HCA) or $435 million (FCA) and to the lower estimates of -$772 million (HCA) or $224 million (FCA) if reduced national alcohol consumption of only 8.1 litres/capita was achieved. The negative estimates when using the HCA occur because the workforce participation rates of young male (15-24 years) and most female ‘high risk’ alcohol consumers was higher than persons reporting ‘low risk’ alcohol consumption and effects were measured over the entire working life. The FCA in contrast captures only a portion of a year’s income under such circumstances and does not weight the behaviour of the younger age groups as heavily. Results of the uncertainty analysis undertaken indicated an 83-85% chance of a net production loss using the HCA method and 30-35% chance using the FCA method (Table 26). This appeared to be mainly due to the potential loss of workforce and leisure production outweighing the net household production gains, when levels of alcohol consumption were reduced.

The FCA method identifies recruitment and training costs of $88 million as being attributable to the net alcohol consumption burden currently. It was estimated that these costs could be reduced by $30 million if the ideal reduction in litres/capita of alcohol consumed was achieved, or $15 million if the progressive target reduction was achieved. In contrast to the aforementioned gains, we have estimated that there would be a net loss to individuals of leisure time, if the net attributed harm of alcohol consumption was totally eliminated from the population, since persons reporting alcohol consumption at 'high risk' levels also report higher days of reduced activity than persons reporting alcohol consumption at 'low risk' levels. The increase in home based production of $64 million at 9.8 litres/capita of alcohol consumption can be expected to be reduced by $21 million or by $11 million at consumption of 6.4 or 8.1 litres/capita, respectively. The leisure gain is -$43 million at current litres of alcohol consumption which can be expected to be reduced by -$12 million or by -$6 million at consumption of 6.4 or 8.1 litres/capita, respectively. Negative results were explained in 4.5.2.1.

4.5.3.3 Taxation Gains to Government

If there are higher individual wages earned by people through not becoming ill or retiring early from the workforce then greater taxation revenue could be expected to follow. At the current levels of alcohol consumption, the taxation forgone due to lost incomes is estimated at ($1,229 million) (HCA) or $192 million (FCA). These will change by -$423 million or -$212 million (HCA) if the lower alcohol consumption target is reached (ideal or progressive target respectively). The taxation foregone will be reduced by $69 million or $36 million (FCA) if the lower alcohol consumption target is reached (ideal or progressive target respectively). The taxation is negative using the HCA since there is expected to be a net loss of production incomes to individuals if alcohol consumption is reduced.

Figure 22 Total potential opportunity cost savings from reductions in high risk alcohol consumption



FCA: Friction Cost Approach (preferred conservative estimate).

Table 25 Financial outcomes uncorrected for joint effects

High risk alcohol consumption	Attributable at current levels of prevalence *uncorrected for joint effects*		
		95% Confidence Interval	
Financial Outcomes	**Mean ($mill)**	**LL ($mill)**	**UL ($mill)**
Health sector costs	2,275	n/a	n/a
Production Costs HCA	(4,503)	(11,867)	3,360
Production Costs FCA	1,202	(1,191)	4,726
Recruitment and training costs	88	n/a	n/a
Leisure based production	(43)	(3,376)	3,306
Home based production	64	(2,548)	2,647
Total production HCA	***(4,482)***	***(13,772)***	***5,212***
Total production FCA	***1,224***	***(5,227)***	***7,893***
Taxation effects HCA	(1,229)	(2,452)	90
Taxation effects FCA	192	(441)	1,056
	Ideal target reduction		
Financial Outcomes			
Health sector costs	789	n/a	n/a
Production Costs HCA	(1,541)	(4,060)	1,123
Production Costs FCA	427	(381)	1,609
Recruitment and training costs	30	n/a	n/a
Leisure based production	(12)	(813)	779
Home based production	21	(495)	532
Total production HCA	***(1,532)***	***(4,418)***	***1,398***
Total production FCA	***435***	***(1,142)***	***2,115***
Taxation effects HCA	(423)	(839)	25
Taxation effects FCA	69	(141)	359
	Progressive target reduction		
Financial Outcomes			
Health sector costs	395	n/a	n/a
Production Costs HCA	(777)	(2,046)	566
Production Costs FCA	220	(189)	846
Recruitment and training costs	15	n/a	n/a
Leisure based production	(6)	(406)	389
Home based production	11	(247)	266
Total production HCA	***(772)***	***(2,190)***	***690***
Total production FCA	***224***	***(556)***	***1,076***
Taxation effects HCA	(212)	(420)	20
Taxation effects FCA	36	(72)	190

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate. Numbers in brackets ( ) indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 26 Likelihood of net production loss

High risk alcohol consumption	Mean ($mill)	Chance of negative result (%)
Attributable		
Total Production HCA	(4,482)	83
Total Production FCA	1,224	35
Ideal		
Total Production HCA	(1,532)	85
Total Production FCA	435	30
Progressive		
Total Production HCA	(772)	85
Total Production FCA	224	30

Notes: HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate).
These are not estimates of immediately realisable cash savings.

4.5.4 Discussion

We have attempted to model the net benefits of a reduction in national rates of alcohol consumption which has required an additional assumption that the percentage change in litres consumed will be translated to reduced prevalence of harmful alcohol consumption levels. This may not be so depending on the targeting and effectiveness of any health promotion message.

Cost estimates associated with alcohol misuse reported by Collins and Lapsley (2008) were generally higher compared to those reported in the current study. For example, net productivity costs of $3.5 billion estimated by Collins and Lapsley were almost three times higher than the total workforce production $1,202 million (FCA) estimated in the current study. Collins and Lapsley quantified costs based on past and present drug abuse by comparing a counterfactual scenario in which no alcohol misuse has occurred and then comparing this to the present population where alcohol misuse is prevalent. In contrast, the current estimates were based on reduced incident cases of disease associated with 'high risk' alcohol consumption in 2008 and the associated lifetime costs based on these incident cases. Although estimates are therefore not directly comparable for this and other methodological differences between studies, a greater understanding of the magnitude of avoidable costs associated with high-risk alcohol consumption has been achieved.

Cross-sectional data issues exist when comparing the people reporting alcohol consumption at ‘high risk’ levels with low risk consumers of alcohol. For example, people who report alcohol consumption at ‘high risk’ levels participate in the workforce at higher levels than do people who report alcohol consumption at low risk levels, which leads to unexpected negative results presented earlier. Further, as noted by Begg at al. (2007), alcohol can have both hazardous and protective health effects and the age and sex distribution of these effects varies in important ways. For example, these benefits outweighed harmful effects for females over the age of 65. This may explain the negative results obtained in the current study for home based and leisure production following a reduction in alcohol consumption. The number of people reporting ‘high risk’ alcohol consumption is small and volatile with wide confidence intervals, which makes the modelled estimates of economic and financial gains also volatile and unstable and more difficult to interpret.

The estimates are the least reliable of all the risk factors considered since they are so volatile and likely to have been affected by misreporting on the NHS 2004-05 of the quantity of alcohol consumed on a long term basis. The uncertainty intervals around each of the economic and financial gains range from negative values to positive amounts of similar size which indicates enormous uncertainty. Nevertheless, at a population level, if ‘high risk’ alcohol consumption were to be decreased important opportunity cost savings from the reduction of diseases associated with this risk factor could be expected to be achieved.

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5.0 INADEQUATE FRUIT AND VEGETABLE CONSUMPTION

Summary of consensus decision for analytic modelling:

Current prevalence
(Australian Population 2008)
↑ 1 serve per day per capita
Progressive target
↑ 2 serves per day per capita
Ideal (realistic) target

5.1 Executive summary

Main findings from the literature review

- In Australia, 46% of Australian adults eat less than two serves of fruit per day and 86% eat less than five serves of vegetables per day.
- Of the overall health burden, 2.7% can be attributed to inadequate fruit and vegetable consumption in men and 1.5% can be attributed to inadequate fruit and vegetable consumption in women.
- Evaluated interventions have led to modest increases in fruit and vegetable consumption of about 17% (0.6 servings per day).
- Australian guidelines recommend an intake of 2 serves of fruit and 5 serves of vegetables per day.

Research findings from this project

Risk reversal after the cessation of the risk behavior takes some time to occur and hence the estimated economic benefits will be realized not immediately but over some period of years instead.

At a population level, if the average consumption of fruit and vegetables were to be increased for the 2008 Australian adult cohort modelled, we would expect important opportunity cost savings from the reduction of diseases associated with this risk factor.

- Australians eat an estimated 503 grams of fruit and vegetables per day: approximately 2 serves of fruit and 3 of vegetables.
- In Australia, the potential opportunity cost savings to the health sector, if the inadequate consumption of fruit and vegetables was eliminated, are $206 million and $63 million, in production and leisure (assessed using the Friction Cost Approach - FCA).
- We found that if the consumption of fruit and vegetables was increased from 503 grams per day per capita by the equivalent of two serves of vegetables to 675 grams per day per capita (ideal target):
  - Potential opportunity cost savings of $71 million in the health sector and $21 million in production and leisure could be realised (FCA) over time
  - The 7,300 annual new cases of disease related to the inadequate consumption of fruit and vegetables could be reduced over time by 2,500
  - The 4,600 annual deaths attributed to an inadequate consumption of fruit and vegetables could be reduced over time by just under 1,600
  - The 55,000 DALYs could be reduced over time by 18,900
- If the consumption of fruit and vegetables was increased from 503 grams per day per capita by the equivalent of one serve of vegetables to 589 grams per day per capita (progressive target):
  - Potential opportunity cost savings of $35 million in the health sector and $11 million in production and leisure could be realised (FCA) over time
  - Annual new cases of disease related to the inadequate consumption of fruit and vegetables could be reduced overtime by 1,250
  - Annual deaths attributed to an inadequate consumption of fruit and vegetables could be reduced over time by approximately 780
  - DALYs could be reduced over time by 9,400
- Many of the health and economic costs associated with the inadequate consumption of fruit and vegetables and hence the benefits of increased consumption are experienced in the elderly, non-working population.

5.2 Definition

This risk factor was quantified using self reported average dietary consumption of fruit and vegetables. Specifying a theoretical minimum risk distribution (the distribution of exposure that would yield the lowest population risk) involved setting an upper estimation that is protective. Lock et al. (2004) set this minimum at consumption of 600 grams (standard deviation of 50 grams) of fruit and vegetables per day for adults, in accordance with WHO guidelines. In Australia, the ‘Go for 2&5’ campaign defined one serve of vegetables as 75 grams and one serve of fruit as 150 grams of fresh fruit (Department of Health and Ageing 2007). This campaign, therefore, set 675 grams of fruit and vegetables per day as a recommended target.

Drawing on this literature, and taking into account available source data, inadequate fruit and vegetable consumption was defined as follows:

Inadequate fruit and vegetable consumption	Inadequate fruit and vegetable consumption: Consumption below the recommended minimum of 2 serves fruit and 5 serves vegetables daily. Adequate consumption: Consumption at or above the recommended minimum of 2 serves fruit and 5 serves vegetables daily.

5.3 Summary of current literature and best available data

5.3.1 Prevalence data

Estimates in the current study are based on data from the 2003 Burden of Disease (BoD) report (Begg et al. 2007); see Table 27 and Table 28).

Table 27 Fruit and vegetable consumption in Australian men

Age	15-29	30-44	45-59	60-69	70-79	80+
Mean grams/day	445	452	496	538	538	538
Standard Deviation	241	235	245	230	219	219

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

Table 28 Fruit and vegetable consumption in Australian women.

Age	15-29	30-44	45-59	60-69	70-79	80+
Mean grams/day	484	506	569	602	577	577
Standard Deviation	237	228	240	234	217	217

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

In Australia, 46% of Australian adults eat less than two serves of fruit per day and 86% eat less than five serves of vegetables per day (Australian Bureau of Statistics 2006). This NHS 2004-05 data has been used to inform the *national* average daily consumption of fruit and vegetables and associated feasible reduction targets for inadequate consumption of fruit and vegetables (refer to section 5.4).

5.3.2 Socioeconomic status

Studies investigating the link between nutrition and health burden have often adjusted for socioeconomic status among their confounding variables (Lock et al. 2004). Serdula et al. (2004) demonstrated that educational level was associated with consumption of fruit and vegetables. The percentage of adults consuming fruit and vegetables five or more times per day was 20% in those who didn't complete high school, 21% in high school graduates, 25% in those with some college and 29% in college graduates. Kamphuis et al. (2006) indicated that people with lower household income consistently had lower fruit and vegetable consumption, and that single people consumed less than those who were married.

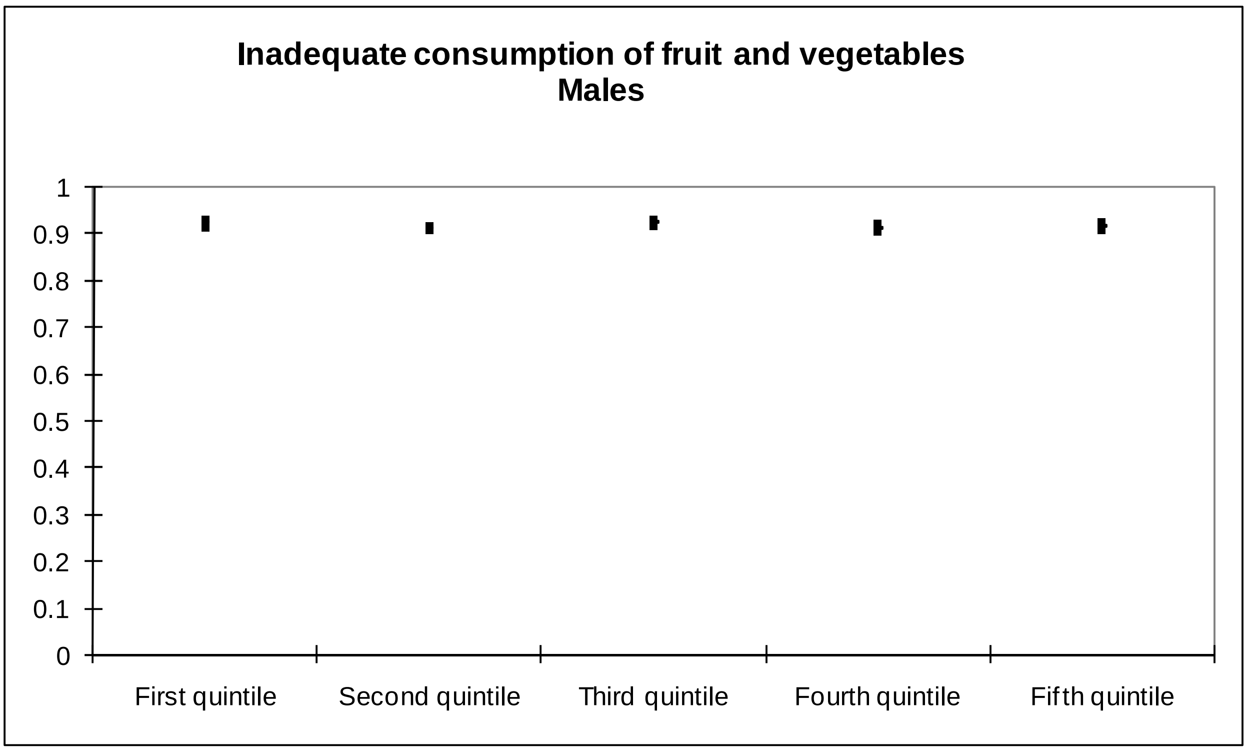
The proportion of persons who report inadequate consumption of fruit and vegetables from the National Health Survey 2004-05, according to socioeconomic quintile is presented in Figure 23 and Table 29.

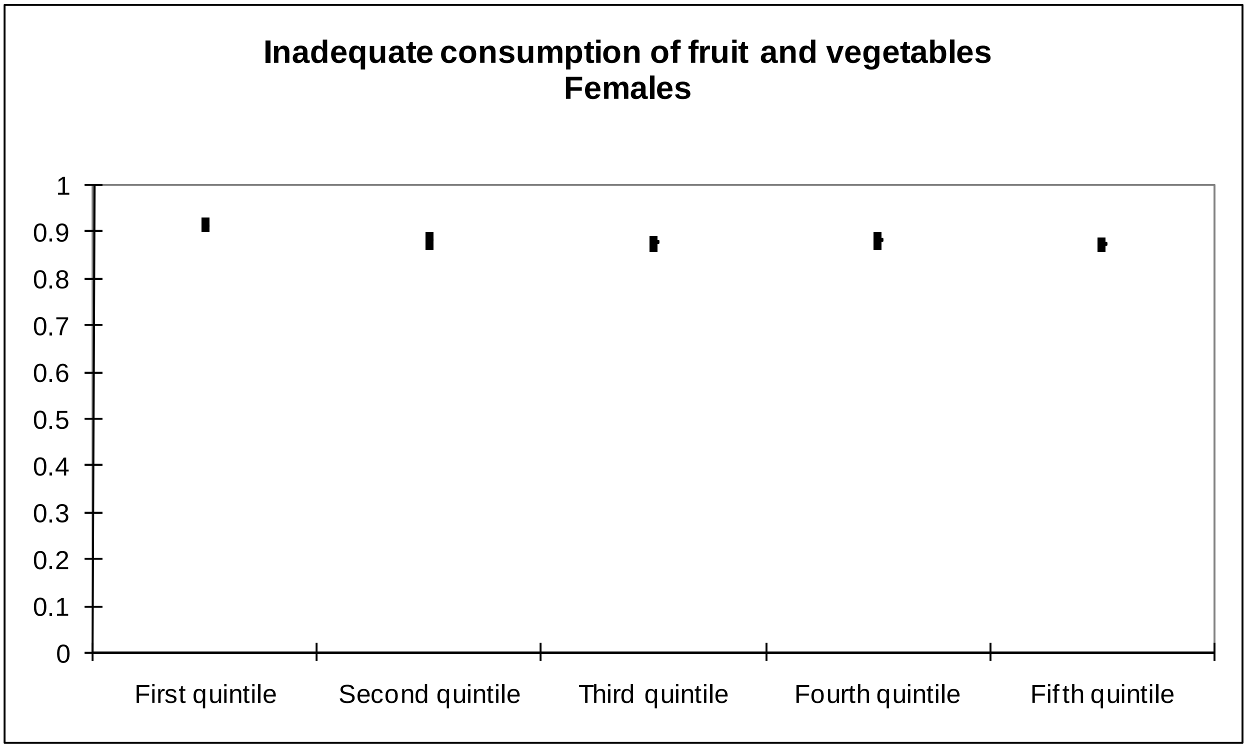
The proportion of men who report an inadequate consumption of fruit and vegetables is consistently high (>90%), and no significant difference is observed between the five socioeconomic quintiles.

While the proportion of women who report inadequate consumption of fruit and vegetables is similarly high across socioeconomic quintiles (>87%), the data indicates a significantly higher proportion in the lowest socioeconomic group (91.2%) compared to the highest socioeconomic group (87.1%).

These data appear to have a ceiling effect, which might limit the capacity to demonstrate a strong relationship between inadequate consumption of fruit and vegetables and socioeconomic status.

Figure 23 Proportion of Australian adults in each socioeconomic quintile who consume an inadequate diet of fruit and vegetables by gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 29 Proportion of Australian adults in each socioeconomic quintile who consume an inadequate diet of fruit and vegetables by gender

	Mean	Lower Limit	Upper Limit
Males			
First quintile	0.922	0.901	0.938
Second quintile	0.912	0.896	0.925
Third quintile	0.922	0.908	0.935
Fourth quintile	0.911	0.892	0.926
Fifth quintile	0.915	0.898	0.93
Females			
First quintile	0.912	0.897	0.926
Second quintile	0.881	0.861	0.898
Third quintile	0.874	0.856	0.891
Fourth quintile	0.879	0.857	0.898
Fifth quintile	0.871	0.854	0.886

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

5.3.3 Health outcomes

Of the overall DALY health burden, 2.7% can be attributed to inadequate fruit and vegetable consumption in men and 1.5% can be attributed to inadequate fruit and vegetable consumption in women (Begg et al. 2007). In terms of DALYs lost, the most prominent contributors to health burden are ischaemic heart disease (69%), stroke (13%), lung cancer (11%) and stomach cancer (3%). Marks et al. (2001) focused on cancer and the associations between low vegetable consumption (< 4 serves/day) and colorectal, lung, prostate and breast cancer and inadequate fruit consumption and lung and breast cancer. Gundgaard et al. (2003) used modelling to consider the impact of increasing fruit and vegetable consumption from 250g to 400g or 500g on cancer incidence, with results showing a 19-32% decrease in cancer incidence.

Results of two meta-analyses undertaken by Dauchet et al. (2005; 2006) found the risk of stroke decreased by 5% and coronary heart disease by 4% for each additional portion per day of fruit and vegetable intake. However, limitations to the meta-analyses are noted by the study authors, including the potential for overestimating these effects.

There is also evidence that dietary consumption of fruit and vegetables may be associated with hypertension, Type 2 diabetes, cataracts and macular degeneration of the eye (Taylor 1993; Steinmetz and Potter 1996).

5.3.4 Other economic cost estimates

For comparison purposes we include the most recent cost data from a reputable source, but reiterate the point that costing studies of disease or risk factors are often incomparable due to the different definitions and assumptions applied. The cost estimates provided in the current study have been consistently and comparably estimated across all the risk factors considered.

In Australia in 1993-94, the total health care costs associated with low consumption of vegetables for colorectal, breast, lung and prostate cancers was estimated at $59 million per year, and total health care costs associated with low consumption of fruit for breast and lung cancers was estimated at $29 million per year (Marks et al. 2001). It was proposed that increasing average vegetable consumption by one serving a day could save $24 million per year and increasing average fruit consumption by one serving a day could save $9 million per year. These estimates are difficult to compare to estimates for other risk factors for three reasons: they are based on old data (1993-94), they do not include indirect and intangible costs, and they do not cover costs from diseases other than cancer (69% of the health burden attributable to insufficient fruit and vegetable consumption is attributed to ischemic heart disease).

Crowley et al. (1992) estimated the economic cost of diet-related (i.e. not only insufficient fruit and vegetables) disease in Australia in 1989-90 at $2.0 billion. This estimate includes both direct health care costs (costs of hospitals, medical expenses, allied health professional services, pharmaceutical expenses and nursing homes) and indirect costs (costs due to sick leave and the NPV of forgone earnings due to premature death) attributable to diet. Using the mid-value population attributable fractions, the direct cost of diet-related disease was estimated to be $1.4 billion and the indirect cost was $0.6 billion. This study might provide a better estimate than Marks et al. (2001), but it also uses old data and is not specific to fruit and vegetable consumption.

Gundgaard et al. (2003) demonstrated that increasing daily consumption of fruit and vegetables would bring about increased life expectancy and reductions in incidence of cancer. However, estimated aggregate healthcare costs remained stable as the resources saved due to the reduction in cancer were offset by the increase in health costs for people living longer.

5.3.5 Prevention

In a review of studies of interventions to increase fruit and vegetable consumption, Ammerman et al. (2002) found a median difference in fruit and vegetable consumption between intervention and control groups of 17%, which translated to 0.6 servings per day. Furthermore, they reported that the median difference between intervention and control groups in the change in total fat intake (as a percentage of total energy intake) was 16%, which translated to a 7% reduction in the percentage of calories from fat. Studies in higher disease-risk populations were more likely to show intervention effects than those among general-risk populations. Intervention components that appeared particularly promising were: social support, goal setting, small groups, food-related activities and family components. Few studies, however, followed participants for more than a year, and those that did generally found a diminution of effect. A more recent review combined results from 13 school-based nutrition interventions and found a net relative change of 19%, which equated to an increase in fruit and vegetable consumption of 0.45 servings per day (Howerton et al. 2007). Another review focused on children reported that 10 out of 15 eligible intervention studies showed a significant increase in fruit and vegetable consumption, with increases ranging from 0.30 to 0.99 serves per day (Knai et al. 2006).

Most public health interventions to date have centred on education to increase individual knowledge and awareness of the health benefits of good nutrition. The Australian government has recently run the 'Go for 2&5' campaign, which encouraged people to consume at least two serves of fruit and five serves of vegetables per day. Survey-based evaluation indicated raised levels of awareness and a significant decrease in low level vegetable consumption (one serve) amongst parents. However, there was no significant increase in the proportion of parents who ate the recommended five or more serves of vegetables per day between surveys (Department of Health and Ageing 2007). Evaluation of the 'Go for 2&5®' campaign in Western Australia reported a net increase of 0.8 serves/day of fruit and vegetables during campaign implementation (Pollard et al. 2008). At 12-months post-intervention, a net decline of 0.3 servings of fruit and vegetables was reported suggesting a 0.5 servings/day increase of fruit and vegetables following implementation.

Havas et al. (1998) found that a multifaceted nutrition education program had an impact on diet. At 2 months post-intervention, those exposed to the intervention had increased their daily consumption of fruit and vegetables by 0.56 serves (compared to 0.13 in controls). After 12 months, however, the difference between groups had dissipated (an additional 0.27 serves per day in both groups). Sorensen et al. (1999) used three different groups (control, workplace intervention, workplace-plus-family intervention) to test whether programs using community-organising strategies could increase fruit and vegetable consumption. They identified a 19% increase in the workplace-plus-family group, a 7% increase in the workplace group and no change in the control group in fruit and vegetable consumption. This equated to a half-a-serve per day increase in the workplace-plus-family group compared with controls. There is also evidence that motivational interviewing is a promising strategy for increasing fruit and vegetable consumption (Resnicow et al. 2001).

Perry et al. (1998) ran a randomised school-based trial of a multi component intervention (behavioural curricula, parental involvement, school food changes) that successfully increased fruit and vegetable consumption in fifth-grade students. Lunch consumption of fruit and vegetables was 1.53 servings in the intervention group compared to 1.06 in controls, and daily fruit and vegetable consumption was 5.24 servings in the intervention group compared to 4.66 in controls. A subsequent program – Cafeteria Power Plus – was more intensive and focussed on school lunch and did not use any classroom time. The results were again positive, though the increase in fruit and vegetable consumption was not as great as those seen with the multi component intervention (Perry et al. 2004).

Food price is also an important factor and has been the focus of interventions. There is evidence that a low-income population may be more likely to increase its fruit and vegetable consumption when incentives such as coupons improve affordability (Anderson et al. 2001). In a high school setting, French et al. (1997) demonstrated that fruit sales increased by about fourfold during a low-price period and carrot sales increased by about twofold. These effects are consistent with those found in a previous study with an adult population (Jeffery et al. 1994).

5.4 Determination of the feasible reductions for inadequate fruit and vegetable consumption

The quantification of inadequate fruit and vegetable consumption and the determination of feasible targets for improving dietary consumption was the most debated aspect of this project. In maintaining consistency across all the risk factors in this project, data on the number of serves of fruit and vegetables currently consumed per day were sourced from the NHS of 2004-05 (Australian Bureau of Statistics 2006). While the literature illustrates clear methodological differences in quantifying fruit and vegetable consumption, a population approach was used to determine the national average fruit and vegetable consumption using the best available source data. A major issue in this area is that the people who self-report food consumption have difficulty quantifying consumption levels in terms of ‘serves per day’ and therefore these data, similar to those of other self-reported risk factor behaviors, are subject to reporting bias. Furthermore, people may alter (improve) their consumption once they have become ill from disease. This cannot be identified from the data we have used. In addition, we have not controlled for other risk factors or socioeconomic status in the analysis and this may have influenced the production and leisure effects. Conversely, in maintaining consistency with the 2003 BoD methodology (and all other risk factors evaluated in this study) we extended beyond cancers to estimate health sector costs for all diseases associated with an inadequate consumption of fruit and vegetables (e.g. ischaemic heart disease, stroke). Therefore, there may be sources of both over- and under-estimation because of methodological differences when comparing our findings to the results of others in this area.

Using the Confidentialised Unit Record Files data from the NHS 2004-05, we determined that Australians eat an estimated average 503 grams of fruit and vegetables per day – that is, approximately 2 serves of fruit and 3 of vegetables. We found that many of the health and economic costs associated with the inadequate consumption of fruit and vegetables, and hence the benefits of increased consumption, were experienced in the elderly, non-working population.

Following external consultation, it was decided that using an Arcadian mean (refer to analytic methods in Part A section 2.3.1) was inappropriate, given the variability in measurement practices and the large cultural differences in international food consumption. On the basis of the ‘Go for 2&5’ campaign, we selected consumption of 675 grams of fruit and vegetables per day as a target. This was also consistent with the approach taken in the 2003 BoD study to estimate DALYs attributable to inadequate consumption of fruit and vegetables (Begg et al. 2007).

Consumption of fruit and vegetables in grams per day:

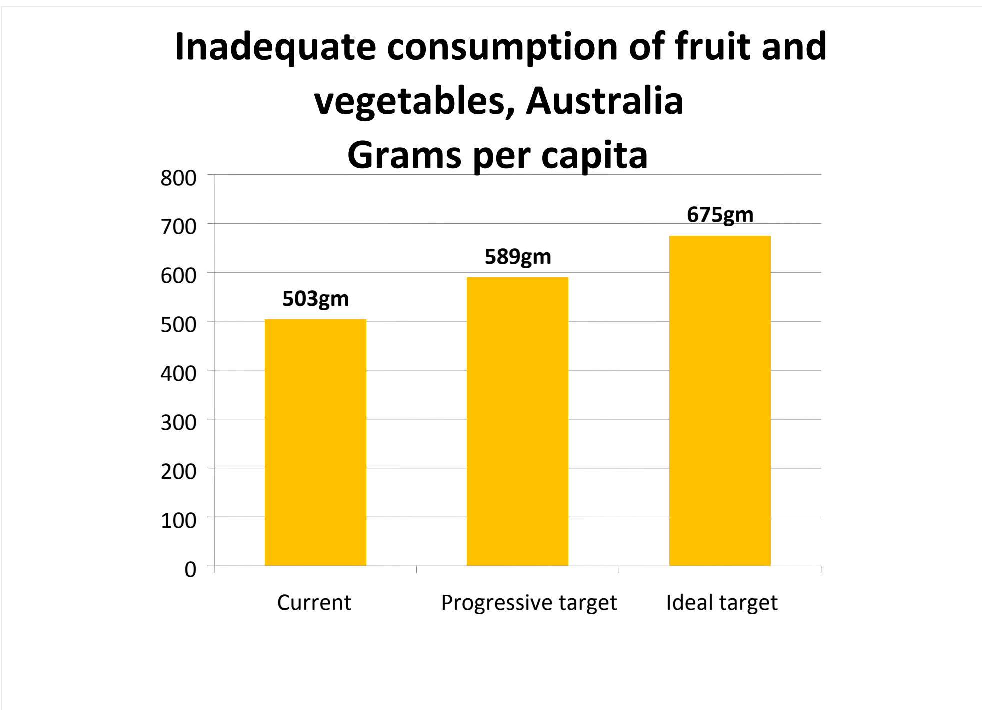
- Australian estimate: 503 grams.
- Target: 675 grams.

Proposed levels to be modelled (appear in Figure 24):

- Current – 503.
- Ideal – 675.
- Progressive – 589.

The difference between the current and target level is 172 grams per day. This translates to approximately 2 additional serves of vegetables or one piece of fruit per day, and is at the low end of the range recommended in the Australian Guide to Healthy Eating (600-1200 grams of fruit and vegetables recommended every day). The net difference between the current (attributable) and avoidable burden will be reported.

Figure 24 Comparison of current and target daily consumption of fruit and vegetables



5.5 Economic and financial benefits of reduced inadequate consumption of fruit and vegetables

The following sections provide the results for the inadequate consumption of fruit and vegetables analysis undertaken using the systematic methods outlined in Part A. Firstly, the 2008 population characteristics are presented followed by estimates for the potential health status, economic and financial outcomes obtained from reducing the prevalence of this risk factor.

5.5.1 Population characteristics of comparator groups

Based on the data from the NHS 2004-05 the following population characteristics were estimated for the 2008 reference population according to age, gender and work force status (Table 30 and Table 31).

Table 30 Males who consume an inadequate diet of fruit and vegetables compared to males who consume an adequate diet of fruit and vegetables

Males:	Inadequate consumption	Adequate consumption
Age summary		
Age 15-64 y N (95% CI)	6,151,486 (6,100,957 – 6,202,015)	505,843 (455,777 – 555,909)
Age 65+ y N (95% CI)	975,979 (951,874 – 1,000,085)	144,262 (120,655 – 167,869)
Age 15+ y Mean (95% CI)	42.9 (42.8 - 43.1)	49.5 (48.2 - 50.9)
In Labour Force (15+ years)*		
% (95% CI)	75% (74% - 76%)	69% (65% - 73%)
Mean days off work (95% CI)	0.29 (0.23 – 0.35)	0.43 (0.23 – 0.63)
Not in Labour Force		
% (95% CI)	25% (24% - 26%)	31% (27% - 35%)
Mean days of reduced activity: 15-64 y (95% CI)	1.57 (1.32 - 1.83)	1.19 (0.44 - 1.94)
Aged 65+ years		
% (95% CI)	13.7% (13.4% - 14.0%)	22.2% (19.2% - 25.5%)
Mean days of reduced activity (95% CI)	1.25 (0.99 - 1.51)	0.94 (0.40 - 1.47)

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years.

Table 31 Females who consume an inadequate diet of fruit and vegetables compared to females who consume an adequate diet of fruit and vegetables

Females:	Inadequate consumption	Adequate consumption
Age summary		
Age 15-64 y	5,918,651	744,916
N (95% CI)	(5,859,960 – 5,977,342)	(686,184 – 803,648)
Age 65+ y	1,130,113	189,698
N (95% CI)	(1,110,033 – 1,150,194)	(169,711 – 209,685)
Age 15+ y	43.9	49.7
Mean (95% CI)	(43.7 – 44.0)	(48.8 - 50.6)
In Labour Force (15+ years)*		
% (95% CI)	60%	55%
	(58% - 61%)	(52% - 58%)
Mean days off work (95% CI)	0.29	0.30
	(0.24 – 0.33)	(0.18 – 0.42)
Not in Labour Force		
% (95% CI)	41%	45%
	(39% - 42%)	(42% - 48%)
Mean days of reduced activity: 15-64 y (95% CI)	1.27	1.52
	(1.12 - 1.42)	(1.06 - 1.97)
Aged 65+ years		
% (95% CI)	16.0%	20.3%
	(15.8% - 16.3%)	(18.3% - 22.5%)
Mean days of reduced activity (95% CI)	1.60	1.26
	(1.37 - 1.83)	(0.83 - 1.69)

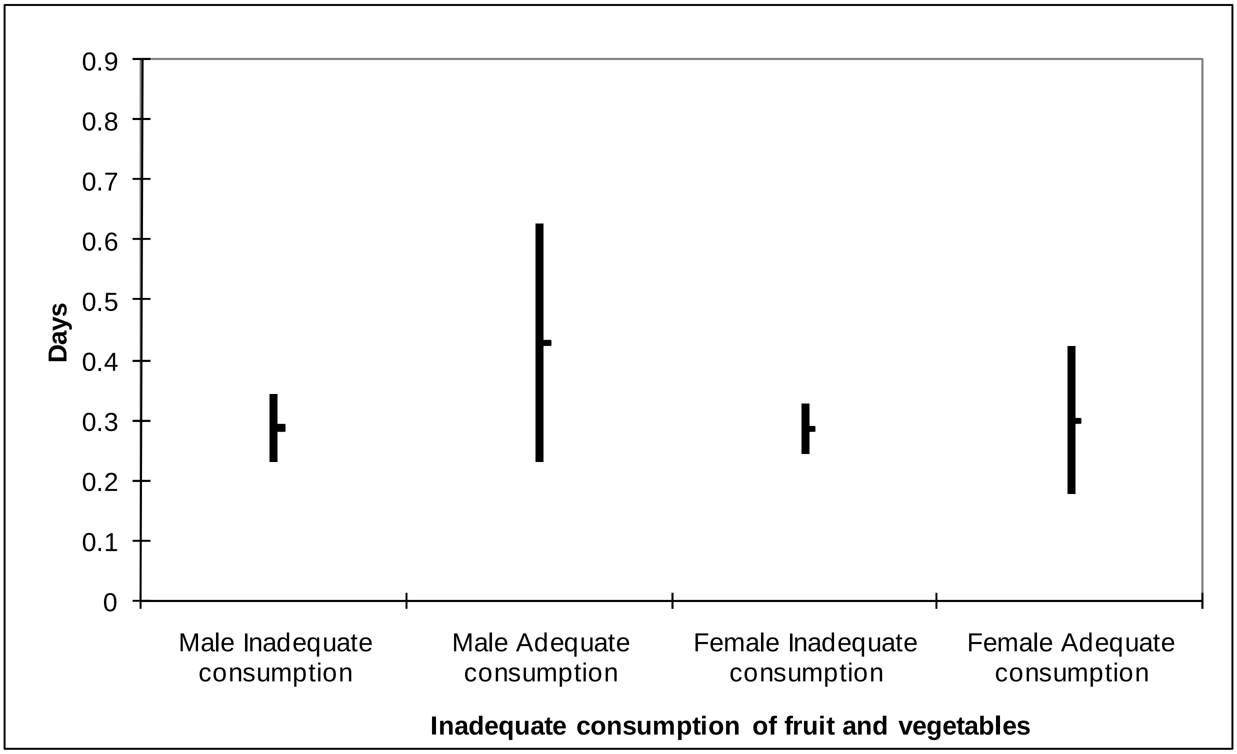
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years.

Absenteeism from paid work – overall

The number of days taken off in a 10-day working period by persons with an inadequate consumption of fruit and vegetables (high risk) compared to those with an adequate consumption (low risk) are presented in Figure 25 and Table 32.

A similar number of days were taken off by persons who reported having an inadequate consumption of fruit and vegetables compared to persons who reported an adequate consumption, with no significant difference between the two groups in either gender.

Figure 25 Days taken off work in a 10-day working period by persons who consume inadequate fruit and vegetables compared to persons who consume adequate fruit and vegetables by gender



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 32 Days taken off work by persons who consume inadequate fruit and vegetables compared to persons who consume an adequate diet of fruit and vegetables

	Mean	Lower Limit	Upper Limit
Males			
Inadequate consumption	0.287	0.229	0.345
Adequate consumption	0.428	0.229	0.626
Females			
Inadequate consumption	0.286	0.244	0.327
Adequate consumption	0.3	0.178	0.422

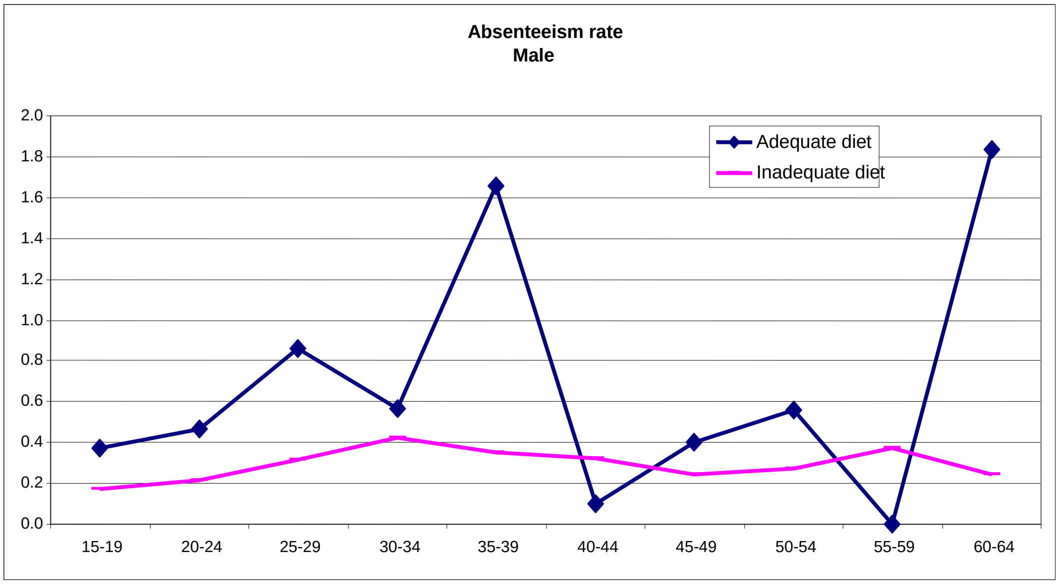
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

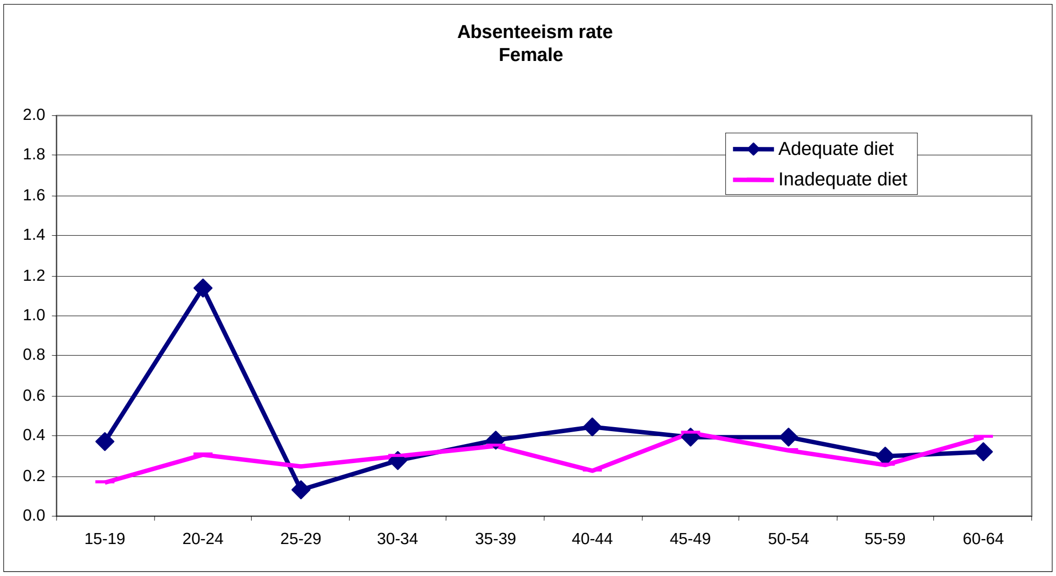
Absenteeism from paid work – by age and gender

Absenteeism rates for persons with an inadequate consumption of fruit and vegetables compared to adequate consumption of fruit and vegetables by age and gender are presented in Figure 26.

The rate of absenteeism for comparison groups varied greatly across age groups, especially for males. Males with an inadequate consumption of fruit and vegetables took fewer days off than males with adequate consumption. However, an exception to this occurred in the 40-44 and 55-59 age groups. Amongst females, the rates of absenteeism were largely similar across all ages except in the 15-24 age group, where females with an inadequate consumption of fruit and vegetables took fewer days off than those with adequate consumption. The rate of absenteeism for males and females with an inadequate consumption of fruit and vegetables remained relatively steady across all age groups, while the smaller group with adequate consumption exhibited more data variability (noise).

Figure 26 Absenteeism rates of persons who consume inadequate fruit and vegetables compared to persons who consume adequate fruit and vegetables by age and gender





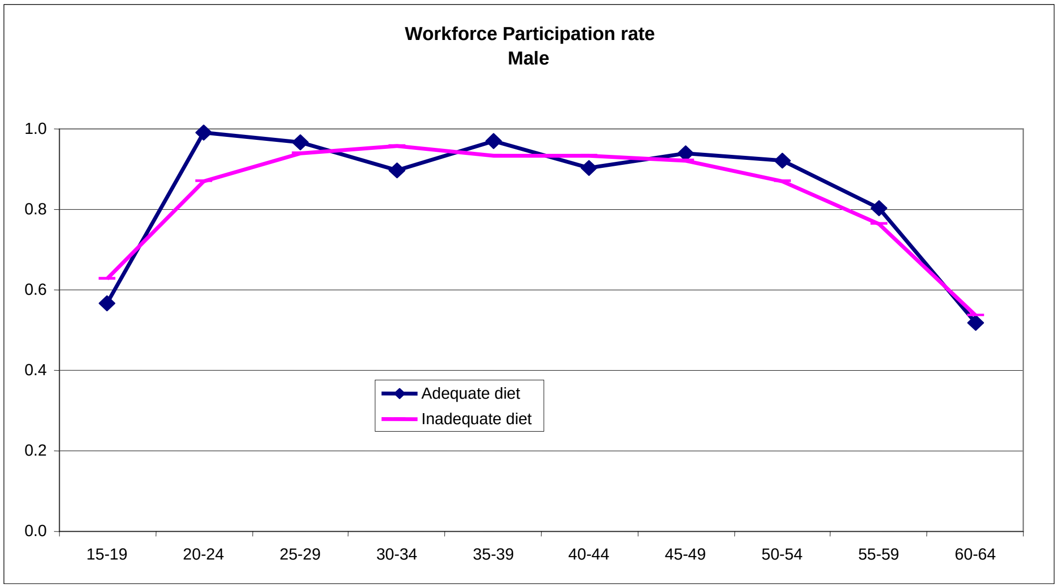
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

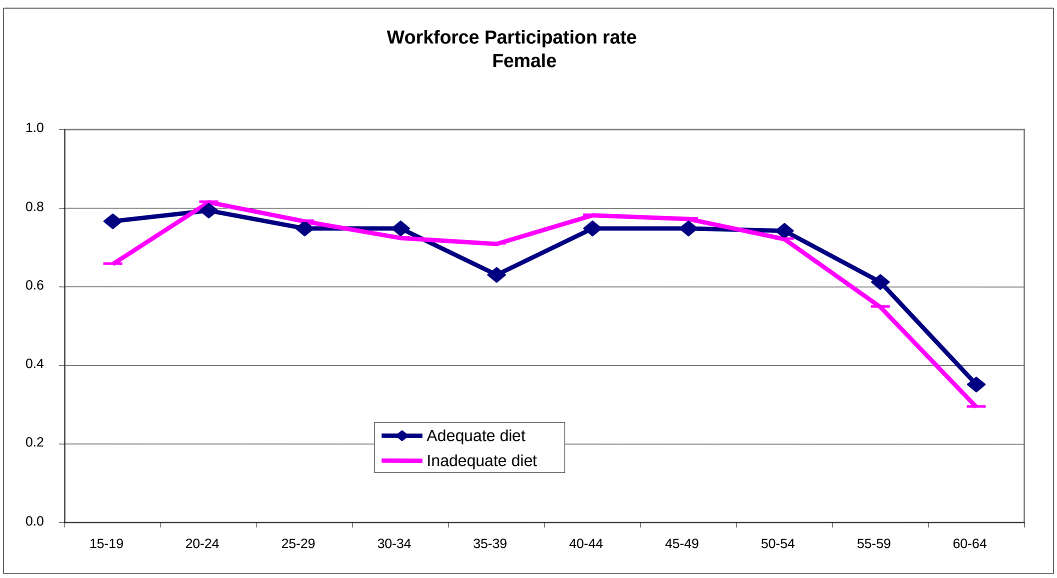
Workforce participation – by age and gender

Workforce participation rates for persons with an inadequate consumption of fruit and vegetables compared to an adequate consumption of fruit and vegetables by age and gender are presented in Figure 27.

Males who reported eating an inadequate consumption of fruit and vegetables had a slightly lower workforce participation rate than males who reported eating an adequate consumption of fruit and vegetables. Males aged 15-19, 30-34, 40-44 years with inadequate consumption of fruit and vegetables were the exceptions. In these age groups males participated in the workforce at a higher rate than the comparator. Females who reported eating an inadequate consumption of fruit and vegetables participated in the workforce at a rate slightly lower than females who reported eating an adequate consumption in half of the age groups presented, and mostly at older ages (15-19, 30-34, 50-64).

Figure 27 Workforce participation rates of persons who consume inadequate fruit and vegetables compared to persons who consume adequate fruit and vegetables by age and gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

5.5.2 Health status and economic gains/losses

The health status and economic gains presented include health gains of potential reduction of DALYs, reduced incidence of disease related to the inadequate consumption of fruit and vegetables and reduced mortality from disease related to the inadequate consumption of fruit and vegetables. The economic gains evaluated also include potential reductions in days of absenteeism from paid employment, reductions in lost days of home based production and reductions in lost days of leisure time; all due to disease related to the inadequate consumption of fruit and vegetables. The mean and 95% uncertainty interval for outcomes able to be modelled as distributions with uncertainty are presented in Table 33.

5.5.2.1 Current losses (attributed economic burden)

Currently we can attribute in the Australian population 7,300 new cases of disease related to the inadequate consumption of fruit and vegetables; 4,600 deaths; and 55,000 DALYs annually to the inadequate consumption of fruit and vegetables (current and past). Over the working lifetime of the working-age population we estimated that there are almost -241,000 working days lost and 32 early retirements due to the inadequate consumption of fruit and vegetables. This early retirement statistic appears quite low because most of the health loss associated with an inadequate consumption of fruit and vegetables occurred in people over the age of 65 years. The negative count of days off work occurred because people who reported an inadequate consumption of fruit and vegetables took fewer days off work than current consumers of an adequate diet of fruit and vegetables. Over the lifetime of all adults, we estimated that there were almost 49,000 days lost because of ill health that would have been used for household production, and almost 90,000 days of lost leisure due to disease related to the inadequate consumption of fruit and vegetables. If we were able to eliminate the inadequate consumption of fruit and vegetables at a population level, by increasing the number of serves of vegetables to two extra, each of these economic and health impacts would decrease over time.

5.5.2.2 Realistic target reductions in consumption of fruit and vegetables

If the consumption of fruit and vegetables was improved nationally to 675grams/capita (i.e. by two more serves of vegetables or one more serve of fruit), some of the attributed health status and economic burden described above would potentially no longer occur. We estimated the new cases of disease related to the inadequate consumption of fruit and vegetables would fall by 2,500; deaths would reduce by just under 1,600; and DALYs by almost 18,900 each year. Over the working lifetime of the working-age population we estimated that there would be -82,000 fewer working days lost, but 11 early retirements due to the inadequate consumption of fruit and vegetables that would potentially not occur. The negative count of days off work occurs because people who reported an inadequate consumption of fruit and vegetables also took fewer days off work currently than current consumers of an adequate diet of fruit and vegetables. This means that if we were to increase the number of people consuming an adequate diet of fruit and vegetable there would be more days of work lost rather than fewer. Moreover, early retirement appears quite low because much of the health loss associated with the inadequate consumption of fruit and vegetables occurs in people over the age of 65 years. Over the lifetime of all adults, if vegetable consumption was increased by two serves, we estimated that there would be 16,600 fewer days lost to illness that would have been used for household production, and 30,600 fewer days of lost leisure arising from illnesses related to the inadequate consumption of fruit and vegetables.

5.5.2.3 Progressive target reduction in consumption of fruit and vegetables

If the consumption of fruit and vegetables was improved nationally to 589grams/capita (i.e. one more serve of vegetables), a smaller proportion of the attributed health status and economic burden described above would potentially no longer occur. We estimated the new cases of disease related to the inadequate consumption of fruit and vegetables would fall by just over 1,250; deaths would fall by 780; and there would be 9,400 fewer DALYs annually. Over the working lifetime of the working-age population there would be -41,000 fewer working days lost, but 5 fewer early retirements due to the inadequate consumption of fruit and vegetables at past levels. Over the lifetime of all adults we estimated that there would be 8,000 fewer days lost to illness that would have been used for household production, and 15,000 fewer days of lost leisure to illnesses related to the inadequate consumption of fruit and vegetables.

Table 33 Health status and economic outcomes uncorrected for joint effects

Inadequate daily consumption of fruit and vegetables	**Attributable at current levels of prevalence *uncorrected for joint effects***		
Health status and economic outcomes		**95% Confidence Interval**	
	Mean (‘000s)	**LL (‘000s)**	**UL (‘000s)**
Per annum			
DALYs	55	n/a	n/a
Incidence of disease	7	n/a	n/a
Mortality	5	n/a	n/a
Lifetime			
Leisure (days)	90	(152)	322
Absenteeism (days)	(241)	n/a	n/a
Days out of home based production role (days)	49	(79)	173
Early retirement (persons)	0.03	n/a	n/a
	Ideal target reduction		
Health status and economic outcomes			
Per annum			
DALYs	19	n/a	n/a
Incidence of disease	3	n/a	n/a
Mortality	2	n/a	n/a
Lifetime			
Leisure (days)	31	(52)	110
Absenteeism (days)	(82)	n/a	n/a
Days out of home based production role (days)	17	(27)	59
Early retirement (persons)	0.01	n/a	n/a
	Progressive target reduction		
Health status and economic outcomes			
Per annum			
DALYs	9	n/a	n/a
Incidence of disease	1	n/a	n/a
Mortality	1	n/a	n/a
Lifetime			
Leisure (days)	15	(26)	55
Absenteeism (days)	(41)	n/a	n/a
Days out of home based production role (days)	8	(13)	30
Early retirement (persons)	0.01	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

5.5.3 Financial gains/losses

The potential opportunity cost savings which benefit the health sector, individuals, business and government are presented in Table 34 and Figure 28.

5.5.3.1 Health sector costs associated with an inadequate consumption of fruit and vegetables

Inadequate fruit and vegetable consumption (past and present) is associated with $206 million of health sector costs that we estimate could be prevented at some point in the life time of males and females in 2008. This could be expected to be reduced by just under $35 million or $71 million if the consumption of fruit and vegetables was increased to 589 grams/capita or 675grams/capita, respectively (i.e. by one or two serves of vegetables daily).

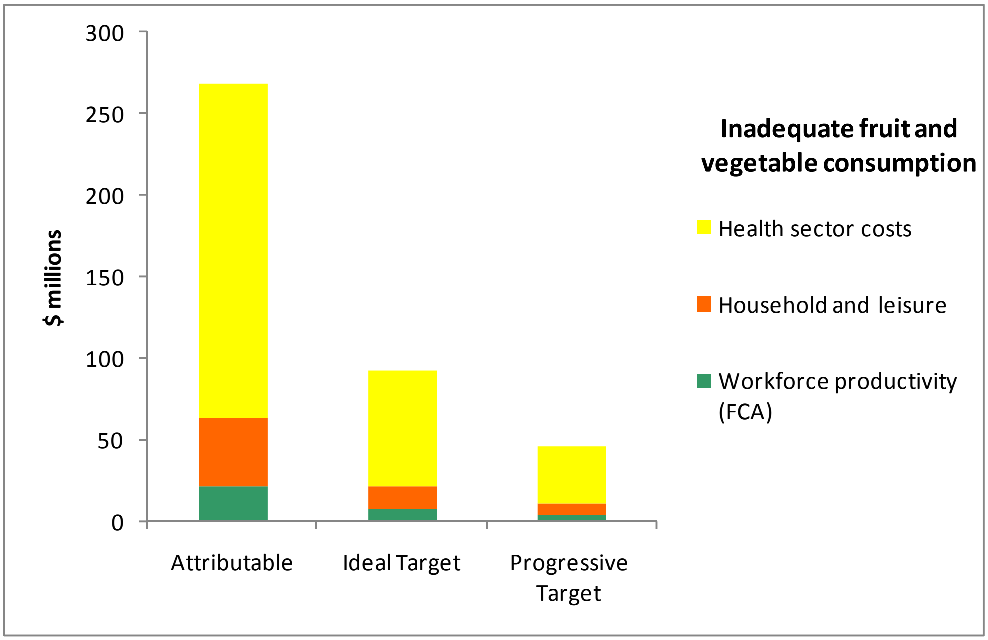
5.5.3.2 Gains to individuals and business

The total opportunity cost savings from production gains (working, household activities and leisure) that could potentially be achieved if the inadequate consumption of fruit and vegetables was eliminated from the population sum to $471 million using the HCA or $63 million using the more realistic FCA. The fewer deaths and incidence of disease related to the inadequate consumption of fruit and vegetables which would arise from increased consumption of fruit and vegetables (675grams/capita) could be expected to lead to total production gains of $161 million (HCA) or $21 million (FCA) and to the lower estimates of $81 million (HCA) or $11 million (FCA) if the increased consumption of fruit and vegetables of 589grams/capita was achieved. Results of the uncertainty analysis undertaken indicated a 13% chance of a net production loss using the FCA method (Table 35). This was due to the potential loss of household and leisure production outweighing net workforce production gains, if fruit and vegetable consumption was increased. A net production loss was not observed using HCA method, as the overall workforce production gain exceeded the potential household and leisure loss. The FCA method identified recruitment and training costs of $20 million as being attributable to the persons currently dying and becoming unwell due to the inadequate consumption of fruit and vegetables. It is estimated that these costs could be reduced by $7 million if the ideal increased consumption of fruit and vegetables was achieved or $3 million if the progressive target for increased consumption of fruit and vegetables was achieved. The attributed potential household gain was $19 million at current prevalence levels of people with an inadequate consumption of fruit and vegetables. This could be expected to be reduced by $6.6 million or by $3.3 million at daily consumption of 675 grams/capita or 589 grams/capita of fruit and vegetables, respectively. An estimated net leisure gain of $22.6 million at current inadequate consumption of fruit and vegetables prevalence could be expected to be reduced by $7.7 million or by $3.9 million at 675grams/capita or 589 grams/capita, respectively.

5.5.3.3 Taxation Gains to Government

If there were higher individual wages earned by people through not becoming ill or retiring early from the workforce then greater taxation revenue could be expected to follow. At the current prevalence of inadequate consumption of fruit and vegetables (70%), the taxation forgone due to lost incomes was estimated at $32 million (HCA) or ($2 million) (FCA). These would change by $5.4 million or $11 million (HCA) if consumption of fruit and vegetables was increased by one or two vegetables (progressive or ideal target, respectively). The taxation foregone would be reduced by -$309,000 or -$627,000 (FCA) if consumption of fruit and vegetables was increased by one or two vegetables (progressive or ideal target, respectively). Recruitment and training costs savings made up the vast majority of the FCA production gains and did not attract taxation.

Figure 28 Total potential opportunity cost savings from increased consumption of fruit and vegetables



FCA: Friction Cost Approach (preferred conservative estimate).

Table 34 Financial outcomes uncorrected for joint effects

Inadequate daily consumption of fruit and vegetables	Attributable at current levels of prevalence *uncorrected for joint effects*		
		95% Confidence Interval	
Financial Outcomes	**Mean ($mill)**	**LL ($mill)**	**UL ($mill)**
Health sector costs	206	n/a	n/a
Production Costs HCA	429	381	479
Production Costs FCA	21	7	32
Recruitment and training costs	20	n/a	n/a
Leisure based production	23	(39)	86
Home based production	19	(31)	68
Total production HCA	***471***	***349***	***592***
Total production FCA	***63***	***(50)***	***174***
Taxation effects HCA	32	25	38
Taxation effects FCA	(2)	(8)	2
	Ideal target reduction		
Financial Outcomes			
Health sector costs	71	n/a	n/a
Production Costs HCA	147	129	164
Production Costs FCA	7	3	11
Recruitment and training costs	7	n/a	n/a
Leisure based production	8	(13)	29
Home based production	7	(11)	23
Total production HCA	***161***	***118***	***202***
Total production FCA	***21***	***(17)***	***59***
Taxation effects HCA	11	8	13
Taxation effects FCA	(0.63)	(3)	1
	Progressive target reduction		
Financial Outcomes			
Health sector costs	35	n/a	n/a
Production Costs HCA	73	65	82
Production Costs FCA	4	1	6
Recruitment and training costs	3	n/a	n/a
Leisure based production	4	(7)	15
Home based production	3	(5)	12
Total production HCA	***81***	***60***	***102***
Total production FCA	***11***	***(9)***	***30***
Taxation effects HCA	5	4	6
Taxation effects FCA	(0.31)	(1)	0.37

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate. Numbers in brackets ( ) indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 35 Likelihood of net production loss

Inadequate consumption of fruit and vegetables	Mean ($mill)	Chance of negative result (%)
Attributable		
Total Production HCA	471	0
Total Production FCA	63	13
Ideal		
Total Production HCA	161	0
Total Production FCA	21	13
Progressive		
Total Production HCA	81	0
Total Production FCA	11	13

Notes: HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate).
These are not estimates of immediately realisable cash savings.

5.5.4 Discussion

The largest potential opportunity cost savings of increased consumption of fruit and vegetable may occur in the health sector, followed by individuals, government and business at similar levels.

It is difficult to compare estimates from the current study with previous literature (refer section 5.3.4). Only one Australian study was identified by the literature review undertaken, which sought to estimate health sector costs associated with low consumption of fruit and vegetables for different cancers (Marks et al. 2001). Consistent with the 2003 BoD methodology and all other risk factors evaluated in this study, we extended beyond cancers to estimate health sector costs for all diseases associated with an inadequate consumption of fruit and vegetables (e.g. ischaemic heart disease, stroke). The current study also extended beyond health sector costs to consider workforce, household and leisure production gains associated with a reduction in the inadequate consumption of fruit and vegetables. While study results are not directly comparable due to fundamental methodological differences, both studies provide a valuable contribution to the literature regarding the potential economic benefits of reducing the inadequate consumption of fruit and vegetables in Australia.

The economic and potential opportunity cost savings of achieving the targets were not large. This can mainly be explained by some counterintuitive losses occurring because people with higher consumption of fruit and vegetables reported having more time off work due to illness. This issue may have arisen because we used cross-sectional data (discussed further below). In addition, there was only a small change in the average daily consumption of fruit and vegetables modelled. Also many of the costs associated with the inadequate consumption of fruit and vegetables, and hence the benefits of increased consumption, are experienced in the elderly, non-working population.

Cross-sectional data issues exist when comparing persons with adequate consumption and those with inadequate consumption. People may alter (improve) their consumption once they have become ill from disease. This cannot be identified from the data we have used. In addition, people who self-report food consumption have difficulty quantifying consumption levels in terms of ‘serves per day’ and therefore these data, similar to those of other self-reported risk factor behaviors, are subject to reporting bias. We have not controlled for other risk factors or socioeconomic status in the analysis and this may influence production and leisure effects. Most persons surveyed have more than one of the risk factors of interest to this study (refer section 9). Sub-population analyses and externalities, such as increases in employment achieved by increases in fruit and vegetable production, were beyond the scope of this project.

In conclusion, at a population level, if the average consumption of fruit and vegetables were to be increased we would expect important opportunity cost savings from the reduction of diseases associated with this risk factor.

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6.0 PHYSICAL INACTIVITY

Summary of consensus decision for analytic modelling:

Current prevalence
(Australian Population 2008)

Progressive target ↓ 5%

Ideal (realistic) target ↓ 10%

6.1 Executive summary

Main findings from the literature review

- In Australia, 67% of men and 74% of women are either sedentary or have a low level of exercise.
- Physical inactivity contributed 6.6% of the overall DALY health burden in Australia, with ischaemic heart disease (51%) the major risk.
- Evidence is inconsistent, but community-wide campaigns can reduce the number of people who are inactive by approximately 4% points.
- A feasible reduction in prevalence of physical inactivity that might accrue from effective public health approaches is 5-10%, or alternatively around 1% per year.

Research findings from this project

Risk reversal after the cessation of the risk behavior takes some time to occur and hence the estimated economic benefits will be realized not immediately but over some period of years instead.

At a population level, if the prevalence of physical inactivity was to be decreased for the 2008 Australian adult cohort modelled, important opportunity cost savings from the reduction of diseases associated with this risk factor could be achieved. These are summarised below.

- In Australia the potential opportunity cost savings to the health sector are $672 million, if the prevalence of physical inactivity was eliminated.
- The potential lifetime opportunity cost savings in production and leisure are $1,135 million (FCA), if the prevalence of physical inactivity was eliminated.

- We found that if physical inactivity prevalence could be reduced from 70% to 60% (ideal target):
    - Potential opportunity cost savings of $96 million in the health sector and $162 million in production and leisure could be realised (FCA) over time
    - The 45,000 annual new cases of physical inactivity related disease could be reduced by 6,000
    - The 13,000 annual deaths attributed to physical inactivity could be reduced over time by 2,000
    - The 174,000 Disability Adjusted Life Years (DALYs) could be reduced by just below 25,000
- If physical inactivity prevalence could be reduced from 70% to 65% (progressive target):
    - Potential opportunity cost savings of $48 million to the health sector and $81 million in production and leisure could be realised (FCA) over time
    - Annual new cases of physical inactivity related disease could be reduced overtime by 3,000
    - Annual deaths attributed to physical inactivity could be reduced over time by 1,000
    - DALYs could be reduced over time by 12,400

6.2 Definition

High activity was defined as 3 sessions of at least 40 minutes vigorous exercise per week. Recommended activity was defined as 3 sessions of at least 20 minutes vigorous exercise or 5 sessions of at least 30 minutes moderate exercise per week. Insufficient exercise consisted of some activity but not enough to meet the recommendation, while inactive was defined as no activity (Begg et al. 2007). Physical activity levels equivalent to 2.5 hours per week of moderate-intensity activity (i.e., an effort equivalent to brisk walking, or approximately 4000kJ/week) are considered an important target for health benefits. Protective effects, however, are expected to continue to higher levels of physical activity.

Drawing on this literature, and taking into account available source data, physical inactivity was defined as follows:

Physical inactivity	Inactive: Sedentary or low activity level. Active: Moderate to high activity level.

6.3 Summary of current literature and best available data

6.3.1 Prevalence data

Estimates in the current study are based on data from the 2003 Burden of Disease (BoD) report (Begg et al. 2007); see Table 36 and Table 37).

Table 36 Physical activity in Australian men

Age	15-29	30-44	45-59	60-69	70-79	80+
High	10%	3%	3%	1%	1%	0%
Recommended	47%	37%	37%	41%	44%	30%
Insufficient	23%	29%	29%	26%	22%	21%
Inactive	20%	31%	32%	33%	33%	49%

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

Table 37 Physical activity in Australian women

Age	15-29	30-44	45-59	60-69	70-79	80+
High	4%	2%	1%	1%	0%	0%
Recommended	37%	32%	35%	38%	27%	17%
Insufficient	35%	38%	33%	28%	28%	24%
Inactive	25%	28%	30%	33%	45%	59%

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

Australian data from the NHS 2004-05 (Australian Bureau of Statistics 2006) indicated that 67% of men and 74% of women were either sedentary or had a low level of exercise. Overall, 70% of adults were sedentary or had a low exercise level, 23% reported moderate exercise and 6% reported high exercise levels.

6.3.2 Socioeconomic status

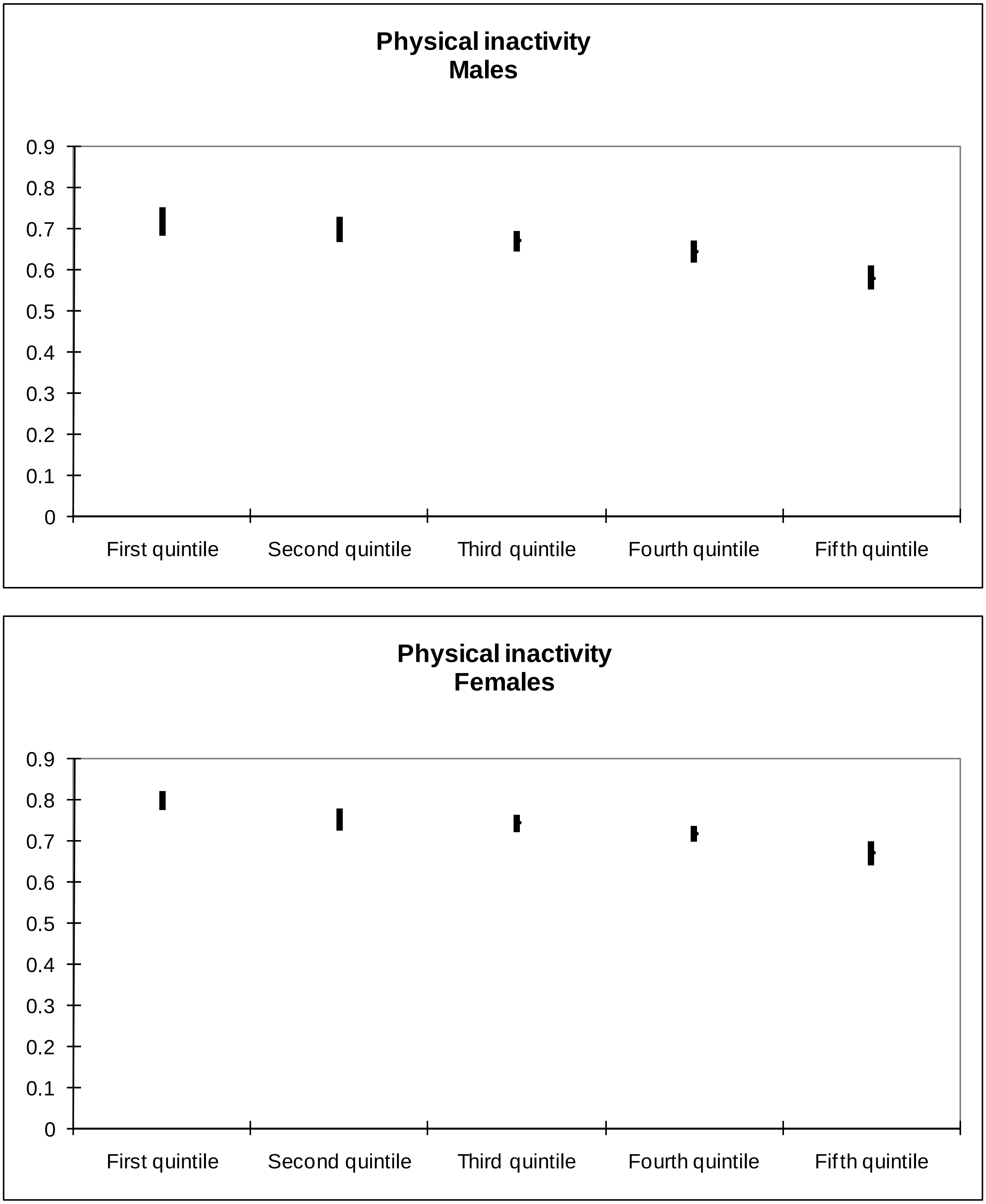
In Australia, the least likely to be active were women, people with lower socioeconomic status, older adults and people from non-English speaking backgrounds (Owen and Bauman 1992). Inactivity in lower socioeconomic groups may be partly due to perceived barriers to physical activity in these groups (Chinn et al. 1999). Although the association may be reversed in developing countries, in a developed country such as the US the likelihood of a person having a healthy lifestyle, including undertaking adequate physical activity, increases as that person's socioeconomic status increases (Kim et al. 2004).

The proportion of persons who report physical inactivity from the NHS 2004-05, according to socioeconomic quintile is presented in Figure 29 and Table 38.

Males and females in lower socioeconomic groups are more likely to report a sedentary activity level compared to higher socioeconomic groups. 72% of men and 80% of women in the lowest socioeconomic group report a sedentary activity level compared to 58% of males and 67% of females in the highest socioeconomic group.

For preventive activities, there may be benefit in accounting for socioeconomic status in program design in order to target groups more likely to report a sedentary activity level.

Figure 29 Proportion of Australian adults in each socioeconomic quintile who report physical inactivity by gender



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 38 Proportion of Australian adults in each socioeconomic quintile who report physical inactivity by gender

	Mean	Lower Limit	Upper Limit
Males			
First quintile	0.717	0.681	0.751
Second quintile	0.697	0.665	0.726
Third quintile	0.669	0.643	0.694
Fourth quintile	0.643	0.616	0.67
Fifth quintile	0.578	0.549	0.606
Females			
First quintile	0.798	0.774	0.82
Second quintile	0.751	0.723	0.777
Third quintile	0.741	0.721	0.76
Fourth quintile	0.716	0.697	0.735
Fifth quintile	0.668	0.638	0.697

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

6.3.3 International comparisons

In the UK, 70% of men and 80% of women are insufficiently physically active to benefit their health (Harland et al. 1999). In the US, only 25% of adults report engaging in the recommended amounts of physical activity (Kahn et al. 2002). Inactivity is even more pronounced in older adults: only 10% of those over 65 in the UK achieved the recommended levels of physical activity (Taylor et al. 2004).

6.3.4 Health outcomes

Authors of the 2003 BoD report (Begg et al. 2007) found that 6.4% of the overall health burden can be attributed to physical inactivity in men and 6.8% can be attributed to physical inactivity in women. In terms of DALYs lost, the most prominent contributors to health burden are ischaemic heart disease (51%), type 2 diabetes (20%), stroke (14%), colorectal cancer (9%) and breast cancer (7%).

The benefits of regular physical activity are widespread, with enhanced general health and reduced risk of all-cause mortality (Kahn et al. 2002). More specifically, physical inactivity has been identified as a modifiable risk factor for cardiovascular disease, ischaemic stroke, diabetes mellitus, colon cancers, osteoporosis, falls-related injuries and mental health problems including depression (Kahn et al. 2002). Physical activity is also an important contributor to other health risk factors such as obesity, high cholesterol and hypertension (van der Bij et al. 2002). In the elderly, physical activity is favourable for muscle strength, aerobic capacity, reduction of fracture risk and general well-being (van der Bij et al. 2002).

6.3.5 Other economic cost estimates

For comparison purposes we included the most recent cost data from a reputable source, but reiterate the point that costing studies of disease or risk factors are often incomparable due to the different definitions and assumptions applied. The cost estimates provided in the current study have been consistently and comparably estimated across all the risk factors considered.

In an Australian study (Stephenson et al. 2000), the annual direct health care cost attributable to physical inactivity was estimated at $377 million. This included the cost of coronary heart disease ($161 million), breast cancer ($16 million), bowel cancer ($16 million), stroke ($101 million), diabetes ($28 million) and depression ($56 million). Given the domains of activity that were not analysed, this is considered a conservative estimate. The estimate is difficult to compare to estimates for other risk factors for two reasons: it is based on old data (1993-94) and it does not include indirect and intangible costs.

In the US, annual direct medical costs attributable to physical inactivity are in the region of $US24 billion, which is 2.5%-3% of all direct medical costs (Oldridge 2008). Other studies from Canada, Switzerland and the UK also report estimates that are in the range of 1.5%-3% of total direct health costs (Oldridge 2008).

6.3.6 Prevention

A number of attempts have been made to synthesise the evidence regarding the effectiveness of interventions to increase physical activity. The review of van der Bij et al. (2002) included 38 studies and classified interventions as home based, group-based or educational. In the short term, physical activity was increased by both group-based and education interventions. However, information on long-term efficacy was either absent or indicated no difference. In their Cochrane review, Foster et al. (2005) found that the effect of interventions on self-reported physical activity across 19 studies was positive and moderate. The heterogeneity of interventions and outcome measures – e.g., kcal/week, kcal/kg/week, minutes of activity per day, activity 'sessions' per month – made it difficult to formulate an average increase in activity that was readily interpretable. Kahn et al. (2002) classified interventions into informational approaches, behavioural and social approaches, and environmental and policy approaches. Of most relevance were the 10 reports identified on community-wide campaigns (informational approach): the 5 studies that measured change in the percentage of people being active showed a median net increase of 4.2%.

Governments have been proactive recently in setting targets for the reduction of physical inactivity. In the US, the objective was to increase the number of people undertaking at least 30 minutes of moderate physical activity on a regular basis from 15% (1997) to 30% (2010) (Kahn et al. 2002). In England, local government authorities set the target of increasing the percentage of people meeting activity guidelines – approximately 30% in 2005 – by 3% by 2008 (Foster et al. 2005). In Canada, a reduction of 10% in inactivity levels was established as an objective for 2003 (Katzmarzyk et al. 2000). It was estimated that achieving this reduction in prevalence would result in savings of CAD$150 million per year. A Dutch study estimated that population-level intervention could be expected to reduce prevalence rates of inactivity by 2% points over 5 years (Bemelmans et al. 2008). The Australian study of Stephenson et al. (2000) included a 5% point increase and a 10% point increase in their sensitivity analyses regarding the consequences of increased physical activity. They estimated that for every 1% increase in moderate activity levels in the population we would avoid 122 deaths per year from coronary heart disease, diabetes mellitus and colon cancer, we would gain 1,764 life years and we would save AUD$3.6 million per year in the health care cost of these three diseases. Others have also indicated that a feasible reduction in prevalence of physical inactivity that might accrue from effective public health approaches is in the region of 5-10%, or alternatively around 1% per year (Jensen et al. 1993; Bauman et al. 1996).

Importantly, there appears to be a relatively short time lag between increasing physical activity and observing the benefits (Paffenbarger et al. 1993; Blair et al. 1995). Blair et al. (1995) demonstrated that the effect of becoming active conferred a benefit on cardiovascular and all cause mortality more rapidly that modifying other risk factors. For example, increasing activity reduced all cause mortality within two years, which was half the time required to see benefits from smoking cessation.

6.4 Determination of the feasible reductions for physical inactivity

Variation in the definition of physical inactivity makes it very difficult to compare across countries. Furthermore, several comparable countries (e.g., the UK, US) have higher levels of inactivity than Australia and cannot be used to set an aspirational target. In this instance, the Advisory Committee decided against nominating an Arcadian ideal (refer methods in Part A section 2.3.1).

One recent study estimated that population-level intervention could be expected to reduce prevalence rates of inactivity by 2% points over 5 years (Bemelmans et al., 2008). Nevertheless, reductions in prevalence of inactivity of 1% per year or 10% on a medium-term basis appear achievable, and targets of this magnitude have been used by others, for example Katzmarzyk et al. (2000) and Stephenson et al. (2000). A 10% point reduction was selected as an ideal target for a feasible reduction in physical inactivity.

Prevalence of physical inactivity:

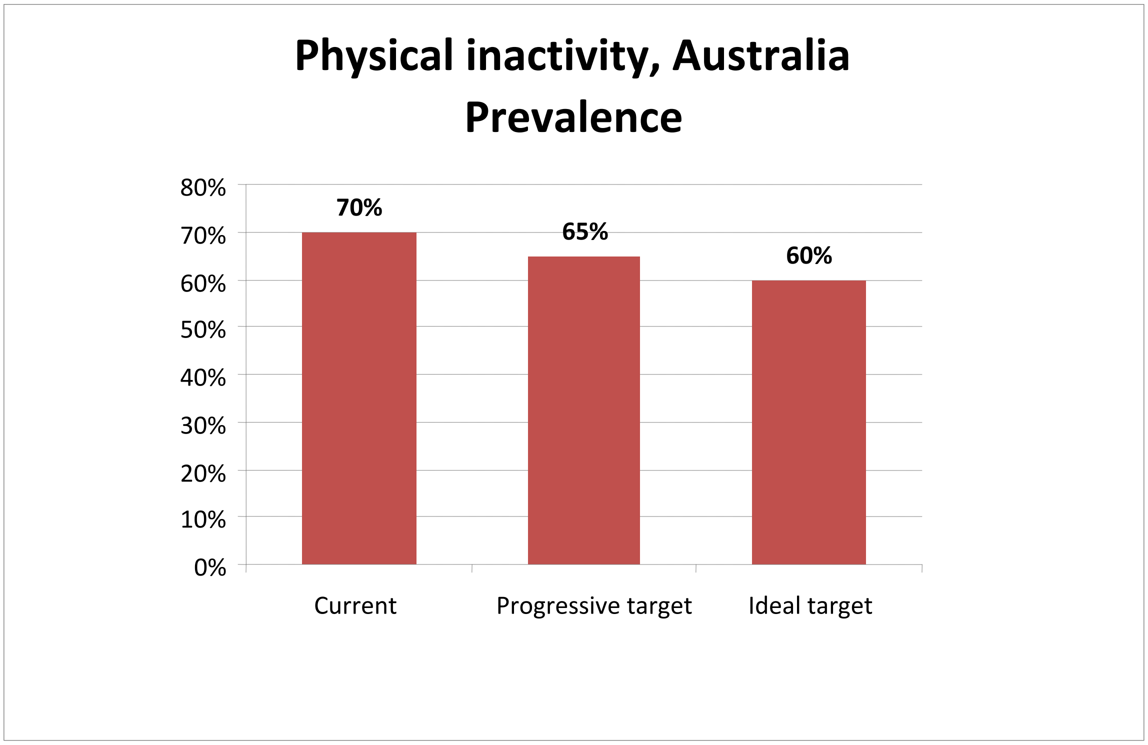
- Australian estimate: 70%.
- Target: 60%.

Proposed prevalence levels to be modelled (appear in Figure 30):

- Current – 70%.
- Ideal – 60%.
- Progressive – 65%.

We will estimate an absolute 5% and 10% reduction in prevalence to produce estimates of avoidable burden (economic and financial). The net difference between the current (attributable) and avoidable burden will be reported.

Figure 30 Comparison of current and target prevalence of physical inactivity



6.5 Economic and financial benefits of reduced physical inactivity prevalence

The following sections provide the results for the physical inactivity analysis undertaken using the systematic methods outlined in Part A. Firstly, the 2008 population characteristics are presented followed by estimates for the potential health status, economic and financial outcomes obtained from reducing the prevalence of this risk factor.

6.5.1 Population characteristics of comparator groups

Based on the data from the NHS 2004-05 the following population characteristics were estimated for the 2008 reference population according to age, gender and work force status (Table 39 and Table 40).

Table 39 Males who are physically inactive compared to males who are active

Males:	Physically inactive	Physically active
Age summary		
Age 15-64 y N (95% CI)	4,332,994 (4,229,842 – 4,436,146)	2,322,617 (2,220,059 – 2,425,175)
Age 65+ y N (95% CI)	775,817 (746,962 – 804,671)	342,985 (313,395 – 372,575)
Age 15+ y Mean (95% CI)	44.9 (44.6 - 45.3)	40.6 (40.1 - 41.2)
In Labour Force (15+ years)*		
% (95% CI)	75% (73% - 76%)	75% (73% - 77%)
Mean days off work (95% CI)	0.32 (0.26 – 0.38)	0.26 (0.18 – 0.34)
Not in Labour Force		
% (95% CI)	26% (24% - 27%)	25% (23% - 27%)
Mean days of reduced activity: 15-64 y (95% CI)	1.93 (1.60 - 2.26)	0.88 (0.54 - 1.21)
Aged 65+ years		
% (95% CI)	15.2% (14.6% - 15.8%)	12.9% (11.8% - 14.0%)
Mean days of reduced activity (95% CI)	1.56 (1.25 - 1.87)	0.43 (0.22 - 0.65)

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years

Table 40 Females who are physically inactive compared to females who are active

Females:	Physically inactive	Physically active
Age summary		
Age 15-64 y N (95% CI)	4,798,508 (4,704,081 – 4,892,935)	1,864,120 (1,769,404 – 1,958,836)
Age 65+ y N (95% CI)	1,059,103 (1,028,507 – 1,089,698)	260,571 (230,005 – 291,136)
Age 15+ y Mean (95% CI)	45.3 (45.0 - 45.6)	42.5 (41.6 - 43.3)
In Labour Force (15+ years)*		
% (95% CI)	57% (56% - 58%)	65% (63% - 67%)
Mean days off work (95% CI)	0.31 (0.26 – 0.35)	0.23 (0.16 – 0.29)
Not in Labour Force		
% (95% CI)	43% (42% - 44%)	35% (33% - 37%)
Mean days of reduced activity: 15-64 y (95% CI)	1.45 (1.26 - 1.65)	0.84 (0.62 - 1.05)
Aged 65+ years		
% (95% CI)	18.1% (17.5% - 18.7%)	12.3% (10.8% - 13.8%)
Mean days of reduced activity (95% CI)	1.75 (1.53 - 1.96)	0.73 (0.50 - 0.96)

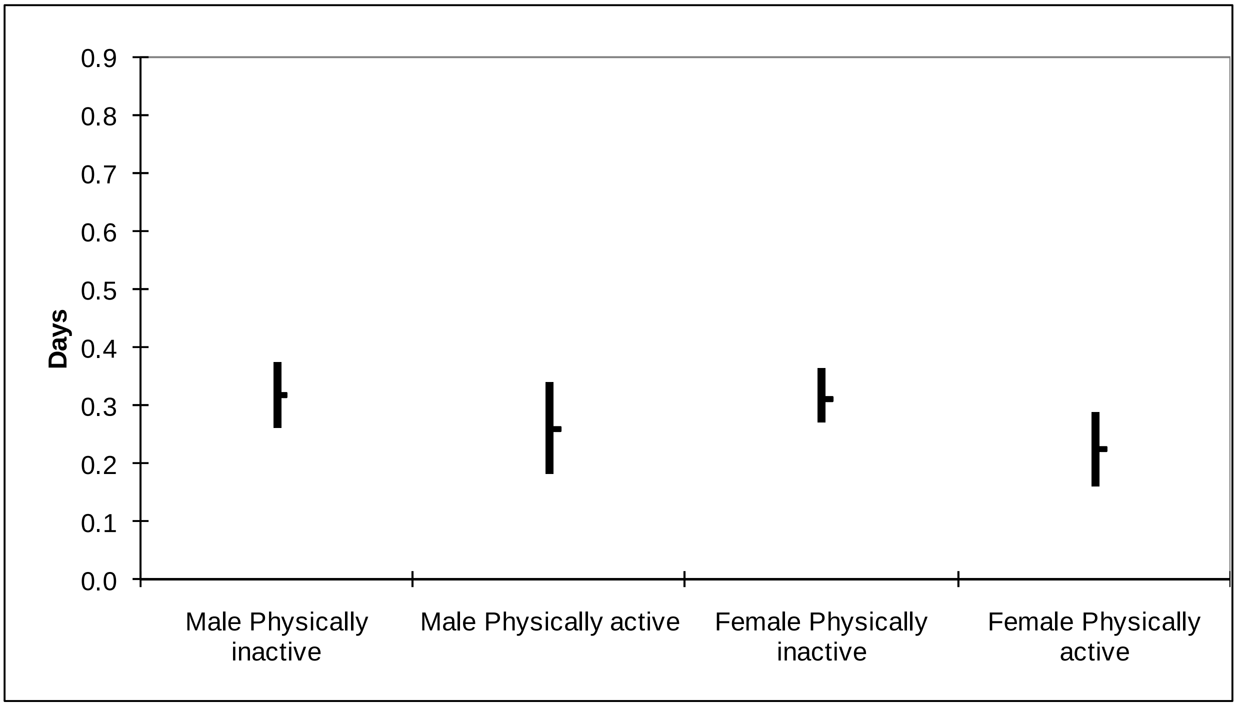
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years

Absenteeism from paid work – overall

The number of days taken off work in a 10-day working period by physically inactive persons compared to active persons is presented in Figure 31 and Table 41.

A similar number of days were taken off by males and females who reported physical inactivity compared to persons who reported being active, with no significant difference between groups or genders.

Figure 31 Days taken off work in a 10-day working period by physically inactive persons compared to active persons by gender



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 41 Days taken off work by physically inactive persons compared to active persons by gender

	Mean	Lower Limit	Upper Limit
Males			
Inactive	0.318	0.261	0.375
Active	0.26	0.181	0.339
Females			
Inactive	0.313	0.271	0.364
Active	0.225	0.161	0.288

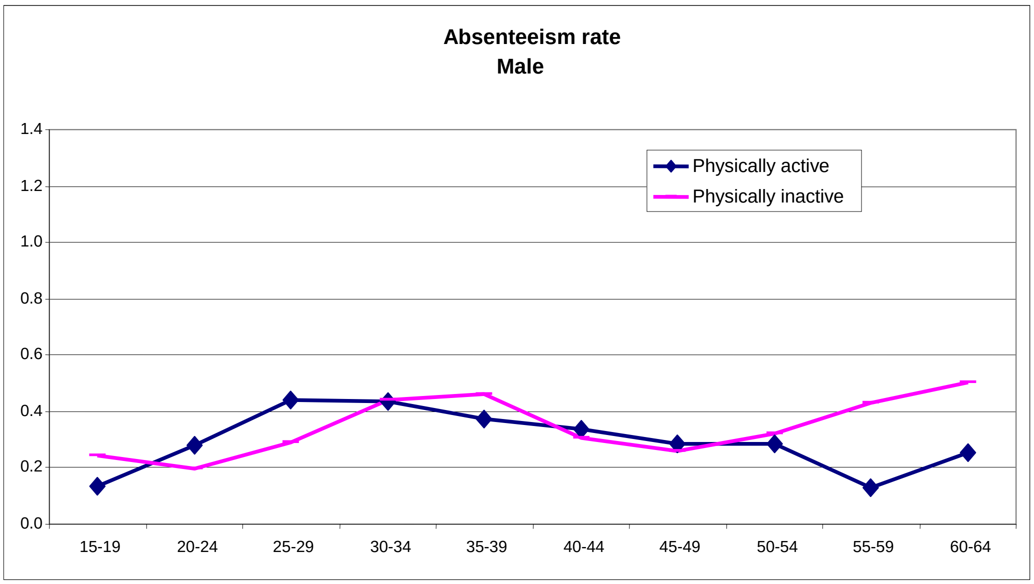
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

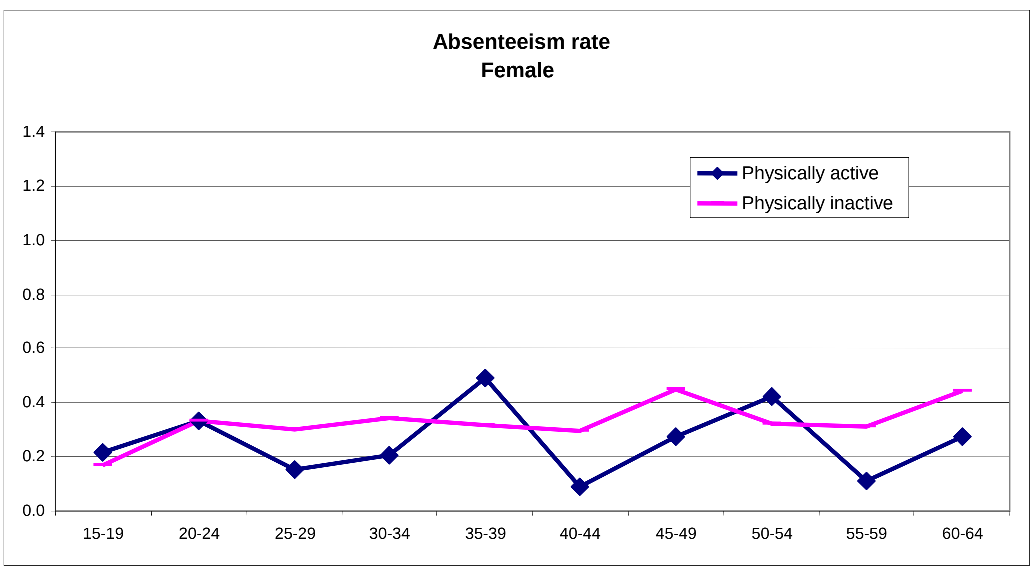
Absenteeism from paid work – by age and gender

Absenteeism rates of sedentary persons compared to active persons by age and gender are presented in Figure 32.

The rate of absenteeism for comparison groups varied greatly across age groups, for males and females. Physically inactive males take more days off work than active males in half of the ten age groups presented, with the largest difference occurring in older males. Physically inactive females take more days off work than active females in most age groups, with three exceptions (ages 15-19, 35-39 and 50-54).

Figure 32 Absenteeism rates of physically inactive persons compared to active persons by age and gender





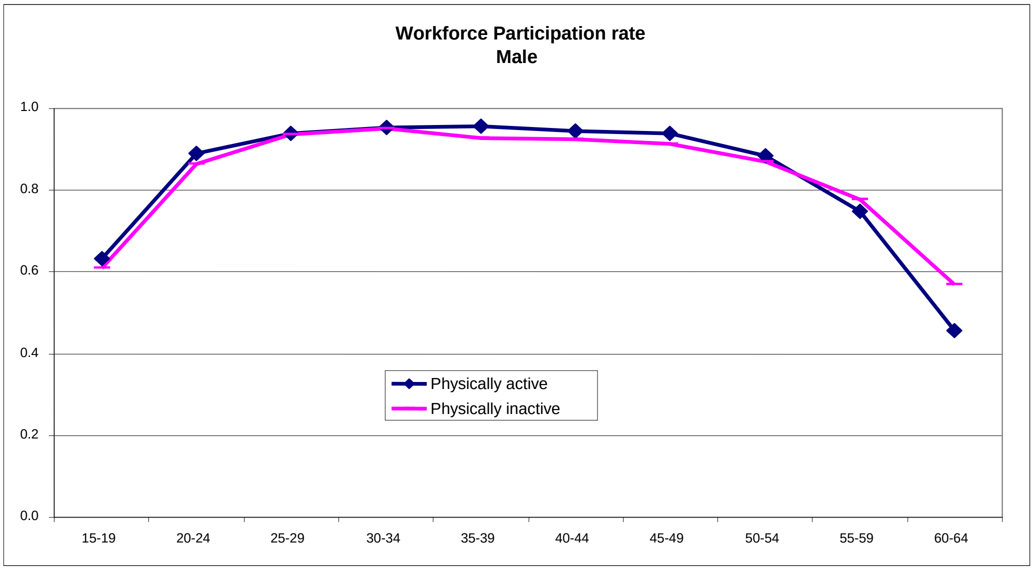
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

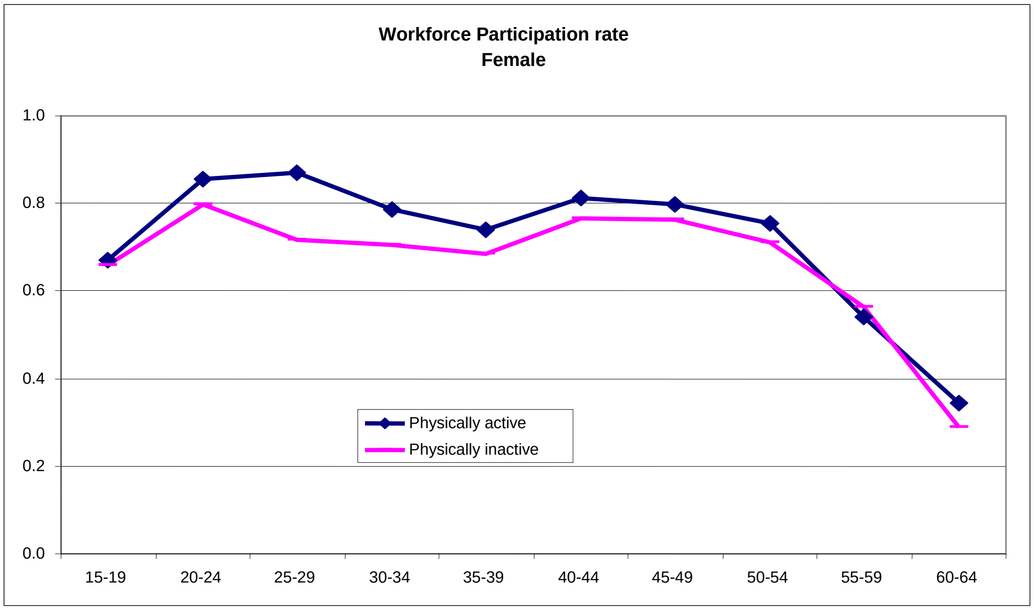
Workforce participation – by age and gender

Workforce participation rates of physically inactive persons compared to active persons by age and gender are presented in Figure 33.

Males and females who reported being physically inactive participate in the workforce at lower rates than persons who reported being active in most age groups. Exceptions were males above the age of 55 and among women aged 55-59, where physically inactive persons participated at a slightly higher rate.

Figure 33 Workforce participation rates of physically inactive persons compared to active persons by age and gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

6.5.2 Health status and economic gains/losses

The health status and economic gains presented include health gains of potential reduction of DALYs, reduced incidence of physical inactivity-related disease and reduced mortality from physical inactivity-related disease. The economic gains evaluated also include potential reductions in days of absenteeism from paid employment, reductions in lost days of home based production and reductions in lost days of leisure time; all due to physical inactivity-related disease. The mean and 95% uncertainty interval for outcomes able to be modelled as distributions with uncertainty are presented in Table 42.

6.5.2.1 Current losses (attributed economic burden)

Currently we can attribute 45,000 new cases of physical inactivity-related disease; 13,000 deaths; and 174,000 DALYs annually to physical inactivity at past and current levels. Over the working lifetime of the working-age population we estimated there were 796,000 working days lost and approximately 125 early retirements due to disease related to physical inactivity. This statistic appears quite low because most of the health loss associated with physical inactivity occurred in people over the age of 65 years. Over the lifetime of all adults we estimated that there were 1.3 million days lost because of ill health that would have been used for household production, and

2.2 million days of lost leisure due to physical inactivity-related illness. If we were able to eliminate physical inactivity entirely from the population, each of these losses would disappear over time.

6.5.2.2 Realistic target reductions reduction in prevalence

If the prevalence of physical inactivity was reduced nationally to 60% from its current prevalence of 70%, some of the attributed economic burden described above would potentially no longer occur. We estimated the new cases of physical inactivity-related disease would potentially fall by 6,000; deaths would reduce by just under 2,000; and DALYs would reduce by just below 25,000 each year. Over the working lifetime of the working-age population we estimated that there would be 114,000 fewer working days lost and 18 early retirements due to physical inactivity that would potentially not occur. Over the lifetime of all adults we estimated that there would be 180,000 fewer days lost to illness that would have been used for household production, and 316,000 fewer days of lost leisure due to physical inactivity-related illness that would potentially not occur.

6.5.2.3 Progressive target reduction in prevalence

If the prevalence of physical inactivity was reduced nationally to only 65% a smaller proportion of the attributed economic burden described above would potentially no longer occur. We estimated the new cases of physical inactivity-related disease would fall by 3,000; deaths would fall by just over 960; and there would be 12,400 fewer DALYs annually. Over the working lifetime of the working-age population there would be 57,000 fewer working days lost and less than 10 early retirements due to physical inactivity at past and current levels that would potentially not occur. Over the lifetime of all adults we estimated that there would be 90,000 fewer days lost to illness that would have been used for household production, and 158,000 fewer days of lost leisure due to physical inactivity-related illness that would potentially not occur.

Table 42 Health status and economic outcomes uncorrected for joint effects

Physical inactivity	Attributable at current levels of prevalence *uncorrected for joint effects*		
		95% Confidence Interval	
	Mean ('000s)	LL ('000s)	UL ('000s)
Health status and economic outcomes			
Per annum			
DALYs	174	n/a	n/a
Incidence of disease	45	n/a	n/a
Mortality	13	n/a	n/a
Lifetime			
Leisure (days)	2,209	2,101	2,320
Absenteeism (days)	796	n/a	n/a
Days out of home based production role (days)	1,263	1,084	1,440
Early retirement (persons)	0.12	n/a	n/a
	Ideal target reduction		
Health status and economic outcomes			
Per annum			
DALYs	25	n/a	n/a
Incidence of disease	6	n/a	n/a
Mortality	2	n/a	n/a
Lifetime			
Leisure (days)	316	300	331
Absenteeism (days)	114	n/a	n/a
Days out of home based production role (days)	180	155	206
Early retirement (persons)	0.02	n/a	n/a
	Progressive target reduction		
Health status and economic outcomes			
Per annum			
DALYs	12	n/a	n/a
Incidence of disease	3	n/a	n/a
Mortality	1	n/a	n/a
Lifetime			
Leisure (days)	158	150	166
Absenteeism (days)	57	n/a	n/a
Days out of home based production role (days)	90	77	103
Early retirement (persons)	0.01	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

6.5.3 Financial gains/losses

The potential opportunity cost savings which benefit the health sector, individuals, business and government are presented in Table 43 and Figure 34.

6.5.3.1 Health sector costs associated with physical inactivity

Physical inactivity (past and present) is associated with $672 million of health sector costs that we estimate could be prevented at some point in the life time of males and females in 2008. This could be expected to be reduced by $96 million or $48 million if physical inactivity prevalence was reduced as described above to 60% or 65%, respectively.

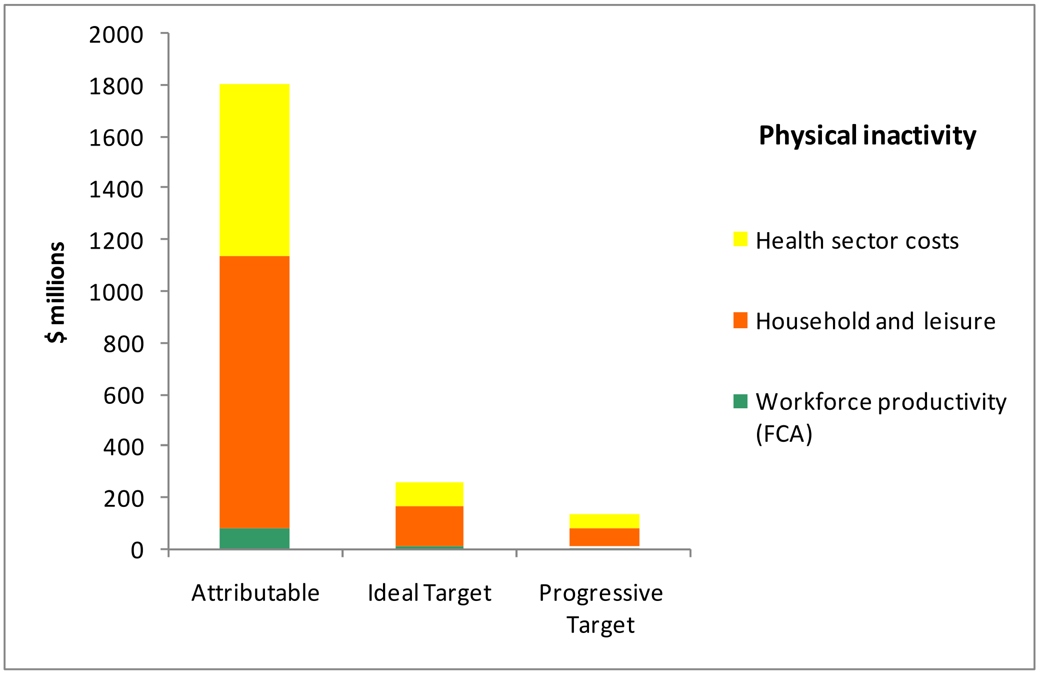
6.5.3.2 Gains to individuals and business

The total opportunity cost savings from production gains (working, household activities and leisure) that could potentially be achieved if physical inactivity was eliminated from the population sum to $2,022 million using the HCA or $1,135 million using the more realistic FCA. The fewer deaths and incidence of physical inactivity-related disease which would arise from reduced prevalence of physical inactivity (at 60%) could be expected to lead to total production gains of $288 million (HCA) or $162 million (FCA); and to the lower estimates of $145 million (HCA) or $81 million (FCA) if reduced physical inactivity prevalence of 65% was achieved. The FCA method identified recruitment and training costs of $34 million as being attributable to the physical inactivity burden currently. It was estimated that these costs could be reduced by $5 million if the ideal reduction in physical inactivity prevalence was achieved or by $2 million if the progressive target reduction in physical inactivity prevalence was achieved. The potential household gain was $500 million at current prevalence of physical inactivity which could be expected to be reduced by $71 million or by $36 million at the lower prevalence of physical inactivity of 60% or 65%, respectively. An estimated potential net leisure gain of $554 million at current prevalence of physical inactivity could be expected to be reduced by $79 million or by $40 million at prevalence of 60% or 65%, respectively.

6.5.3.3 Taxation Gains to Government

If there are higher individual wages earned by people through not becoming ill or retiring early from the workforce then greater taxation revenue could be expected to follow. At the current prevalence of physical inactivity (70%), the taxation forgone due to lost incomes was estimated at $87 million (HCA) or $14 million (FCA). These would change by $12 million or $6 million (HCA) if the lower prevalence target was reached (ideal or progressive target respectively). The taxation foregone would be reduced by $2 million or $1 million (FCA) if the lower prevalence target is reached (ideal or progressive target, respectively).

Figure 34 Total potential opportunity cost savings from reductions in physical inactivity



FCA: Friction Cost Approach (preferred conservative estimate).

Table 43 Financial outcomes uncorrected for joint effects

Physical inactivity	Attributable at current levels of prevalence Uncorrected for joint effects		
		95% Confidence Interval	
Financial Outcomes	**Mean ($mill)**	**LL ($mill)**	**UL ($mill)**
Health sector costs	672	n/a	n/a
Production Costs HCA	968	803	1,133
Production Costs FCA	81	45	127
Recruitment and training costs	34	n/a	n/a
Leisure based production	554	417	720
Home based production	500	426	574
Total production HCA	***2,022***	***1,776***	***2,281***
Total production FCA	***1,135***	***954***	***1,346***
Taxation effects HCA	87	71	107
Taxation effects FCA	14	4	30
	Ideal target reduction		
Financial Outcomes			
Health sector costs	96	n/a	n/a
Production Costs HCA	138	114	161
Production Costs FCA	12	7	18
Recruitment and training costs	5	n/a	n/a
Leisure based production	79	60	103
Home based production	71	61	82
Total production HCA	***288***	***253***	***326***
Total production FCA	***162***	***136***	***192***
Taxation effects HCA	12	10	15
Taxation effects FCA	2	1	4
	Progressive target reduction		
Financial Outcomes			
Health sector costs	48	n/a	n/a
Production Costs HCA	69	58	81
Production Costs FCA	6	3	9
Recruitment and training costs	2	n/a	n/a
Leisure based production	40	30	51
Home based production	36	30	41
Total production HCA	***145***	***127***	***164***
Total production FCA	***81***	***68***	***96***
Taxation effects HCA	6	5	8
Taxation effects FCA	1	0.26	2

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate.

6.5.4 Discussion

The largest potential opportunity cost savings of reduced prevalence of physical inactivity would occur in individuals, followed by the health sector, business and government, respectively.

It is difficult to compare current study estimates of potential savings with earlier literature (refer section 6.3.5). Only one Australian study estimating the health sector costs associated with physical inactivity was identified from the literature review undertaken. Stephenson et al (2000) estimated the health care costs associated with physical inactivity at $377 million, assuming a prevalence of physical inactivity in Australia of 44%. Drawing on more recent literature, the current study determined physical inactivity prevalence at 70% and utilised current cost data to estimate health sector costs at $672 million. The current study estimate is likely higher as more recent (and therefore inflated) health sector costs were included and a higher attributable prevalence estimate of physical inactivity was used. The current study also extended beyond health sector costs to consider workforce, household and leisure production opportunity cost savings associated with a reduction in physical inactivity. While study results are not directly comparable due to fundamental methodological differences, both studies provide a valuable contribution to the literature regarding the potential economic benefits of reducing physical inactivity in Australia.

Many of the costs of physical inactivity, and hence the benefits of reduced physical inactivity, are experienced in the elderly, non-working population. These occur after long term exposure to physical inactivity. The younger age groups have most to gain by remaining physically active as they would progress through life with greatly reduced risks to health and working life.

Cross-sectional data issues exist when comparing the physically active with sedentary. We have not controlled for other risk factors or socioeconomic status in the analysis that may influence production and leisure effects. Most persons surveyed have more than one of the risk factors of interest to this study (refer section 9). It is also possible that persons increase their level of activity following the onset of an illness e.g. diabetes or heart disease. The data used in this study cannot determine the cause and effect relationship between physical inactivity and health.

In conclusion, at a population level, if the prevalence of physical inactivity was to be decreased important opportunity cost savings from the reduction of diseases associated with this risk factor could be achieved.

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7.0 TOBACCO SMOKING

Summary of consensus decision for analytic modelling:

Current prevalence
(Australian Population 2008) → ↓ 4% Progressive target → ↓ 8% Ideal (realistic) target

7.1 Executive summary

Main findings from the literature review

- In Australia in 2004-05, 23% of adults were current smokers, with 21% smoking daily and 2% less than daily.
- Smoking contributes 7.8% to the overall health burden in Australia, with lung cancer (35%) and COPD (27%) the major risks.
- Meta-analyses of randomized controlled trials of behavioural therapies and of nicotine replacement therapies (NRT) and several other anti-smoking medications demonstrates that group and individual counselling (whether in person, or (much more inexpensively) by telephone), varenicline, bupropion and the five available nicotine replacement therapies are all more efficacious than placebo at promoting smoking abstinence at 6 and 12 months. Refer Cochrane library; Eisenberg et al. (2008). It is difficult however to detect the impact of effective clinical interventions such as these on population prevalence, for example see Wakefield et al. (2008).
- In addition to reducing the number of cigarettes smoked, increasing the price of tobacco products has clearly been demonstrated to reduce numbers of people smoking across the whole population (Scollo and Winstanley 2008) and (in combination with falls in the price of NRT), would be likely to increase use of pharmacotherapies that improve success rates (Tauras et al. 2005).
- Advertising in the mass media can greatly increase use of telephone Quitlines and internet-based quitting resources, for example see (Miller et al. 2003). Campaigns shaped

by behavioural and communications research can be highly effective in reducing smoking prevalence (National Cancer Institute 2008) and in Australia have been shown to be highly cost-effective in reducing tobacco-related disease (Carter and Scollo 2000; Hurley and Matthews 2008).

- In recent years in Australian populations with comprehensive tobacco control programs including adequately-funded media education campaigns and legislation (such as banning smoking in public places), smoking prevalence has been reducing by about one percentage point per year, for instance see Germain et al. (2008). While the prevalence of smoking is relatively low in Australia and has been declining over many years, it is even lower in California, where only 15% of adults smoked in 2004-05 and where smoking rates continue to fall.
- A recent study (Wakefield et al. 2008) confirms findings of an expert international review (National Cancer Institute 2008) that rates of decline in smoking prevalence are closely related not just to the extent of price increases but also to the reach and intensity of media advertising campaigns. With increases in taxes and funding for media education it is likely that declines in smoking prevalence in Australia could be accelerated (Wakefield et al. 2008).

Research findings from this project

We modelled health status, economic and financial benefits based on the prevalence of the risk factor of interest in the 2008 Australian population. These benefits will not occur instantaneously, and the results are provided to inform decision making regarding the importance of disease prevention. In reality, risk reversal after the cessation of a risk behavior can take some time to occur and hence the estimated benefits will not be realized immediately but over some period of years instead. For example, it can take about 15 years for the risk of coronary heart disease in an ex-smoker to become the same as for a never smoker (Department of Health and Aged Care 2002).

At a population level, if the prevalence of tobacco smoking was to be decreased for the 2008 Australian adult cohort modelled, important opportunity cost savings from the reduction of diseases associated with this risk factor could be achieved. These are summarised below.

- Currently in Australia the potential opportunity cost savings to the health sector are $1,412 million, if we were able to eliminate smoking from the population.
- The current potential opportunity cost savings in production and leisure are $1,215 million FCA, if we were able to eliminate smoking from the population.
- We found that if the prevalence of tobacco smoking could be reduced from 23% to 15% (ideal target):
    - Potential opportunity cost savings of $491 million to the health sector and $415 million in production and leisure could be realised (FCA) over time
    - The 455,000 annual new cases of smoking related disease could be reduced by 158,000
    - The 16,000 annual deaths attributed to smoking could be reduced over time by 5,000
    - The 205,000 Disability Adjusted Life Years (DALYs) could be reduced by 71,000
- If the prevalence of tobacco smoking could be reduced from 23% to 19% (progressive target):
    - Potential opportunity cost savings of $246 million to the health sector and $207 million in production and leisure could be realised (FCA) over time
    - Annual new cases of smoking related disease could be reduced by 79,000
    - Deaths attributed to smoking could be reduced by 3,000
    - DALYs could be reduced over time by 36,000

7.2 Definition

Smoking status was based on self-report of the NHS 2004-05 survey participants. Given the long lag time between exposure to tobacco smoke and the occurrence of cancers and COPD, however, the attributable burden in the Burden of Disease report (Begg et al. 2007) was not estimated from the current prevalence of smoking. The method employed was that of Peto et al. (1992), who proposed an artificial compound prevalence measure of the relevant past exposure to tobacco. This ‘smoking impact ratio’ is derived from a comparison of lung cancer mortality rates in the population of interest and lung cancer mortality rates among non-smokers and smokers observed in a large long-term follow-up study in the United States. Compared with cancers and COPD, the time between exposure to tobacco and other negative health outcomes is considerably shorter.

The Burden of Disease report used prevalence estimates of smoking for adults aged 18 years and over in 2001, two years before the baseline year of 2003 (Australian Bureau of Statistics 2001).

Drawing on this literature, and taking into account available source data, tobacco smoking was defined as follows:

Tobacco smoking	Current smokers: Persons who smoke tobacco on a regular or irregular daily basis. Ex-smokers: Persons who no longer smoke on a regular or irregular basis.

7.3 Summary of current literature and best available data

7.3.1 Prevalence data

Estimates in the current project are based on data from the 2003 Burden of Disease report (Begg et al., 2007; see Table 44 and Table 45). Not included in the tables is the prevalence of prenatal exposure (16%) and maternal smoking (27%) in the 0-4 age group, or the prevalence of past smoking or passive smoking.

Table 44 Smoking in Australian men

Age	15-29	30-44	45-59	60-69	70-79	80+
Current smoker	30%	31%	23%	16%	9%	7%

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

Table 45 Smoking in Australian women

Age	15-29	30-44	45-59	60-69	70-79	80+
Current smoker	25%	25%	18%	12%	9%	2%

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

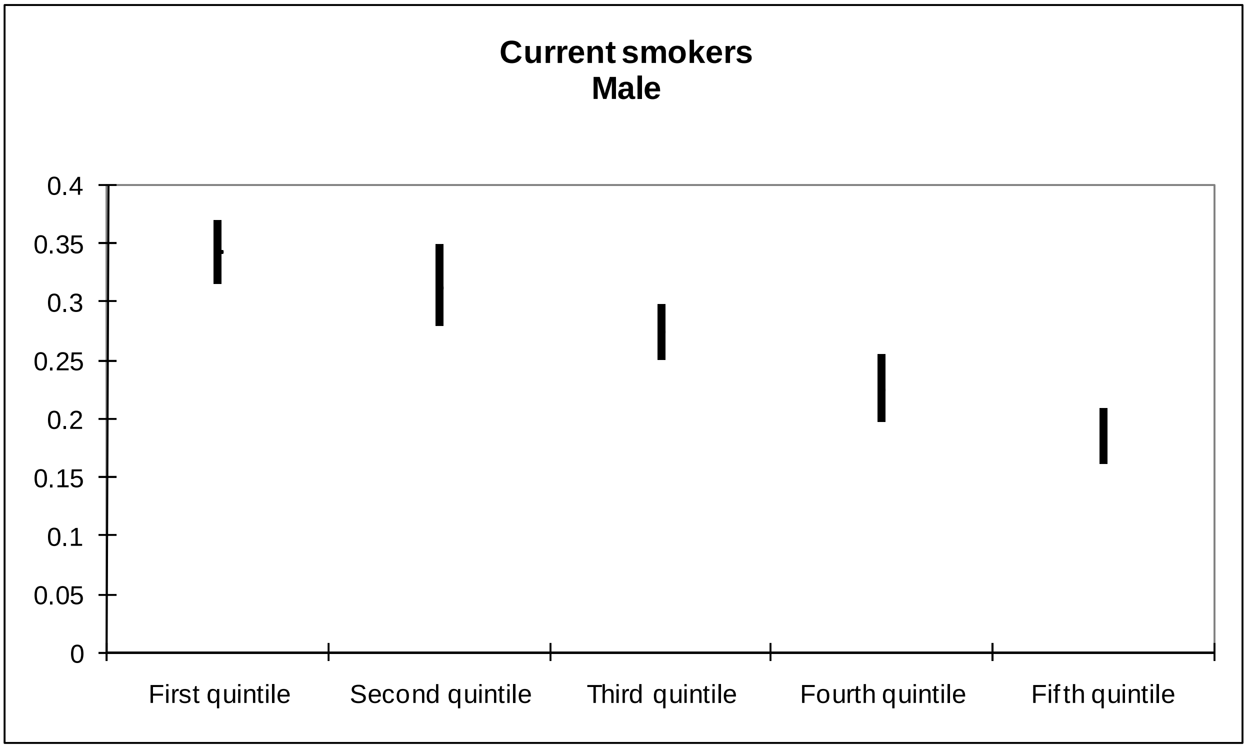
Data from the NHS of 2004-05 (Australian Bureau of Statistics 2006) provides evidence that 26% of men and 20% of women were current daily smokers. Overall, 23% of adults were current daily smokers, with 21% smoking daily and 2% less than daily, 30% were ex-smokers and 47% had never smoked.

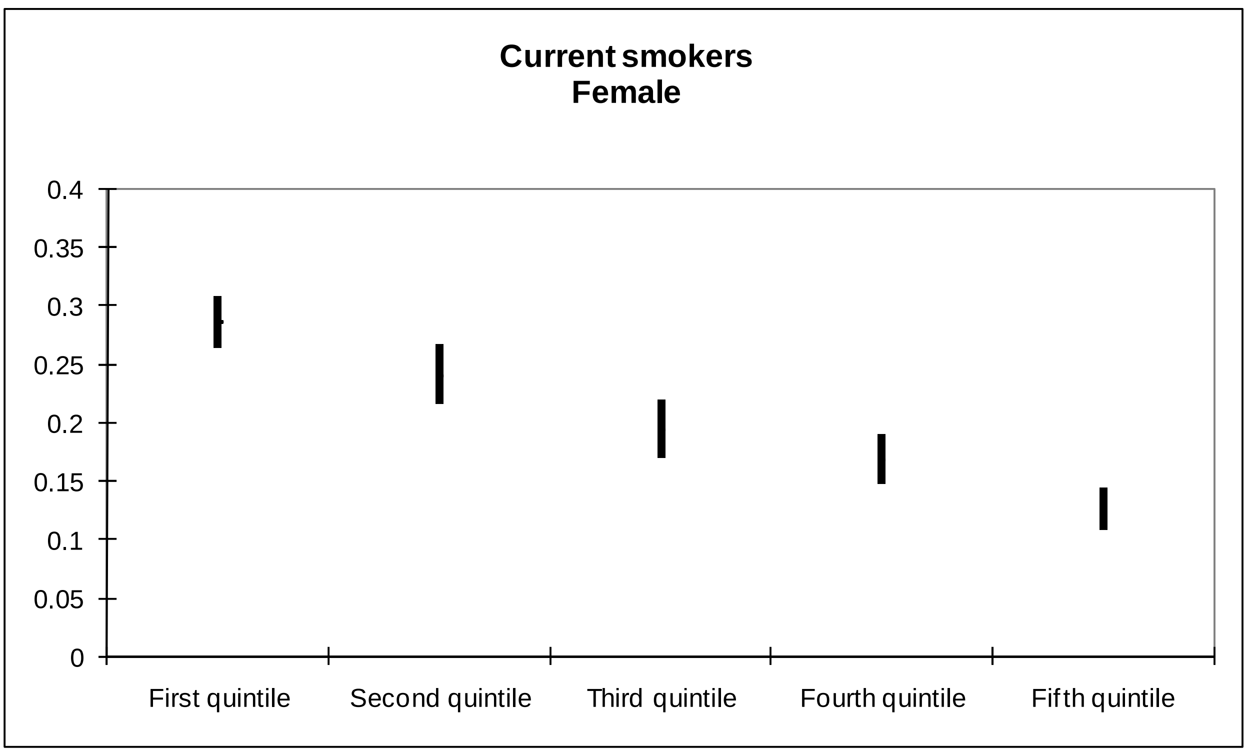
7.3.2 Socioeconomic status

Inequalities in prevalence exist, with smokers more likely to be poor and less educated than non-smokers. Data from the 2007 National Drug Strategy Household Survey (Australian Institute of Health and Welfare 2008) indicated that prevalence of current smoking is 26% in the most disadvantaged one-fifth of all ABS census districts and only 13% in the least disadvantage one-fifth of all districts. Higher socioeconomic status is associated with higher quit rates (Harwood et al. 2007), and recent reductions in prevalence have been most marked in people with more years of education and higher incomes (Secker-Walker et al. 2002). Findings from the HABITAT study, currently being undertaken in Brisbane, indicate that the likelihood of smoking is independently related to deprivation (Giskes 2008).

The proportion of persons in each socioeconomic quintile who report being a current smoker in the NHS 2004-05 is presented in Figure 35 and Table 46. Males and females in higher socioeconomic groups were less likely to report being a current smoker compared to lower socioeconomic groups. For example, 34.2% of men and 28.5% of women in the lowest socioeconomic group report currently smoking compared to 18.3% of men and 12.5% of women in the highest socioeconomic group. This suggests that there may be benefit in accounting for socioeconomic status in the design of preventive programs, which might target those groups more likely to report being current smokers.

Figure 35 Proportion of Australian adults in each socioeconomic quintile who report being a current smoker by gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 46 Proportion of Australian adults in each socioeconomic quintile who report being a current smoker by gender

		95% Confidence Interval	
	Mean	**Lower Limit**	**Upper Limit**
Males			
First quintile	0.342	0.315	0.369
Second quintile	0.312	0.279	0.348
Third quintile	0.273	0.25	0.297
Fourth quintile	0.224	0.197	0.254
Fifth quintile	0.183	0.16	0.208
Females			
First quintile	0.285	0.263	0.307
Second quintile	0.239	0.215	0.266
Third quintile	0.193	0.169	0.219
Fourth quintile	0.168	0.147	0.19
Fifth quintile	0.125	0.108	0.144

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

7.3.3 International comparisons

In the US, prevalence of smoking in 2004 was 21% (16% daily, 5% some days) and in 2005 it remained 21%. In California in 2004 and 2005, smoking prevalence was only 15%, including 10% daily and 5% less than daily (Behavioral Risk Factor Surveillance System 2008).

7.3.4 Health outcomes

Authors of the 2003 BoD report (Begg et al. 2007) showed that 9.6% of the overall health burden can be attributed to smoking in men and 5.8% can be attributed to smoking in women. Smoking contributes 7.8% to the overall health burden in Australia.

In terms of DALYs lost, the most prominent contributors to health burden are lung cancer (35%), COPD (27%), ischaemic heart disease (15%), stroke (6%) and oesophageal cancer (3%). In developed countries, tobacco smoking is estimated to cause 87% of all lung cancer deaths and 82% of all COPD deaths, as well as 10% of all infant deaths. In addition, smoking has been associated with oesophageal and stomach cancers, heart disease, stroke, peripheral vascular disease, pneumonia and inflammatory bowel disease. Smoking is estimated to cause more deaths, hospital admissions and primary care visits than any other single risk factor (Fiore et al. 2000; Ridolfo and Stevenson 2001).

7.3.5 Other economic cost estimates

For comparison purposes we include the most recent cost data from a reputable source, but reiterate the point that costing studies of disease or risk factors are often incomparable due to the different definitions and assumptions applied. The cost estimates provided in the current study have been consistently and comparably estimated across all the risk factors considered.

Collins & Lapsley (2008) estimated that the total cost of smoking to the community in Australia in 2004-05 was $31.5 billion, including $12.0 billion in tangible costs ($8.0 billion net labour costs, $0.3 billion total healthcare) and $19.5 billion of intangible costs. The largest component of tangible costs reflected reduced production due to premature death. The only intangible cost it was feasible to estimate was loss of life (and not costs associated with morbidity), so this estimate should be seen as very conservative. The estimation technique used was the demographic approach, which was described earlier for high risk alcohol consumption. Costs are defined as “the value of the net resources that in a given year are unavailable to the community for consumption or investment purposes as a result of the effects of past and present drug abuse, plus the intangible costs imposed by this abuse”. The counterfactual situation that is compared to the actual 2004-05 drug abuse situation is one in which there has been no drug abuse for an extended period of time. The study estimates the social costs that were borne in 2004-05 and that resulted from all drug abuse in 2004-05 and in previous years.

7.3.6 Prevention

The research literature on primary and secondary prevention of smoking is perhaps the largest of any health risk factor. Recent systematic reviews have considered the effectiveness of interventions to reduce smoking in the workplace (Moher et al. 2005), in the school environment (Thomas and Perera 2006), family-based approaches in children and adolescents (Thomas et al.

2007), mass media interventions in adults (Bala et al. 2008) and interventions in a global context (Jha et al. 2006).

Meta-analyses of randomized controlled trials of behavioural therapies and of nicotine replacement therapies (NRT) and several other anti-smoking medications demonstrates that group and individual counselling (whether in person, or (much more inexpensively) by telephone), varenicline, bupropion and the five available nicotine replacement therapies are all more efficacious than placebo at promoting smoking abstinence at 6 and 12 months (refer Cochrane library; (Eisenberg et al. 2008).

It is difficult however to detect the impact of effective clinical interventions such as these on population prevalence, for example see Wakefield et al. (2008). From their review of community interventions in adults, Secker-Walker et al. (2002) identified an estimated decline in smoking prevalence of -1% to 3% per year. Based on these figures, we may expect a 1% point decline in prevalence per year to be an achievable reduction goal. Indeed, a report into social costs of smoking in Victoria estimated the benefits of reducing smoking prevalence by 5% points over 5 years as a feasible reduction (Collins and Lapsley 2006).

In Australia, the recent National Tobacco Campaign was shown to be successful in terms of both effectiveness and cost-effectiveness (Carter and Scollo 2000). There is some evidence that telephone counselling is a particularly cost-effective intervention for smoking cessation (Shearer and Shanahan 2006). Advertising in the mass media can greatly increase use of telephone Quit lines and internet-based quitting resources, for example see Miller et al. (2003). Campaigns shaped by behavioural and communications research can be highly effective in reducing smoking prevalence (National Cancer Institute 2008) and in Australia have been shown to be highly cost-effective in reducing tobacco-related disease (Carter and Scollo 2000; Hurley and Matthews 2008).

In addition to reducing the number of cigarettes smoked, increasing the price of tobacco products has clearly been demonstrated to reduce numbers of people smoking across the whole population (Scollo and Winstanley 2008) and (in combination with falls in the price of NRT), would be likely to increase use of pharmacotherapies that improve success rates (Tauras et al. 2005). A recent study (Wakefield et al. 2008) confirmed findings of an expert international review (National Cancer Institute 2008) that rates of decline in smoking prevalence are closely related not just to the extent of price increases but also to the reach and intensity of media advertising campaigns. With increases in taxes and funding for media education it is likely that declines in smoking prevalence in Australia could be accelerated (Wakefield et al. 2008).

As mentioned above, there is a variable time lag between quitting smoking and reaping the benefits in terms of reduced health risk. The risk of coronary heart disease is halved one year after quitting and returns to the risk level of a non-smoker after 15 years, while the risk of lung cancer is less than halved after 10 years and continues to fall (Department of Health and Aged Care 2002). The risk of stroke is reduced more quickly, returning to that of non-smokers 3-5 years after quitting (National Health and Medical Research Council 1996).

7.4 Determination of the feasible reductions for smoking prevalence

As the literature review did not identify any readily usable estimates for feasible reductions, prevalence rates for tobacco smoking from other countries were consulted (refer methods in Part A section 2.3.1). California was selected for the Arcadian mean as it represents world’s best practice in smoking prevention, with strong government involvement. California is broadly comparable to Australia in terms of population demographics and cultural values. Data from 2004-05 indicated that 23% of Australian adults were current smokers, including 2% less than daily (Australian Bureau of Statistics 2006). In California in 2004 and 2005, prevalence of smoking was only 15%, including 5% less than daily (Behavioral Risk Factor Surveillance System 2008). We do recognize, however, that the national prevalence estimates for smoking in Australia may not be representative of smoking prevalence in individual states, and that some states may already have achieved these targets.

Prevalence of smoking:

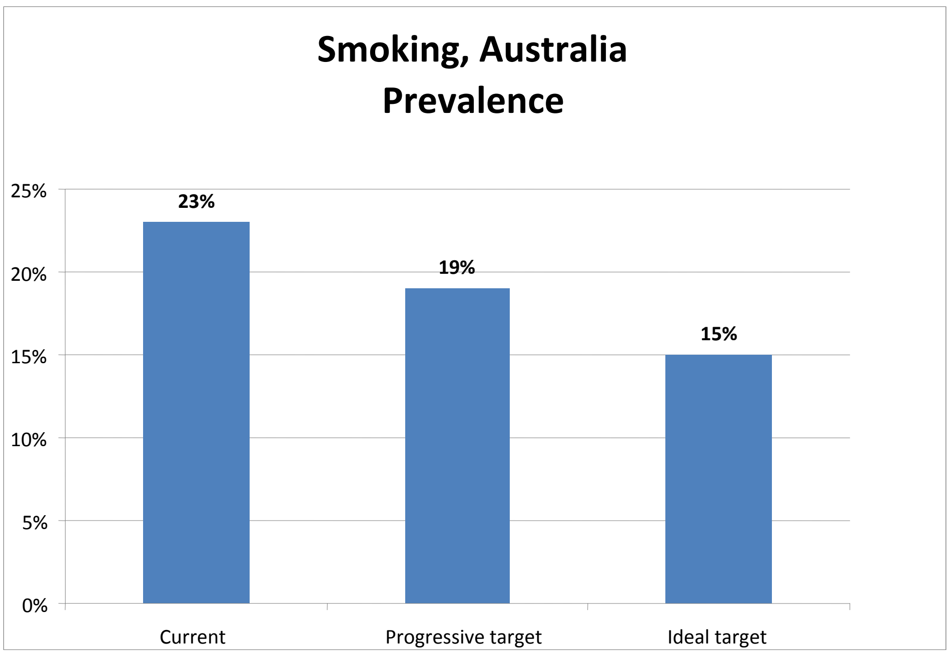
- Australian estimate: 23%.
- Californian estimate: 15%.

Proposed prevalence levels to be modelled (appear in Figure 36):

- Current – 23%.
- Ideal – 15%.
- Progressive – 19%.

We have calculated an absolute 4% and 8% reduction in prevalence of tobacco smoking to produce estimates of avoidable burden (health status, economic and financial). The net difference between the current (attributable) and avoidable burden is reported.

Figure 36 Comparison of current and target prevalence of tobacco smoking



7.5 Economic and financial benefits of reduced smoking prevalence

The following sections provide the results for the tobacco smoking analysis undertaken using the systematic methods outlined in Part A. Firstly, the 2008 population characteristics are presented followed by estimates for the potential health status, economic and financial outcomes obtained from reducing the prevalence of this risk factor.

7.5.1 Population characteristics of comparator groups

Based on the data from the NHS 2004-05 the following population characteristics were estimated for the 2008 reference population according to age, gender and work force status (Table 47 and Table 48).

Table 47 Male current smokers compared to male ex-smokers

Males:	Current smokers	Ex-smokers
Age summary		
Age 15-64 y N (95% CI)	1,829,391 (1,747,967-1,910,816)	1,548,199 (1,466,488-1,629,910)
Age 65+ y N (95% CI)	109,022 (88,760 -129,283)	667,528 (633,132-701,924)
Age 15+ y Mean (95% CI)	39.8 (39.1– 40.4)	54.3 (53.6 – 55.0)
In Labour Force (15+ years)*		
% (95% CI)	81% (79% - 83%)	62% (60% - 64%)
Mean days off work (95% CI)	0.38 (0.26 - 0.50)	0.33 (0.22 - 0.44)
Not in Labour Force		
% (95% CI)	19% (17% - 21%)	38% (36% - 40%)
Mean days of reduced activity: 15-64 y (95% CI)	2.04 (1.43-2.65)	2.52 (1.91 - 3.12)
Aged 65+ years		
% (95% CI)	5.6% (4.7% - 6.7%)	30.1% (28.6% - 31.7%)
Mean days of reduced activity (95% CI)	0.81 (0.22-1.40)	1.44 (1.10 - 1.78)

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years.

Table 48 Female current smokers compared to female ex-smokers

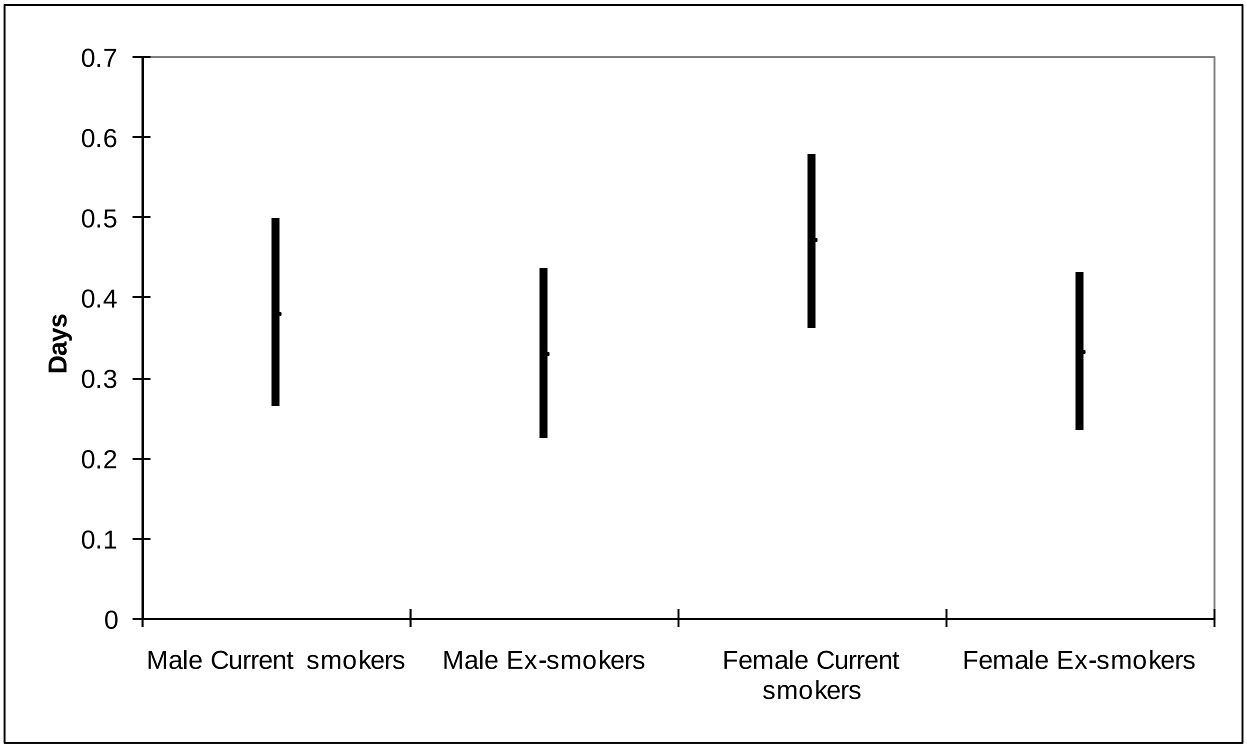
Females:	Current smokers	Ex-smokers
Age summary		
Age 15-64 y N (95% CI)	1,440,908 (1,362,169-1,519,647)	1,367,902 (1,289,423-1,446,381)
Age 65+ y N (95% CI)	83,396 (65,460-101,333)	349,654 (317,660-381,648)
Age 15+ y Mean (95% CI)	39.8 (39.1 – 40.4)	49.1 (48.3 – 49.9)
In Labour Force (15+ years)*		
% (95% CI)	65% (62% - 68%)	56% (54% - 59%)
Mean days off work (95% CI)	0.47 (0.36 - 0.58)	0.33 (0.23 - 0.43)
Not in Labour Force		
% (95% CI)	35% (32% - 38%)	44% (41% - 46%)
Mean days of reduced activity: 15-64 y (95% CI)	1.95 (1.54 - 2.36)	1.27 (0.88 - 1.66)
Aged 65+ years		
% (95% CI)	5.5% (4.4% - 6.8%)	20.4% (18.6% - 22.2%)
Mean days of reduced activity (95% CI)	1.20 (0.40 – 2.00)	2.03 (1.56 - 2.50)

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years.

Absenteeism from paid work – overall

The number of days taken off work in a 10-day working period by current smokers compared to ex-smokers is presented in Figure 37 and Table 49. Overall a similar number of days are taken off work by persons who reported being a current smoker compared to persons who reported being an ex-smoker, with no significant difference between the two groups or genders.

Figure 37 Days taken off work in a 10-day working period by current smokers compared to ex-smokers by gender



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 49 Days taken off work by current smokers compared to ex-smokers by gender

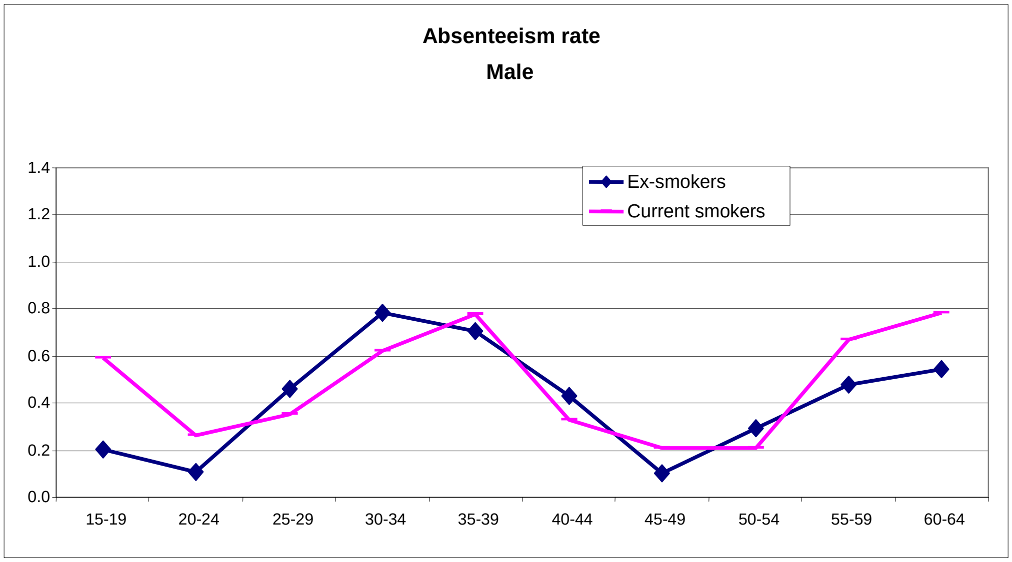
	Mean	Lower Limit	Upper Limit
Males			
Current smokers	0.38	0.263	0.497
Ex-smokers	0.329	0.224	0.435
Females			
Current smokers	0.471	0.362	0.579
Ex-smokers	0.332	0.234	0.431

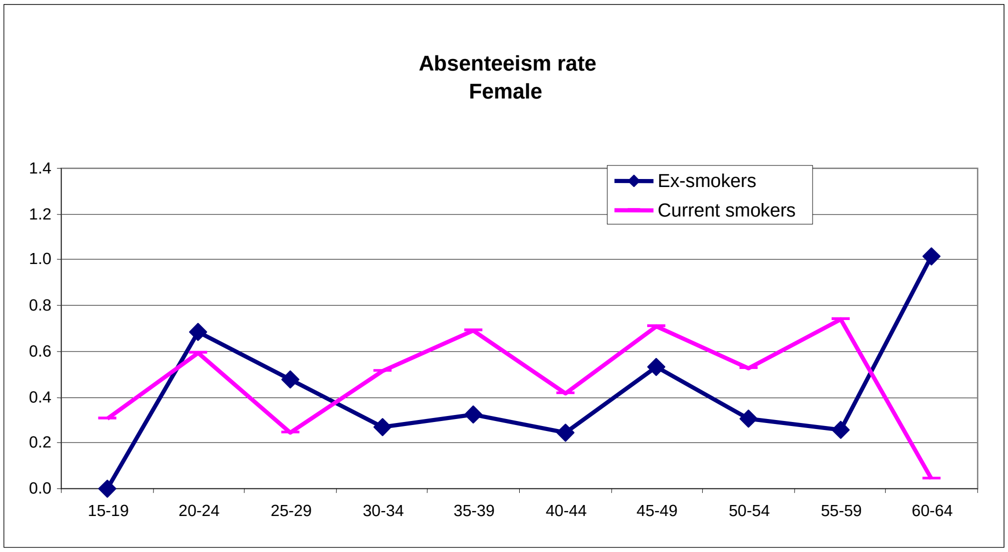
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Absenteeism from paid work – by age and gender

Absenteeism rates of current smokers compared to ex-smokers are presented by age and gender in Figure 38. The rate of absenteeism for comparison groups varies greatly across age groups, for males and females. Rates of absenteeism are slightly higher for current male smokers compared to ex-smokers. Males aged 25-34, 40-44 and 50-54 are the exceptions, with current smokers taking fewer days off work. Similarly, female current smokers take more days off work than female ex-smokers in most age groups with females aged 20-29 and 60-64 the only exceptions. We repeat that past smoking rather than current smoking is most influential on health.

Figure 38 Days taken off work in a 10-day working period by current smokers compared to ex smokers by age and gender



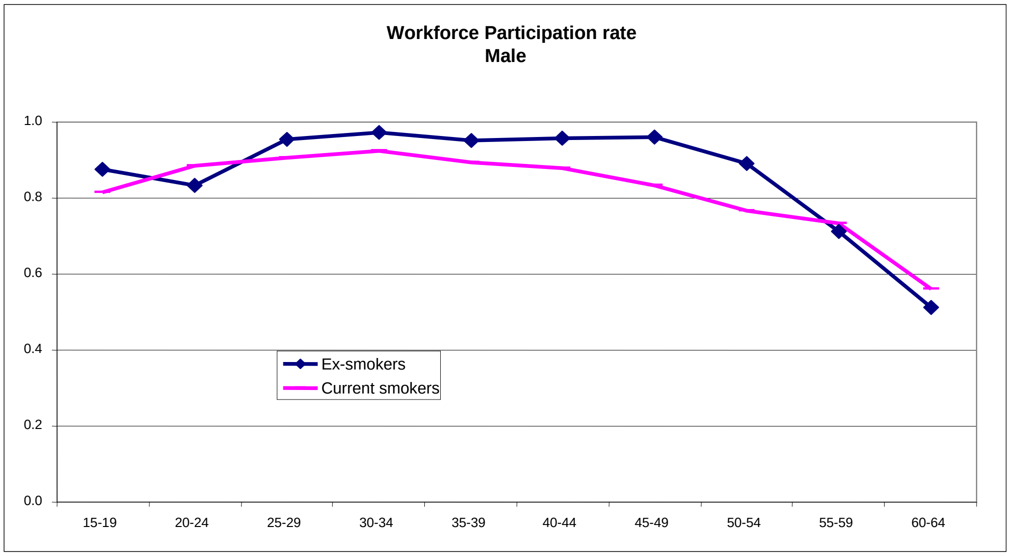


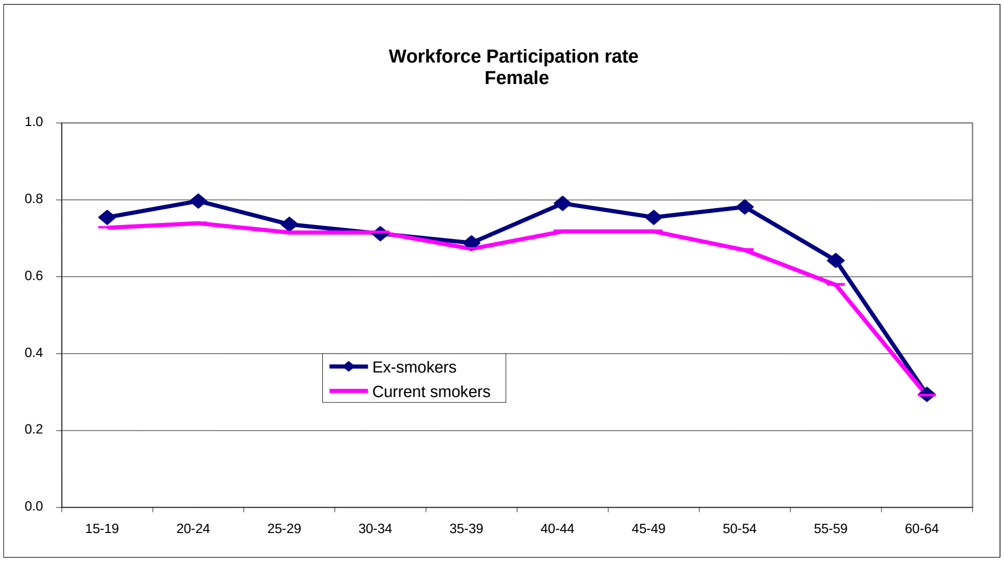
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Workforce participation – by age and gender

Workforce participation rates of current smokers compared to ex-smokers are presented by age and gender in Figure 39. Males who reported being a current smoker participated in the workforce at a lower rate than males who reported being an ex-smoker. The only exceptions to this include males aged 20-24 and 55 and older, where current smokers participated in the workforce at a higher rate. Females who reported being a current smoker participated in the workforce at a lower rate than females who reported being an ex-smoker across all age groups. We reiterate that past smoking rather than current smoking is most influential on health.

Figure 39 Workforce participation and absenteeism rates of current smokers compared to ex smokers by age and gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

7.5.2 Health status and economic gains/losses

The health status and economic gains presented include health gains of potential reduction of DALYs, reduced incidence of smoking-related disease and reduced mortality from smoking-related disease. The economic gains evaluated also include potential reductions in days of absenteeism from paid employment, reductions in lost days of home based production and reductions in lost days of leisure time; all due to smoking-related disease. The mean and 95% uncertainty interval for outcomes able to be modelled as distributions with uncertainty are presented in Table 50.

7.5.2.1 Current losses (attributed economic burden)

Currently we can attribute 455,000 new cases of smoking-related disease, 16,000 deaths and 205,000 DALYs annually to smoking at past levels. Over the working lifetime of the working-age population we estimated there were 5.1 million working days lost and more than 9,000 early retirements due to past smoking. Over the lifetime of all adults we estimated there were 1.072 million days lost because of ill health that would have been used for household production, and 66,000 days of lost leisure due to smoking-related illness. If we were able to eliminate smoking entirely from the population, each of these losses would disappear over time.

7.5.2.2 Realistic target reductions in prevalence

If the prevalence of smoking was reduced nationally to 15% some of the attributed economic burden described above would potentially no longer occur. We estimated the new cases of smoking-related disease would fall by 158,000; deaths would reduce by 5,000; and DALYs by 71,000 each year. Over the working lifetime of the working-age population we estimated there would be 2.2 million fewer working days lost and more than 3,000 early retirements due to smoking at past levels that would potentially not occur. Over the lifetime of all adults we estimated there would be 373,000 fewer days lost to illness that would have been used for household production, and 23,000 fewer days of lost leisure due to smoking-related illness that would potentially not occur.

7.5.2.3 Progressive target reduction in prevalence

If the prevalence of smoking was reduced nationally to only 19% some (a smaller proportion) of the attributed economic burden described above would potentially no longer occur. We estimated the new cases of smoking-related disease would fall by 79,000; deaths would fall by 3,000; and there would be 36,000 fewer DALYs annually. Over the working lifetime of the working-age population there would be 887,000 fewer working days lost and over 1,600 early retirements due to smoking at past levels that would potentially not occur. Over the lifetime of all adults we estimated that would be 186,000 fewer days lost to illness that would have been used for household production, and 12,000 fewer days of lost leisure due to smoking-related illness that would potentially not occur.

Table 50 Health status and economic outcomes uncorrected for joint effects

Tobacco smoking	Attributable at current levels of prevalence *uncorrected for joint effects*		
		95% Confidence Interval	
	Mean ('000s)	LL ('000s)	UL ('000s)
Health status and economic outcomes			
Per annum			
DALYs	205	n/a	n/a
Incidence of disease	455	n/a	n/a
Mortality	16	n/a	n/a
Lifetime			
Leisure (days)	66	(2,373)	2,561
Absenteeism (days)	5,102	n/a	n/a
Days out of home based production role (days)	1,072	(473)	2,553
Early retirement (persons)	9	n/a	n/a
	Ideal target reduction		
Health status and economic outcomes			
Per annum			
DALYs	71	n/a	n/a
Incidence of disease	158	n/a	n/a
Mortality	5	n/a	n/a
Lifetime			
Leisure (days)	23	(825)	891
Absenteeism (days)	2,203	n/a	n/a
Days out of home based production role (days)	373	(164)	888
Early retirement (persons)	3	n/a	n/a
	Progressive target reduction		
Health status and economic outcomes			
Per annum			
DALYs	36	n/a	n/a
Incidence of disease	79	n/a	n/a
Mortality	3	n/a	n/a
Lifetime			
Leisure (days)	12	(413)	445
Absenteeism (days)	887	n/a	n/a
Days out of home based production role (days)	186	(82)	444
Early retirement (persons)	2	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

7.5.3 Financial gains/losses

The potential opportunity cost savings which benefit the health sector, individuals, business and government are presented in Table 51 and Figure 40.

7.5.3.1 Health sector costs associated with smoking

Smoking (past and present) is associated with $1,412 million of health sector costs that we estimate could be prevented at some point in the life time of males and females in 2008. This can be expected to be reduced by $491 million or $246 million if smoking prevalence is reduced as described above to 15% or 19%, respectively.

7.5.3.2 Gains to individuals and business

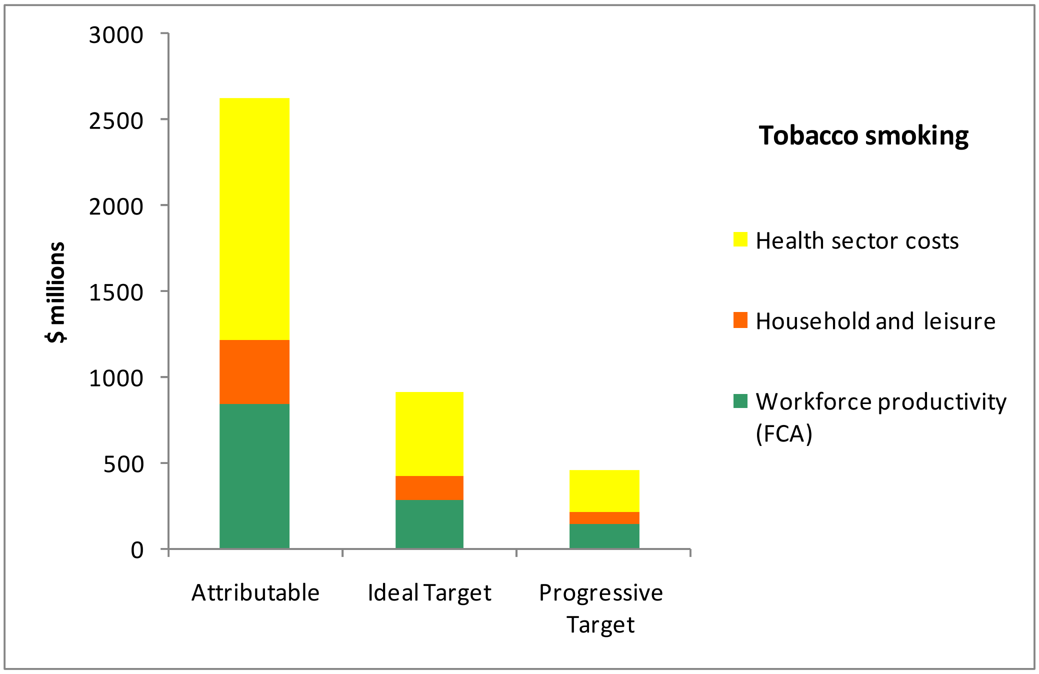
The total opportunity cost savings from production gains (working, household activities and leisure) that could potentially be achieved if smoking was eliminated from the population sum to $8,631 million using the HCA or $1,215 million using the more realistic FCA. The fewer deaths and incidence of smoking-related disease which would arise from reduced prevalence of smoking (at 15%) could be expected to lead to total production gains of $2,942 million (HCA) or $415 million (FCA). If the progressive target was achieved, total production gains of $1,478 million (HCA) or $207 million (FCA) might be realised. Results of the uncertainty analysis undertaken indicated a 4-5% chance of a net production loss using the FCA method (Table 52). This appeared to be mainly due to the potential loss of leisure production, and to a lesser extent household production, outweighing the net workforce production gains, when smoking prevalence was reduced. A net production loss is not observed using HCA method as the overall workforce production gain exceeds the potential leisure and household production loss.

The FCA method identifies recruitment and training costs of $240 million as being attributable to the current smoking burden. It is estimated that these costs could be reduced by $84 million if the ideal reduction in smoking prevalence was achieved; or $42 million if the progressive target reduction in smoking prevalence was achieved. In contrast to the aforementioned gains, we have estimated that there would be a net loss to individuals of leisure time, if smoking was totally eliminated from the population, since ex-smokers report higher days of reduced activity than smokers. The leisure loss is -$51 million at current smoking prevalence which can be expected to be reduced by -$18 million or by -$9 million at prevalence of 15% or 19% respectively.

7.5.3.3 Taxation Gains to Government

If there are higher individual wages earned by people through not becoming ill or retiring early from the workforce then greater taxation revenue could be expected to follow. At the current prevalence of smoking (23%), the taxation forgone due to lost incomes is estimated at $891 million (HCA) or $154 million (FCA). These will change by $299 million or $150 million (HCA) if the lower prevalence target is reached (ideal or progressive target respectively). The taxation foregone will be reduced by $52 million or $26 million (FCA) if the lower prevalence target is reached (ideal or progressive target respectively).

Figure 40 Total potential opportunity cost savings from reductions in tobacco smoking



FCA: Friction Cost Approach (preferred conservative estimate).

Table 51 Financial outcomes uncorrected for joint effects

Tobacco smoking	Attributable at current levels of prevalence *uncorrected for joint effects*		
		95% Confidence Interval	
Financial Outcomes	**Mean ($mill)**	**LL ($mill)**	**UL ($mill)**
Health sector costs	1,412	n/a	n/a
Production Costs HCA	8,259	3,045	13,392
Production Costs FCA	842	316	1,657
Recruitment and training costs	240	n/a	n/a
Leisure based production	(51)	(674)	576
Home based production	424	(188)	1,008
Total production HCA	***8,631***	***3,164***	***13,981***
Total production FCA	***1,215***	***(203)***	***2,652***
Taxation effects HCA	891	(60)	1,790
Taxation effects FCA	154	24	368
	Ideal target reduction		
Financial Outcomes			
Health sector costs	491	n/a	n/a
Production Costs HCA	2,812	943	4,667
Production Costs FCA	285	101	576
Recruitment and training costs	84	n/a	n/a
Leisure based production	(18)	(235)	200
Home based production	147	(65)	350
Total production HCA	***2,942***	***1,016***	***4,863***
Total production FCA	***415***	***(57)***	***914***
Taxation effects HCA	299	(28)	621
Taxation effects FCA	52	5	128
	Progressive target reduction		
Financial Outcomes			
Health sector costs	246	n/a	n/a
Production Costs HCA	1,413	544	2,297
Production Costs FCA	143	53	288
Recruitment and training costs	42	n/a	n/a
Leisure based production	(9)	(117)	100
Home based production	74	(33)	175
Total production HCA	***1,478***	***568***	***2,389***
Total production FCA	***207***	***(30)***	***458***
Taxation effects HCA	150	(7)	303
Taxation effects FCA	26	3	64

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate. Numbers in brackets ( ) indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 52 Likelihood of net production loss

Tobacco smoking	**Mean ($mill)**	**Chance of negative result (%)**
Attributable		
Total Production HCA	8,631	0
Total Production FCA	1,215	4
Ideal		
Total Production HCA	2,942	0
Total Production FCA	415	5
Progressive		
Total Production HCA	1,478	0
Total Production FCA	207	4

Notes: HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate).
These are not estimates of immediately realisable cash savings.

7.5.4 Discussion

The largest potential opportunity cost savings of reduced prevalence of smoking will occur in the health sector, followed by individuals, government and business respectively.

Cost estimates associated with tobacco smoking reported by Collins and Lapsley (2008) were generally higher than those reported in the current study. For example, net productivity costs of $8.0 billion estimated by Collins and Lapsley is almost three times higher than the $842 million estimated in the current study using the FCA. A key methodological difference is that Collins and Lapsley quantified costs based on past and present tobacco smoking by comparing a counterfactual scenario in which no tobacco smoking has occurred and then comparing this to the present population where tobacco smoking is prevalent. In contrast, the current estimates were based on incident cases of tobacco related disease in 2008 and the associated lifetime costs based on these incident cases. Although estimates are therefore not directly comparable for this and other methodological differences between studies, a greater understanding of the magnitude of avoidable costs associated with tobacco smoking has been achieved.

Past levels of smoking rather than current are most influential in determining the current health burden, health sector costs and production and leisure costs. Many of the costs of smoking and the benefits of reduced smoking are experienced in the elderly, non-working population. These occur after long term exposure to tobacco. However the younger age groups have most to gain by quitting smoking as they would progress through life with greatly reduced risks to health and working life.

Cross-sectional data issues exist when comparing ex-smokers with current smokers. Ex-smokers may have poorer health than smokers since as a group they are older and work less. The poor health may or may not be related to past smoking exposure. We have not controlled for other risk factors or socioeconomic status in the analysis that may influence production and leisure effects and most persons surveyed have more than one of the risk factors of interest to this study (refer section 9).

In conclusion, at a population level, if the prevalence of tobacco smoking was to be decreased important opportunity cost savings from the reduction of diseases associated with this risk factor could be achieved.

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8.0 HIGH BODY MASS INDEX

Summary of consensus decision for analytic modelling:

Current prevalence (Australian Population 2008) → ↓ 1.5% Progressive target → ↓ 3% Ideal (realistic) target

8.1 Executive summary

Main findings from the literature review

- In Australia, 62% of men and 45% of women are overweight or obese.
- High body mass contributed 7.5% to the overall health burden in Australia, with Type 2 diabetes (40%) and ischaemic heart disease (34%) the major risks.
- Interventions can bring about decreases in body weight of up to 5kg, but long-term change is difficult.
- Obesity rates are generally increasing, so it may be difficult to substantially reduce the prevalence of obesity with population-wide intervention programs with current knowledge.

Research findings from this project

Risk reversal after the cessation of the risk behavior takes some time to occur and hence the estimated economic benefits will not be realized immediately but rather over some period of years instead.

At a population level, if the prevalence of high BMI was to be decreased for the 2008 Australian adult cohort modelled, important opportunity cost savings from the reduction of diseases associated with this risk factor could be achieved. These are summarised below.

- Currently in Australia the potential opportunity cost savings to the health sector are $812 million, if we were able to eliminate obesity and overweight from the population.
- The current potential opportunity cost savings in production and leisure are $742 million FCA over time, if we were able to eliminate obesity and overweight from the population.

- We found that if the prevalence of obesity could be reduced from 27% to 24% (ideal target):
  - Potential opportunity cost savings of $90 million in the health sector and $82 million in production and leisure could be realised (FCA) over time
  - The 79,000 annual new cases of disease related to obesity or overweight could be reduced by 9,000
  - The 10,000 annual deaths attributed to obesity and overweight could be reduced over time by just in excess of 1,000
  - The 198,000 Disability Adjusted Life Years (DALYs) could be reduced by 25,000
- If obesity prevalence could be reduced from 27% to 25.5% (progressive target):
  - Potential opportunity cost savings of $45 million in the health sector and $41 million in production and leisure could be realised (FCA) over time
  - Annual new cases of disease related to obesity or overweight could be reduced by 4,000
  - Deaths attributed to obesity and overweight could be reduced by 600
  - DALYs could be reduced over time by 13,000

8.2 Definition

Body mass index (BMI), calculated by dividing weight (in kg) by height (in m^2), is usually classified into underweight (BMI<18.5), normal weight (BMI 18.5-24.9), overweight (BMI 25-29.9) and obese (BMI 30 or above). These levels were not used for the Burden of Disease calculations, which instead used a method where BMI is measured on a continuous scale and risk is assessed against a minimum counterfactual population BMI distribution with a mean of 21 and a standard deviation of 1. This means that risk was attributed to all people in the population with a BMI of greater than 21, with the degree of risk increasing exponentially above this value. The consequence of this approach is that some of the attributable risk from high body mass comes from the large proportion of the population that is not overweight or obese in the conventional sense, but whose risk of disease is elevated, at least to some degree.

Drawing on this literature, and taking into account available source data, high BMI was defined as follows:

High Body Mass Index	Obese or overweight: BMI greater than 25, based on self-reported height and weight. Normal weight: BMI less than 25, based on self-reported height and weight (including underweight).

8.3 Summary of current literature and best available data

8.3.1 Prevalence data

Estimates in the current study are based on data from the 2003 Burden of Disease (BoD) report (Begg et al. 2007); see Table 53 and Table 54) and the prevalence estimate of obesity in Australian adults of 27% using the AusDiab 2005 general population sample (Barr et al. 2006).

Table 53 Body Mass Index in Australian men

Age	30-44	45-59	60-69	70-79	80+
Body Mass Index	26.8	27.5	27.2	27.1	25.8
Standard Deviation	4.1	4.0	3.7	3.8	3.5

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

Table 54 Body Mass Index in Australian women

Age	30-44	45-59	60-69	70-79	80+
Body Mass Index	25.4	27.2	28.5	27.0	24.9
Standard Deviation	5.4	5.7	5.8	5.2	4.5

Source: The burden of disease and injury in Australia 2003 (Begg et al. 2007).

Australian data from 2004-05 indicated that, in men, 43% were overweight and 19% were obese, while in women, 28% were overweight and 17% were obese (Australian Bureau of Statistics 2006). However, these figures are likely to be underestimates, with relatively high numbers of people not stating their weight (5% in men, 11% in women). Indeed, 2004-05 data from the

AusDiab 2005 study (Barr et al. 2006) indicated that 27% of their general population sample was obese.

8.3.2 Socioeconomic status

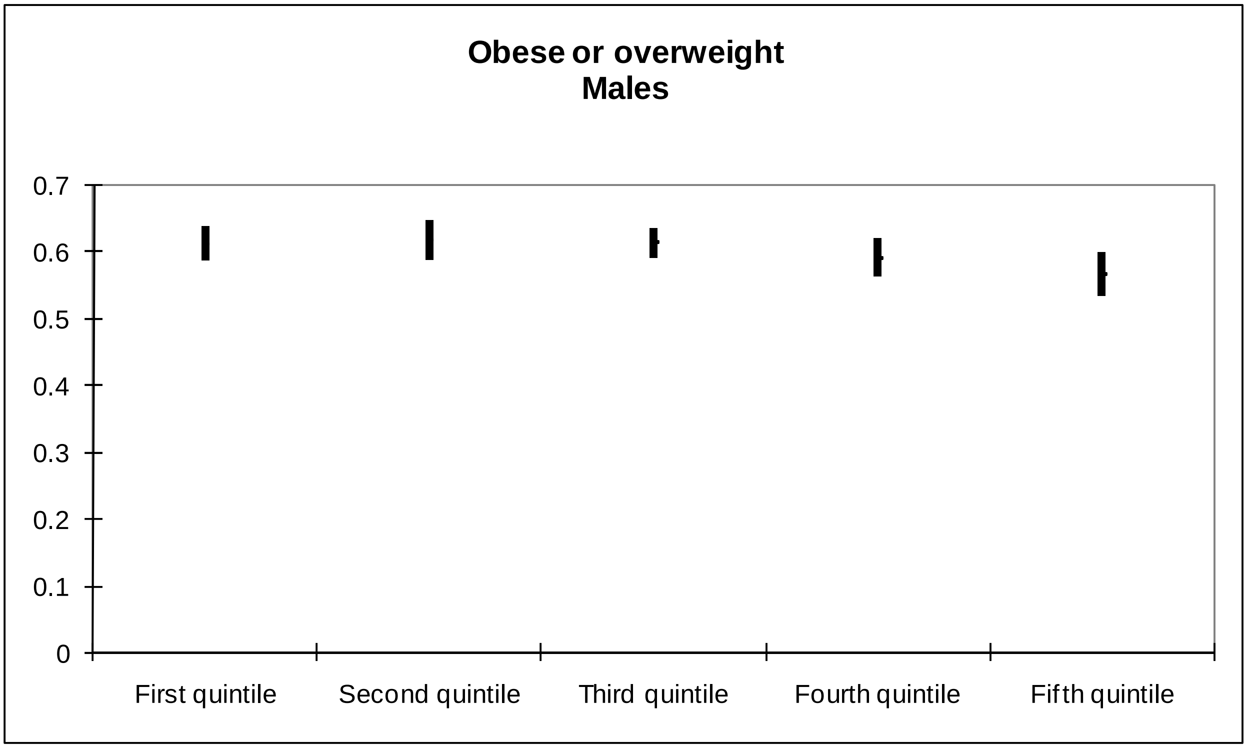
The ABS (2006) data showed that adults in the highest socioeconomic quintile were least likely to be obese (10% of females, 14% of males) while adults in the lowest socioeconomic quintile were most likely to be obese (19% of females, 19% of males). Evidence from the United States, where obesity in adults had increased from 13% to 32% between the 1960s to 2004, suggests that low socioeconomic status groups are disproportionately represented at all ages (Wang and Beydoun 2007). There is an inverse relationship between the energy density of foods (kJ/g) and energy cost ($/MJ), and financial disparities in access to healthy food may explain why the highest rates of obesity are found in those with lower incomes (Drewnowski and Darmon 2005).

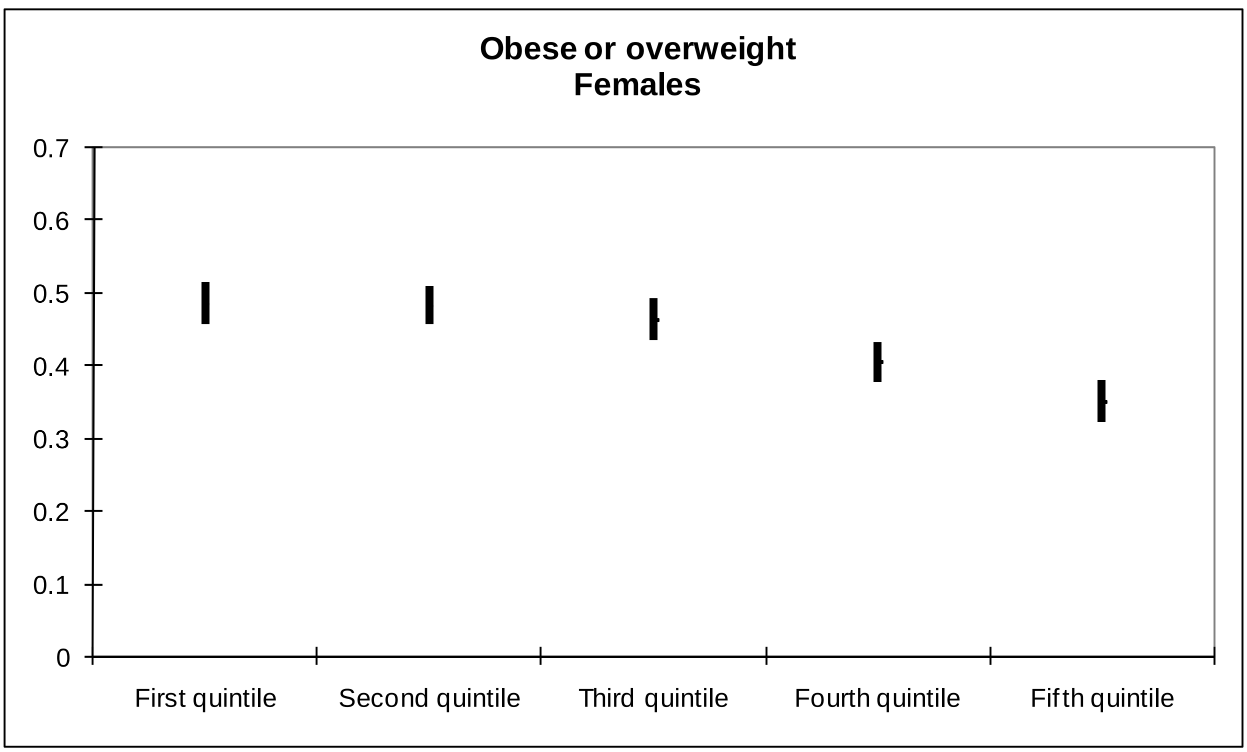
The proportion of persons in each socioeconomic quintile who report being obese or overweight by gender in the NHS 2004-05 is presented in Figure 41 and Table 55.

The proportion of males who reported being obese or overweight did not differ according to socioeconomic group. However, this was not the case for females where the proportion who reported being obese or overweight was relatively similar across the first three socioeconomic quintiles and then dropped significantly lower in the fourth and fifth quintiles. We found that 48% of females in the lowest socioeconomic group reported being obese or overweight compared to 35% in the highest socioeconomic group.

Given the noted inconsistencies between genders, a larger sample size would be useful to reduce the confidence intervals around the means to establish a clearer relationship between BMI and socioeconomic status overall. It should also be noted that self reported height and weight are notoriously inaccurate (Vos and Begg 1999). Physical measurement surveys provide more valid data and would be considered more valuable.

Figure 41 Proportion of Australian adults in each socioeconomic quintile who report being obese or overweight by gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 55 Proportion of Australian adults in each socioeconomic quintile who report being obese or overweight by gender

		95% Confidence Interval	
	Mean	**Lower Limit**	**Upper Limit**
Males			
First quintile	0.612	0.586	0.638
Second quintile	0.617	0.587	0.645
Third quintile	0.613	0.59	0.635
Fourth quintile	0.591	0.561	0.62
Fifth quintile	0.566	0.533	0.599
Females			
First quintile	0.484	0.455	0.514
Second quintile	0.482	0.457	0.507
Third quintile	0.463	0.434	0.492
Fourth quintile	0.404	0.377	0.432
Fifth quintile	0.349	0.321	0.38

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

8.3.3 International comparisons

In OECD data, the most recent obesity figures for Australia are from 1999, when 22% of Australians were obese (BMI>30) (Organization for Economic Cooperation and Development 2008). This was a considerably higher prevalence than many other OECD countries at that time, including Italy (9%), Netherlands (9%) and Sweden (8%). By 2005, prevalence in these countries had increased slightly: Italy (10%), Netherlands (11%) and Sweden (11%). Based on an analysis by the World Health Organization (2005), the prevalence of obesity among males and females 15 years and over in Australia (24% and 25%) was much lower than that in the US (37% and 42%). However, it was similar to that in Canada (24% and 23%) and the United Kingdom (22% and 24%), and considerably higher than that in France (8% and 7%).

8.3.4 Health outcomes

Authors of the 2003 BoD report (Begg et al. 2007) found that 7.7% of the overall health burden can be attributed to high body mass in men and 7.3% can be attributed to high body mass in women. In terms of DALYs lost, the most prominent contributors to health burden are Type 2 diabetes (40%), ischaemic heart disease (34%), stroke (11%), colorectal cancer (5%) and breast cancer (4%). High body mass is also associated with greater risk of osteoarthritis and other risk factors, such as high blood pressure (Eckersley 2001). There is strong evidence that weight loss of 5-10% of original body weight leads to major metabolic and cardiovascular health benefits in overweight people, including blood pressure reduction, lowering of cholesterol and triglyceride levels, improved control in those with Type 2 diabetes and improvement or resolution of sleep apnoea (National Health and Medical Research Council 2003).

8.3.5 Other economic cost estimates

For comparison purposes we include the most recent cost data from a reputable source, but reiterate the point that costing studies of disease or risk factors are often incomparable due to the different definitions and assumptions applied. The cost estimates provided in the current study have been consistently and comparably estimated across all the risk factors considered.

The total financial cost of obesity in Australia in 2008 was estimated as $8.3 billion (Access Economics 2008). Of this, productivity costs were estimated at $3.6 billion (44%), health system costs were $2.0 billion (24%) and carer costs were $1.9 billion (23%). The remainder was made up of transfer payments and other indirect costs. A much greater dollar value was attributed to the net cost of lost wellbeing due to obesity, which was estimated at $49.9 billion. Thus the total cost of obesity in 2008 was $58.2 billion.

8.3.6 Prevention

On an individual level, current evidence suggests that the short-term goal should be the loss of 1-4 kg per month, with the medium-term goal of losing 10% of initial weight (National Health and Medical Research Council 2003; Dietitians Association of Australia 2004). In real-world settings, however, losing 0.5-1 kg per month may be a more realistic target. In a Cochrane review of psychological interventions, Shaw et al. (2005) surveyed 36 studies. Behaviour therapy led to significantly greater weight reductions than placebo (average decrease of 2.5 kg), and was even more effective when combined with a diet/exercise approach. Cognitive-behaviour therapy, when combined with a diet/exercise intervention, was found to increase weight loss compared with diet/exercise alone (average decrease of 4.9 kg). Shaw et al. (2006) reviewed 43 studies that evaluated exercise interventions for high body mass, and found that exercise combined with diet resulted in a greater weight reduction than diet alone (average decrease of 1.0 kg).

An extensive literature review from the Department of Health and Ageing (University of Sydney 2005) outlined promising interventions at a population level, in those at risk of weight-related chronic health problems, in indigenous Australians, in rural and remote populations and in older adults. Interventions focusing on increasing fruit and vegetable consumption and decreasing total dietary fat have been particularly successful at preventing weight gain or assisting weight loss (Agency for Healthcare Research and Quality 2000). The Australian Government is currently pursuing ‘Healthy Weight for Adults and Older Australians’, which is a national action agenda to address overweight and obesity from 2006-2010 (Commonwealth of Australia 2006). In France, trials of community interventions for obesity prevention in children (EPODE) were set up in 2004. Results have been encouraging, but a review of the situation in Europe stressed the need for proper evaluation of intervention programs as the current state of knowledge remains very poor (Fussenegger et al. 2008).

It must be remembered that we are seeing annual increases in the prevalence of people who are overweight or obese. In the United States these increases are in the range of 0.3-0.9 percentage points per year (Wang and Beydoun 2007). Evidence from longitudinal studies of the Australian population suggests that modest changes in energy intake and energy expenditure can account for average weight gain of around 0.5 kg per year (Brown et al. 2005). As such, it may be difficult to bring about substantial reductions in the prevalence of obesity with population-wide intervention programs. A recent report from the National Preventative Health Taskforce (National Preventive Health Taskforce 2008) set the conservative target of “halting and reversing” the rising prevalence of obesity in Australia by 2020. A Dutch study estimated that population-level intervention could be expected to reduce prevalence rates of overweight by only 3% points over 5 years (Bemelmans et al. 2008).

While there is convincing evidence that reducing energy intake (e.g., lowering intake of energy-dense foods) and increasing energy expenditure (e.g., regular physical activity) lowers the likelihood of weight gain, how successful certain interventions are in achieving these outcomes is difficult to determine. For example, Ogilvie et al. (2004) reviewed whether changes in walking and cycling infrastructure resulted in reduced car use and therefore prevention of weight gain at a population level, and found mixed results. Overall, comprehensive studies on population level interventions are lacking. A report prepared by the NSW Centre for Public Health Nutrition (Gill et al. 2004) concluded that there was too small a body of reliable research to provide firm guidance on consistently effective interventions for adults or children.

There are other issues that complicate prevention. First, the issue of risk reversibility: large community cardiovascular disease prevention trials (Farquhar et al. 1990; Jeffery 1995) have demonstrated a time lag of 5-10 years between the implementation of community-wide programs and the behaviour change needed to impact on weight status. Second, patterns of weight reduction are different for men and women. Third, encouraging low-income households to move away from energy-dense foods and consume more costly foods may not be an effective public health strategy. We need a comprehensive approach that takes behavioural nutrition and the economics of food choice into account (Drewnowski and Darmon 2005).

8.4 Determination of the feasible reductions for high BMI

The use of an Arcadian mean (refer methods in Part A section 2.3.1) was determined to not be ideal for providing a realistic target for a reduced prevalence of high BMI. Data from the WHO (2005) show that the prevalence of obesity among males and females 15 years and over in Australia (24% and 25%) was considerably higher than that in France (8% and 7%). Yet using French prevalence as an Arcadian mean is not a realistic feasible reduction. As stated in the previous section, the Australian population is experiencing an average weight gain of around 0.5 kg per person per year (Brown et al. 2005). The conservative target of the National Preventative Health Taskforce (2008) reflects this situation. In the modelling study of Bemelmans et al. (2008), only some of the 3% reduction in prevalence of overweight was attributable to reduced obesity. Nevertheless, a 3% point reduction in obesity was selected as a small but achievable target by the study Advisory Committee. The prevalence estimate from the AusDiab 2005(Barr et al. 2006) general population sample of obesity in Australian adults of 27% was chosen as superior to the WHO (2005) estimate.

Prevalence of obesity:

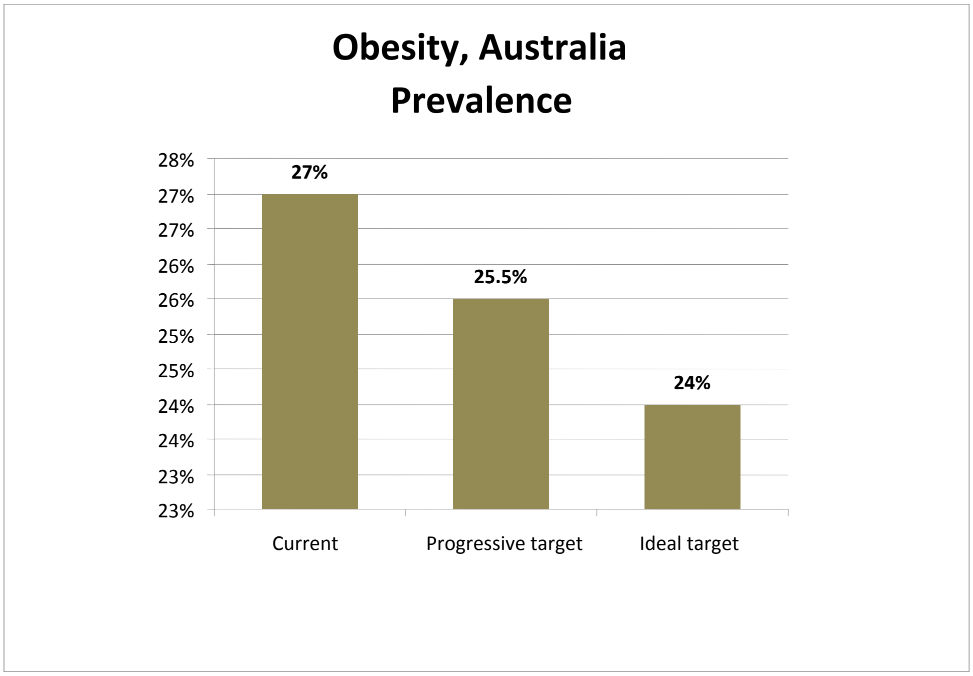
- Australian estimate: 27%.
- Target: 24%.

Proposed prevalence levels to be modelled (appear in Figure 42):

- Current – 27%.
- Ideal – 24%.
- Progressive – 25.5%.

We have calculated an absolute 1.5% and 3% reduction in prevalence of obesity to produce the estimates of avoidable burden (health status, economic and financial) resulting from reductions in both obesity and overweight assuming that population based strategies would affect both. The net difference between the current (attributable) and avoidable burden is reported.

Figure 42 Comparison of current and target prevalence of obesity



8.5 Economic and financial benefits of reduced overweight or obesity prevalence

The following sections provide the results for the high body mass index analysis undertaken using the systematic methods outlined in Part A. Firstly, the 2008 population characteristics are presented followed by estimates for the potential health status, economic and financial outcomes obtained from reducing the prevalence of this risk factor.

8.5.1 Population characteristics of comparator groups

Based on the data from the NHS 2004-05 the following population characteristics were estimated for the 2008 reference population according to age, gender and work force status (Table 56 and Table 57).

Table 56 Males who are obese or overweight compared to males who are normal weight

Males:	Obese or overweight	Normal BMI <= 24.99
Age summary		
Age 15-64 y N (95% CI)	3,774,457 (3,686,905 – 3,862,010)	2,478,525 (2,398,169 – 2,558,881)
Age 65+ y N (95% CI)	599,275 (570,135 - 628,415)	459,594 (428,557 - 490,630)
Age 15+ y Mean (95% CI)	45.9 (45.5 - 46.3)	40.3 (39.8 - 40.9)
In Labour Force (15+ years)*		
% (95% CI)	77% (76% - 79%)	72% (71% - 74%)
Mean days off work (95% CI)	0.30 (0.24 – 0.37)	0.30 (0.20 – 0.40)
Not in Labour Force		
% (95% CI)	23% (21% - 24%)	28% (26% - 29%)
Mean days of reduced activity: 15-64 y (95% CI)	2.09 (1.67 - 2.51)	1.02 (0.73 - 1.30)
Aged 65+ years		
% (95% CI)	13.7% (13.0% - 14.4%)	15.6% (14.7% - 16.7%)
Mean days of reduced activity (95% CI)	1.17 (0.86 - 1.47)	1.20 (0.81 - 1.58)

Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years

Table 57 Females who are obese or overweight compared to females who are normal weight

Females:	Obese or overweight	Normal BMI <= 24.99
Age summary		
Age 15-64 y N (95% CI)	2,528,950 (2,439,787 – 2,618,112)	3,452,692 (3,359,226 – 3,546,158)
Age 65+ y N (95% CI)	568,120 (532,188 – 604,051)	568,118 (534,135 – 602,101)
Age 15+ y Mean (95% CI)	48.0 (47.5 - 48.5)	41.5 (41.1 - 41.9)
In Labour Force (15+ years)*		
% (95% CI)	56% (54% - 58%)	63% (61% - 64%)
Mean days off work (95% CI)	0.36 (0.29 – 0.44)	0.23 (0.19 – 0.28)
Not in Labour Force		
% (95% CI)	44% (42% - 46%)	37% (36% - 39%)
Mean days of reduced activity: 15-64 y (95% CI)	1.59 (1.33 - 1.84)	1.03 (0.82 - 1.24)
Aged 65+ years		
% (95% CI)	18.3% (17.2% - 19.5%)	14.1% (13.3% - 15.0%)
Mean days of reduced activity (95% CI)	1.67 (1.31 - 2.04)	1.32 (1.01 - 1.63)

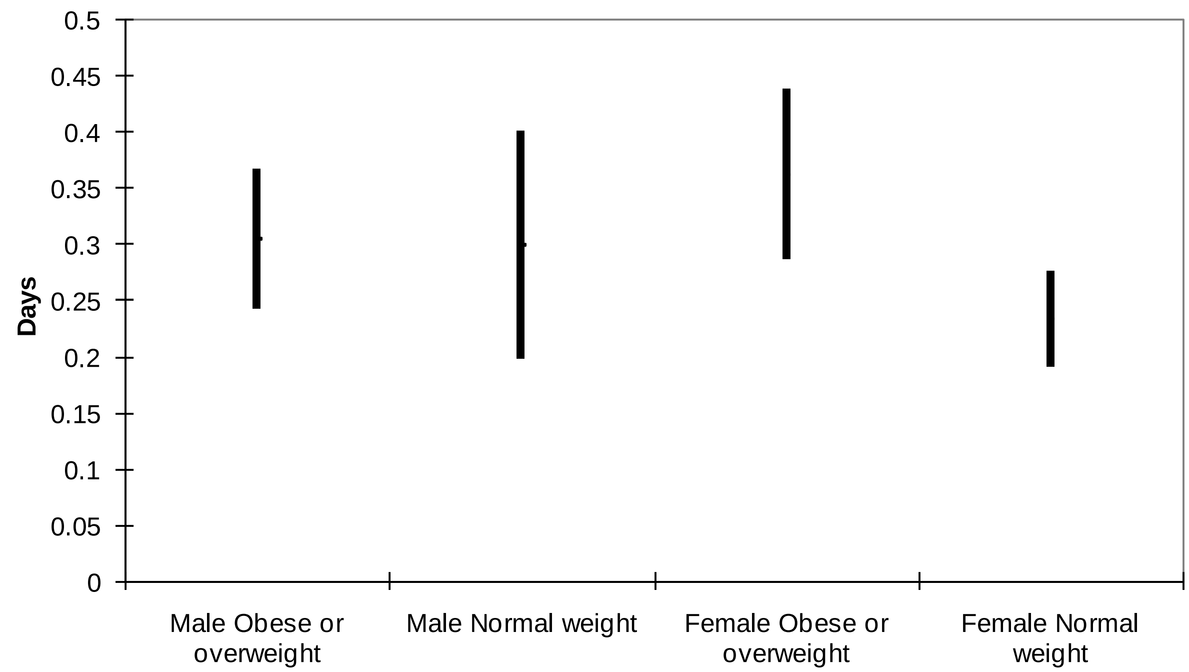
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006); CI: Confidence Interval; N: Number. Mean days measured over a two week period. *includes unemployed seeking work and 65+ years

Absenteeism from paid work – overall

The number of days taken off work in a 10-day working period by obese or overweight persons compared to normal weight persons is presented in Figure 43 and Table 58.

A similar number of days were taken off work by males who reported being obese or overweight compared to males who reported being normal weight. Obese or overweight females reported a significantly higher fraction of days off work compared to females who reported normal weight.

Figure 43 Days taken off work in a 10-day working period by obese or overweight persons compared to normal weight persons by gender



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Table 58 Days taken off work by obese or overweight persons compared to normal weight persons by gender

	Mean	Lower Limit	Upper Limit
Males			
Obese or overweight	0.304	0.242	0.366
Normal weight	0.299	0.197	0.401
Females			
Obese or overweight	0.362	0.286	0.437
Normal weight	0.234	0.191	0.276

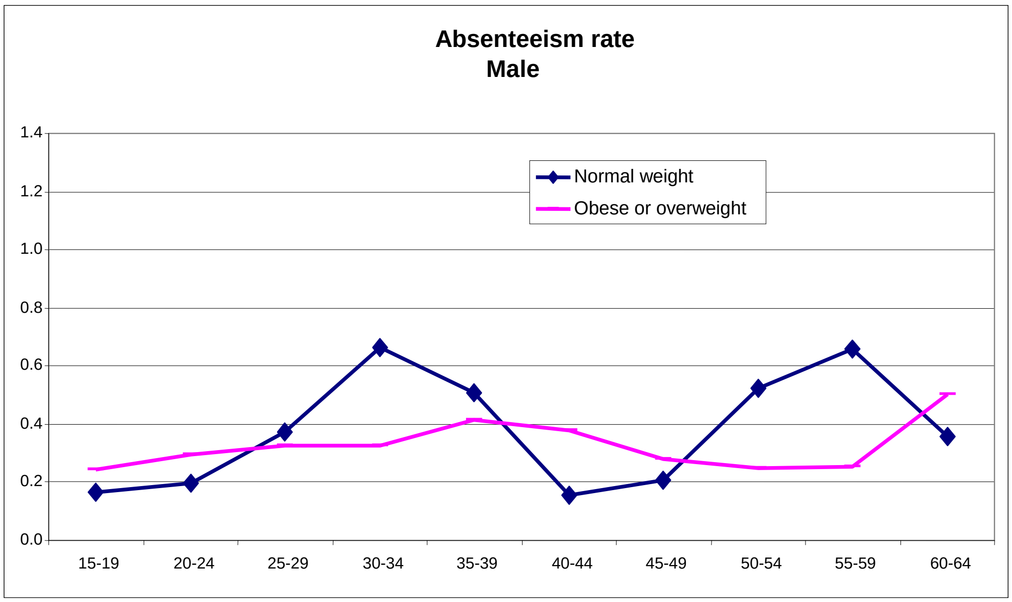
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

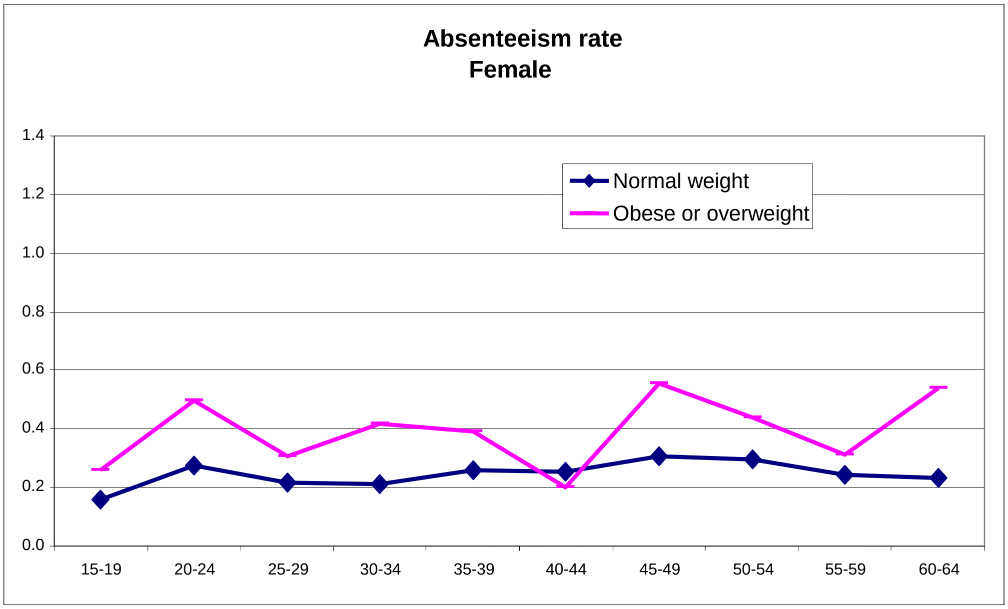
Absenteeism from paid work – by age and gender

Absenteeism rates for obese and overweight persons compared to normal weight persons by age and gender are presented in Figure 44.

The rate of absenteeism for the comparison groups varies greatly across age groups, for males and females. Obese and overweight males reported taking more days off work compared to normal weight males in half of the age groups presented (15-24, 40-49 and 60-64 years). Obese or overweight females reported taking more days off work than normal weight females in all age groups, with one exception (40-44 age group).

Figure 44 Absenteeism rates of obese or overweight persons compared to normal weight persons by age and gender





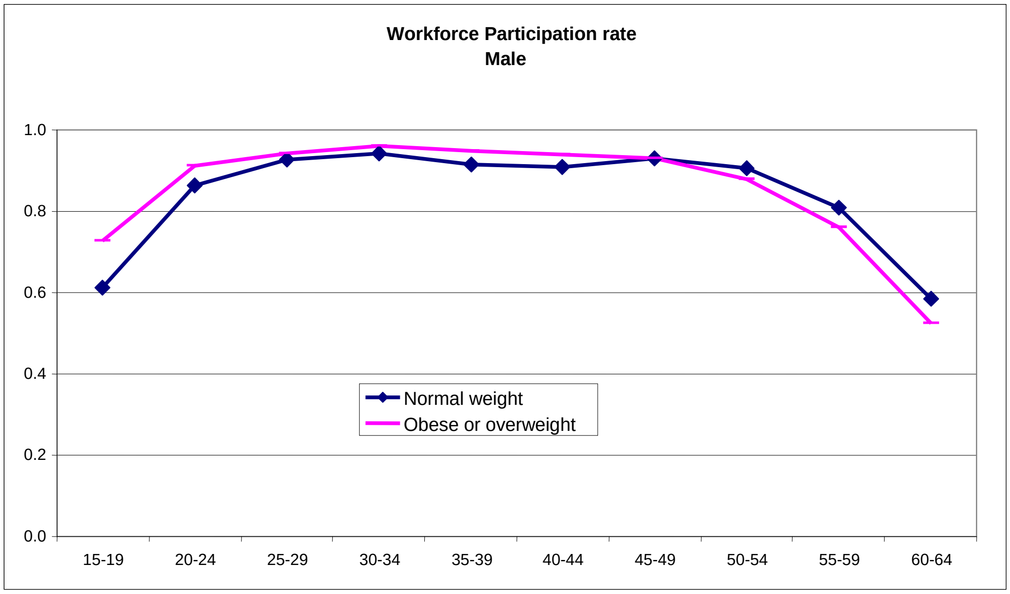
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

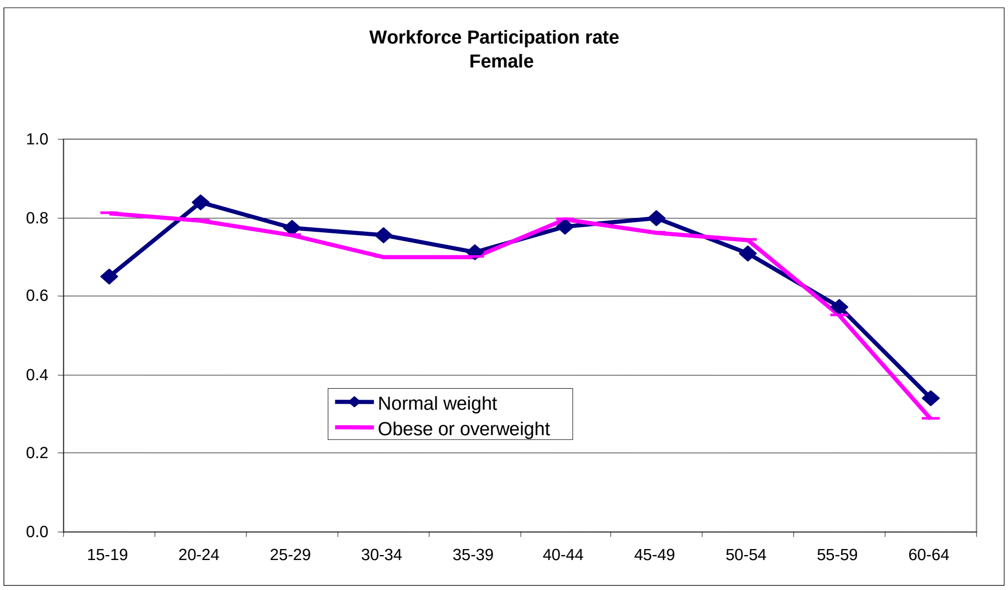
Absenteeism from paid work – by age and gender

Workforce participation rates for obese and overweight persons compared to normal weight persons by age and gender are presented in Figure 45.

Below the age of 44, males who reported being obese or overweight participate in the workforce at a rate slightly above the males who reported being normal weight. Above the age of 45, the opposite is then observed with obese or overweight males participating in the workforce at a lower rate. For females, workforce participation rates are largely similar between the two comparison groups. From the age of 20, the workforce participation of obese or overweight females dropped slightly below that of normal weight females except in age groups 40-44 and 50-54 years.

Figure 45 Workforce participation rates of obese or overweight persons compared to normal weight persons by age and gender





Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

8.5.2 Health status and economic gains/losses

The health status and economic gains presented include health gains of potential reduction of DALYs, reduced incidence of disease related to overweight or obesity and reduced mortality from disease related to overweight or obesity. The economic gains evaluated also include potential reductions in days of absenteeism from paid employment, reductions in lost days of home based production and reductions in lost days of leisure time; all due to disease related to overweight or obesity. The mean and 95% uncertainty interval for outcomes able to be modelled as distributions with uncertainty are presented in Table 59.

8.5.2.1 Current losses (attributed economic burden)

Currently we can attribute 79,000 new cases of disease related to overweight or obesity, 9,500 deaths and almost 198,000 DALYs annually to overweight or obesity at past and current levels. Over the working lifetime of the working-age population in 2008 we estimated there were 141,000 working days lost and almost 700 early retirements due to overweight or obesity. Over the lifetime of all adults we estimated there were 889,000 days lost because of ill health that would have been used for household production, and 1.4 million days of lost leisure due to disease related to overweight or obesity. If we were able to eliminate overweight or obesity entirely from the population, each of these losses would disappear over time.

8.5.2.2 Realistic target reductions in prevalence

If the prevalence of overweight or obesity was reduced nationally to 24% some of the attributed economic burden described above would potentially no longer occur. We estimated the new cases of disease related to overweight or obesity would fall by 8,800; deaths would reduce by just over 1,100; and DALYs by 25,000 each year. Over the working lifetime of the working-age population we estimated there would be almost 16,000 fewer working days lost and just over 70 early retirements due to overweight or obesity that would potentially not occur. Over the lifetime of all adults we estimated there would be almost 99,000 fewer days lost to illness that would have been used for household production, and almost 153,000 fewer days of lost leisure due to disease related to overweight or obesity that would potentially not occur.

8.5.2.3 Progressive target reduction in prevalence

If the prevalence of overweight or obesity was reduced nationally to only 25.5% some (a smaller proportion) of the attributed economic burden described above would potentially no longer occur. We estimated the new cases of disease related to overweight or obesity would fall by just under 4,400; deaths would fall by 580; and there would be just over 12,500 fewer DALYs annually. Over the working lifetime of the working-age population there would be 7,800 fewer working days lost and just under 40 early retirements due to overweight or obesity that would potentially not occur. Over the lifetime of all adults we estimated there would be 49,000 fewer days lost to illness that would have been used for household production, and 76,000 fewer days of lost leisure due to disease related to overweight or obesity that would potentially not occur.

Table 59 Health status and economic outcomes uncorrected for joint effects

Obese or overweight	Attributable at current levels of prevalence *uncorrected for joint effects*		
		95% Confidence Interval	
	Mean ('000s)	LL ('000s)	UL ('000s)
Health status and economic outcomes			
Per annum			
DALYs	198	n/a	n/a
Incidence of disease	79	n/a	n/a
Mortality	10	n/a	n/a
Lifetime			
Leisure (days)	1,375	1,270	1,464
Absenteeism (days)	141	n/a	n/a
Days out of home based production role (days)	889	738	1,054
Early retirement (persons)	1	n/a	n/a
	Ideal target reduction		
Health status and economic outcomes			
Per annum			
DALYs	25	n/a	n/a
Incidence of disease	9	n/a	n/a
Mortality	1	n/a	n/a
Lifetime			
Leisure (days)	153	141	163
Absenteeism (days)	16	n/a	n/a
Days out of home based production role (days)	99	82	117
Early retirement (persons)	0.07	n/a	n/a
	Progressive target reduction		
Health status and economic outcomes			
Per annum			
DALYs	13	n/a	n/a
Incidence of disease	4	n/a	n/a
Mortality	1	n/a	n/a
Lifetime			
Leisure (days)	76	71	81
Absenteeism (days)	8	n/a	n/a
Days out of home based production role (days)	49	41	59
Early retirement (persons)	0.04	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

8.5.3 Financial gains/losses

The potential opportunity cost savings which benefit the health sector, individuals, business and government are presented in Table 60 and Figure 46.

8.5.3.1 Health sector costs associated with overweight or obesity

Overweight or obesity (past and present) is associated with just under $812 million of health sector costs that we estimate could be prevented at some point in the life time of males and females in 2008. This can be expected to be reduced by $90 million or $45 million if obesity prevalence is reduced as described above to 24% or 25.5% respectively with a similar relative change in overweight prevalence.

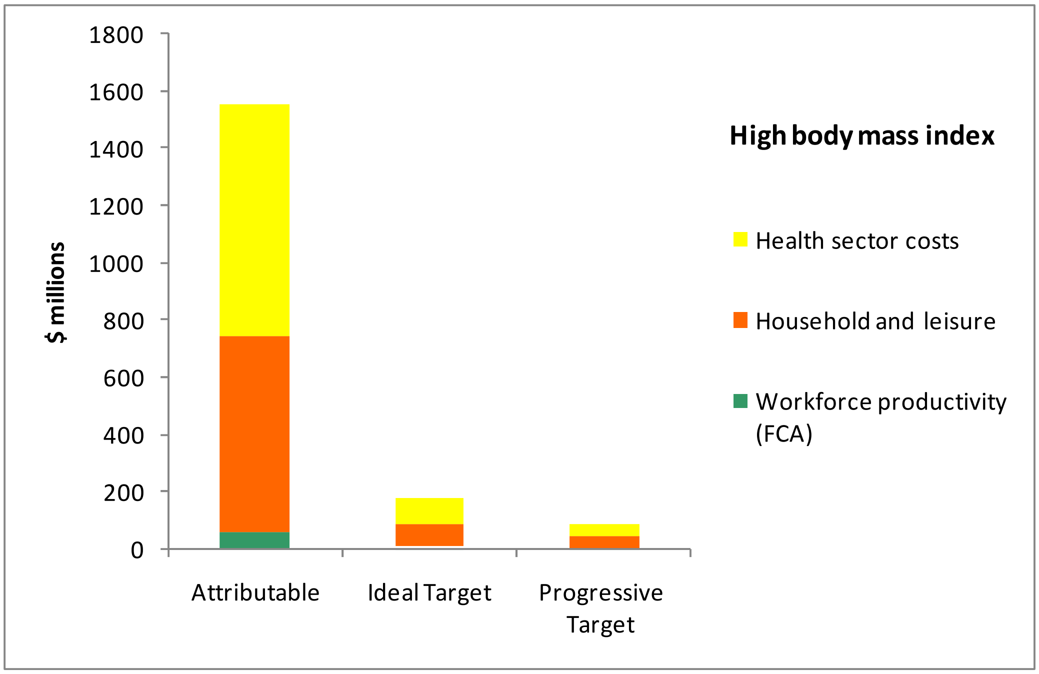
8.5.3.2 Gains to individuals and business

The total opportunity cost savings from production gains (working, household activities and leisure) that could potentially be achieved if overweight or obesity was eliminated from the population sum to $1,561 million using the HCA or just under $742 million using the more realistic FCA. The fewer deaths and incidence of disease related to overweight or obesity which would arise from reduced prevalence of overweight or obesity (24%) could be expected to lead to total production gains of just under $174 million (HCA) or $82 million (FCA). If the progressive target was achieved, total production gains of just under $87 million (HCA) or $41 million (FCA) might be realised. The FCA method identifies recruitment and training costs of just under $56 million as being attributable to the current overweight or obesity burden. It is estimated that these costs could be reduced by $6 million if the ideal reduction in obesity prevalence was achieved or $3 million if the progressive target reduction in obesity prevalence was achieved. The household gain is $351 million given the current prevalence of disease related to overweight or obesity and can be expected to be reduced by $39 million or by almost $20 million at obesity prevalence of 24% or 25.5% respectively. An estimated net leisure gain of just under $332 million at current overweight or obesity prevalence can be expected to be reduced by just under $37 million or by $18 million at obesity prevalence of 24% or 25.5%, respectively.

8.5.3.3 Taxation Gains to Government

If there are higher individual wages earned by people through not becoming ill or retiring early from the workforce then greater taxation revenue could be expected to follow. At the current prevalence of obesity (27%), the taxation forgone due to lost incomes is estimated at $44 million (HCA) or -$11 million (FCA). These will change by just under $5 million or $2.4 million (HCA) if the lower prevalence target is reached (ideal or progressive target respectively). The taxation foregone will be reduced by -$1.26 million or just under -$600,000 (FCA) if the lower prevalence target is reached (ideal or progressive target respectively). Recruitment and training costs savings make up the vast majority of the FCA production gains and do not attract taxation.

Figure 46 Total potential opportunity cost savings from reductions in high BMI



FCA: Friction Cost Approach (preferred conservative estimate).

Table 60 Financial outcomes uncorrected for joint effects

Obese or overweight	Attributable at current levels of prevalence *uncorrected for joint effects*		
		95% Confidence Interval	
Financial Outcomes	**Mean ($mill)**	**LL ($mill)**	**UL ($mill)**
Health sector costs	812	n/a	n/a
Production Costs HCA	877	604	1,154
Production Costs FCA	58	(22)	126
Recruitment and training costs	56	n/a	n/a
Leisure based production	332	249	431
Home based production	351	290	419
Total production HCA	***1,561***	***1,257***	***1,865***
Total production FCA	***742***	***596***	***894***
Taxation effects HCA	44	(2)	79
Taxation effects FCA	(11)	(52)	15
	Ideal target reduction		
Financial Outcomes			
Health sector costs	90	n/a	n/a
Production Costs HCA	98	67	130
Production Costs FCA	6	(3)	15
Recruitment and training costs	6	n/a	n/a
Leisure based production	37	28	48
Home based production	39	32	47
Total production HCA	***174***	***140***	***209***
Total production FCA	***82***	***67***	***99***
Taxation effects HCA	5	(0.37)	9
Taxation effects FCA	(1)	(6)	2
	Progressive target reduction		
Financial Outcomes			
Health sector costs	45	n/a	n/a
Production Costs HCA	49	34	65
Production Costs FCA	3	(1)	7
Recruitment and training costs	3	n/a	n/a
Leisure based production	18	14	24
Home based production	20	16	23
Total production HCA	***87***	***70***	***104***
Total production FCA	***41***	***33***	***50***
Taxation effects HCA	2	(0.15)	4
Taxation effects FCA	(0.60)	(3)	1

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate. Numbers in brackets ( ) indicate the possibility of losses resulting from achieving the target, rather than gains.

8.5.4 Discussion

The largest potential opportunity cost savings of reduced prevalence of obesity will occur in the health sector, followed by individuals, business and government respectively.

It is difficult to compare estimates from the current study with previous literature (refer section 8.3.5). In determining health sector costs, different inflation rates were applied by Access Economics (2008) compared to the current study to estimate costs in the reference year. Moreover, Access Economics included additional cost categories (eg. carer costs, funeral costs) which were beyond the scope of the current study and only estimated workforce productivity using the HCA. As a result, the estimate of $8.3 billion (productivity, health system and carer costs) by Access Economics is considerably higher than, for example, the $742 million (workforce FCA, household and leisure time production) estimated in the current project. While study results are not directly comparable due to these fundamental methodological differences, both studies provide a valuable contribution to the literature regarding the potential economic benefits of reducing overweight and obesity in Australia.

In the absence of any specific targeted interventions we have assumed that a reduction in the prevalence of obesity will result in a similar relative percentage reduction in the prevalence of overweight persons. We used the reported workplace behaviours and days of reduced activity of the obese and overweight combined, due to small numbers of people reporting as obese. This risk factor is traditionally underreported and it was expected that by including both categories of overweight and obese, more robust reliable estimates would be generated.

Cross-sectional data issues exist when comparing the obese and overweight with normal weight. Differences in workforce behaviour of the two groups may be associated with the risk factor but is not necessarily caused by the risk factor. We have not controlled for other risk factors or socioeconomic status in the analysis that may influence production and leisure effects. Most persons surveyed have more than one of the risk factors of interest to this study

Past as well as current levels of obesity and overweight are most influential in determining the current health burden, health sector costs and production and leisure costs. Many of the costs of overweight and obesity and hence the benefits of reduced obesity are experienced in the later adult life. These occur after long term exposure to obesity and overweight. The younger age groups have most to gain by maintaining healthy weight as they would progress through life with greatly reduced risks to health and working life.

In conclusion, at a population level, if the prevalence of high BMI was to be decreased important opportunity cost savings from the reduction of diseases associated with this risk factor could be achieved.

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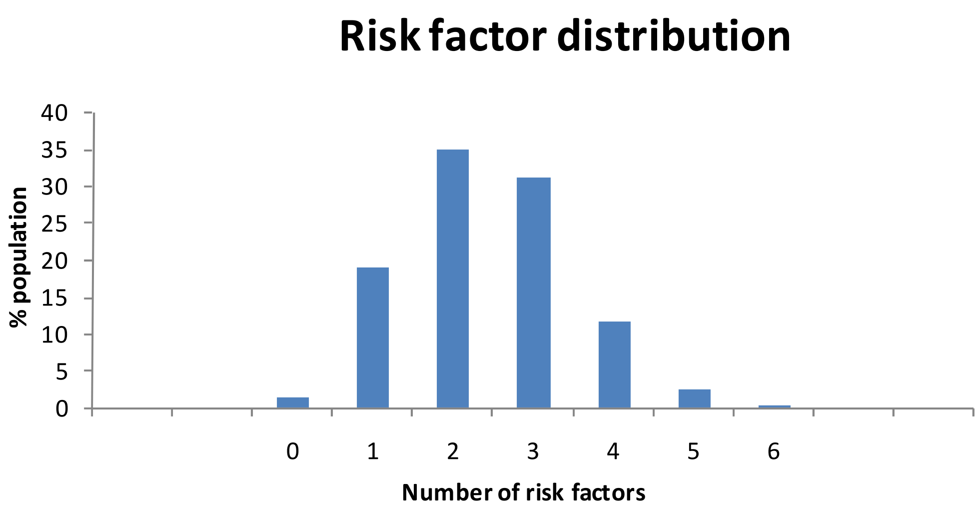
9.0 CORRECTING FOR JOINT EFFECTS OF RISK FACTORS

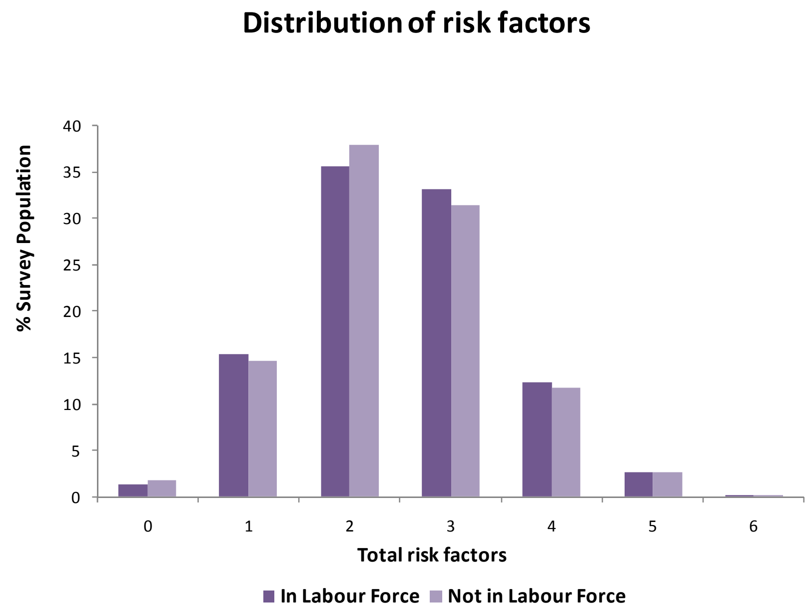
Total potential benefits from reducing the incidence of disease associated with a reduced prevalence of individual risk factors may be overestimated if these were to be simply added together (refer section 2.7). This is because they are not mutually exclusive, since it is more common for people to report two or more risk factors than one risk factor (Figure 47). Using data from the NHS 2004-05, the distribution of risk factors assessed was consistent regardless of workforce status (Figure 48). Moreover, we found that people with less socioeconomic disadvantage (quintile 5), were less likely to have two or more of our risk factors of interest (Figure 49).

Figure 47 Proportion of Australians who have none, or one or more of the six risk factors of interest



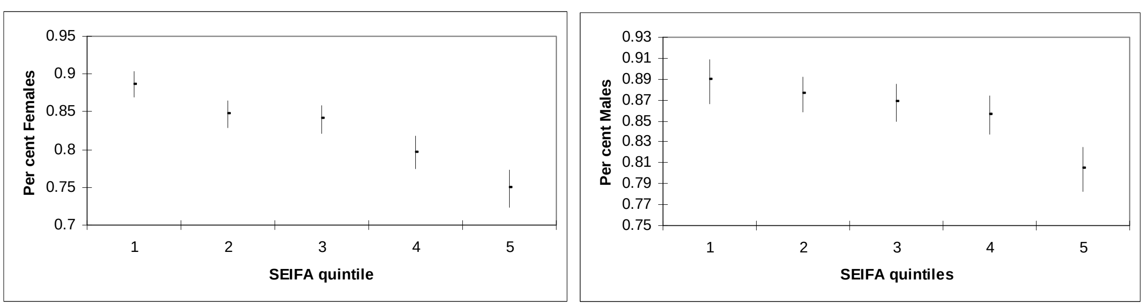
Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

Figure 48 Proportion of Australians who have none, or one or more of the six risk factors of interest according to workforce status



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006).

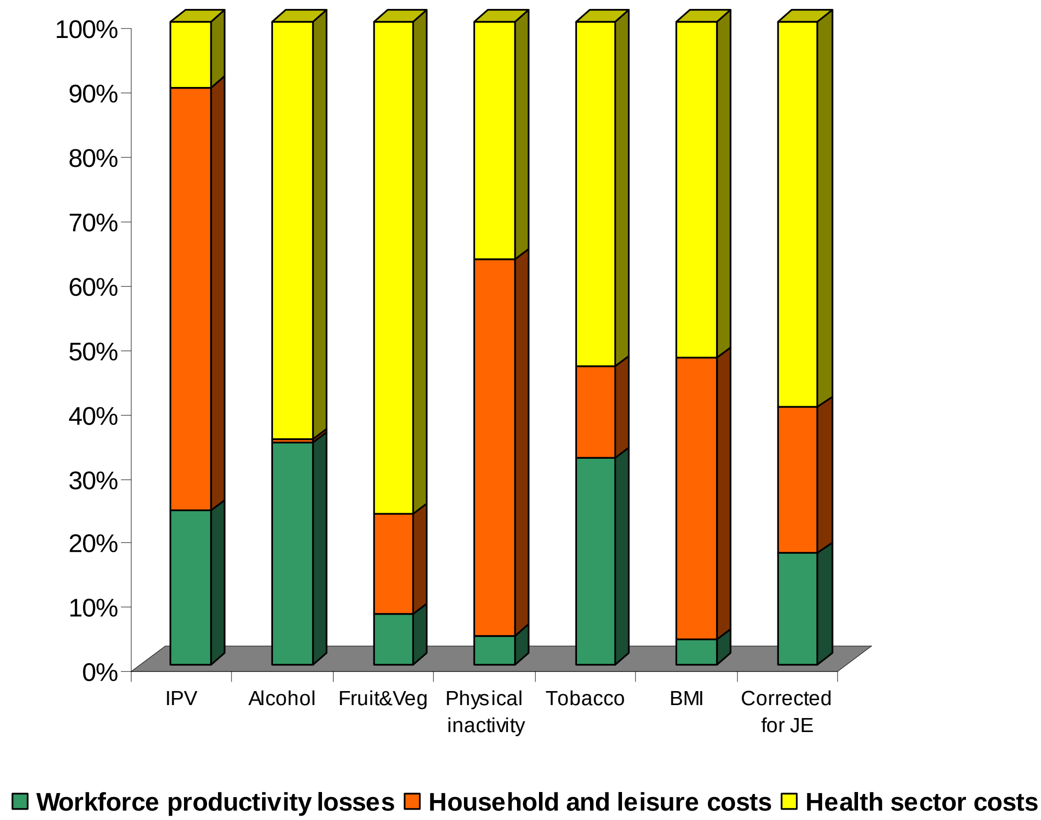
Figure 49 Proportion of males and females who have two or more of the six risk factors of interest according to socioeconomic status



Source: National Health Survey 2004-05 (Australian Bureau of Statistics 2006). SEIFA: Socio-Economic Indexes For Areas

In this project, we found that the distribution of direct health sector costs and indirect costs from reduced productivity varied by risk factor (Figure 50). This was largely explained by intrinsic differences in demographic characteristics and workforce participation as described in sections 2.6 and 2.7. When corrections for joint effects were applied, health sector costs explained approximately 60% of the costs to society set out in Table 61.

Figure 50 Distribution of productivity losses (FCA) and heath sector costs attributed to each uncorrected risk factor, plus total with correction for joint effects



IPV: Intimate Partner Violence; BMI: Body Mass Index; JE: Joint Effects

The following sections provide the results adjusted for the application of the joint effects correction method. Results are provided in an aggregate form to ***provide an indication of the opportunity costs savings if all of the risk factors were to be reduced concurrently***. While we were able to provide the combined corrected effects in each scenario, there were too many additional assumptions required to generate corrected estimates for each risk factor individually. In general, the corrected estimates were approximately half of the sum of the individual uncorrected estimates (the exception being health expenditure, refer section 2.7.1).

9.1 Opportunity cost savings from reductions in the prevalence of the six risk factors combined, corrected for joint effects

Total costs to society attributed to the risk factors of interest, after correction for joint effects, sum to nearly $9,000 million (Table 61). This is the ***upper limit of potential opportunity cost savings*** that could be achieved if risk was fully reversible, if effective interventions existed to achieve this reversal, and if funding was available to fully implement the interventions.

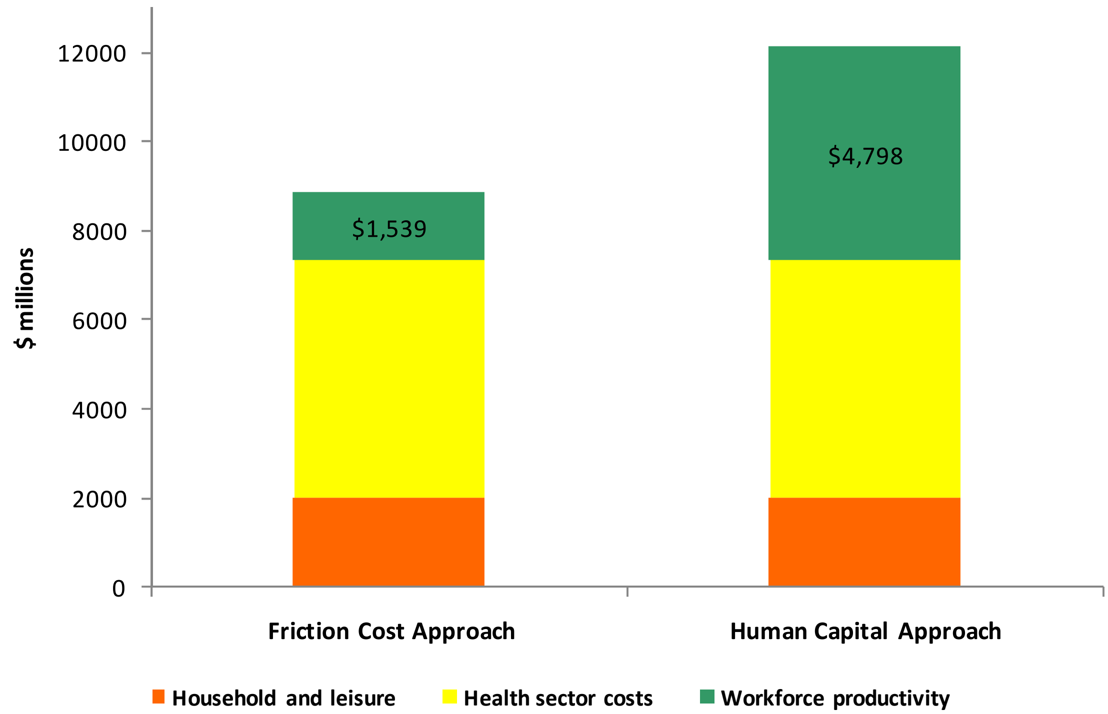
Table 61 Total potential attributable opportunity cost savings

	Uncorrected individual risk factors $ millions						Combined risk factors
Attributable	**IPV**	**High risk alcohol**	**Inadequate F & V**	**Physical inactivity**	**Tobacco smoking**	**High BMI**	**Corrected for JE**
Total production FCA	1,801	1,224	63	1,135	1,215	742	3,540
Health sector offsets	207	2,275	206	672	1,412	812	5,329
Total	2,008	3,498	269	1,807	2,627	1,554	8,869

Notes: FCA: Friction cost approach for valuing workforce productivity losses; IPV: Intimate Partner Violence; F&V: Fruit and Vegetable BMI: Body mass index; JE: Joint effects. Values are net present value using a 3% discount rate.

Because there is debate in the literature about the best method for valuing workforce production (refer section 2.4.5), we present data to illustrate the magnitude of difference between the two standard approaches. The net present value (NPV) of total production losses corrected for the joint effects of risk factors using the Friction Cost Approach (FCA) and the alternate Human Capital Approach (HCA) are both presented in Figure 51. The HCA estimates are considerably higher than those determined using the FCA. For example, if the ideal target for tobacco smoking was met, total uncorrected workforce production gains of $2,812 million (HCA) or $285 million (FCA) would be expected. As the tobacco example illustrates, the adoption of one approach rather than the other clearly has a dramatic effect upon the results, and it is therefore important to recognise that there are valid arguments for adopting either method. While we prefer the FCA approach, we acknowledge that one potential compromise is to argue that workforce production gains will fall somewhere between the HCA and FCA production estimates reported (refer discussion section below).

Figure 51 Total attributable production losses based on the FCA and HCA methods for valuing workforce productivity



Next we move from the upper limit of potential gains based on current prevalence levels, to potential reductions of that prevalence through achievement of the targets. If the ideal risk factor reduction targets were realised the total potential opportunity cost savings after correction for joint effects sum to just over $2,300 million (Table 62). If only progressive targets were realised, the total potential opportunity cost savings after correction for joint effects would be just over $1,170 million.

Table 62 Total potential opportunity cost savings if ideal targets were achieved

	Uncorrected individual risk factors $ millions						Combined risk factors
Ideal reduction	**IPV**	**High risk alcohol**	**Inadequate F & V**	**Physical inactivity**	**Tobacco smoking**	**High BMI**	**Corrected for JE**
Total production FCA	333	435	21	162	415	82	830
Health sector offsets	38	789	71	96	491	90	1,504
Total	371	1,225	92	258	906	173	2,334

Notes: FCA: Friction cost approach for valuing workforce productivity losses; IPV: Intimate Partner Violence; F&V: Fruit and vegetable; BMI: Body mass index; JE: Joint Effects. Values are net present value using a 3% discount rate.

The specific health status, economic and financial benefits attributable to the risk factors corrected for joint effects are provided in Table 63 and Table 64. Note that ‘financial benefits’ in this report are defined as the dollar valuation of opportunity cost savings, which are not the same thing as immediately realisable cash savings.

Table 63 Economic and health status outcomes attributable to all risk factors corrected for joint effects at current prevalence levels

All 6 risk factors	Attributable at current levels of prevalence — Corrected for joint effects		
		95% Uncertainty interval	
	Mean (‘000s)	**LL (‘000s)**	**UL (‘000s)**
Health status and economic outcomes			
Per annum			
Disability Adjusted Life Years	414	n/a	n/a
Incidence of disease	517	n/a	n/a
Mortality	26	n/a	n/a
Lifetime			
Leisure (days)	3,415	(4,062)	10,833
Absenteeism (days)	16,419	n/a	n/a
Days out of home based production role (days)	3,115	(759)	7,000
Early retirement (persons)	5	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 64 provides the potential health status and economic benefits corrected for joint effects if the ideal target reductions across all risk factors could be achieved. If attainment of the ideal feasible reductions across all risk factors were systematically achieved, then more than 95,000 DALYs could be averted when corrected for joint effects (this is equivalent to 23% of the current attributable DALY burden associated with these risk factors).

Table 64 Economic and health status outcomes of all risk factors corrected for joint effects if the ideal targets were achieved

All 6 risk factors	Ideal reduction		
	Corrected for joint effects		
		95% Uncertainty interval	
	Mean (‘000s)	LL (‘000s)	UL (‘000s)
Health status and economic outcomes			
Per annum			
Disability Adjusted Life Years	95	n/a	n/a
Incidence of disease	161	n/a	n/a
Mortality	6	n/a	n/a
Lifetime			
Leisure (days)	529	(1,195)	2,233
Absenteeism (days)	5,050	n/a	n/a
Days out of home based production role (days)	626	(173)	1,433
Early retirement (persons)	1	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 65 on the next page provides details of the potential health status and economic benefits corrected for joint effects if the progressive target reductions could be achieved. In Table 66 the financial outcomes are outlined when corrections for joint effects are applied based on the current levels of prevalence for the risk factors. These latter figures provide an indication of the total financial opportunity costs savings that could be realised if the disease risk factors were eliminated.

Table 65 Economic and health status outcomes of all risk factors corrected for joint effects if the progressive targets were achieved

All 6 risk factors	Progressive target reduction – Corrected for joint effects		
		95% Uncertainty interval	
	Mean ('000s)	**LL ('000s)**	**UL ('000s)**
Health status and economic outcomes			
Per annum			
Disability Adjusted Life Years	48	n/a	n/a
Incidence of disease	80	n/a	n/a
Mortality	3	n/a	n/a
Lifetime			
Leisure (days)	264	(597)	1,116
Absenteeism (days)	2,403	n/a	n/a
Days out of home based production role (days)	313	(86)	717
Early retirement (persons)	1	n/a	n/a

Notes: Disability Adjusted Life Years (DALYs), incidence of disease and mortality calculated for all age groups. Leisure and home based production calculated for persons aged 15+ years. Absenteeism and early retirement calculated for persons aged 15-64 years. LL: lower limit; UL: upper limit. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 66 Financial outcomes attributable to all risk factors, corrected for joint effects, at the current levels of prevalence

All 6 risk factors	Attributable at current levels of prevalence		
	Corrected for joint effects		
		95% Uncertainty interval	
	Mean ($m)	LL ($m)	UL ($m)
Financial Outcomes			
Health sector offsets	5,329	n/a	n/a
Production gains/(losses) HCA	4,798	(366)	10,495
Production gains/(losses) FCA	1,539	121	3,610
Recruitment and training costs	270	n/a	n/a
Leisure based production	769	(1,154)	2,849
Home based production	1,232	(298)	2,775
Total production HCA	***6,799***	***620***	***13,258***
Total production FCA	***3,540***	***(213)***	***7,444***
Taxation effects HCA	76	(798)	1,040
Taxation effects FCA	249	(125)	752

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate. Numbers in brackets ( ) in the LL indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 67 and Table 68 provide the potential financial benefits corrected for joint effects if ideal and progressive targets could be achieved. Where 95% uncertainty intervals were estimated these are provided. Given the large number of assumptions and uncertainty around primary input variables, it was not surprising that the lower confidence limit occasionally produced a negative result (i.e. implies that there is a chance that benefits may not be achieved). The results of the uncertainty analysis undertaken indicated a 2-6% chance of a net production loss using the HCA and FCA method (Table 69).

Table 67 Financial outcomes of all risk factors, corrected for joint effects, if the ideal targets were achieved

All 6 risk factors	Ideal reduction $ millions Corrected for joint effects		
		95% Uncertainty interval	
	Mean	LL	UL
Financial Outcomes			
Health sector offsets	1,504	n/a	n/a
Production Costs HCA	1,196	(648)	3,070
Production Costs FCA	473	(2)	1,155
Recruitment and training costs	79	n/a	n/a
Leisure based production	110	(361)	602
Home based production	248	(69)	568
Total production HCA	***1,553***	***(435)***	***3,569***
Total production FCA	***830***	***(109)***	***1,843***
Taxation effects HCA	(22)	(323)	289
Taxation effects FCA	78	(45)	244

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate. Numbers in brackets ( ) indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 68 Financial outcomes of all risk factors, corrected for joint effects, if the progressive targets were achieved

All 6 risk factors	Progressive target reduction $ millions Corrected for joint effects		
		95% Uncertainty interval	
	Mean	LL	UL
Financial Outcomes			
Health sector offsets	752	n/a	n/a
Production Costs HCA	598	(266)	1,528
Production Costs FCA	240	(3)	614
Recruitment and training costs	40	n/a	n/a
Leisure based production	55	(181)	301
Home based production	124	(35)	284
Total production HCA	***777***	***(188)***	***1,786***
Total production FCA	***419***	***(55)***	***923***
Taxation effects HCA	(11)	(159)	151
Taxation effects FCA	40	(24)	131

Notes: These financial outcomes are opportunity cost estimates and not immediately realisable cash savings. The total opportunity cost savings are the sum of the health sector offsets and the combined workforce, household and leisure production effects. The mean estimates can be added together in this way, but not the uncertainty intervals, as both the components and the total are run as independent simulations. Recruitment and training costs are included in production gains/losses using the FCA but not counted using the HCA. No probabilistic uncertainty analysis was conducted for health sector offsets. Taxation is treated as a transfer payment and should not be added to production effects or health sector offsets. HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate). Health sector, leisure and home based production estimates are based on persons 15+ years. Production gains/(losses) and taxation effects are based on persons 15-64 years. LL: lower limit; UL: upper limit. Values are net present value using a 3% discount rate. Numbers in brackets ( ) indicate the possibility of losses resulting from achieving the target, rather than gains.

Table 69 Likelihood of a net production loss, corrected for joint effects

All 6 risk factors	Mean ($mill)	Chance of negative result (%)
Attributable		
Total Production HCA	6,799	2
Total Production FCA	3,540	3
Ideal		
Total Production HCA	1,553	6
Total Production FCA	830	4
Progressive		
Total Production HCA	777	6
Total Production FCA	419	4

Notes: HCA: Human Capital Approach; FCA Friction Cost Approach (preferred conservative estimate).
These are not estimates of immediately realisable cash savings.

In this chapter the importance of correcting for joint effects of risk factors was highlighted. The size of the potential opportunity cost savings and its component parts were identified for the six risk factors together. The size of the opportunity cost savings varied directly with the reduction in risk factor prevalence. Where small reductions in prevalence were forecasted, total potential opportunity cost savings were smallest. The reductions in prevalence reported here were identified as feasible in light of current knowledge of health promotion and disease prevention.

9.2 References

Australian Bureau of Statistics (2006). National Health Survey 2004-05, Cat. No. 4364.0. Canberra, Australian Bureau of Statistics.

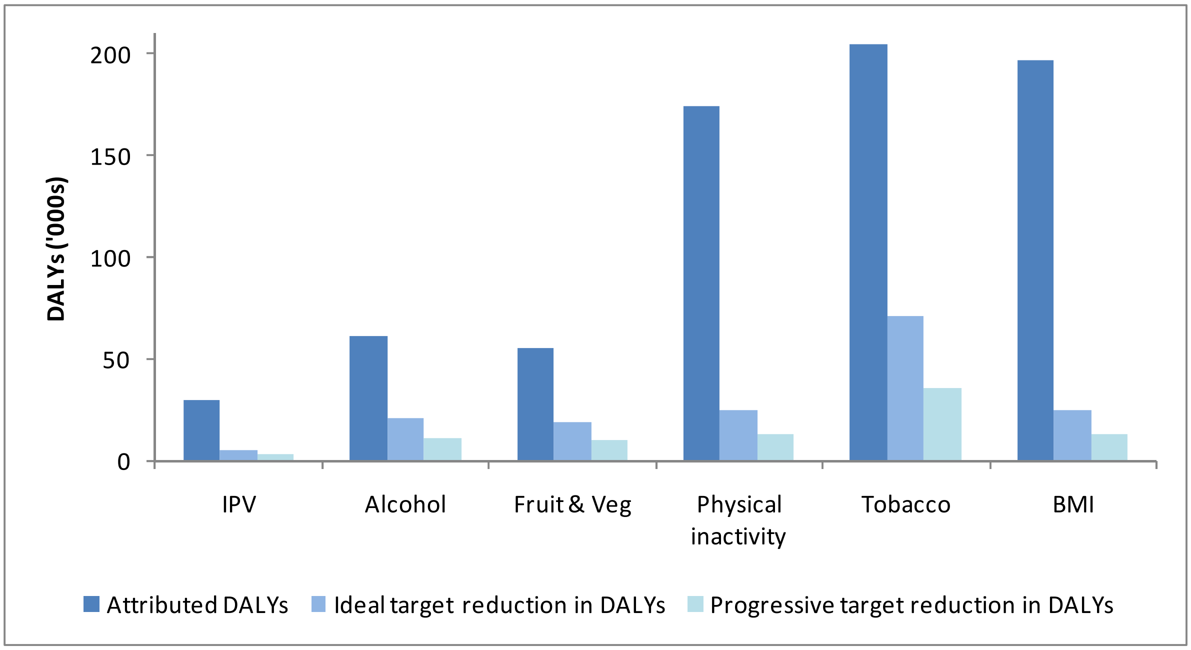
10.0 Summary of major findings

For descriptive purposes, a summary of the major findings (uncorrected) are provided by individual risk factors in this chapter. As highlighted in the previous chapter, the results of individual risk factors cannot be directly added without correcting for joint effects (refer section 9)., As stated previously, the estimates of attributable costs reflect the NPV of lifetime productivity losses and health sector costs estimated for the 2008 Australian cohort for each of the risk factors. These represent the potential opportunity costs savings if these risk factors could be eliminated completely. However, this is unlikely because the avoidable burden will never reach 100% (refer Figure 2 in Section 2.3.1). Therefore, the 'conservative' potential opportunity costs savings are those we might achieve if feasible reduction targets were met.

A summary of the major findings are provided in Figure 52 to 54 to illustrate the differences in individual risk factors for descriptive purposes. The choice of ideal targets is very important and can alter the amount of potential opportunity cost savings. On the basis of the ideal targets chosen given the explicit criteria for selecting, the largest potential total opportunity cost savings (uncorrected) were found from reductions in high risk alcohol consumption, followed by tobacco smoking, IPV, physical inactivity, high BMI and increases in fruit and vegetable consumption, respectively.

Figure 52 presents the comparison of the attributed DALYs and the potential reductions that could be expected over time if the target reductions in risk factor prevalence were achieved.

Figure 52 Potential health benefits from achieving feasible reductions in risk factor prevalence (uncorrected) for the 2008 Australian adult cohort

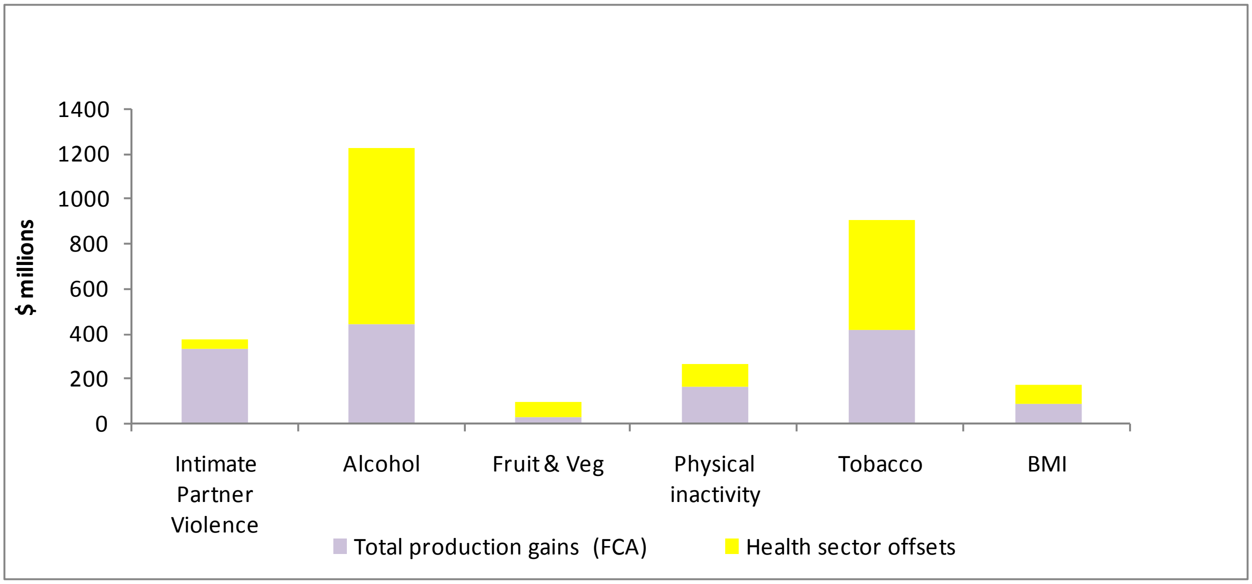


DALYs: Disability Adjusted Life Years; IPV: Intimate partner violence; BMI: Body Mass Index.

Even with full achievement of the target reductions there would remain a sizeable DALY burden associated with the risk factors. The largest target reductions in DALYs were obtained from reduced tobacco smoking followed by high BMI, physical inactivity, high risk alcohol consumption, increased fruit and vegetables consumption and reduced IPV prevalence.

Figure 53 presents the ranking of total potential opportunity cost savings (uncorrected) for production and health sector gains if the ideal target reductions were achieved.

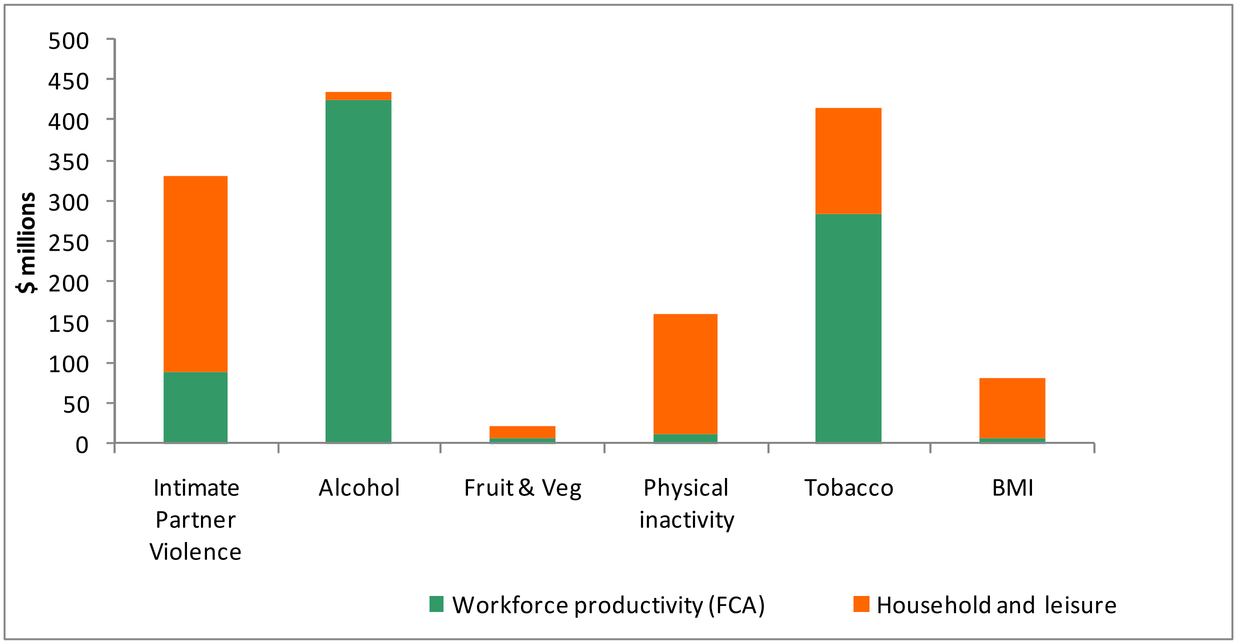
Figure 53 Potential opportunity costs savings from increased productivity and reduced health sector expenditure if ideal target reductions in risk factor prevalence were achieved (uncorrected) for 2008 Australian adult cohort



FCA: Friction Cost Approach (preferred conservative estimate).

We were unable to provide further breakdowns of the potential change in health sector costs, but could breakdown production gains into household and workforce components. In Figure 54 the composition of the potential opportunity cost savings (uncorrected) in production gains is presented using the scenario of the achievement of the ideal targets established during this project. Most potential opportunity cost savings (uncorrected) in production gains would occur due to reductions in high risk alcohol consumption followed closely by tobacco smoking and IPV, then physical inactivity, high BMI and increases in fruit and vegetable consumption. These latter targets comprised smaller reductions in prevalence compared to the change in high risk alcohol consumption and tobacco use. The potential opportunity cost savings of reducing alcohol consumption and reduced tobacco smoking use would predominantly consist of production gains in the paid workforce. For other risk factors the potential opportunity cost savings would be mostly household and leisure production due to the age groups and gender (e.g. IPV) affected.

Figure 54 Potential opportunity costs savings related to productivity if ideal target reductions in risk factor prevalence were achieved (uncorrected) for the 2008 Australian adult cohort



FCA: Friction Cost Approach (preferred conservative estimate); BMI: Body Mass Index.

The attributable production losses and health sector costs (uncorrected) for each of the risk factors represent the net present value of independently attributable lifetime costs to society for the current level of the individual risk factors in the population. Variations in the amount and distribution of costs by health sector or productivity for individual risk factors are clear. This is largely because illnesses associated with IPV and physical inactivity for example do not always lead to health sector costs. For example, depression and anxiety associated with IPV are typically under-diagnosed and under-treated, and conditions such as arthritis associated with physical inactivity do not generate high health sector costs. IPV appears to have the highest potential to yield opportunity cost savings in household production and leisure time.

The breakdown between household/leisure and working production gains was remarkably different across the risk factors largely due to age group differences of the risk factor related disease. The potential opportunity cost savings of reducing high risk alcohol consumption would predominantly consist of working production gains since the illness related to this risk factor (alcohol abuse, etc) affect young persons of working age. With respect to fruit and vegetable consumption, the largest component of the potential opportunity cost savings arose within the health sector, followed by household and leisure and finally working production gains. In contrast, the potential opportunity cost savings of reducing physical inactivity would largely arise from household and leisure, since the diseases related to this risk factor affect persons beyond working age. The potential opportunity cost savings of reducing tobacco smoking would mostly arise from working productivity gains, since the diseases related to this risk factor affect persons in the paid workforce, as well as older age retired persons. With respect to high BMI, the largest component of the potential opportunity cost savings where found within the health sector, closely followed by household and leisure.

11.0 DISCUSSION

In this project we have identified the potential benefits to society if feasible reductions in the prevalence of the risk factors of interest could be achieved. These potential benefits were modelled for a single (2008) population cohort as lifetime estimates. If the ideal targets for reductions in risk factor prevalence could be achieved collectively, then substantial opportunity costs savings were indicated ($2,334 million NPV at 3% discount rate using the FCA method with correction for joint risk factor effects). We used conservative estimates to value total productivity effects based on common approaches in economics (e.g. the use of average wage rates).

Turning to the potential health gains, the absolute benefits from avoidable disease burden amongst the risk factors were consistent with the potential opportunity cost savings. That is, the greatest gains could be achieved from reducing high risk alcohol consumption and tobacco smoking. This is because alcohol consumption and tobacco smoking are associated with a larger number of fatal and non-fatal diseases compared to the other risk factors. However, the proportionate gains in household production, leisure time, workforce participation, health expenditure and fewer incident cases of disease and deaths did vary amongst each of the risk factors. For example, achieving the ideal feasible reduction in physical inactivity prevalence would create more household productivity and leisure time than reductions in alcohol consumption which had a greater influence on workforce productivity. These findings reflect the differences in workforce status, age and gender distributions in each of the populations at risk.

We accessed and used the best sources of current Australian data that would permit a systematic assessment for each risk factor and received expert advice where assumptions could not easily be directly made from the available data. The findings reported are indicative of the potential ***opportunity cost savings*** from ***avoidable disease burden*** if we could reduce the prevalence of these risk factors. However, it must be emphasised that ***opportunity cost savings*** are not estimates of immediately realisable financial savings, but rather estimates of resources reflecting current practice that could be available for other purposes. Therefore, the results presented are ***only broadly indicative of potential financial cost savings and should be interpreted with***

caution. In addition, this project does not provide any information about which interventions would best be applied to achieve the risk factor prevalence reductions, as this was beyond the project scope. Nevertheless, ***these data do provide a wealth of new information to inform policy discussion and promote greater investment in public health strategies to combat chronic disease in Australia.*** Future research is also recognised as an important way forward if we are to have better evidence to select specific interventions and to support decision analytic modelling for health promotion.

Because there is debate in the literature about the best method for valuing workforce production (see section 2.4.5), we presented data in this *Research Report* to illustrate the magnitude of difference between the Friction Cost Approach (FCA) and the alternate Human Capital Approach (HCA). The HCA estimates are considerably higher than those determined using the FCA. The sizeable differences occur because of the assumption in each method concerning the replacement of workers absent for a long time through death or disability. The HCA values the production losses as the total income stream forgone due to the premature death or retirement. This approach effectively assumes the worker would not be replaced with another worker and that their forgone production is totally lost. In contrast, the FCA assumes the worker would be replaced within a short period (the “frictional period”) and hence the loss of production is much less.

The adoption of one approach rather than the other for valuing workforce production has a dramatic effect upon the results, and it is therefore important to acknowledge that there are valid arguments for adopting either method. We prefer the more conservative FCA approach. The essence of our position is that we believe it is more suitable for answering the research question we were charged with – that is, for *estimating actual production gains/losses in the general economy*. For this question it seemed important to us to take into account the fact that businesses will adjust to short term and long term absences. Further, we argue that the HCA is more suited to answering a different research question – that is, placing a monetary value on human life, where the total forgone income stream due to premature death provides a sensible floor estimate. Nonetheless, we readily accept that one potential compromise is to argue that workforce production gains will fall somewhere between the HCA and FCA production estimates reported.

11.1 Strengths of the research

This research provides a wealth of new information to inform policy change and promote greater investment in public health strategies to combat chronic disease in Australia. The main strengths of the analyses presented are the consistent methods and data sources applied, including comprehensive assessment by age, gender and workforce status to account for variation within each risk factor population. Using the best available evidence, we provided a comprehensive and consistent examination of the health status, economic and financial gains that may be possible when single risk factors are addressed. Summary estimates, corrected for the joint effects of multiple risk factors contributing to the same diseases, are also provided. These summary estimates are useful where policy initiatives address feasible reductions in the prevalence of all selected risk factors. Joint effects correction methods prevent overestimation of overall benefits. This is of particular importance given that the majority of Australians have two or more of these risk factors.

The selection of targets for prevalence reduction is an important policy decision. In this research we adopted a pragmatic and consensus-based approach to interpreting ‘best available’ evidence, which included active participation by an independent Advisory Committee. The Advisory Committee included a range of multidisciplinary experts in public health, policy and health economics. When issues identified were beyond the scope of the appointed experts, external consultation was sought. The prevalence scenarios were modelled separately for each risk factor using best available evidence on what constituted agreed realistic and feasible reductions. However, the decision on what constituted ‘best available’ evidence varied between the risk factors. This was an important aspect of the project in recognising the unique attributes of each risk factor and the status of available evidence on risk reversibility and the effectiveness of interventions.

Another important acknowledgment made in this project was the influence of socioeconomic status and risk factor prevalence. Socioeconomic disadvantage was associated more strongly with some risk factors than others. In addition, people with the least socioeconomic disadvantage were found to be less likely to have two or more of our risk factors. As socioeconomic status is something that is not readily modifiable in the short term, it was an important consideration in the choice of Arcadian ideals, as it formed one of the rationales for choice of the country comparator.

We have identified potential benefits of realistic reductions in prevalence of six risk factors. These can be considered as case studies to argue the value of health promotion strategies relative to other strategies, such as funding expansion of acute care services. However, this project should not be used to directly priortise health sector spending, since only benefits have been captured and the cost of achieving these benefits have not been considered. Results of the NHMRC-funded ACE-prevention project (Carter et al. 2008) due to report in late 2009 onwards, do evaluate a range of preventive interventions that address the risk factors of interest to this project.

11.2 Limitations of the research

The main limitation of this project is the reliance on self-reported cross sectional data to identify an association between the risk factors and reduced productivity due to ill health. Assuming causality in the absence of rigorous longitudinal data means that our results must be regarded as broadly indicative, rather than authoritative, until further testing and validation of causal relationships can be completed. This is because self reported data is less reliable than actual measurement data, since persons exaggerate, fail to remember accurately, misunderstand questions and diseases, or simply misreport information. None of the survey responses in the NHS on which we have heavily relied to provide the results for this project were verified by actual measurement.

For some of the risk factors (tobacco smoking, inadequate fruit and vegetable consumption and high risk alcohol consumption), self reported data regarding absenteeism and reduced days of activity associated with ill health was counterintuitive for some age-sex and employment status-sex cells. For example, people without the risk factor (ex-smokers) were more ill and absent from work than persons with the risk factor (current smokers). By adopting a consistent method for each of the risk factors, some of the economic and financial outcomes became negative when the prevalence of the risk factor was reduced. This finding occurred in some of the analyses for tobacco smoking, inadequate fruit and vegetable consumption and high risk alcohol consumption. This was particularly evident in the domains of household productivity and leisure time. Nonetheless, such findings may be plausible and, in part, be explained by some of these people (who were mainly not in the workforce or over 65 years or age) already being unwell and thus being less productive because of established health effects, which may have prompted them to become an ex-smoker or reduce their alcohol consumption.

In an ideal world to answer the research question, investigators would design a study to follow a large cohort of Australians participating in a behavioural change health intervention for the rest of their life. This would include providing comparable data from a control population who were not exposed to the intervention. Differentials in mortality, workplace absenteeism and longer term workforce participation decisions, household production impacts and leisure decisions could then be reliably compared. However, in the absence of such detailed information, since most health intervention studies collect health outcome data only or cross sectional survey data, many assumptions were required. Uncertainty analysis was undertaken using a range of potential values wherever possible (refer section 2.8). Uncertainty analysis places point estimates (means) within an uncertainty range. It is hoped that reporting both point estimates and uncertainty ranges assists decision-makers in assessing how robust the point estimates are and also provides an indication of a worst case/ best case scenario.

A second limitation is the paucity of effectiveness evidence for specific interventions to inform judgements about feasible reductions in risk factor prevalence. This highlights the scope to trial and evaluate prevention interventions. Future research in this area is an important way forward if we are to have better evidence for prioritising specific interventions to achieve prevalence reductions and to support further decision analytic modelling for health promotion.

A third limitation is that the forecasted gains will occur over time. The timeframe for this project did not permit a quantitative assessment of when these opportunity cost savings and health status benefits would be achieved. However, this approach is not often undertaken because of the additional levels of uncertainty it would create in the analyses making estimates less reliable.

Time lags to achieve effects, the amount of risk reversibility and the influence of past and present exposure to health promotion and prevention initiatives are all major confounding factors if one were to undertake such an approach. For example, it takes longer for the relative risk of cancers to reverse to normal than for the risk of cardiovascular disease. Risk factors associated with cancers, therefore, will take longer to realise potential economic and financial gains. However, reducing the prevalence of risk factors associated with cardiovascular disease will yield benefits sooner than those associated with cancers. To account for the intrinsic value of time itself, all economic and financial benefits arising from health gains were modelled for the lifetime of the beneficiaries. All benefits occurring in future years were discounted by 3% per annum back to the reference year (2008).

We have underestimated the potential gains from the reductions in prevalence of risk factors since we have adopted the view that only the incident cases of diseases related to the risk factors for the 2008 population will be reduced (i.e. looking at new cases avoided, but not health benefits among people who were already ill). For example, prevalent or existing cases of cardiovascular disease and stroke would also be likely to benefit from becoming physically active, eating more fruit and vegetables, losing weight and/or quitting smoking. Another source of underestimation was that we did not measure the likely benefits in future cohorts if reductions in our risk factors were further reduced. Doing so could be expected to achieve important lifetime benefits for each population targetted. These benefits would be marginally less than in 2008 since fewer cases in each population would be exposed to the risk factors given the accrual of the health promotion impacts over time.

Lastly, we cannot easily model the impact of a reduction in mortality, because the costs associated with death occur during a lifetime rather than at the point of death. It is much simpler to model the prevention of incident cases. Thus an incidence-based approach was necessary to complete the research in the time available for the project, but biases the estimates in a conservative direction. Offsetting this bias, however, was the omission of any time lag effects in the modelling between the reduction in the prevalence of a risk factor, the assumed reversal of the elevated risk of disease and consequential reductions in the incidence of diseases associated with that risk factor. The omission of time lags biases the results in an optimistic direction and means we are unable to specify exactly when benefits will be realised. Overall, we demonstrated the potential magnitude of reducing highly prevalent risk factors on society in the one reference year (2008). Such estimates provide evidence that equivalent reductions in risk factors in future years would also enable large opportunity costs savings. Investment in health promotion and public health interventions, despite lag times to achieve benefits are clearly warranted.

11.3 Conclusions and Future Directions

We have demonstrated that reductions in the prevalence of six behavioural risk factors (of an order that is achievable with appropriate public health interventions) will translate into substantial health status, economic and financial benefits. We have also stressed, that whilst important, the notion of 'opportunity cost savings' needs to be carefully interpreted. Opportunity cost savings are not estimates of immediately realisable financial savings, but rather estimates of resources reflecting current practice that could be available for other purposes**.** In the health context, they are estimates of resources devoted to the treatment of preventable disease that could be released for other activities. Therefore, the results presented are ***only broadly indicative of potential financial savings.***

Taking an incidence-based approach we have generated truly relevant indicative values associated with the prevention of new cases of disease. The particular novelty of this research was not only measuring household and leisure for the first time, but also identifying the importance of household and leisure relative to workforce production and health sector costs associated with chronic disease prevention. This provides a fuller picture for considering the potential health status, economic, and financial effects of health promotion and disease prevention approaches in Australia if feasible targets for reducing risk factors were to be achieved. Investment in disease prevention and health promotion in Australia is dwarfed by spending on treatment of disease. The findings in this project contribute important new knowledge about the major impact on health sector expenditure and productivity, with productivity defined broadly as workforce participation, household production and leisure time.

11.4 References

Carter, R., Vos, T., et al. (2008). "Priority setting in health: origins, description and application of the Australian Assessing Cost-Effectiveness initiative." Expert Rev. Pharmacoeconomics Outcomes Res **8**(6): 593-617.

12.0 APPENDICES

Appendix 1 Stata analytical code (.do files) used to interrogate Basic and Expanded CURF data on the RADL

Interrogate Expanded CURF file `NHS05HHX.DTA` to obtain access to SEIFA variable `CDDISWT`

```
use "`NHS05HHX.DTA'"

sort  ABSHID ABSFID ABSIID ABSPID ABSJID
keep  ABSHID ABSFID ABSIID ABSPID ABSJID CDDISWT

generate SDISPWT5 = 1 if (CDDISWT == 1 | CDDISWT == 2)
replace SDISPWT5 = 2 if (CDDISWT == 3 | CDDISWT == 4)
replace SDISPWT5 = 3 if (CDDISWT == 5 | CDDISWT == 6)
replace SDISPWT5 = 4 if (CDDISWT == 7 | CDDISWT == 8)
replace SDISPWT5 = 5 if (CDDISWT == 9 | CDDISWT == 10)

label variable SDISPWT5 "Quintiles of SEIFA Index Disadvantage, Population
weighted"
label define sdispwt5lb 1 "First quintile" 2 "Second quintile" 3 "Third
quintile" 4 "Fourth quintile" 5 "Fifth quintile"
label values SDISPWT5 sdispwt5lb

save "`SAVED'XEBRDRFs"


*
```

Interrogate Basic CURF RADL to create demographic, risk factor, Labour Force and health-related action variables

```
/*****************************************************************
*
*      LAST EDIT 1 October 2008

*      CREATE VARIABLES FOR NHS04_5 USING BASIC CURF on RADL
*
*****************************************************************/

*use Basic CURF RADL to create variables and merge with SEIFA variable and
conduct analysis by SEIFA categories

use "`NHS05PNB.DTA'"

sort  ABSHID ABSFID ABSIID ABSPID ABSJID
keep  ABSHID ABSFID ABSIID ABSPID ABSJID SEX AGECB  EMPSTABC NHSFINWT  ///
      NHPACANJ  NHPAHARN  NHPADIAD  MNKESSLR  DIETQ2  DIETQ3  EXLEVEL  BMBMICAT
SMKREGLR WRKOFFQ2  ///
      OTHREDAC ROLEDAY AL2K3DAY AL2K7DAY NJVEHBC NJATTACB NJFLLSBC NJ1STACT
INJQ14BC INJQ20 ///
      INJQ21 INJQ23 WSILLNCF REDANCF ///
      WPM0101 WPM0102 WPM0103 WPM0104 WPM0105 WPM0106 WPM0107 WPM0108 WPM0109
WPM0110  ///
```

```
      WPM0111 WPM0112 WPM0113 WPM0114 WPM0115 WPM0116 WPM0117 WPM0118 WPM0119
WPM0120  ///
      WPM0121 WPM0122 WPM0123 WPM0124 WPM0125 WPM0126 WPM0127 WPM0128 WPM0129
WPM0130  ///
      WPM0131 WPM0132 WPM0133 WPM0134 WPM0135 WPM0136 WPM0137 WPM0138 WPM0139
WPM0140  ///
      WPM0141 WPM0142 WPM0143 WPM0144 WPM0145 WPM0146 WPM0147 WPM0148 WPM0149
WPM0150  ///
      WPM0151 WPM0152 WPM0153 WPM0154 WPM0155 WPM0156 WPM0157 WPM0158 WPM0159
WPM0160

/***********************************************************
      CREATE VARIABLES with PERSONAL LEVEL DATA
***********************************************************/


/*******************************************************
      ALCOHOL RISK LEVEL
             *adults 18+
*******************************************************/

generate ALCRSK = 1 if (AL2K7DAY == 3 | AL2K7DAY == 2)
replace ALCRSK = 0 if (AL2K7DAY == 1 | AL2K7DAY == 4 | AL2K7DAY == 5 |
AL2K7DAY == 6 )
replace ALCRSK = 2 if (AL2K7DAY == 0 | AL2K7DAY == 9)

label variable ALCRSK "Alcohol risk level"
label define alcrsklb 0 "No or low alcohol risk" 1 "High or medium alcohol
risk" 2 "Not applicable or unknown"
label values ALCRSK alcrsklb

generate HIALCRSK = 1 if (AL2K7DAY == 3 | AL2K7DAY == 2)
replace HIALCRSK = 0 if (AL2K7DAY == 1 | AL2K7DAY == 4 | AL2K7DAY == 5 |
AL2K7DAY == 6)
replace HIALCRSK = . if (AL2K7DAY == 0 | AL2K7DAY == 9)

label variable HIALCRSK "Alcohol risk level"
label define hialcrsklb 0 "No or low alcohol risk" 1 "High or medium alcohol
risk"

label values HIALCRSK hialcrsklb

***

generate HIHIALCRSK = 1 if (AL2K7DAY == 3)
replace HIHIALCRSK = 0 if (AL2K7DAY == 1 | AL2K7DAY == 4 | AL2K7DAY == 5 |
AL2K7DAY == 6)
replace HIHIALCRSK = . if (AL2K7DAY == 0 | AL2K7DAY == 9 | AL2K7DAY == 2)

label variable HIHIALCRSK "High Alcohol risk level"
label define hihialcrsklb 0 "No or low alcohol risk" 1 "High alcohol risk"
label values HIHIALCRSK hihialcrsklb

***

generate LOALCRSK = 0 if (AL2K7DAY == 3 | AL2K7DAY == 2)
```

```
replace LOALCRSK = 1 if (AL2K7DAY == 1 | AL2K7DAY == 4 | AL2K7DAY == 5 |
AL2K7DAY == 6)
replace LOALCRSK = . if (AL2K7DAY == 0 | AL2K7DAY == 9)

label variable LOALCRSK "Alcohol risk level"
label define loalcrsklb 0 "High or medium alcohol risk" 1 "No or low alcohol
risk"
label values LOALCRSK loalcrsklb

/***************************************************
      SMOKING RISK
             *adults 18+
**************************************************/

generate SMKRSK = 1 if (SMKREGLR == 1 | SMKREGLR == 2)
replace SMKRSK = 0 if (SMKREGLR == 4)
replace SMKRSK = 2 if (SMKREGLR == 3)
replace SMKRSK = 3 if (SMKREGLR == 0)

label variable SMKRSK "Smoker status risk level"
label define smkrsklb 0 "Never smoked regularly" 1 "Current ir/regular
smoker" 2 "Ex regular smoker" 3 "Not applicable"
label values SMKRSK smkrsklb

generate CURSMKRSK = 1 if (SMKREGLR == 1 | SMKREGLR == 2)
replace CURSMKRSK = 0 if (SMKREGLR == 3 | SMKREGLR == 4)
replace CURSMKRSK = . if (SMKREGLR == 0)

label variable CURSMKRSK "Smoker status risk level"
label define cursmkrsklb 0 "Never smoked regularly or Exsmoker" 1 "Current
ir/regular smoker"
label values CURSMKRSK cursmkrsklb
/***************************************************
      RISK due to DIETARY BEHAVIOURS
             *adults and children 12+
**************************************************/

generate DIETRSK = 1 if (DIETQ2 >0 & DIETQ3 >0)
replace DIETRSK = 0 if ((DIETQ2 == 5 | DIETQ2 ==6) & (DIETQ3 >= 2 & DIETQ3
<=6))
replace DIETRSK = 2 if (DIETQ2 == 0 & DIETQ3 ==0)

label variable DIETRSK "Dietary behaviours risk level"
label define dietrsklb 0 "Adequate fuit and vegetables" 1 "Inadequate fruit
and vegetables" 2 "Not applicable"
label values DIETRSK dietrsklb

generate HIDIETRSK = 1 if (DIETQ2 >0 & DIETQ3 >0)
replace HIDIETRSK = 0 if ((DIETQ2 == 5 | DIETQ2 ==6) & (DIETQ3 >= 2 & DIETQ3
<=6))
replace HIDIETRSK = . if (DIETQ2 == 0 & DIETQ3 ==0)

label variable HIDIETRSK "Dietary behaviours risk level"
label define hidietrsklb 0 "Adequate fuit and vegetables" 1 "Inadequate fruit
and vegetables"
label values HIDIETRSK hidietrsklb
```

```
/**************************************************
      RISK due to OBESITY
             *persons 15+
*************************************************/
* 3.35% THIN so include with Normal category

generate BMIRSKOVB = 1 if (BMBMICAT == 6 | BMBMICAT == 7 | BMBMICAT==8)
replace BMIRSKOVB = 0 if (BMBMICAT >= 1 & BMBMICAT <= 5)
replace BMIRSKOVB = 2 if (BMBMICAT == 0 | BMBMICAT == 99)

label variable BMIRSKOVB "Risk due to Obesity or Overwight"
label define bmirskovblb 0 "Normal BMI <= 24.99" 1 "Obese or Overweight BMI
>= 25" 2 "Not applicable or unknown"
label values BMIRSKOVB bmirskovblb

generate HIBMIRSKOVB = 1 if (BMBMICAT == 6 | BMBMICAT == 7 | BMBMICAT==8)
replace HIBMIRSKOVB = 0 if (BMBMICAT >= 1 & BMBMICAT <= 5)
replace HIBMIRSKOVB = . if (BMBMICAT == 0 | BMBMICAT == 99)

label variable HIBMIRSKOVB "Risk due to Obesity or Overwight"
label define hibmirskovblb 0 "Normal BMI <= 24.99" 1 "Obese or Overweight BMI
>= 25"
label values HIBMIRSKOVB hibmirskovblb

******

generate BMIRSKOB = 1 if (BMBMICAT == 7 | BMBMICAT== 8)
replace BMIRSKOB = 0 if (BMBMICAT >= 1 & BMBMICAT <= 5)
replace BMIRSKOB = 2 if (BMBMICAT == 0 | BMBMICAT == 6 | BMBMICAT == 99)

label variable BMIRSKOB "Risk due to Obesity versus Normal"
label define bmirskoblb 0 "Normal BMI <= 24.99" 1 "Obese BMI >=30" 2 "Not
applicable, unknown or BMI 25-29.99"
label values BMIRSKOB bmirskoblb

generate HIBMIRSKOB = 1 if (BMBMICAT == 7 | BMBMICAT== 8)
replace HIBMIRSKOB = 0 if (BMBMICAT >= 1 & BMBMICAT <= 5)
replace HIBMIRSKOB = . if (BMBMICAT == 0 | BMBMICAT == 6 | BMBMICAT == 99)

label variable HIBMIRSKOB "Risk due to Obesity versus Normal"
label define hibmirskoblb 0 "Normal BMI <= 24.99" 1 "Obese BMI >=30"
label values HIBMIRSKOB hibmirskoblb
```

```
/*************************************************
      RISK due to LACK of EXERCISE
             *persons 15+
*************************************************/

generate EXCSRSK = 1 if (EXLEVEL >= 3 & EXLEVEL <= 5)
replace EXCSRSK = 0 if (EXLEVEL == 1 | EXLEVEL == 2)
replace EXCSRSK = 2 if (EXLEVEL == 0 | EXLEVEL == 8)

label variable EXCSRSK "Risk due to physical inactivity"
label define excsrsklb 0 "Moderate to High exercise level" 1 "Sedentary or
Low exercise level" 2 "Not applicable or unknown"
label values EXCSRSK excsrsklb

generate HIEXCSRSK = 1 if (EXLEVEL >= 3 & EXLEVEL <= 5)
replace HIEXCSRSK = 0 if (EXLEVEL == 1 | EXLEVEL == 2)
replace HIEXCSRSK = . if (EXLEVEL == 0 | EXLEVEL == 8)

label variable HIEXCSRSK "Risk due to physical inactivity"
label define hiexcsrsklb 0 "Moderate to High exercise level" 1 "Sedentary or
Low exercise level"
label values HIEXCSRSK hiexcsrsklb

/*************************************************
                        GENDER
                      All persons
*************************************************/
generate GENDER = 1 if SEX == 1
replace GENDER = 0 if SEX ==2

label define genderlb 0 "Female" 1 "Male"
label values GENDER genderlb


generate MALE = 1 if SEX == 1
replace MALE = 0 if SEX ==2

generate FEMALE = 1 if SEX == 2
replace FEMALE = 0 if SEX == 1

/*************************************************
                      AGE GROUP
                     All persons
*************************************************/

generate AGE15over = 1 if (AGECB ==4)
replace AGE15over = 2 if (AGECB ==5)
replace AGE15over = 3 if (AGECB ==6)
replace AGE15over = 4 if (AGECB ==7)
replace AGE15over = 5 if (AGECB ==8)
replace AGE15over = 6 if (AGECB ==9)
replace AGE15over = 7 if (AGECB ==10)
replace AGE15over = 8 if (AGECB ==11)
replace AGE15over = 9 if (AGECB ==12)
replace AGE15over = 10 if (AGECB ==13)
replace AGE15over = 11 if (AGECB >= 14)
replace AGE15over = . if (AGECB < 4)
```

```
label variable AGE15over "Age in 5 y categories 15+"
label define age15overlb 1 "15-19" 2 "20-24" 3 "25-29" 4 "30-34" 5 "35-39" 6
"40-44" 7 "45-49" 8 "50-54" 9 "55-59" 10 "60-64" 11 "65+"
label values AGE15over age15overlb


generate LFAGECAT15 = 0 if (AGECB < 4)
replace LFAGECAT15 = 1 if (AGECB >=4 & AGECB <= 13)
replace LFAGECAT15 = 2 if (AGECB >= 14)

label variable LFAGECAT15 "Labour force 15-64 age categories"
label define lfagecat15lb 0 "<15" 1 "15-64 inclusive" 2 "65+ years"
label values LFAGECAT15 lfagecat15lb

generate LFAGECAT01 = 1 if (AGECB >= 14)
replace LFAGECAT01 = 0 if (AGECB >=4 & AGECB <= 13)
replace LFAGECAT01 = . if (AGECB < 4)

label variable LFAGECAT01 "Labour force 15-64 age categories"
label define lfagecat01lb 0 "15-64 inclusive" 1 "65+ years"
label values LFAGECAT01 lfagecat01lb

/*****************************************************
      LABOUR FORCE and EMPLOYMENT STATUS

*****************************************************/

generate LFEMPSTAT = 1 if (EMPSTABC == 1)
replace LFEMPSTAT = 2 if (EMPSTABC == 2)
replace LFEMPSTAT = 3 if (EMPSTABC == 3)
replace LFEMPSTAT = 4 if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPSTAT "Labour force and employment status"
label define lfempstatlb 1 "Employed full-time" 2 "Employed part-time" 3
"Unemployed, seeking FT or PT work" 4 "Not in labour force or NA"
label values LFEMPSTAT lfempstatlb

generate LFEMPSTATm = 1 if (EMPSTABC == 1)
replace LFEMPSTATm = 2 if (EMPSTABC == 2)
replace LFEMPSTATm = 3 if (EMPSTABC == 3)
replace LFEMPSTATm = . if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPSTATm "Labour force and employment status"
label define lfempstatmlb 1 "Employed full-time" 2 "Employed part-time" 3
"Unemployed, seeking FT or PT work"
label values LFEMPSTATm lfempstatmlb

generate LFEMPFUL = 1 if (EMPSTABC == 1)
replace LFEMPFUL = 0 if (EMPSTABC == 2 | EMPSTABC == 3)
replace LFEMPFUL = . if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPFUL "Full-time employment status"
label define lfempfullb 1 "Employed full-time" 0 "Employed part-time or
Unemployed, seeking FT or PT work"
label values LFEMPFUL lfempfullb
```

```
***

generate NLFORCE = 1 if (EMPSTABC == 4)
replace NLFORCE = 0 if (EMPSTABC == 1 | EMPSTABC == 2 | EMPSTABC == 3)
replace NLFORCE = . if (EMPSTABC == 0)

label variable NLFORCE "Not in Labour Force"
label define nlforcelb 1 "Not in labour force" 0 "Employed full/part-time or
Unemployed, seeking work"
label values NLFORCE nlforcelb
********

generate LFEMPFP = 1 if (EMPSTABC == 1 | EMPSTABC == 2)
replace LFEMPFP = 2 if (EMPSTABC == 3)
replace LFEMPFP = 3 if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPFP "Full or Part time employment status"
label define lfempfplb 1 "Employed full-time or part-time" 2 "Unemployed,
seeking FT or PT work" 3 "Not in labour force or NA"
label values LFEMPFP lfempfplb


generate LFEMPFPUST = 1 if (EMPSTABC == 1 | EMPSTABC == 2)
replace LFEMPFPUST = 0 if (EMPSTABC == 3)
replace LFEMPFPUST = . if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPFPUST "Full or Part time employment status vs Unemployed"
label define lfempfpustlb 1 "Employed full-time or part-time" 0 "Unemployed,
seeking FT or PT work"
label values LFEMPFPUST lfempfpustlb

***

generate LFEMPFPUN = 1 if (EMPSTABC == 1 | EMPSTABC == 2 | EMPSTABC == 3)
replace LFEMPFPUN = 0 if (EMPSTABC == 4)
replace LFEMPFPUN = . if (EMPSTABC == 0)

label variable LFEMPFPUN "Employed or seeking full or part time employment"
label define lfempfpunlb 1 "Employed/seeking full or part-time work" 0 "Not
in labour force or NA"
label values LFEMPFPUN lfempfpunlb

/************************
      ABSENTEEISM
     employed persons 15-64
************************/

generate ABSNTWI = 1 if (WRKOFFQ2 == 1)
replace ABSNTWI = 0 if (WRKOFFQ2 == 2)
replace ABSNTWI = 2 if (WRKOFFQ2 == 0)

label variable ABSNTWI "Absent from work in previous 2 weeks for own illness"
label define absntwilb 0 "No absence from work because of own illness" 1
"Days absent from work because of own illness" 2 "NA"
label values ABSNTWI absntwilb

generate ABSNTWIm = 1 if (WRKOFFQ2 == 1)
```

```
replace ABSNTWIm = 0 if (WRKOFFQ2 == 2)
replace ABSNTWIm = . if (WRKOFFQ2 == 0)

label variable ABSNTWIm "Absent from work in previous 2 weeks for own illness"
label define absntwimlb 0 "No absence from work because of own illness" 1 "Days absent from work because of own illness"
label values ABSNTWIm absntwimlb

******

generate DOFFWKIL10 = WSILLNCF if (WRKOFFQ2 == 1 & (WSILLNCF >=1 & WSILLNCF <=10))
replace DOFFWKIL10 = 0 if (WSILLNCF == 15 | WRKOFFQ2 == 0 | WRKOFFQ2 == 2)

label variable DOFFWKIL10 "Number of days off work due to illness (Max 10)"

generate DOFFWKIL14 = WSILLNCF if (WRKOFFQ2 == 1 & (WSILLNCF >=1 & WSILLNCF <=14))
replace DOFFWKIL14 = 0 if (WSILLNCF == 15 | WRKOFFQ2 == 0 | WRKOFFQ2 == 2)

label variable DOFFWKIL14 "Number of days off work due to illness (Max 14)"


/************************
      REDUCED ACTIVITY
      persons 5+
*************************/

generate REDACTI = 1 if (OTHREDAC == 1)
replace REDACTI = 0 if (OTHREDAC == 2)
replace REDACTI = 2 if (OTHREDAC == 0 | OTHREDAC == 3)

label variable REDACTI "Reduced activity due to own illness"
label define redactilb 0 "No reduced activity due to own illness" 1 "Days reduced activity due to own illness" 2 "NA or 14 days off work"
label values REDACTI redactilb

generate REDACTIm = 1 if (OTHREDAC == 1)
replace REDACTIm = 0 if (OTHREDAC == 2)
replace REDACTIm = . if (OTHREDAC == 0 | OTHREDAC == 3)

label variable REDACTIm "Reduced activity due to own illness"
label define redactimlb 0 "No reduced activity due to own illness" 1 "Days reduced activity due to own illness"
label values REDACTIm redactimlb

*******

generate DREDACT14 = REDANCF if (OTHREDAC == 1 & (REDANCF >=1 & REDANCF <=14))
replace DREDACT14 = 0 if REDANCF == 15
replace DREDACT14 = . if (OTHREDAC == 0 | OTHREDAC == 3)
label variable DREDACT14 "Number of days reduced activity  (Max 14)"

*generate totdaysoff =  WSILLNCF + REDANCF  if ( WRKOFFQ2==1 &  OTHREDAC==1)
*summarize  totdaysoff
```

```
* Maximum combined days off = 14 so assume mutually exclusive


/************************
      DAYS OUT OF ROLE
      persons 5-64
************************/

generate ROLDYI = 1 if (ROLEDAY == 1)
replace ROLDYI = 0 if (ROLEDAY == 2)
replace ROLDYI = 2 if (ROLEDAY == 0)

label variable ROLDYI "Days out of role"
label define roldyilb 0 "No days out of role" 1 "Days out of role" 2 "NA"
label values ROLDYI roldyilb

generate ROLDYIm = 1 if (ROLEDAY == 1)
replace ROLDYIm = 0 if (ROLEDAY == 2)
replace ROLDYIm = . if (ROLEDAY == 0)

label variable ROLDYIm "Days out of role"
label define roldyimlb 0 "No days out of role" 1 "Days out of role"
label values ROLDYIm roldyimlb

/****************************************
      DEPRESSION and ANXIETY
        Persons 18+
****************************************/

*Kessler Psychological Distress Scale

generate ANXDEPRS = 1 if (MNKESSLR >=10 & MNKESSLR <=15)
replace ANXDEPRS = 2 if (MNKESSLR >=16 & MNKESSLR <=21)
replace ANXDEPRS = 3 if (MNKESSLR >=22 & MNKESSLR <=50)
replace ANXDEPRS = 4 if (MNKESSLR == 0)

label variable ANXDEPRS " Level of psychological distress"
label define anxdeprslb 1 "Low psychological distress" 2 "Moderate
psychological distress" 3 "High or very high psychological distress" 4 "NA"
label values ANXDEPRS anxdeprslb

generate ANXDEPRSm = 0 if (MNKESSLR >=10 & MNKESSLR <=21)
replace ANXDEPRSm = 1 if (MNKESSLR >=22 & MNKESSLR <=50)
replace ANXDEPRSm = . if (MNKESSLR == 0)

label variable ANXDEPRSm " Level of psychological distress"
label define anxdeprsmlb 0 "Low or moderate psychological distress" 1 "High
or very high psychological distress"
label values ANXDEPRSm anxdeprsmlb

*********************
*Any Risk factors, Total Risk Factors, Risk Factor categories
*NB HIHIALCRSK excludes medium risk (high versus low/no risk)

generate anyRF = 1 if (HIHIALCRSK==1 | CURSMKRSK==1 | HIDIETRSK==1 |
HIBMIRSKOVB==1 | HIEXCSRSK==1 | ANXDEPRSm==1)
```

```
replace anyRF=0 if ((HIHIALCRSK==0 | AL2K7DAY==2) & CURSMKRSK==0 & HIDIETRSK==0 & HIBMIRSKOVB==0 & HIEXCSRSK==0 & ANXDEPRSm==0)


generate hialc10=HIHIALCRSK
replace hialc10=0 if hialc10==.

generate cursmk10=CURSMKRSK
replace cursmk10=0 if cursmk10==.

generate hidiet10=HIDIETRSK
replace hidiet10=0 if hidiet10==.

generate hiwght10=HIBMIRSKOVB
replace hiwght10=0 if hiwght10==.

generate hiexcs10=HIEXCSRSK
replace hiexcs10=0 if hiexcs10==.

generate hianxd10=ANXDEPRSm
replace hianxd10=0 if hianxd10==.

generate totRF = (hialc10 + cursmk10 + hidiet10 + hiwght10 + hiexcs10 + hianxd10)
replace totRF=. if anyRF==.

generate RFcat = 1 if totRF ==1
replace RFcat = 2 if totRF ==2
replace RFcat = 3 if totRF ==3
replace RFcat = 4 if totRF == 4
replace RFcat = 5 if (totRF ==5 | totRF==6)
replace RFcat = 0 if anyRF ==0

generate RF2more=1 if  (RFcat>=2 & RFcat<=5)
replace RF2more=0 if  (RFcat==0 | RFcat==1)

label variable RF2more "Number of Risk Factors"
label define rf2morelb 0 "None or one Risk Factor" 1 "Two to six Risk Factors"
label values RF2more rf2morelb

/****************************************************************
      *SAVE GENERATED VARIABLES INTO FILE
***************************************************************/

save "`SAVED'PBEBRDRF"


*
```

Merge Basic and Expanded CURF variables

```
*******************************
*merges RADL_Basic Person variable file with Expanded HHX Seifa variable file
*1 October 2008

******************************
```

```
use "`SAVED'PBEBRDRF"

merge ABSHID using "`SAVED'XEBRDRFs.dta", uniqusing

svyset _n [pweight=NHSFINWT], jkrweight(WPM01*) vce(jackknife) mse singleunit(missing)

save "`SAVED'XsEBRDRFpB"
```

Interrogate merged files to estimate counts and proportions of Australians aged 15+ years with risk factors by SEIFA category

```
****************************
* EBRDRF 1 Oct 2008
* Counts and proportions in SEIFA categories by risk factors
**********************************************

use "`SAVED'XsEBRDRFpB"

preserve

*Combined risk factor levels for 15-64 AND 65+ years

keep if (LFAGECAT15==1 | LFAGECAT15==2)

************************************
*** Combined risk factors
***********************************
*Counts of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 RF2more, count se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 RF2more, count se ci format(%10.0g)

*Proportions of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 RF2more, row se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 RF2more, row se ci format(%10.0g)

************************************
*** Alcohol risk level HIGH versus No or Low risk, EXCLUDES Medium risk
***********************************
*Counts of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 HIHIALCRSK, count se ci format(%10.0g)

*Females
```

```
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 HIHIALCRSK, count se ci
format(%10.0g)

*Proportions of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 HIHIALCRSK, row se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 HIHIALCRSK, row se ci
format(%10.0g)

************************************
*** Smoking Current versus Never or exsmokers
***********************************
*Counts of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 CURSMKRSK, count se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 CURSMKRSK, count se ci
format(%10.0g)

*Proportions of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 CURSMKRSK, row se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 CURSMKRSK, row se ci
format(%10.0g)

*********see below for never and ex and current smokers

************************************
*** Dietary adequacy
***********************************
*Counts of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 HIDIETRSK, count se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 HIDIETRSK, count se ci
format(%10.0g)

*Proportions of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 HIDIETRSK, row se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 HIDIETRSK, row se ci
format(%10.0g)

************************************
```

```
*** Obese or overweight versus normal or thin
***********************************
*Counts of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 HIBMIRSKOVB, count se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 HIBMIRSKOVB, count se
ci format(%10.0g)

*Proportions of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 HIBMIRSKOVB, row se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 HIBMIRSKOVB, row se ci
format(%10.0g)
************************************
*** Sedentary or low activity level versus moderate or high levels
***********************************
*Counts of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 HIEXCSRSK, count se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 HIEXCSRSK, count se ci
format(%10.0g)

*Proportions of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 HIEXCSRSK, row se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 HIEXCSRSK, row se ci
format(%10.0g)

************************************
*** High or very high Anxiety depression versus
***********************************
*Counts of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 ANXDEPRSm, count se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 ANXDEPRSm, count se ci
format(%10.0g)

*Proportions of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 ANXDEPRSm, row se ci
format(%10.0g)
```

```
*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 ANXDEPRSm, row se ci
format(%10.0g)

****************************

restore

***********************************************
***********************************************
use "`SAVED'XsEBRDRFpB"

preserve

*Combined risk factor levels for 15-64 AND 65+ years

keep if ((LFAGECAT15==1 | LFAGECAT15==2) & SMKRSK <3)

************************************
*** Smoker status risk level 0 Never smoked 1 Current 2 Ex smoker
***********************************

*Counts of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 SMKRSK, count se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 SMKRSK, count se ci
format(%10.0g)

*Proportions of people by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 SMKRSK, row se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 SMKRSK, row se ci
format(%10.0g)

**************
restore


*
```

Interrogate merged files to estimate absenteeism and reduced activity of employed Australians aged 15 -64 years by SEIFA category

```
****************************************************************
*
*     EBRDRF LAST EDIT 1 October 2008
*     Absenteeism and reduced activity analyses by SEIFA quintiles
*
****************************************************************/

****************************************************************
```

```
*For employed people NB KEEP LFAGECAT15==1 for 15-64 years inclusive
***************************************************************

use "`SAVED'XsEBRDRFpB"

***********************************************************

preserve
keep if (LFAGECAT15==1)

*Average rate of absence from work for 15-64 years in
*Full-time or Part-time employment by gender & SEIFA quintile
svy jackknife, subpop(LFEMPFPUST): mean ABSNTWIm, over(GENDER SDISPWT5)

***************

*Mean length of absence from work (F or P) for those who have
*days off by gender and SEIFA quintile (Max 14 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL14 >0  & DOFFWKIL14 <=14) &
LFEMPFPUST==1): mean DOFFWKIL14, over(GENDER SDISPWT5)

********************

*Mean length of absence from work (F or P) overall by gender
*and SEIFA quintile (Max 14 days)
svy jackknife, subpop(if (DOFFWKIL14 >=0  & DOFFWKIL14 <=14) & LFEMPFPUST ==
1): mean DOFFWKIL14, over(GENDER SDISPWT5)

* CHECK CHECK Mean length of absence from work (F or P) overall
*by gender (Max 14 days)
svy jackknife, subpop(if (DOFFWKIL14 >=0  & DOFFWKIL14 <=14) & LFEMPFPUST ==
1) : mean DOFFWKIL14, over(GENDER)

*******************
*Employment status counts by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 LFEMPSTAT, count se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 LFEMPSTAT, count se ci
format(%10.0g)

*Employment status proportions within SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 LFEMPSTAT, row se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 LFEMPSTAT, row se ci
format(%10.0g)

***********************

*Mean rate of reduced activity for by
*GENDER and SEIFA quintile
svy jackknife : mean REDACTIm, over(SDISPWT5 GENDER)
```

```
*Mean number of days of reduced activity if experienced
*by gender and SEIFA quintile
svy jackknife, subpop(if REDACTIm == 1 & (DREDACT14 >0 & DREDACT14 <=14)):
mean DREDACT14, over(GENDER SDISPWT5)

*Mean number of days of reduced activity overall
*by gender and SEIFA quintile
svy jackknife, subpop(if REDACTI <2): mean DREDACT14, over(GENDER SDISPWT5)

*Counts of people who had days of reduced activity by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 REDACTI, count se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 REDACTI, count se ci
format(%10.0g)


*Proportions of people who had days of reduced activity by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 REDACTI, row se ci
format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 REDACTI, row se ci
format(%10.0g)

**************
restore

*
```

Interrogate merged files to estimate days of reduced activity of Australians aged 15+ years not in the Labour Force by SEIFA category

```
***********************************
* Not in Labour Force and reduced activity by SEIFA category
* Age 15+ years
*EBRDRF 1 October 2008
************************************

use "`SAVED'XsEBRDRFpB"

********************

preserve
keep if ((LFAGECAT15==1 | LFAGECAT15==2) & NLFORCE==1)

*Mean rate of reduced activity by GENDER and SEIFA quintile
svy jackknife : mean REDACTIm, over(SDISPWT5 GENDER)

*Mean number of days of reduced activity if experienced by GENDER and SEIFA quintile
svy jackknife, subpop(if REDACTIm == 1 & (DREDACT14 >0 & DREDACT14 <=14)): mean DREDACT14, over(GENDER SDISPWT5)

*Mean number of days of reduced activity overall by GENDER and SEIFA quintile
svy jackknife, subpop(if REDACTI <2): mean DREDACT14, over(GENDER SDISPWT5)


*Counts of people who had days of reduced activity by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 REDACTIm, count se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 REDACTIm, count se ci format(%10.0g)

*Proportions of people who had days of reduced activity by SEIFA quintile
*Males
svy jackknife, subpop(MALE) mse : tabulate SDISPWT5 REDACTIm, row se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate SDISPWT5 REDACTIm, row se ci format(%10.0g)

*******************
restore
```

Interrogate Expanded CURF file NHS05PNX.DTA to obtain access to age in years variable AGECX

```
*

use "`NHS05PNX.DTA'"

sort  ABSHID ABSFID ABSIID ABSPID ABSJID
keep  ABSHID ABSFID ABSIID ABSPID ABSJID AGECX


save "`SAVED'XEBRDRFage"

*
```

Merge file with Basic CURF variables

```
*******************************
*merges RADL_Basic Person variable file with Expanded PNX age in years variable file
*1 October 2008

******************************

use "`SAVED'PBEBRDRF"

merge ABSHID using "`SAVED'XEBRDRFage.dta", uniqusing

svyset _n [pweight=NHSFINWT], jkrweight(WPM01*) vce(jackknife) mse singleunit(missing)

save "`SAVED'XageEBRDRFpB"


*
```

Interrogate CURF data to estimate mean age by gender in risk factor categories for Australians aged 15+ years

```
***************************************
*Mean age by gender and risk factors
* RADL AGECX 1 Oct 2008
***************************************

use "`SAVED'XageEBRDRFpB"
preserve

* Age 15+ years
* AGECX has age 85 and over coded as 85 in numeric format

keep if (LFAGECAT15==1 | LFAGECAT15==2)

* 2 or more RFs Vs 0 or 1
svy jackknife: mean AGECX, over(GENDER RF2more)
svy jackknife: mean AGECX, over(RF2more)
```

```
* Hi alcohol risk Vs no or Low (Excludes medium)
svy jackknife: mean AGECX, over(GENDER HIHIALCRSK)
svy jackknife: mean AGECX, over(HIHIALCRSK)

* Smoking by ll categories including NA
svy jackknife: mean AGECX, over(GENDER SMKRSK)
svy jackknife: mean AGECX, over(SMKRSK)

* Adequate Vs inadequate diet (F&Vs)
svy jackknife: mean AGECX, over(GENDER HIDIETRSK)
svy jackknife: mean AGECX, over(HIDIETRSK)

* Obese or overweight Vs Normal or thin
svy jackknife: mean AGECX, over(GENDER HIBMIRSKOVB)
svy jackknife: mean AGECX, over(HIBMIRSKOVB)

* Sedentary or low activity level Vs  Mod or high activity level
svy jackknife: mean AGECX, over(GENDER HIEXCSRSK)
svy jackknife: mean AGECX, over(HIEXCSRSK)

*Very high or high anxiety depression Vs Low or moderate
svy jackknife: mean AGECX, over(GENDER ANXDEPRSm)
svy jackknife: mean AGECX, over(ANXDEPRSm)

* Males and females
svy jackknife: mean AGECX, over(GENDER)

* Males and females in 15-64 and 65+ groups
svy jackknife: mean AGECX, over(GENDER LFAGECAT15)
svy jackknife: mean AGECX, over(LFAGECAT15)

* Gender by full or partime employment Vs Unemployed
svy jackknife: mean AGECX, over(GENDER LFEMPFPUST)
svy jackknife: mean AGECX, over(LFEMPFPUST)

* Full or part time employed by Days off or not
svy jackknife, subpop(LFEMPFPUST): mean AGECX, over(GENDER ABSNTWIm)
svy jackknife, subpop(LFEMPFPUST): mean AGECX, over(ABSNTWIm)

* Gender by Not in Labour Force Vs in Labour Force (inc unemployed)
svy jackknife: mean AGECX, over(GENDER NLFORCE)
svy jackknife: mean AGECX, over(NLFORCE)

* Not in Labour Force by days of reduced activity or not
svy jackknife, subpop(NLFORCE): mean AGECX, over(GENDER REDACTIm)
svy jackknife, subpop(NLFORCE): mean AGECX, over(REDACTIm)


*************************
restore
```

Appendix 2 Stata analytical code (.do files) used to interrogate Basic CURF data on CD ROM

*

Create demographic, risk factor, Labour Force and health-related action variables

```
/****************************************************************
*
*	LAST EDIT 17 September 2008
*	PROGRAM: CREATE VARIABLES FOR NHS04_5 USING BASIC CURF on CD
*
****************************************************************/

*do "D:\Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_CD_0405_EBRDRF_Variables.do"

version 10

log using "D:\Dora2008\VicHealth_Deakin\CURFdata2008\PersonV17Sep08_NHS0405_ebrdrf.smcl", replace
clear
set memory 500M
set more off

use "D:\Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\nhs05pnb.dta", clear
sort  ABSHID ABSFID ABSIID ABSPID ABSJID
save "D:\Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405s.dta", replace
use "D:\Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405s.dta", clear
keep  ABSHID ABSFID ABSIID ABSPID ABSJID SEX AGECB  EMPSTABC NHSFINWT  ///
   NHPACANJ NHPAHARN NHPADIAD MNKESSLR DIETQ2 DIETQ3 EXLEVEL BMBMICAT SMKREGLR WRKOFFQ2  ///
	OTHREDAC ROLEDAY AL2K3DAY AL2K7DAY NJVEHBC NJATTACB NJFLLSBC NJ1STACT INJQ14BC INJQ20 ///
	INJQ21 INJQ23 WSILLNCF REDANCF ///
	WPM0101 WPM0102 WPM0103 WPM0104 WPM0105 WPM0106 WPM0107 WPM0108 WPM0109 WPM0110  ///
	WPM0111 WPM0112 WPM0113 WPM0114 WPM0115 WPM0116 WPM0117 WPM0118 WPM0119 WPM0120  ///
	WPM0121 WPM0122 WPM0123 WPM0124 WPM0125 WPM0126 WPM0127 WPM0128 WPM0129 WPM0130  ///
	WPM0131 WPM0132 WPM0133 WPM0134 WPM0135 WPM0136 WPM0137 WPM0138 WPM0139 WPM0140  ///
	WPM0141 WPM0142 WPM0143 WPM0144 WPM0145 WPM0146 WPM0147 WPM0148 WPM0149 WPM0150  ///
	WPM0151 WPM0152 WPM0153 WPM0154 WPM0155 WPM0156 WPM0157 WPM0158 WPM0159 WPM0160

save "D:\Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405s.dta", replace
```

```
use "D:\Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405s.dta", clear

/***********************************************************
	CREATE VARIABLES with PERSONAL LEVEL DATA
***********************************************************/


/*******************************************************
	ALCOHOL RISK LEVEL
	*adults 18+
*******************************************************/

generate ALCRSK = 1 if (AL2K7DAY == 3 | AL2K7DAY == 2)
replace ALCRSK = 0 if (AL2K7DAY == 1 | AL2K7DAY == 4 | AL2K7DAY == 5 | AL2K7DAY == 6 )
replace ALCRSK = 2 if (AL2K7DAY == 0 | AL2K7DAY == 9)

label variable ALCRSK "Alcohol risk level"
label define alcrsklb 0 "No or low alcohol risk" 1 "High or medium alcohol risk" 2 "Not applicable or unknown"
label values ALCRSK alcrsklb

generate HIALCRSK = 1 if (AL2K7DAY == 3 | AL2K7DAY == 2)
replace HIALCRSK = 0 if (AL2K7DAY == 1 | AL2K7DAY == 4 | AL2K7DAY == 5 | AL2K7DAY == 6)
replace HIALCRSK = . if (AL2K7DAY == 0 | AL2K7DAY == 9)

label variable HIALCRSK "Alcohol risk level"
label define hialcrsklb 0 "No or low alcohol risk" 1 "High or medium alcohol risk"
label values HIALCRSK hialcrsklb

***

generate HIHIALCRSK = 1 if (AL2K7DAY == 3)
replace HIHIALCRSK = 0 if (AL2K7DAY == 1 | AL2K7DAY == 4 | AL2K7DAY == 5 | AL2K7DAY == 6)
replace HIHIALCRSK = . if (AL2K7DAY == 0 | AL2K7DAY == 9 | AL2K7DAY == 2)

label variable HIHIALCRSK "High Alcohol risk level"
label define hihialcrsklb 0 "No or low alcohol risk" 1 "High alcohol risk"
label values HIHIALCRSK hihialcrsklb

***

generate LOALCRSK = 0 if (AL2K7DAY == 3 | AL2K7DAY == 2)
replace LOALCRSK = 1 if (AL2K7DAY == 1 | AL2K7DAY == 4 | AL2K7DAY == 5 | AL2K7DAY == 6)
replace LOALCRSK = . if (AL2K7DAY == 0 | AL2K7DAY == 9)

label variable LOALCRSK "Alcohol risk level"
label define loalcrsklb 0 "High or medium alcohol risk" 1 "No or low alcohol risk"
label values LOALCRSK loalcrsklb

/**************************************************
	SMOKING RISK
	*adults 18+
**************************************************/

generate SMKRSK = 1 if (SMKREGLR == 1 | SMKREGLR == 2)
replace SMKRSK = 0 if (SMKREGLR == 4)
replace SMKRSK = 2 if (SMKREGLR == 3)
```

```
replace SMKRSK = 3 if (SMKREGLR == 0)

label variable SMKRSK "Smoker status risk level"
label define smkrsklb 0 "Never smoked regularly" 1 "Current ir/regular smoker" 2 "Ex regular smoker" 3 "Not applicable"
label values SMKRSK smkrsklb

generate CURSMKRSK = 1 if (SMKREGLR == 1 | SMKREGLR == 2)
replace CURSMKRSK = 0 if (SMKREGLR == 3 | SMKREGLR == 4)
replace CURSMKRSK = . if (SMKREGLR == 0)

label variable CURSMKRSK "Smoker status risk level"
label define cursmkrsklb 0 "Never smoked regularly or Exsmoker" 1 "Current ir/regular smoker"
label values CURSMKRSK cursmkrsklb
/**************************************************
	 RISK due to DIETARY BEHAVIOURS
	*adults and children 12+
*************************************************/

generate DIETRSK = 1 if (DIETQ2 >0 & DIETQ3 >0)
replace DIETRSK = 0 if ((DIETQ2 == 5 | DIETQ2 ==6) & (DIETQ3 >= 2 & DIETQ3 <=6))
replace DIETRSK = 2 if (DIETQ2 == 0 & DIETQ3 ==0)

label variable DIETRSK "Dietary behaviours risk level"
label define dietrsklb 0 "Adequate fuit and vegetables" 1 "Inadequate fruit and vegetables" 2 "Not applicable"
label values DIETRSK dietrsklb

generate HIDIETRSK = 1 if (DIETQ2 >0 & DIETQ3 >0)
replace HIDIETRSK = 0 if ((DIETQ2 == 5 | DIETQ2 ==6) & (DIETQ3 >= 2 & DIETQ3 <=6))
replace HIDIETRSK = . if (DIETQ2 == 0 & DIETQ3 ==0)

label variable HIDIETRSK "Dietary behaviours risk level"
label define hidietrsklb 0 "Adequate fuit and vegetables" 1 "Inadequate fruit and vegetables"
label values HIDIETRSK hidietrsklb

/**************************************************
	 RISK due to OBESITY
	*persons 15+
*************************************************/
* 3.35% THIN so include with Normal category

generate BMIRSKOVB = 1 if (BMBMICAT == 6 | BMBMICAT == 7 | BMBMICAT==8)
replace BMIRSKOVB = 0 if (BMBMICAT >= 1 & BMBMICAT <= 5)
replace BMIRSKOVB = 2 if (BMBMICAT == 0 | BMBMICAT == 99)

label variable BMIRSKOVB "Risk due to Obesity or Overwight"
label define bmirskovblb 0 "Normal BMI <= 24.99" 1 "Obese or Overweight BMI >= 25" 2 "Not applicable or unknown"
label values BMIRSKOVB bmirskovblb

generate HIBMIRSKOVB = 1 if (BMBMICAT == 6 | BMBMICAT == 7 | BMBMICAT==8)
replace HIBMIRSKOVB = 0 if (BMBMICAT >= 1 & BMBMICAT <= 5)
replace HIBMIRSKOVB = . if (BMBMICAT == 0 | BMBMICAT == 99)

label variable HIBMIRSKOVB "Risk due to Obesity or Overwight"
label define hibmirskovblb 0 "Normal BMI <= 24.99" 1 "Obese or Overweight BMI >= 25"
```

```
label values HIBMIRSKOVB hibmirskovblb

******

generate BMIRSKOB = 1 if (BMBMICAT == 7 | BMBMICAT== 8)
replace BMIRSKOB = 0 if (BMBMICAT >= 1 & BMBMICAT <= 5)
replace BMIRSKOB = 2 if (BMBMICAT == 0 | BMBMICAT == 6 | BMBMICAT == 99)

label variable BMIRSKOB "Risk due to Obesity versus Normal"
label define bmirskoblb 0 "Normal BMI <= 24.99" 1 "Obese BMI >=30" 2 "Not applicable, unknown or BMI 25-29.99"
label values BMIRSKOB bmirskoblb

generate HIBMIRSKOB = 1 if (BMBMICAT == 7 | BMBMICAT== 8)
replace HIBMIRSKOB = 0 if (BMBMICAT >= 1 & BMBMICAT <= 5)
replace HIBMIRSKOB = . if (BMBMICAT == 0 | BMBMICAT == 6 | BMBMICAT == 99)

label variable HIBMIRSKOB "Risk due to Obesity versus Normal"
label define hibmirskoblb 0 "Normal BMI <= 24.99" 1 "Obese BMI >=30"
label values HIBMIRSKOB hibmirskoblb

/***************************************************
        RISK due to LACK of EXERCISE
        *persons 15+
**************************************************/

generate EXCSRSK = 1 if (EXLEVEL >= 3 & EXLEVEL <= 5)
replace EXCSRSK = 0 if (EXLEVEL == 1 | EXLEVEL == 2)
replace EXCSRSK = 2 if (EXLEVEL == 0 | EXLEVEL == 8)

label variable EXCSRSK "Risk due to physical inactivity"
label define excsrsklb 0 "Moderate to High exercise level" 1 "Sedentary or Low exercise level" 2 "Not applicable or unknown"
label values EXCSRSK excsrsklb

generate HIEXCSRSK = 1 if (EXLEVEL >= 3 & EXLEVEL <= 5)
replace HIEXCSRSK = 0 if (EXLEVEL == 1 | EXLEVEL == 2)
replace HIEXCSRSK = . if (EXLEVEL == 0 | EXLEVEL == 8)

label variable HIEXCSRSK "Risk due to physical inactivity"
label define hiexcsrsklb 0 "Moderate to High exercise level" 1 "Sedentary or Low exercise level"
label values HIEXCSRSK hiexcsrsklb

/***************************************************
                GENDER
            All persons
**************************************************/
generate GENDER = 1 if SEX == 1
replace GENDER = 0 if SEX ==2

label define genderlb 0 "Female" 1 "Male"
label values GENDER genderlb

generate MALE = 1 if SEX == 1
replace MALE = 0 if SEX ==2
```

```
generate FEMALE = 1 if SEX == 2
replace FEMALE = 0 if SEX == 1

/**************************************************
                    AGE GROUP
                   All persons
**************************************************/
generate AGE15inc = 1 if (AGECB ==4)
replace AGE15inc = 2 if (AGECB ==5)
replace AGE15inc = 3 if (AGECB ==6)
replace AGE15inc = 4 if (AGECB ==7)
replace AGE15inc = 5 if (AGECB ==8)
replace AGE15inc = 6 if (AGECB ==9)
replace AGE15inc = 7 if (AGECB ==10)
replace AGE15inc = 8 if (AGECB ==11)
replace AGE15inc = 9 if (AGECB ==12)
replace AGE15inc = 10 if (AGECB ==13)
replace AGE15inc = 11 if (AGECB >= 14)
replace AGE15inc = 0 if (AGECB < 4)

label variable AGE15inc "Age in 5 y categories 15+"
label define age15inclb 0 "<15" 1 "15-19" 2 "20-24" 3 "25-29" 4 "30-34" 5 "35-39" 6 "40-44" 7 "45-49" 8 "50-54" 9
"55-59" 10 "60-64" 11 "65+"
label values AGE15inc age15inclb

generate AGE15over = 1 if (AGECB ==4)
replace AGE15over = 2 if (AGECB ==5)
replace AGE15over = 3 if (AGECB ==6)
replace AGE15over = 4 if (AGECB ==7)
replace AGE15over = 5 if (AGECB ==8)
replace AGE15over = 6 if (AGECB ==9)
replace AGE15over = 7 if (AGECB ==10)
replace AGE15over = 8 if (AGECB ==11)
replace AGE15over = 9 if (AGECB ==12)
replace AGE15over = 10 if (AGECB ==13)
replace AGE15over = 11 if (AGECB >= 14)
replace AGE15over = . if (AGECB < 4)

label variable AGE15over "Age in 5 y categories 15+"
label define age15overlb 1 "15-19" 2 "20-24" 3 "25-29" 4 "30-34" 5 "35-39" 6 "40-44" 7 "45-49" 8 "50-54" 9 "55-
59" 10 "60-64" 11 "65+"
label values AGE15over age15overlb


generate LFAGECAT15 = 0 if (AGECB < 4)
replace LFAGECAT15 = 1 if (AGECB >=4 & AGECB <= 13)
replace LFAGECAT15 = 2 if (AGECB >= 14)

label variable LFAGECAT15 "Labour force 15-64 age categories"
label define lfagecat15lb 0 "<15" 1 "15-64 inclusive" 2 "65+ years"
label values LFAGECAT15 lfagecat15lb

generate LFAGECAT01 = 1 if (AGECB >= 14)
replace LFAGECAT01 = 0 if (AGECB >=4 & AGECB <= 13)
replace LFAGECAT01 = . if (AGECB < 4)
```

```
label variable LFAGECAT01 "Labour force 15-64 age categories"
label define lfagecat01lb 0 "15-64 inclusive" 1 "65+ years"
label values LFAGECAT01 lfagecat01lb

/****************************************************
        LABOUR FORCE and EMPLOYMENT STATUS

****************************************************/

generate LFEMPSTAT = 1 if (EMPSTABC == 1)
replace LFEMPSTAT = 2 if (EMPSTABC == 2)
replace LFEMPSTAT = 3 if (EMPSTABC == 3)
replace LFEMPSTAT = 4 if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPSTAT "Labour force and employment status"
label define lfempstatlb 1 "Employed full-time" 2 "Employed part-time" 3 "Unemployed, seeking FT or PT work" 4 "Not in labour force or NA"
label values LFEMPSTAT lfempstatlb

generate LFEMPFUL = 1 if (EMPSTABC == 1)
replace LFEMPFUL = 0 if (EMPSTABC == 2 | EMPSTABC == 3)
replace LFEMPFUL = . if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPFUL "Full-time employment status"
label define lfempfullb 1 "Employed full-time" 0 "Employed part-time or Unemployed, seeking FT or PT work"
label values LFEMPFUL lfempfullb

***

generate NLFORCE = 1 if (EMPSTABC == 4)
replace NLFORCE = 0 if (EMPSTABC == 1 | EMPSTABC == 2 | EMPSTABC == 3)
replace NLFORCE = . if (EMPSTABC == 0)

label variable NLFORCE "Not in Labour Force"
label define nlforcelb 1 "Not in labour force" 0 "Employed full/part-time or Unemployed, seeking work"
label values NLFORCE nlforcelb
********

generate LFEMPFP = 1 if (EMPSTABC == 1 | EMPSTABC == 2)
replace LFEMPFP = 2 if (EMPSTABC == 3)
replace LFEMPFP = 3 if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPFP "Full or Part time employment status"
label define lfempfplb 1 "Employed full-time or part-time" 2 "Unemployed, seeking FT or PT work" 3 "Not in labour force or NA"
label values LFEMPFP lfempfplb


generate LFEMPFPUST = 1 if (EMPSTABC == 1 | EMPSTABC == 2)
replace LFEMPFPUST = 0 if (EMPSTABC == 3)
replace LFEMPFPUST = . if (EMPSTABC == 4 | EMPSTABC == 0)

label variable LFEMPFPUST "Full or Part time employment status vs Unemployed"
label define lfempfpustlb 1 "Employed full-time or part-time" 0 "Unemployed, seeking FT or PT work"
label values LFEMPFPUST lfempfpustlb
```

```
***

generate LFEMPFPUN = 1 if (EMPSTABC == 1 | EMPSTABC == 2 | EMPSTABC == 3)
replace LFEMPFPUN = 0 if (EMPSTABC == 4)
replace LFEMPFPUN = . if (EMPSTABC == 0)

label variable LFEMPFPUN "Employed or seeking full or part time employment"
label define lfempfpunlb 1 "Employed/seeking full or part-time work" 0 "Not in labour force or NA"
label values LFEMPFPUN lfempfpunlb

/************************
          ABSENTEEISM
    employed persons 15-64
************************/

generate ABSNTWI = 1 if (WRKOFFQ2 == 1)
replace ABSNTWI = 0 if (WRKOFFQ2 == 2)
replace ABSNTWI = 2 if (WRKOFFQ2 == 0)

label variable ABSNTWI "Absent from work in previous 2 weeks for own illness"
label define absntwilb 0 "No absence from work because of own illness" 1 "Days absent from work because of own illness" 2 "NA"
label values ABSNTWI absntwilb

generate ABSNTWIm = 1 if (WRKOFFQ2 == 1)
replace ABSNTWIm = 0 if (WRKOFFQ2 == 2)
replace ABSNTWIm = . if (WRKOFFQ2 == 0)

label variable ABSNTWIm "Absent from work in previous 2 weeks for own illness"
label define absntwimlb 0 "No absence from work because of own illness" 1 "Days absent from work because of own illness"
label values ABSNTWIm absntwimlb

******

generate DOFFWKIL10 = WSILLNCF if (WRKOFFQ2 == 1 & (WSILLNCF >=1 & WSILLNCF <=10))
replace DOFFWKIL10 = 0 if (WSILLNCF == 15 | WRKOFFQ2 == 0 | WRKOFFQ2 == 2)

label variable DOFFWKIL10 "Number of days off work due to illness (Max 10)"

generate DOFFWKIL14 = WSILLNCF if (WRKOFFQ2 == 1 & (WSILLNCF >=1 & WSILLNCF <=14))
replace DOFFWKIL14 = 0 if (WSILLNCF == 15 | WRKOFFQ2 == 0 | WRKOFFQ2 == 2)

label variable DOFFWKIL14 "Number of days off work due to illness (Max 14)"


/************************
          REDUCED ACTIVITY
     persons 5+
************************/

generate REDACTI = 1 if (OTHREDAC == 1)
replace REDACTI = 0 if (OTHREDAC == 2)
replace REDACTI = 2 if (OTHREDAC == 0 | OTHREDAC == 3)

label variable REDACTI "Reduced activity due to own illness"
```

```
label define redactilb 0 "No reduced activity due to own illness" 1 "Days reduced activity due to own illness" 2 "NA
or 14 days off work"
label values REDACTI redactilb

generate REDACTIm = 1 if (OTHREDAC == 1)
replace REDACTIm = 0 if (OTHREDAC == 2)
replace REDACTIm = . if (OTHREDAC == 0 | OTHREDAC == 3)

label variable REDACTIm "Reduced activity due to own illness"
label define redactimlb 0 "No reduced activity due to own illness" 1 "Days reduced activity due to own illness"
label values REDACTIm redactimlb

*******

generate DREDACT14 = REDANCF if (OTHREDAC == 1 & (REDANCF >=1 & REDANCF <=14))
replace DREDACT14 = 0 if REDANCF == 15
replace DREDACT14 = . if (OTHREDAC == 0 | OTHREDAC == 3)
label variable DREDACT14 "Number of days reduced activity  (Max 14)"

*generate totdaysoff =  WSILLNCF + REDANCF  if ( WRKOFFQ2==1 &  OTHREDAC==1)
*summarize  totdaysoff
* Maximum combined days off = 14 so assume mutually exclusive


/************************
        DAYS OUT OF ROLE
   persons 5-64
************************/

generate ROLDYI = 1 if (ROLEDAY == 1)
replace ROLDYI = 0 if (ROLEDAY == 2)
replace ROLDYI = 2 if (ROLEDAY == 0)

label variable ROLDYI "Days out of role"
label define roldyilb 0 "No days out of role" 1 "Days out of role" 2 "NA"
label values ROLDYI roldyilb

generate ROLDYIm = 1 if (ROLEDAY == 1)
replace ROLDYIm = 0 if (ROLEDAY == 2)
replace ROLDYIm = . if (ROLEDAY == 0)

label variable ROLDYIm "Days out of role"
label define roldyimlb 0 "No days out of role" 1 "Days out of role"
label values ROLDYIm roldyimlb

/****************************************
        DEPRESSION and ANXIETY
    Persons 18+
****************************************/

*Kessler Psychological Distress Scale

generate ANXDEPRS = 1 if (MNKESSLR >=10 & MNKESSLR <=15)
replace ANXDEPRS = 2 if (MNKESSLR >=16 & MNKESSLR <=21)
replace ANXDEPRS = 3 if (MNKESSLR >=22 & MNKESSLR <=50)
replace ANXDEPRS = 4 if (MNKESSLR == 0)
```

```
label variable ANXDEPRS " Level of psychological distress"
label define anxdeprslb 1 "Low psychological distress" 2 "Moderate psychological distress" 3 "High or very high psychological distress" 4 "NA"
label values ANXDEPRS anxdeprslb

generate ANXDEPRSm = 0 if (MNKESSLR >=10 & MNKESSLR <=21)
replace ANXDEPRSm = 1 if (MNKESSLR >=22 & MNKESSLR <=50)
replace ANXDEPRSm = . if (MNKESSLR == 0)

label variable ANXDEPRSm " Level of psychological distress"
label define anxdeprsmlb 0 "Low or moderate psychological distress" 1 "High or very high psychological distress"
label values ANXDEPRSm anxdeprsmlb

/**************************************************
	PRIORITY DISEASE linked to RISK FACTORS
	CANCER, HEART AND CIRCULATORY DISEASES, DIABETES, POOR MENTAL HEALTH
**************************************************/
* Any cancer ( all persons)

generate ANYCANCER =1 if (NHPACANJ >= 1 & NHPACANJ <= 4 )
replace ANYCANCER =0 if (NHPACANJ == 5)

label variable ANYCANCER "Cancer status - ever any diagnosed"
label define anycancerlb 0 "No cancer ever diagnosed" 1 "Cancer diagnosed, any type"
label values ANYCANCER anycancerlb


*Heart and circulatory disease (all persons)

generate ANYHRTCRC =1 if (NHPAHARN >= 1 & NHPAHARN <= 4 )
replace ANYHRTCRC =0 if (NHPAHARN == 5)

label variable ANYHRTCRC "Heart & circulatory disease - ever any diagnosed"
label define anyhrtcrclb 0 " No heart & circulatory disease ever diagnosed" 1 "Heart & circulatory disease diagnosed, any type"
label values ANYHRTCRC anyhrtcrclb


*Diabetes (all persons)

generate ANYDIAB =1 if (NHPADIAD >= 1 & NHPADIAD <= 4 )
replace ANYDIAB =0 if (NHPADIAD == 5)

label variable ANYDIAB "Diabetes - ever any diagnosed, excludes HSL"
label define anydiablb 0 " No diabetes ever diagnosed" 1 "Diabetes diagnosed, any type"
label values ANYDIAB anydiablb

**********************
*Any Risk factors, Total Risk Factors, Risk Factor categories
*NB HIHIALCRSK excludes medium risk (high versus low/no risk)

generate anyRF = 1 if (HIHIALCRSK==1 | CURSMKRSK==1 | HIDIETRSK==1 | HIBMIRSKOVB==1 | HIEXCSRSK==1 | ANXDEPRSm==1)
replace anyRF=0 if ((HIHIALCRSK==0 | AL2K7DAY==2) & CURSMKRSK==0 & HIDIETRSK==0 & HIBMIRSKOVB==0 & HIEXCSRSK==0 & ANXDEPRSm==0)
```

```
generate hialc10=HIHIALCRSK
replace hialc10=0 if hialc10==.

generate cursmk10=CURSMKRSK
replace cursmk10=0 if cursmk10==.

generate hidiet10=HIDIETRSK
replace hidiet10=0 if hidiet10==.

generate hiwght10=HIBMIRSKOVB
replace hiwght10=0 if hiwght10==.

generate hiexcs10=HIEXCSRSK
replace hiexcs10=0 if hiexcs10==.

generate hianxd10=ANXDEPRSm
replace hianxd10=0 if hianxd10==.

generate totRF = (hialc10 + cursmk10 + hidiet10 + hiwght10 + hiexcs10 + hianxd10)
replace totRF=. if anyRF==.

generate RFcat = 1 if totRF ==1
replace RFcat = 2 if totRF ==2
replace RFcat = 3 if totRF ==3
replace RFcat = 4 if totRF == 4
replace RFcat = 5 if (totRF ==5 | totRF==6)
replace RFcat = 0 if anyRF ==0

generate RF2more=1 if  (RFcat>=2 & RFcat<=5)
replace RF2more=0 if  (RFcat==0 | RFcat==1)

label variable RF2more "Number of Risk Factors"
label define rf2morelb 0 "None or one Risk Factor" 1 "Two to six Risk Factors"
label values RF2more rf2morelb


/****************************************************************
            SAVE GENERATED VARIABLES INTO FILE
***************************************************************/

save        "D:\Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v.dta",
replace

/**************************************************
    RENAMING WEIGHT VARIABLES
**************************************************/

rename NHSFINWT PWEIGHT

rename WPM0101 REPW01
rename WPM0102 REPW02
rename WPM0103 REPW03
rename WPM0104 REPW04
rename WPM0105 REPW05
```

rename WPM0106 REPW06
rename WPM0107 REPW07
rename WPM0108 REPW08
rename WPM0109 REPW09
rename WPM0110 REPW10
rename WPM0111 REPW11
rename WPM0112 REPW12
rename WPM0113 REPW13
rename WPM0114 REPW14
rename WPM0115 REPW15
rename WPM0116 REPW16
rename WPM0117 REPW17
rename WPM0118 REPW18
rename WPM0119 REPW19
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rename WPM0123 REPW23
rename WPM0124 REPW24
rename WPM0125 REPW25
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rename WPM0155 REPW55
rename WPM0156 REPW56
rename WPM0157 REPW57
rename WPM0158 REPW58
rename WPM0159 REPW59
rename WPM0160 REPW60

*local mult = 59/60

svyset _n [pweight=PWEIGHT], jkrweight(REPW*) vce(jackknife) mse singleunit(missing)

*svyset, clear

save
"D:\Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v17Sep08.dta", replace

****

log close

*

Estimate absenteeism rates among employed Australians aged 15-64 years

****
*
* EBRDRF LAST EDIT 6 August 2008
* .do Absenteeism and reduced activity analyses
*
***/

**NHS_Basic_EBRDRFanalysis.do*

*Average rate of absence from work for 15-64 years in Full-time employment by gender and agegroup
svy jackknife, subpop(LFEMPFUL): mean ABSNTWIm, over(GENDER AGE15over)

*Average rate of absence from work for 15-64 years in Full-time or Part-time employment by gender & agegroup
svy jackknife, subpop(LFEMPFPUST): mean ABSNTWIm, over(GENDER AGE15over)

*Average rate of absence from work for 15-64 years in Full-time employment by gender
svy jackknife, subpop(LFEMPFUL): mean ABSNTWIm, over(GENDER)

*Average rate of absence from work for 15-64 years in Full-time or Part-time employment by gender
svy jackknife, subpop(LFEMPFPUST): mean ABSNTWIm, over(GENDER)

****
*Mean length of absence from work (F or P) for those who have days off by gender and agegroup (Max 10 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL10 >0 & DOFFWKIL10 <=10) & LFEMPFPUST==1)
: mean DOFFWKIL10, over(GENDER AGE15over)

*Mean length of absence from work (F or P) for those who have days off by gender and agegroup (Max 14 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL14 >0 & DOFFWKIL14 <=14) & LFEMPFPUST==1):
mean DOFFWKIL14, over(GENDER AGE15over)

*Mean length of absence from work (F) for those who have days off by gender and agegroup (Max 10 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL10 >0 & DOFFWKIL10 <=10) & LFEMPFUL==1):
mean DOFFWKIL10, over(GENDER AGE15over)

*Mean length of absence from work (F) for those who have days off by gender and agegroup (Max 14 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL14 >0 & DOFFWKIL14 <=14) & LFEMPFUL==1):
mean DOFFWKIL14, over(GENDER AGE15over)

```
*Mean length of absence from work (F or P) for those who have days off by gender (Max 10 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL10 >0  & DOFFWKIL10 <=10) & LFEMPFPUST==1): mean DOFFWKIL10, over(GENDER)

*Mean length of absence from work (F or P) for those who have days off by gender (Max 14 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL14 >0  & DOFFWKIL14 <=14) & LFEMPFPUST==1): mean DOFFWKIL14, over(GENDER)

*Mean length of absence from work (F) for those who have days off by gender (Max 10 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL10 >0  & DOFFWKIL10 <=10) & LFEMPFUL==1): mean DOFFWKIL10, over(GENDER)

*Mean length of absence from work (F) for those who have days off by gender (Max 14 days)
svy jackknife, subpop(if ABSNTWIm == 1 & (DOFFWKIL14 >0  & DOFFWKIL14 <=14) & LFEMPFUL==1): mean DOFFWKIL14, over(GENDER)

********************
*Mean length of absence from work (F or P) overall by gender and agegroup (Max 10 days)
svy jackknife, subpop(if (DOFFWKIL10 >=0  & DOFFWKIL10 <=10) & LFEMPFPUST == 1): mean DOFFWKIL10, over(GENDER AGE15over)

*Mean length of absence from work (F or P) overall by gender and agegroup (Max 14 days)
svy jackknife, subpop(if (DOFFWKIL14 >=0  & DOFFWKIL14 <=14) & LFEMPFPUST == 1): mean DOFFWKIL14, over(GENDER AGE15over)

*Mean length of absence from work (F) overall by gender and agegroup (Max 10 days)
svy jackknife, subpop(if (DOFFWKIL10 >=0  & DOFFWKIL10 <=10) & LFEMPFUL == 1): mean DOFFWKIL10, over(GENDER AGE15over)

*Mean length of absence from work (F) overall by gender and agegroup (Max 14 days)
svy jackknife, subpop(if (DOFFWKIL14 >=0  & DOFFWKIL14 <=14) & LFEMPFUL == 1): mean DOFFWKIL14, over(GENDER AGE15over)

*Mean length of absence from work (F or P) overall by gender (Max 10 days)
svy jackknife, subpop(if (DOFFWKIL10 >=0  & DOFFWKIL10 <=10) & LFEMPFPUST == 1) : mean DOFFWKIL10, over(GENDER)

*Mean length of absence from work (F or P) overall by gender (Max 14 days)
svy jackknife, subpop(if (DOFFWKIL14 >=0  & DOFFWKIL14 <=14) & LFEMPFPUST == 1) : mean DOFFWKIL14, over(GENDER)

*Mean length of absence from work (F) overall by gender (Max 10 days)
svy jackknife, subpop(if (DOFFWKIL10 >=0  & DOFFWKIL10 <=10) & LFEMPFUL == 1): mean DOFFWKIL10, over(GENDER)

*Mean length of absence from work (F) overall by gender (Max 14 days)
svy jackknife, subpop(if (DOFFWKIL14 >=0  & DOFFWKIL14 <=14) & LFEMPFUL == 1): mean DOFFWKIL14, over(GENDER)


*******************
*Employment status >= 15 years
*Males
svy jackknife, subpop(MALE) mse : tabulate AGE15over LFEMPSTAT, count se ci format(%10.0g)

*Females
```

```
svy jackknife, subpop(FEMALE) mse : tabulate AGE15over LFEMPSTAT, count se ci format(%10.0g)

*Employment status >= 15 years, proportions within agegroups
*Males
svy jackknife, subpop(MALE) mse : tabulate AGE15over LFEMPSTAT, row se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate AGE15over LFEMPSTAT, row se ci format(%10.0g)

************************
*Mean rate of reduced activity for >=15 years by GENDER and agegroup
svy jackknife : mean REDACTIm, over(AGE15over GENDER)

*Mean number of days of reduced activity if experienced by gender and agegroup
svy jackknife, subpop(if REDACTIm == 1 & (DREDACT14 >0 & DREDACT14 <=14)): mean DREDACT14, over(GENDER AGE15over)

*Mean number of days of reduced activity overall by gender and agegroup
svy jackknife, subpop(if REDACTI <2): mean DREDACT14, over(GENDER AGE15over)

*Mean rate of days out of role for >=15 years by GENDER and agegroup
svy jackknife, subpop(if ROLDYI < 2) : mean ROLDYI, over(GENDER AGE15over)

*Counts of people who had days of reduced activity
*Males
svy jackknife, subpop(MALE) mse : tabulate AGE15over REDACTI, count se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate AGE15over REDACTI, count se ci format(%10.0g)

*Proportions of people who had days of reduced activity
*Males
svy jackknife, subpop(MALE) mse : tabulate AGE15over REDACTI, row se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate AGE15over REDACTI, row se ci format(%10.0g)


*
```

Estimate absenteeism by risk factor categories

```
***************************************************************
*
*	EBRDRF LAST EDIT 13 August 2008
*	.do Subgroups analysis
*
***************************************************************/

version 10

log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\RF2more_Employed_Analysis_ebrdrf.smcl", replace
clear
set memory 500M
set more off
```

```
use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v17Sep08
.dta", clear

svyset

**

*For people with 2 or more risk factors in employment/labour force
preserve
keep if (RF2more == 1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For people with 0 or 1 risk factor in employment
preserve
keep if (RF2more == 0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

**

*For all Australians
preserve
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For high to moderate risk alcohol consumers
preserve
keep if (HIALCRSK==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For high risk alcohol consumers
preserve
keep if (HIHIALCRSK==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For no or low risk alcohol consumers
preserve
keep if (LOALCRSK==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

****************************************************************/

version 10

log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\HiHiAlcrsk_Analysis_ebrdrf.smcl", replace
clear
set memory 500M
set more off
```

```
use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v.dta",
clear

svyset

*For high risk alcohol consumers
preserve
keep if (HIHIALCRSK==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

***
log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Smoking_Analysis_ebrdrf.smcl", replace
clear
set memory 500M
set more off

use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v.dta",
clear

svyset

*For Current smokers, regular or irregular
preserve
keep if (SMKRSK==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For Ex-smokers
preserve
keep if (SMKRSK==2)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For Never-smokers
preserve
keep if (SMKRSK==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

***
log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Dietrisk_Analysis_ebrdrf.smcl", replace
clear
set memory 500M
set more off

use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v.dta",
clear

svyset

*For High Dietary risk - inadequate fruit and vegetables
preserve
```

```
keep if (HIDIETRSK==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For Low Dietary risk - Adequate fruit and vegetables
preserve
keep if (HIDIETRSK==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

***
log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Obesity_Analysis_ebrdrf.smcl", replace
clear
set memory 500M
set more off

use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v.dta",
clear

svyset

*For Obese or overweight
preserve
keep if (HIBMIRSKOVB==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For Obese ONLY
preserve
keep if (HIBMIRSKOB==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore


*For Normal (or thin) weight, BMI <=24.99
preserve
keep if (HIBMIRSKOVB==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

***

log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Exercise_Analysis_ebrdrf.smcl", replace
clear
set memory 500M
set more off

use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v.dta",
clear

svyset

*For Moderate to high levels of physical activity
preserve
```

```
keep if (EXCSRSK==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore


*For Sedentary or low levels of physical activity
preserve
keep if (EXCSRSK==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

***
log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\DepressionAnxiety_Analysis_ebrdrf.smcl",
replace
clear
set memory 500M
set more off

use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v.dta",
clear

svyset

*For High or very high psychological distress
preserve
keep if (ANXDEPRS==3)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For Moderate psychological distress
preserve
keep if (ANXDEPRS==2)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For Low psychological distress
preserve
keep if (ANXDEPRS==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For Low or moderate psychological distress
preserve
keep if (ANXDEPRSm==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

***

log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\CancerCVDDiab_Analysis_ebrdrf.smcl", replace
clear
set memory 500M
set more off
```

```
use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v.dta",
clear

svyset

*For any Cancer ever
preserve
keep if (ANYCANCER==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For no Cancer
preserve
keep if (ANYCANCER==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

************************************

*For any Heart or circulatory disease ever
preserve
keep if (ANYHRTCRC==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For no Heart or circulatory disease
preserve
keep if (ANYHRTCRC==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

************************************

*For any Diabetes ever, excludes HSL
preserve
keep if (ANYDIAB==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*For no Diabetes
preserve
keep if (ANYDIAB==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_EBRDRFanalysis.do"
restore

*************************************
*Not in Labour Force
**************************************

version 10

*log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NotinLabourForce_RF2more.smcl", replace
clear
set memory 500M
set more off
```

```
*use
"D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Confidential\DCP_CURF\SAVED_Person_0405v17Sep08
.dta", clear

svyset

*****

*For Not in Labour Force and 2-6 risk factors - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & RF2more==1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force and 0-1 risk factors - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & RF2more==0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*****

*For Not in Labour Force + Hi Alcohol risk - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & HIHIALCRSK == 1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + Low Alcohol risk - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & HIHIALCRSK == 0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + Current Smoker - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & SMKRSK == 1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + eX-Smoker - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & SMKRSK == 2)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NotinLabourForce_NeverSmokers.smcl",
replace
*For Not in Labour Force + Never-Smokers - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & SMKRSK == 0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + Sedentary - days of reduced activity and out of role
```

```
preserve
keep if (NLFORCE ==1 & EXCSRSK == 1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + Active - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & EXCSRSK == 0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + IPV-Hi Anxiety/Depression - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & ANXDEPRS == 3)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + IPV-Medium Anxiety/Depression - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & ANXDEPRS == 2)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + Overweight/Obese - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & BMIRSKOVB == 1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + Normal weight - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & BMIRSKOVB == 0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + Adequate fruit and vegetables - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & HIDIETRSK == 0)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

*For Not in Labour Force + INadequate fruit and vegetables- days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & HIDIETRSK == 1)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore

***********************************************
*log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NotinLabourForce_RiskFactorCategory.smcl", replace
*For Not in Labour Force by Risk Factor Category - days of reduced activity and out of role
preserve
*RFcat=5, FIVE or SIX Risk Factors
keep if (NLFORCE ==1 & RFcat == 5)
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_AgeCat01_EBRDRFanalysis.do"
restore
```

```
********************************************

*log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NotinLabourForce_RiskFactorCategory_over15.smcl", replace
*For aged 15 years and over and Not in Labour Force by Risk Factor Category - days of reduced activity and out of role
preserve
keep if (NLFORCE ==1 & (LFAGECAT01 == 0 | LFAGECAT01 == 1))
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_NLF_RFcat_EBRDRFanalysis.do"
restore

*****
*? Female proportions ?
****

preserve
keep if (NLFORCE ==1 & RF2more==1)
*Females
svy jackknife, subpop(FEMALE) mse : tabulate LFAGECAT01 REDACTI, row se ci format(%10.0g)
restore

preserve
keep if (NLFORCE ==1 & RF2more==0)
*Females
svy jackknife, subpop(FEMALE) mse : tabulate LFAGECAT01 REDACTI, row se ci format(%10.0g)
restore

***********************************************
log using "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\Employed_RiskFactorCategory_Absenteesim.smcl", replace

*For all Australians in the workforce by total risk factor category - absenteeism etc
preserve
do "D:\NSRI_Dora2008\VicHealth_Deakin\CURFdata2008\NHS_Basic_RFcat_EBRDRFanalysis.do"
restore


***********************************************

log close

*
```

Estimate days of reduced activity for Australians not in Labour Force

```
 preserve

.keep if (NLFORCE ==1)

*Mean rate of reduced activity for >=15 years by GENDER and Age category (15-64, 65+)
svy jackknife : mean REDACTIm, over(LFAGECAT01 GENDER)
```

```
*Mean number of days of reduced activity if experienced by GENDER and Age category (15-64, 65+)
svy jackknife, subpop(if REDACTIm == 1 & (DREDACT14 >0 & DREDACT14 <=14)): mean DREDACT14, over(GENDER LFAGECAT01)

*Mean number of days of reduced activity overall by GENDER and Age category (15-64, 65+)
svy jackknife, subpop(if REDACTI <2): mean DREDACT14, over(GENDER LFAGECAT01)

*Mean rate of days out of role for >=15 years by GENDER and Age category (15-64, 65+)
svy jackknife, subpop(if ROLDYI < 2) : mean ROLDYI, over(GENDER LFAGECAT01)

*Counts of people who had days of reduced activity
*Males
svy jackknife, subpop(MALE) mse : tabulate LFAGECAT01 REDACTI, count se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate LFAGECAT01 REDACTI, count se ci format(%10.0g)

*Proportions of people who had days of reduced activity
*Males
svy jackknife, subpop(MALE) mse : tabulate LFAGECAT01 REDACTI, row se ci format(%10.0g)

*Females
svy jackknife, subpop(FEMALE) mse : tabulate LFAGECAT01 REDACTI, row se ci format(%10.0g)

*********
restore
```