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Weighing the cost of obesity: A case for action

A study on the additional costs of obesity and benefits of intervention in Australia

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Foreword

Obesity is an increasingly serious issue for many nations across the world, including Australia. More than a quarter of Australia's adult population is obese, one of the highest prevalence rates in the world. Obesity leads to higher health and quality of life risks for individuals and major additional economic costs to society.

A number of previous reports have shown that the costs of obesity are considerable to Australia. This report adds to this evidence base by, for the first time in Australia, taking a bottom up approach to a cost-benefit analysis (linked to Body Mass Index) that shows how the costs vary among the three classes of obesity. Additionally, we looked at the impact of three different scenarios on Australia through to 2025, including taking no further action, implementing some of the most prospective obesity interventions and halting the growth of obesity prevalence.

If we do nothing more than what we do now, obesity prevalence rates and costs will continue to increase through to 2025 and be a serious burden on society. Reducing obesity will mean a better quality of life for many Australians and our report shows that it also makes economic sense to invest, in the short term as well as the long term. We found that implementing a bundle of interventions would lead to an economic benefit to society in a relatively short timeframe.

One of the key findings from the report is that, although the bundle of interventions identified would be cost effective, they would not be enough to halt the growth in obesity. We will have to do much more if we are to meet the WHO target of halting the growth in obesity. Obesity is a complex issue that goes beyond a simple lack of self-control. There needs to be additional research to understand the issue, particularly in the areas of obesity prevention and the major challenge of weight regain.

PwC was engaged by Obesity Australia (in part pro bono) and consulted with subject matter experts in their network to develop this report. We are thankful for their contribution and proud to be part of this conversation.

James van Smeerdijk
Partner

Executive summary

Key findings from this report

1. The prevalence and severity of obesity in Australia has increased considerably since 1995, leading to additional direct, indirect and health and wellbeing costs to individuals, families and Australians in general. These costs and the benefits of intervention are assessed and discussed in this report.
2. If no further action is taken to curb the growth in obesity, this report projects that there will be a total of $87.7 billion in additional direct and indirect costs to Australia accumulated across the 10 years to 2025.
3. Implementing a set of selected obesity interventions would be a positive investment with a benefit cost ratio (BCR) of 1.7 in a conservative, ten year model resulting in a benefit of $2.1 billion for Australia.
4. The selected interventions would help slow the growth rate of obesity but would likely not be enough to meet the World Health Organization (WHO) target of returning to and maintaining the 2010 obesity prevalence levels.
5. Meeting the WHO target would mean a benefit of $10.3 billion for Australia over the next 10 years. It will require further investment in a range of established and innovative approaches for obesity prevention, more impactful obesity interventions and a lower rate of weight regain after successful weight loss.

Obesity is a global issue that many countries are having difficulty addressing. There is no simple solution and no country has yet been successful in significantly reducing obesity prevalence. Excess body weight has considerable impacts on individuals, the health care system and society. Obesity leads to serious chronic diseases, impacts mental wellness, reduces the quality and length of life for individuals, and leads to higher costs for society.

Based on the Australian National Health Survey results,[1] 27.5 per cent of Australians were obese in 2011-12, an increase of 47 per cent since 1995. Not only has the prevalence of obesity increased, so has the severity of obesity. For example in the comparison of the Australian Health Survey results between 2007-08 and 2011-12, there has been an increase in the percentage of obese people with a Body Mass Index (BMI) of 40 and above (class III), which is associated with considerable increases in health complications and death. The prevalence of obesity in Australia is expected to continue to increase with an expected 7.2 million obese people or 33.9 per cent of the projected population by 2025.

Estimating the costs of obesity and the benefit of intervention in Australia

The call to action around obesity is not new. Many credible reports have documented the urgency and scale of the obesity challenge. However, for the first time in Australia this report:

- includes both a cost of obesity and benefits of intervention analysis
- estimates the national direct and indirect costs of obesity using a bottom-up approach (through linking costs to BMI)

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[1] Australian Bureau of Statistics (2013), *Australian Health Survey: Updated Results, 2011-12*, 'Table 5.1 Body Mass Index (a), Persons (estimate), Relative Standard Error of estimate, Proportion of persons, Relative Standard Error of proportion and 95% Margin of Error – Australia', non-age standardised rates, cat. no. 4364.0.55.003, Retrieved on March 2015, <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument>

- focuses on the costs and benefits of intervention across the three classes of obesity

This and previous reports shows that there are considerable costs to Australia because of obesity. One of the goals of this study is to better understand the potential gains from intervening and supporting people to have and maintain a healthy body weight. Intervening to reduce the burden of obesity through a bundle of well designed interventions will free up economic resources, be of economic benefit to the community and help people have a higher quality of life.

This report shows that by acting now, through investment in a bundle of well designed obesity interventions, the economy will benefit and governments will save money in the shorter term (the next ten years) and this will also save lives and produce even larger fiscal and economic benefits in the longer term. The analysis approach for this report was purposely conservative with a ten year time scope (estimating total lifetime benefits would lead to a higher BCR) and a selection of 11 obesity cost metrics (out of the many identified).

Defining the specific detailed obesity interventions, investment and scale necessary to implement in Australia and reduce obesity prevalence, was not part of this report's scope and would need to be assessed separately. However, what is clear is that a bundle of different, interrelated and well designed interventions will be necessary and that all of the key interventions identified in the report should be considered for potential investment. They are all estimated to break even economically within 19 years, with the majority breaking even before 10 years. Additionally, the report defines target areas where further research investment could yield outcomes that will help meet the World Health Organization (WHO) target commitment to have the prevalence of obesity rate at 2010 levels.

Although there is an abundance of research, obesity is a complex issue and further research to improve the understanding of the long term impacts of interventions, the potential for society-wide or environmental initiatives, weight regain rates and the best prevention approaches would add further context and validation of these results. Any new initiatives should include ongoing assessment to determine success and longer term impact to contribute to the evidence base for Australia as well as globally and to guide continuous improvement and iteration. Intervention projects will almost certainly require some time to be fully operational and achieve optimal impact. However, without additional and increased investment in well designed obesity interventions there will be 50 per cent more obese people and the cumulative, marginal economic costs of obesity in Australia will reach $87.7 billion by 2025, not including the impact on the quality of life of the obese, their families and carers.

Costs of obesity

Obesity is not only a health and quality of life risk for individuals, it also impacts society through the direct and indirect costs it generates. There are various costs to different stakeholders that have been outlined in section 2. For this report, where our aim was to take a conservative approach based on existing evidence, eleven evidence-based areas of costs of obesity were evaluated. The total costs for these areas in Australia in 2011-12, were estimated to be $8.6 billion (in 2014-15 dollars). This total figure includes $3.8 billion in direct costs and $4.8 billion in indirect costs. These marginal costs are based on a bottom-up approach using BMI as the comparator and include the costs of comorbidities associated with obesity such as diabetes, heart disease and cancer.

Table 1 Additional costs from obesity in 2011-12 for adults (18+), in 2014-15 dollars

Cost categories		Value ($millions)
Direct costs	GP services	$255
	Allied health services	$125
	Specialist services	$297
	Hospital care	$1,165
	Pharmaceuticals	$1,445
	Weight loss interventions	$368
	Public interventions	$154
Subtotal - direct costs		$3,809
Indirect costs	Absenteeism	$477
	Presenteeism	$544
	Government subsidies	$323
	Foregone tax	$3,448
Subtotal - indirect costs		$4,792
Total cost		**$8,600**

Further costs such as those from reduced wellbeing and foregone earnings were assessed but have not been included in the $8.6 billion estimate as they are more conceptual in nature and so, from a conservative investment point of view, these are only discussed qualitatively. Although more conceptual in nature, it is important to note that these costs have serious impacts on people and society and their absence from our modelling does not imply that we consider them to be less important than the more readily demonstrable and quantifiable direct and indirect costs that have been included.

Australia in 2025

Three scenarios were assessed for this report and the results are presented in the sections below:

1. Take no further action to fight obesity growth in Australia
2. Implement a set of selected interventions to target obesity
3. Meet the WHO target to halt obesity growth rates

The estimated benefits of interventions are based on the potential impact to target groups' average BMI levels and the resulting reduction in obesity related costs.

1. Take no further action

If no further action is taken to slow the growth of obesity then there will be 2.4 million more obese people in 2025 than in 2011-12 and $87.7 billion in additional costs due to obesity to society over the ten years (2015-16 to 2024-25). There will also be a higher proportion of obesity class III, meaning higher health risks and costs.

Table 1 The expected growth in obesity with no additional interventions

	Obesity class I (BMI 30 – 34.9)	Obesity class II (BMI 35 – 39.9)	Obesity class III (BMI 40+)	Total
Number of obese by 2025	4,186,450	1,722,900	1,337,100	7,246,450
Per cent increase in people relative to 2011-12	33%	52%	147%	50%
Additional costs between 2015-16 and 2024-25 ($ billion)	$42.1	$21.5	$24.1	$87.7

2. Invest in a set of selected interventions

There are a number of reports that have outlined the various behavioural, pharmacological, surgical or environmental interventions that can be used to reduce obesity. A set of potential obesity interventions for this analysis were identified based on a high level literature scan. PwC did not conduct a cost effectiveness analysis of all of potential obesity interventions. The key sources used as a basis for potential cost effective intervention options were the ACE[2] report and a recent economic analysis of obesity interventions by McKinsey Global Institute[3]. Both reports have strengths and limitations. The authors needed to rely on the best evidence available and sometimes speculative analysis as population wide interventions are difficult to evaluate. Potential interventions identified in the ACE and McKinsey reports were then further discussed and selected with Obesity Australia and subject matter experts based on potential cost effectiveness, feasibility and strength of evidence.

The interventions selected for inclusion in this report highlight a variety of cost effective options and provide a scale of potential impact across four major categories. This is not a comprehensive list of options and it is not the intention of this report that one intervention or category be prioritised over others. The following interventions are included:

Personal	Education	Environment	Medical
▪ Weight loss management programs ▪ GP intervention	▪ Parental education ▪ School curriculum	▪ Reformulation ▪ Labelling ▪ Tax on unhealthy foods	▪ Bariatric surgery ▪ Pharmaceuticals
Intervention	*Intervention & Prevention*	*Intervention & Prevention*	*Intervention*

Assumptions on intervention impact, cost and weight regain were made using publicly available peer-reviewed research results (when available) and involved detailed discussions with subject matter experts. Actual real world impact of obesity interventions will depend on

2 Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention.* Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

3 McKinsey Global Institute (2014). *Overcoming Obesity: An initial economic analysis.* Retrieved from http://www.mckinsey.com/~/media/McKinsey/dotcom/Insights/Economic%20Studies/How%20the%20world%20could%20better%20fight%20obesity/MGI%20Obesity_Full%20report_November%202014.ashx.

the target groups, participation rates, weight regain rates, stakeholder buy in, level of investment and support.

Implementing this set of selected obesity interventions (described in more detail in Section 6) to 2025 would cost $1.3 billion and lead to a savings of $2.1 billion to society (in that ten years, in 2015 present value terms) showing a benefit cost ratio (BCR) of 1.7. Of the savings, 76 per cent would be to government through reduced healthcare costs, subsidy costs and foregone earnings. The investment and savings (benefit) from this set of interventions will economically break even after six years, after which they will be cost saving. After 2025 and the ten year model period, there will continue to be benefits for intervention participants for the rest of their lives (assuming they maintain the weight loss from the model). There is an estimated cumulative benefit of $24.8 million per annum, per estimated cohort who go through the interventions.

The following table shows the potential impact on the obese population by 2025.

Table 2 The impact of a set of selected interventions on the 2025 obese population and associated costs and benefits between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Change in number of obese by 2025	-100,750	-100,700	-48,150	-249,600
Per cent change in number of obese by 2025	-2.4%	-5.8%	-3.6%	-3.4%
Benefit of interventions between 2015-16 and 2024-25 ($ million)	$750	$790	$550	$2,090
Costs of intervention between 2015-16 and 2024-25 ($ million)	$600	$330	$320	$1,250
BCR				**1.7**

One major challenge to achieving benefits is the issue of weight regain after intervention. It is difficult to reduce obesity once it is established and even with successful intervention, weight regain is common. The ten year model includes considerable estimates around weight regain for each intervention (except those in environment) and despite this, the set of interventions are still found to be a positive investment. To highlight the economic importance of such weight regain, if half as many people regained weight after intervention as at present in the model, then there would be a 34 per cent increase in benefits and an overall BCR of 2.2 for the selected set of interventions. It is important to note a moderate weight loss of 5 to 10 per cent is beneficial and reduces comorbidity risks such as diabetes and cardiovascular disease.[4] Even if people gain some or all of their weight back, any moderate amount of weight loss is still positive.

4 Wing, R.R., Land, W., Wadden, T.A., Safford, M., Knowler, W.C., Bertoni, A.G., Hill, J.O., Brancati, F.L., Peters, A., Wagenknecht, L., and the Look AHEAD Research Group (2011). Benefits of Modest Weight Loss in Improving Cardiovascular

The ten year model is a conservative estimate of the benefits of the selected set of interventions. For those who are successful in losing weight, the benefit of intervention will be for a lifetime, but this model only captures the first ten years of this benefit. Additionally the model assumes that there will be an investment in interventions for each of the ten years. That means that it includes costs in the last few years for which the accompanying benefits will mostly come after 2025.

3. Meet the World Health Organization targets

The WHO target is to halt the growth in obesity, return to and maintain the 2010 obesity prevalence levels. It is estimated that the obesity prevalence rate in 2010 was 26 per cent. If Australia were to have a prevalence rate of 26 per cent prevalence in 2025, that would mean 1.6 million fewer obese people and an estimated ten year cumulative benefit of $10.3 billion by 2025.

Table 3 The impact of meeting the WHO target on the 2025 obese population and benefits from a reduced obese population between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Change in number of obese by 2025	-605,800	-388,850	-567,350	-1,562,000
Per cent change in number of obese by 2025	-14.5%	-22.6%	-42.4%	-21.6%
Benefits from reduced obese population between 2015-16 and 2024-25 ($ million)	$2,550	$2,090	$5,690	$10,330

A key observation is that, even if fully applied, the set of selected interventions (assessed in this report) would mean Australia would fall short of meeting even 50 per cent of the WHO target. Further solutions will need to be considered, developed and assessed. There may be new technologies or innovative solutions that can help with weight loss and with weight regain prevention. If it is assumed that the same BCR from the set of interventions applies for the WHO target, then there would need to be an investment of around $6 billion to 2025 to meet that target.

Risk Factors in Overweight and Obese Individuals with Type 2 Diabetes. *Diabetes Care*. 34 (7). Retrieved from http://care.diabetesjournals.org/content/34/7/1481.full

Table 1.14 Obese population in 2025 under each scenario

	Obesity class I	Obesity class II	Obesity class III	Total
Obese population in 2025 in status quo	4,186,450	1,722,900	1,337,100	7,246,450
Obese population in 2025 with set of interventions	4,085,700	1,622,200	1,288,950	6,996,850
Obese population in 2025 if WHO target is met	3,580,650	1,334,050	769,750	5,684,450

Contents

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1 Background

Obesity is a global issue that is becoming an epidemic for developed countries like Australia. Excess body weight has considerable negative impacts on individuals, the health care system and society. Obesity leads to serious chronic diseases, impacts mental wellness, reduces the quality and length of life for individuals, and leads to higher costs for society.

This report presents estimates of the costs of obesity in Australia in 2011-12 and the benefits of implementing a set of general interventions. The project scope, approach, and underlying framework are presented in the Appendix of this report.

1.1 Definition of obesity

The World Health Organization (WHO) states that obesity is a chronic disease defined as 'a condition of abnormal or excessive fat accumulation in adipose tissue, to the extent that health may be impaired'. While there are a number of methods to identify obesity, the body mass index (BMI) provides the most widely used, albeit crude, way to measure population-level obesity.[5] Using BMI, the WHO established the classification system shown in Table 1.1.1, which also shows how the likelihood of co-morbidities increases with BMI.

Table 1.1.1 Weight classification of adults by BMI

Classification	BMI	Risk of co-morbidities
Underweight	< 18.50	Low (but risk of other clinical problems increased)
Normal range	18.50 – 24.99	Average
Overweight	≥ 25.00	
Pre-obese	25.00 – 29.99	Increased
Obesity class I	30.00 – 34.99	Moderate
Obesity class II	35.00 – 39.99	Severe
Obesity class III	≥ 40.00	Very severe

Source: World Health Organization (2000). *Technical report series 894: Obesity: Preventing and managing the global epidemic*, Geneva: World Health Organization, p.9.

1.2 Prevalence of obesity

Table 1.2.1 shows the most current estimates of obesity rates in Australia for the adult population aged 18 years and older, by gender. It shows that males and females are equally likely to be obese, with 27.5 per cent of both populations identified as obese. By contrast, women are much less likely than men to be overweight, with 28.2 per cent of females identified as overweight, compared to 42.2 per cent of males. Globally, there is a trend that men have higher rates of overweight and women have higher rates of obesity.[6] In 2011-12, there were 4,835,102 obese people in Australia.

5 World Health Organization (2000). *Technical report series 894: Obesity: Preventing and managing the global epidemic*. Geneva: World Health Organization.

6 World Health Organization. *Controlling the global obesity epidemic*. Geneva: World Health Organization. Retrieved from http://www.who.int/nutrition/topics/obesity/en/

Australia has one of the highest obesity prevalence rates in the world and has also seen some of the largest growth rates for a developed country since 1980.[7] Previous Australian Health Survey results show a continued increase in Australia, with estimated obesity prevalence rates rising 47 per cent between 1995 and 2011-12.

Table 1.2.1 Rates of BMI categories, adult population (18 years +), 2011-12

Category (measured BMI)	Males	Females
Underweight (less than 18.49)	1.2%	2.1%
Normal weight (18.50 – 24.99)	29.1%	42.2%
Pre-obese (25.0 – 29.99)	42.2%	28.2%
Obese (30.0 and higher)	27.5%	27.5%
Total	100%	100%

Source: Australian Bureau of Statistics (2013), *Australian Health Survey: Updated Results, 2011-12*, 'Table 5.1 Body Mass Index (a), Persons (estimate), Relative Standard Error of estimate, Proportion of persons, Relative Standard Error of proportion and 95% Margin of Error – Australia', non-age standardised rates, cat. no. 4364.0.55.003, Retrieved on March 2015, <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument>

Rates of obesity in children are lower than those for adults (and criteria for ascribing obesity are different), but still significant. In 2011-12, 7.2 per cent of male children and 7.5 per cent of female children aged 17 years or younger were obese.[8]

Obesity is also more prevalent among disadvantaged segments of the population, including those with lower levels of education and people of Aboriginal and Torres Strait Islander (ATSI) backgrounds:

- Whereas 18.0 per cent of adults with a postgraduate degree were obese in 2011-12, 31.9 per cent of those with a certificate and 30.7 per cent with no non-school qualification were obese.[9]
- In 2013-14, 36.2 per cent of ATSI males and 43.3 per cent of ATSI females were classified as obese.[10]

1.3 Class of obesity

The risk of co-morbidities and mortality impacts increases with higher BMIs. Not only has the prevalence of obesity increased since 1995, the increasing severity of obesity is also an issue. A comparison of the Australian Health Survey results between 2007-08 and 2011-12 shows that, among those who are categorised as obese, there has been an increase in the percentage of obese people with a BMI of 40 and above, which is associated with

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7 The Lancet (2013). *Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis*, for the Global Burden of Disease Study 2013.

8 Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12*, 'Table 5.1 Body Mass Index (a), Persons (estimate), Relative Standard Error of estimate, Proportion of persons, Relative Standard Error of proportion and 95% Margin of Error – Australia', non-age standardised rates, cat. no. 4364.0.55.003, Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

9 Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12*, 'Table 7.3 Body Mass Index by selected population characteristics, Proportion of persons', cat. no. 4364.0.55.003, Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

10 Australian Bureau of Statistics (2014). *Australian Aboriginal and Torres Strait Islander Health Survey: Updated Results 2012-13*, 'Table 8.3 Health risk factors by selected population characteristics by indigenous status, Proportion of persons', cat. no. 4727.0.55.006, Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4727.0.55.0012012-13?OpenDocument

considerable increases in health complications and death. One study analysed 20 international prospective studies on adults and found that, when compared to people with a normal weight, people with a BMI between 40 and 59 experienced an estimated loss of life of 6.5 to 13.7 years.[11]

Table 1.3.1 Per cent of total obese population by class level, 2007-08 and 2011-12

Category (measured BMI)	2007-08	2011-12
Obesity class I	67.5%	65.2%
Obesity class II	23.6%	23.5%
Obesity class III	8.9%	11.3%
Total	100%	100%

Source: ABS 2015, Customised report. *Australian Health Survey 2011-12*

Australian men are more likely to be overweight but it seems that women are much more likely to be in the obesity class III level (see Table 1.3.2).

Table 1.3.2 Per cent of total obese population by class level and gender

Category (measured BMI)	Males	Females
Obesity class I	71.0%	59.2%
Obesity class II	21.5%	25.6%
Obesity class III	7.5%	15.2%
Total	100%	100%

Source: Australian Bureau of Statistics (2015). Customised report. *Australian Health Survey 2011-12: Health Service Usage and Health Related Actions, 2011–12 — Australia*

1.4 Long-term obesity

The prevalence of obesity amongst children noted above, along with medical advancements, means that people are living longer with obesity. Research shows that health and mortality risks increase with the number of years someone is obese.[12]

A previous study on the cost of overweight and obesity to Australia examined five year follow-up data and found that people who remained obese over the five years had higher direct costs than those who went from overweight or normal weight to obese.[13]

Obesity in middle age is also linked to disability in older ages.[14] Table 1.4.1 shows that the highest proportion of obese people is aged 35 to 64 years across all three class levels.

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[11] Kitahara et al. (2014). Association between Class III Obesity (BMI of 40-59 kg/m2) and Mortality: A Pooled Analysis of 20 Prospective Studies, *PLoS Medicine*, 11 (7), art. no. e1001673.

[12] Abdullah, A., Wolfe, R., Stoelwinder, J.U., de Courten, M., Stevenson, C., Walls, H.L., and Peeters, A. (2011). The number of years lived with obesity and the risk of all-cause and cause-specific mortality. *International Journal Epidemiology*. 40(4): 985-996.

[13] Colagiuri, S., Lee, C.M., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264.

[14] Victorian Health Promotion Foundation (2014). *Negative growth: the future of obesity in Australia*, Research highlights. Publication number: P-HE-142.

Table 1.4.1 Class of obesity, per cent of obese adult population by age, 2011-12

Age of obese population	Obesity class I	Obesity class II	Obesity class III
18-24	4.3%	2.2%	0.9%
25-34	9.1%	3.3%	1.6%
35-44	11.6%	4.8%	2.5%
45-54	14.2%	4.2%	2.5%
55-64	13.2%	4.8%	1.8%
65-74	8.2%	2.9%	1.7%
75+	4.6%	1.4%	0.3%
Total	65.2%	23.5%	11.3%

Source: Australian Bureau of Statistics (2015). Customised report. *Australian Health Survey 2011-12: Health Service Usage and Health Related Actions, 2011–12 — Australia.*

1.5 Expected growth in prevalence and severity

Prevalence of obesity in Australia is expected to continue to increase through to 2025. One study estimated that the prevalence of obese and overweight population is estimated to be 72 per cent of the Australian population by 2025 (63 per cent in 2011-12) and the prevalence of obese population is likely to reach 33.2 per cent by 2025.[15]Another study found higher estimates with 83 per cent of males and 75 per cent of females aged 20 years and older being overweight or obese by 2025.[16] The study also estimated that by 2025, one third of Australian children will be overweight and obese.

Assuming an obesity prevalence rate of 33.2 per cent by 2025 would mean a year on year growth of 1.5 per cent from 2011-2012. Additionally the total Australian population will continue to grow and, based on the ABS population projection, the obese population is expected to increase by a total of 3.2 per cent per year.

Assuming an adult population prevalence of 33.2 per cent in 2025 and a continued increase in the ratio of class III obese (based on increases between 2007-08 and 2011-12) it estimated that there will be 7.2 million obese persons in 2025.

[15] Walls, H.L., Magliano, D.J., Stevenson, C.E., Backholer, K., Mannan, H.R., Shaw, J.E., Peeters, A. (2012). Projected progression of the prevalence of obesity in Australia. *Obesity*. 20 (4):872-878. Note that Walls, et al estimated obesity prevalence for adults 25 years and over to reach 33.9 per cent in 2025. This study applied assumptions drawn from Walls, et al and estimated obesity prevalence for adults 18 years and over to be 33.2 per cent. Refer to Appendix C for the detailed assumption and approach.

[16] Haby, M. (2012). Future predictions of body mass index and overweight prevalence in Australia, 2005-2025. *Health Promotion International*. (2):250-260.

Table 1.5.1 Class of obesity, per cent of obese adult population by age, 2011-12 and cost of obesity between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Number of obese by 2025	4,186,450	1,722,900	1,337,100	7,246,450
Per cent increase in people relative to 2011-12	33%	52%	147%	50%
Additional costs between 2015-16 and 2024-25 ($ billion)	$42.1	$21.5	$24.1	$87.7

1.6 WHO target to halt obesity rates

Noncommunicable diseases such as cardiovascular disease and diabetes are the world's biggest killers[17] and so the WHO developed a *Global Action Plan for the prevention and control of noncommunicable diseases 2013-2020* with the ultimate goal of reducing premature mortality from noncommunicable diseases by 25 per cent by 2025. The Australian Government is a signatory to this plan. One of the voluntary global targets is to halt the rise in obesity. The Plan noted that countries will select indicators that are appropriate to their national context, however, many have interpreted this as halting obesity prevalence rates to the levels from 2010.[18]

Before the WHO targets, Australia had set national obesity goals in 2009 through the National Partnership Agreement on Preventative Health to decrease the proportion of adults and children at unhealthy weight held by 2015. The cessation of the Agreement and funding means that there is currently no national approach to obesity.

Using National Health Survey prevalence rates in 2007-08 and 2011-12[19] it is estimated that the obesity prevalence rate in 2010 was 26 per cent. If Australia were to maintain a 26 per cent prevalence rate to 2025, that would mean 1.6 million fewer obese people by 2025 and an estimated cumulative benefit of $10.3 billion between 2016 and 2025.

17 World Health Organization (2013). *Global Action Plan for the prevention and control of noncommunicable diseases 2013-2020*. Retrieved from http://www.who.int/nmh/publications/ncd-action-plan/en/

18 Willcox, S. (2014). *Chronic diseases in Australia: the case for changing course (Background and policy paper)*. Retrieved from http://www.mitchellinstitute.org.au/wp-content/uploads/2014/10/Chronic-diseases-in-Australia-the-case-for-changing-course-sharon-willcox.pdf

19 Australian Bureau of Statistics (2015). Customised report. *Australian Health Survey 2011-12: Health Service Usage* and *Health Related Actions, 2011–12 — Australia*.

Table 1.6.1 The impact of meeting the WHO target on the 2025 obese population and benefits from reduced obese population between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Reduction in number of obese by 2025	-605,800	-388,850	-567,350	-1,562,000
Per cent reduction in number of obese by 2025	-14.5%	-22.6%	-42.4%	-21.6%
Benefits from reduced obese population between 2015-16 and 2024-25 ($ million)	$2,550	$2,090	$5,690	$10,330

1.7 Complexity of obesity

Obesity is complex, weight loss on a national scale is difficult in the current environment, and weight regain is a barrier to long term success and realisation of the benefits.

1.7.1 No simple solution

Obesity is a global challenge that many countries are having difficulty addressing. There is no simple solution and no country has yet been successful in reducing obesity prevalence.

Also, not every obesity intervention is appropriate for every obese person. For example, bariatric surgery is not currently an option for the majority of class I and II obese. Various interventions will need to be in place to target different population groups. Additionally, food selection is very personal and so there will likely be people who are resistant to change and/or who may not be interested in losing weight.

1.7.2 The obesigenic environment

Obesity is complex and not as simple as just a lack of personal discipline. There are many reports that explore the various causes of obesity, one being that the availability and culture of the food system today supports overconsumption of energy-dense nutrient-poor foods (obesigenic). The Australian ACE Prevention[20] study found that diet and exercise interventions can be cost effective, but are not enough alone to reduce the burden of overweight and obesity. They called for interventions to be included that change the environment and target all of society, not just those which target individuals. The 2014 McKinsey report on obesity also found that environmental approaches (such as portion control, food reformulation and limiting unhealthy foods) have the highest impact across the full population and are the most cost effective.[21]

[20] Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention.* Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

[21] McKinsey Global Institute (2014). *Overcoming Obesity: An initial economic analysis.* Retrieved from http://www.mckinsey.com/~/media/McKinsey/dotcom/Insights/Economic%20Studies/How%20the%20world%20could%20better%20fight%20obesity/MGI%20Obesity_Full%20report_November%202014.ashx

To change the food environment to be less obesigenic, a broad set of stakeholders need to participate such as the food industry. It will be important to clarify the costs and benefits with these stakeholders in order to gain support for collaboration and change.

1.7.3 Weight regain

It is difficult to reduce obesity once it is established, especially longer term, even with successful intervention, weight regain is often an issue. Some researchers believe that the obesigenic environment plays a role in obesity recidivism rates.[22] Also, some research has shown the body may be fighting weight loss by decreasing resting metabolism and increasing hunger hormones.[23] There is very little research on weight regain after 1-2 years, an area that requires further work to understand the obesity epidemic. It seems however that continued therapy and maintenance support is important for minimizing weight regain.[24] Because of these challenges, focusing on obesity prevention as well as interventions is important.

It is important to note a moderate weight loss of 5 to 10 per cent is beneficial and reduces comorbidity risks such as diabetes and cardiovascular disease.[25] Even if people gain some or all of their weight back, any moderate amount of weight loss is still positive.

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22 Wadden, T.A., Butryn, M.L., and Byrne, K.J. (2004). Efficacy of Lifestyle Modification for Long Term Weight Control. *Obesity Research,*Vol 12 (S12). Retrieved from http://onlinelibrary.wiley.com/doi/10.1038/oby.2004.282/pdf

23 Farias, M.M., Cuevas, A.M.and Rodriguez, F (2011, April). Metabolic Syndrome and Related Disorders. April 2011, 9(2): 85-89. doi:10.1089/met.2010.0090.

24 Ulen, C.G., Huizinga, M.M., Beech, B., and Elasy, T.A. (2008). Weight Regain Prevention. *Clinical* Diabetes, Vol 26(3), Retrieved from http://clinical.diabetesjournals.org/content/26/3/100.full

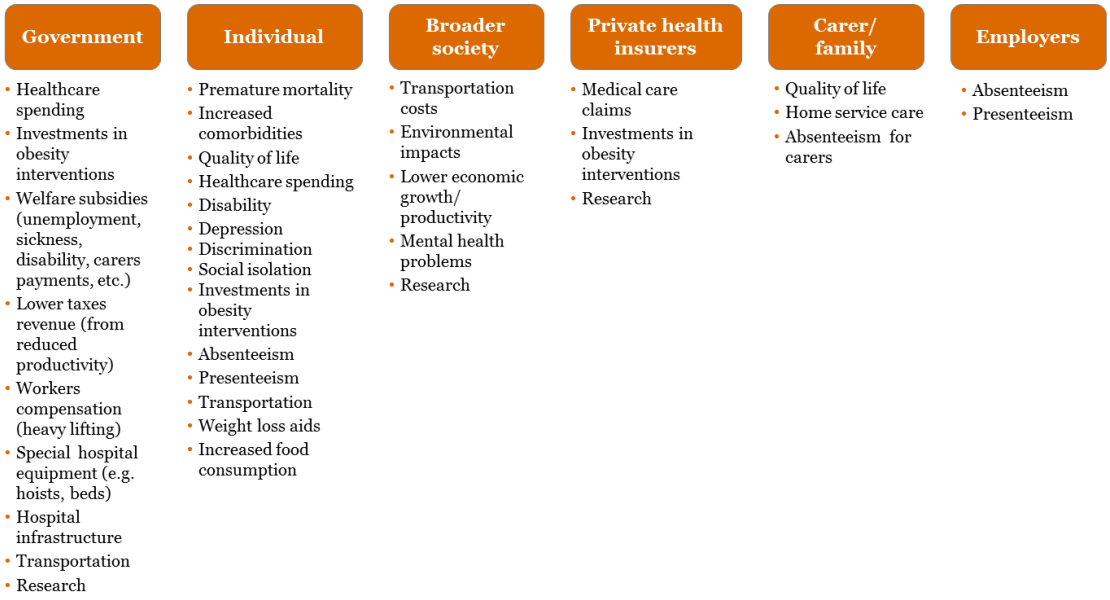
25 Wing, R.R., Land, W., Wadden, T.A., Safford, M., Knowler, W.C., Bertoni, A.G., Hill, J.O., Brancati, F.L., Peters, A., Wagenknecht, L., and the Look AHEAD Research Group (2011). Benefits of Modest Weight Loss in Improving Cardiovascular Risk Factors in Overweight and Obese Individuals with Type 2 Diabetes. *Diabetes Care.* 34 (7). Retrieved from http://care.diabetesjournals.org/content/34/7/1481.full

2 Costs of obesity

Obesity is not only a health and quality of life risk for individuals, but it also affects society through the direct and indirect costs that it generates. As noted earlier, the increased likelihood of co-morbidities associated with obesity leads to higher medical care use, which translates into higher medical spending. Furthermore, obesity can reduce individuals' ability to work effectively, generating notable productivity losses. Finally, obesity reduces individuals' health and wellbeing, leading to a range of economic, personal and societal costs.

There are many costs associated with obesity that are borne by multiple stakeholders, including Commonwealth and state and territory governments, the obese population, private health insurers, carers and family members, employers and broader society. Figure 1.7.1 summarises the myriad costs of obesity borne by each stakeholder.

Figure 1.7.1 Cost of obesity and relevant stakeholders



This study focuses on eleven of these costs and estimates the costs of obesity in Australia according to the monetary value of these measures. It looks specifically at the costs attributable to obesity beyond those incurred normally. In other words, it considers the additional costs incurred by obese people relative to non-obese people. For example, while people of all weights incur medical costs, the model incorporates only the difference between the medical costs for non-obese people and the medical costs for obese people. This difference is assumed to be the impact due to obesity. By extension, this is an estimate of the savings that could be realised if there was no obesity. The selected costs, shown in Table 2.1.1, were chosen for their causal link to obesity and the availability of quality research for reference.

There are also many costs of obesity that cannot be reliably monetised due to the lack of information or are inherently non-quantifiable. These include important financial, health and wellbeing costs such as depression, discrimination and lower educational attainment.

Together, this means that the estimates presented below should be interpreted as a lower bound estimate of the costs of obesity.

2.1 Direct and indirect costs

The modelling underlying this report found that the cost of obesity in Australia in 2011-12 was $8.6 billion (in 2014-15 dollars). This includes $3.8 billion in direct costs and $4.8 billion in indirect costs.

Table 2.1.1 Additional costs from obesity in 2011-12 for adults (18+), in 2014-15 dollars

Cost categories		Value ($millions)
Direct costs	GP services	$255
	Allied health services	$125
	Specialist services	$297
	Hospital care	$1,165
	Pharmaceuticals	$1,445
	Weight loss interventions	$368
	Public interventions	$154
Subtotal - direct costs		$3,809
Indirect costs	Absenteeism	$477
	Presenteeism	$544
	Government subsidies	$323
	Foregone tax	$3,448
Subtotal - indirect costs		$4,792
Total cost		**$8,600**

The resulting direct and indirect costs are comparable to previous studies on the costs of obesity in Australia presented in Table 2.1.2. Although each study used a different approach and metrics to estimate direct and indirect costs, the combined costs range from $8.6 billion to $9.7 billion (in 2014-15 dollars) which consistently indicates obesity places a considerable financial burden on Australia. For example, the direct costs of obesity would be equivalent to approximately 2.6 per cent of the national healthcare spending in 2011-12, which was $148.9 billion (2014-15 dollars).[26]

[26] Australian Institute of Health and Welfare. *2.2. How much does Australia spend on health care?* Retrieved April 2015 from http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129547594, p.10

Table 2.1.2 Additional costs from obesity in 2011-12 for adults (18+), in 2014-15 dollars (billions)

Report	Direct cost estimate	Indirect cost estimate
PwC study (2015)	$3.8	$4.8
Colagiuri et al. - The cost of overweight and obesity in Australia (2010)	$3.1	-
Access Economics – The economic costs of obesity (2008)	$5.5	$4.2
Medibank – Obesity in Australia: financial impacts and cost benefits of intervention (2010)	$1.5	$7.3

Note: Monetary values are in 2014-15 dollars. The Colagiuri direct cost estimate does not include the Government subsidy costs

Table 2.1.3 shows how much each stakeholder group bears of the total obesity costs. The Commonwealth funds the vast majority of the direct and indirect cost of obesity.

Table 2.1.3 Costs of obesity in 2011-12 for adults (18+) by cost type and stakeholders, in 2014-15 dollars (million)

Stakeholders	Direct cost	Indirect cost	Total cost
Commonwealth government	$2,290	$3,770	$6,060
State government	$390	-	$390
Private Health Insurance	$400	-	$400
Individuals	$730	-	$730
Employers	-	$1,020	$1,020
Total	**$3,810**	**$4,790**	**$8,600**

Table 2.1.4 shows that direct and indirect costs are influenced by obesity class level. Total costs for obesity class III are over 100 per cent higher than obesity class level I.

Table 2.1.4 Costs of obesity per person in 2011-12 for adults (18+) by cost type and obesity class levels, in 2014-15 dollars

Obesity classification	Direct cost	Indirect cost	Total cost
Obesity class I	$580	$890	$1,470
Obesity class II	$1,050	$900	$1,950
Obesity class III	$1,450	$1,730	$3,180
Total average pp	**$790**	**$990**	**$1,780**

Notes:
(1) Costs of public intervention (as part of weight loss) per person are assumed to be evenly distributed across the three obesity classes
(2) Costs of bariatric surgery (as part of weight loss) per person are assumed to be evenly distributed across the obesity class II and III populations
(3) Forgone earnings and health and wellbeing cost have been excluded from this table as these are conceptual cost (discussed below). Foregone earnings have been estimated to be $2,380 per obesity class I person, $2,410 per obesity class II person and $2,870 per obesity class III person. Health and wellbeing cost is estimated to be $9,800 per person for individuals of all obesity classes.

2.2 'Conceptual' costs involving health and wellbeing

In addition to the direct and indirect costs shown above there are further, more conceptual costs borne by individuals in the form of health and wellbeing impacts and forgone earnings. Given the nature of these costs, they are reported separately from the direct and indirect costs itemised above.

The estimated health and wellbeing cost to individuals from obesity was $47.4 billion in 2011-12. This cost is based on an estimate of the obesity impact on quality and length of life. Previous literature similarly found a much larger health and wellbeing cost than estimated direct and indirect costs of obesity. For example, Medibank Health Solutions estimated this cost to be $34.4 billion (in 2014-15 dollars) and Access Economics estimated it at $58 billion (in 2014-15 dollars) for Australia.

Another relatively large cost to the individual stakeholder group is the approximate $11.8 billion in potential foregone earnings. This is as a result of individuals who aren't employed to their full potential due to obesity. The estimate is based on national average earnings not achieved for the higher numbers of the obese population not participating in the workforce. The foregone earnings cost is also excluded from the direct and indirect estimates as there is limited research and available information in this area and so the assumption about foregone earnings is more conceptual in nature. It is unclear what activities this population is undertaking and what support or additional benefits they may be receiving.

The remaining chapters of this report explain the calculations and results of the direct, indirect and conceptual cost estimates and the appendices provide the technical detail underlying the estimations.

3 Direct costs

The direct costs of obesity are those costs attributable to obesity and can include the medical costs of treating individuals with obesity and its co-morbidities and government spending to reduce obesity rates.

3.1 General practitioner (GP) visits

Although a direct comparison of the number of GP visits in a year for obese and non-obese is not currently publically available, the results from the Australian Health Study show that the likelihood of having visited a doctor in the last three months and year increases with BMI levels.

Table 3.1.1 Health service usage, GP visits, 2011-12

Category (measured BMI)	Less than 3 months ago	In the last year
Not overweight/obese	51.9%	83.1%
Overweight	55.2%	86.2%
Obesity class I	57.6%	88.7%
Obesity class II	66.8%	90.6%
Obesity class III	65.2%	91.8%

Source: Australian Bureau of Statistics (2015). Customised report. *Australian Health Survey 2011-12: Health Service Usage and Health Related Actions, 2011–12 — Australia.*

Almost one third of obese National Health Survey respondents discussed 'reaching a healthy weight' with their GP in the last year, compared to 9.4 per cent of overweight respondents and 3.4 per cent of not overweight or obese respondents. The data supports the assumption that obesity contributes to increased GP visits. There is also evidence that obesity-related visits take longer than average, with one study finding that GP visits for which obesity was managed were significantly longer at 18.1 minutes than the overall average time for GP visits of 15.3 minutes.[27]

Based on average Australian GP visit estimates and supplemental cost data for GPs visits from a study by Colagiuri et al.,[28] it was estimated that the obese population had 19 per cent to 37 per cent higher GP visit costs (depending on obesity class levels) than non-obese people. This leads to a marginal cost of about $255 million per year in GP visits due to obesity of which 87 per cent is allocated to the Commonwealth government. The individual contribution is based on the estimated (19 to 37 per cent) increase in GP visit costs and statistics showing that about 20 per cent of GP visits are not bulk-billed and when patients pay, it is an average contribution of $30 in 2011-12 (2014-15 dollars).[29]

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[27] Valenti, L. (2008). *The management of overweight and obesity in adults attending general practice in Australia*, Masters of Medical Studies submitted to Centre for Clinical Epidemiology and Biostatistics (CCEB), University of Newcastle.

[28] Colagiuri, S., Lee, C.M., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264.

[29] Australian Government Department of Health, *Annual Medicare Statistics - Financial year 2007-08 to 2013-14,* 'Table 2 National figures', Retrieve on March 2015 from http://health.gov.au/internet/main/publishing.nsf/Content/34A89144DB4185EDCA257BF0001AFE29/$File/MBS%20Statistics%20Financial%20Year%202013-14%20external%2020140718.xlsx

3.2 Allied health visits

Results from the National Health Survey show that 23 per cent of obese respondents consulted an 'other healthcare professional' in the last 12 months, slightly more than 23 per cent for the not overweight/obese.[30] A 2008 Australian study looked at GP, allied health and specialist visits (where overweight or obesity was managed) for obese and overweight patients and compared to the overall adult average, they had a much higher rate of referrals to allied health services with the majority being for nutritionist/dietitian services.[31] Results from the Colagiuri et al. study found that the obese population had 18 to 40 per cent higher allied health visit costs (depending on obesity class levels) compared to the non-obese.[32] Based on this, the additional allied health costs in 2011-12 were $125 million due to obesity of which the Commonwealth covers about 97 per cent.

3.3 Specialist visits

Results from the National Health Survey show that 40 per cent of obese respondents consulted a specialist in the last 12 months, compared to 33 per cent for the not overweight/obese.[33] The 2008 Australian study[34] looked at GP, allied health and specialist visits (where overweight or obesity was managed) for obese and overweight patients actually found that the rates for specialists visits referrals was not higher for the obese and overweight population. However, results from the Colagiuri et al.[35] study found that the obese population had 24 to 57 per cent higher specialist visit costs (depending on obesity class levels) compared to the non-obese. Based on this, the additional specialist costs in 2011-12 were $297 million due to obesity, of which the Commonwealth covers about 81 per cent.

3.4 Hospital care

Although some studies have shown that hospital stays for obese patients are longer for some specialties and shorter for others, overall average hospital care costs per year are higher for obese patients than those who are not obese.[36] As with GP services, Table 3.4.1 shows there is an increased likelihood of hospital use in the last 12 months as BMI increases.

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30 Australian Bureau of Statistics (2013). *Australian Health Survey: Health Service Usage and Health Related Actions, 2011–12*, 'Table 5.3 Selected health risk factors by health service usage and health actions taken(a), Proportion of estimate ', time series spreadsheet, cat. no. 4364.0.55.002. Retrieved March 2015 from http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/03AE249118F2D72FCA257B4B0014C0A1/$File/43640d0005_2011 2012.xls

31 Valenti, L. (2008). *The management of overweight and obesity in adults attending general practice in Australia*, Masters of Medical Studies submitted to Centre for Clinical Epidemiology and Biostatistics (CCEB), University of Newcastle.

32 Colagiuri, S., Lee, C.M., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264.

33 Australian Bureau of Statistics (2013). *Australian Health Survey: Health Service Usage and Health Related Actions, 2011–12*, 'Table 5.3 Selected health risk factors by health service usage and health actions taken(a), Proportion of estimate ', time series spreadsheet, cat. no. 4364.0.55.002. Retrieved March 2015 from http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/03AE249118F2D72FCA257B4B0014C0A1/$File/43640d0005_2011 2012.xls

34 Valenti, L. (2008). *The management of overweight and obesity in adults attending general practice in Australia*, Masters of Medical Studies submitted to Centre for Clinical Epidemiology and Biostatistics (CCEB), University of Newcastle.

35 Colagiuri, S., Lee, C.M., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264.

36 Hauck, K., Hollingsworth, B. (2010). The impact of severe obesity on hospital length of stay. *Medical Care*. 48(4): 335-340.

Table 3.4.1 Use of medical facilities in the last 12 months, 2011-2012

Category (measured BMI)	Admitted to hospital as inpatient	Visited an outpatient clinic	Visited emergency/casualty
Not overweight	11.9%	7.2%	10.1%
Overweight	12.7%	8.2%	11.8%
Obesity class I	14.5%	9.0%	11.5%
Obesity class II	17.7%	10.0%	14.2%
Obesity class III	20.9%	14.9%	19.4%

Source: Australian Bureau of Statistics (2015). Customised report. *Australian Health Survey: Health Service Usage and Health Related Actions, 2011–12 — Australia*

The average increases in inpatient, outpatient and emergency department costs per obese person were estimated for obesity class levels I, II and III using the National Health Survey responses; a 2014 Australian study by Buchmueller and Johar, which estimated the relationship between obesity and health expenditures in Australia;[37] and a 2005 study from the US that estimated the hospital cost difference between obesity class level II and III.[38] The Buchmueller and Johar study is based on administrative health care claims for public and private hospitals for the period 2006–2009 for adults 45 and over, and the analysis captures the additional health care expenditures incurred by obese individuals as a result of their co-morbidities as well as acute health care episodes. For individuals aged 18 – 44 years, the results for the older cohort were adjusted down using the proportions of national health care spend averages per age group.[39] There is an estimated additional $1.2 billion in hospital care costs for obese patients.

The majority of costs for hospital inpatient and emergency departments are covered by the state and territory Governments, with the federal Government funding the outpatient services. Individual contributions of 15 per cent were estimated using national average individual funding estimates per person for private and public hospitals.[40] Private health insurance contribution of 34 per cent was estimated using the national average health expenditure for private health insurers (hospital and hospital ancillary) and multiplied by the per cent increase found in hospital care.

3.5 Additional hospital care costs

Hospitals are investing in more costly infrastructure and bariatric equipment to treat more severely obese patients. There is a large range of equipment that is designed to support these patients such as reinforced beds, pressure mattresses, chairs, wheelchairs, specialised toilets and shower chairs, hoists, lifters, etc. The specialised equipment is important to the safety of obese patients as well as hospital staff who are at a higher risk of manual handling injuries.

It is unclear how much each state and territory is investing in bariatric equipment on an annual basis, however, the costs are likely to be considerable as many products appear to be two to three time more expensive than 'regular' equipment. For example Manning Base Hospital in Taree has invested in bariatric patient beds that can hold up to 350kg for 20 per

37 Buchmueller, T.C., Johar, M. (2015). Obesity and Health Expenditures: Evidence from Australia. *Economics and Human Biology*. Retrieved from http://dx.doi.org/10.1016/j.ehb.2015.01.001.

38 Arterburn, D.E., Maciejewski, M.L., and Tsevat, J. (2005). Impact of morbid obesity on medical expenditures in adults. *International Journal of Obesity*. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15685247

39 Australian Institute of Health and Welfare. *2.2. How much does Australia spend on health care?* Retrieved April 2015 from http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129547594, p.10

40 Australian Institute of Health and Welfare. *AIHW health expenditure database 2010-11.*

cent of their beds.[41] These beds range in costs however appear to be about three times more expensive than a regular patient bed at $3,000.

In 2011-12 there were over 56,000 public hospital beds in Australia.[42] If the public hospitals invested in bariatric beds for 20 per cent of public beds (like Manning Base), that would have meant an additional cost of over $67 million for states and territories. If each of these beds included a pressure mattress at an additional cost of about $250, that would add another $2.8 million to the estimate.

Ambulance services across the country have been investing in trucks and equipment specially designed for transporting severely obese patients. There appeared to be at least 30 bariatric ambulances in Australia in 2011-12 at an additional cost of about $140,000 per vehicle (double that of a regular ambulance).[43] That would have meant additional spending of $4.2 million for states and territories for ambulance upgrades.

Despite investments in heavy lifting equipment, additional staff are often needed to assist severely obese patients. A public analysis by Bendigo Health[44] estimates that 4 to 6 staff are needed to turn a bariatric patient (using lifting equipment) compared to 2 for a patient of average weight (80kg). The Bendigo Health analysis also estimates that bariatric rooms being built in new hospitals are about 20 per cent larger than standard patient rooms. These additional staff needs, related manual handling injuries and larger rooms lead to further operating and infrastructure costs for hospitals.

As mentioned above, it is unclear how much each state and territory is spending on an annual basis for bariatric equipment and infrastructure, so these costs have not been included in the overall cost of obesity estimate.

3.6 Cost of pharmaceuticals

Average pharmaceutical care costs per year are higher for obese individuals than non-obese individuals. The average increased cost per obese person is estimated at $378 to $868 in 2014-15 dollars (depending on the obesity class) using results from the Buchmueller and Johar study for those aged 45 years and older. For individuals aged 18 – 44 years, the results for the older cohort were adjusted down using the proportions of national health care spend averages per age group and range from $129 to $295 in 2014-15 dollars depending of the class of obesity.[45]

Several other studies were referenced to test that the cost assumptions on pharmaceuticals are reasonable. As a reference point, in 2000-01, research estimated that about $334 (in 2014-15 dollars) per person with diabetes was spent on just diabetes medications (insulins and analogues and oral blood glucose lowering agents).[46] Another study, using 2004 data,

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41 Nurse Uncut (2011, May 3). Bariatric patients: nursing are and specialist equipment. *Nurse Uncut*. Retrieved from http://www.nurseuncut.com.au/bariatric-patients-nursing-care-specialist-equipment/

42 Australian Institute of Health and Welfare. *Australian Hospital Statistics 2011-2012*.

43 Gold Coast Bulletin (2014, June 28). Obesity on the Gold Coast costing millions in extra resources for hospitals. *Gold Coast Bulletin*. Retrieved on http://www.goldcoastbulletin.com.au/news/obesity-on-the-gold-coast-costing-millions-in-extra-resources-for-hospitals/story-fnj94j0t-1226969546697; Riotact (2009, July 31). ACT Ambulances get a fatter lifter. *Riotact*. Retrieved from http://the-riotact.com/act-ambulances-get-a-fatty-lifter/13133; The Queensland Times (2010, November 18). Taking weight off ambos. *The Queensland Times*. Retrieved from http://www.qt.com.au/news/taking-weight-off-ambos-ipswich-obesity/700554/; Australian Financial Review (2014), 'Fat trucks and big beds: how obesity weighs heavily on the health system', http://www.afr.com/business/health/pharmaceuticals/fat-trucks-and-big-beds-how-obesity-weighs-heavily-on-the-health-system-20140202-iy54i

44 Bendigo Health, *Impact of unhealthy behaviours on our hospital system*. Retrieved from http://docs.health.vic.gov.au/docs/doc/03F3350EB68BF48CCA257D64000E4009/$FILE/John%20Mulder%20Cost%20of%20unhealthy%20behaviours%20.pdf

45 AIHW disease expenditure database 2008-09 cited in AIHW, '2.2. How much does Australia spend on health care?', viewed April 2015, http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129547594, p.10

46 Dixon T (2005). *Costs of diabetes in Australia, 2000-01*. Bulletin No. 26. AIHW Cat. No. AUS 59. Canberra: AIHW.

found that annual pharmaceutical costs of obese patients with atherothrombotic disease were $227 (in 2014-15 dollars) higher than those of normal-weight patients.[47]

The estimated annual cost of pharmaceuticals due to obesity is $1.4 billion, with the majority of costs going to the Commonwealth government. The individual costs of 6 per cent were estimated using the national individual contribution estimates for benefit–paid pharmaceuticals[48] and the estimated per cent increase in cost per obese person calculated using the Buchmueller and Johar study mentioned above.

3.7 Weight loss interventions

The cost of personal investments in weight loss is significant. IBISWorld estimated that Australians spent $6.6 billion[49] on weight loss industries such as gym memberships, sporting goods, low-calorie foods and beverages, weight loss counselling, and weight loss supplements meaning that Australians spend on average $400 for these goods and services. Of that $6.6 billion, the estimated spending on weight loss counselling services and related low-calorie foods and dietary supplements was $613.5 million in 2013-14. It would be difficult to estimate the additional spending from obesity on things like gym memberships and sporting gear as non-obese people would use these services/products regularly as well. However it is assumed that the majority (80 per cent) of spending on weight loss counselling services and related low-calorie foods and dietary supplements was from overweight or obese populations, leading to a cost of $209 million per year (or $47 person) for obese individuals.

Data from IMS health shows that over 600,000 units of weight loss drugs (Xenical®, Duromine® and Metermine®) was sold in Australia in 2014. Assuming the majority of these were purchased by obese individuals, obese people spend approximately $60.3 million on weight loss drugs per year.

The main medical weight loss intervention is bariatric surgery, which has increased in use with the rise of obesity in Australia. In 1998-99 there were 500 separations for bariatric surgery recorded, compared to an estimated 17,000 in 2007-08.[50]

In 2013-14 there were over 100,000 MBS claims related to bariatric procedures, with the majority of these related to adjustments. Almost all of bariatric procedures are conducted in private hospitals (as the procedures are often considered cosmetic) and most patients have private health insurance.[51] An AIHW report on weight loss surgery found that in 2007-08, eleven per cent of bariatric surgeries (with an average cost of $15,500) were paid out of pocket by the individual, whereas the 82 per cent of bariatric surgery patients who had private health insurance paid an average gap of $4,500.[52] It is assumed that the same proportion of patients had private health insurance for bariatric surgery in 2011-12.

The cost of bariatric surgery due to obesity is estimated to be $321 million in 2011-12. The cost to government is $42 million and private health insurance is $182 million and assumed to be included in claims data and overall averages for hospital care costs (discussed above); therefore, government and private health expenditure on bariatric surgery has not been

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47 Ademi, Z., Walls, H.L., Peeters, A., Liew, D., Hollingsworth, B., Stevenson, C., Steg, P.-G., Bhatt, D.L., Reid, C.M. (2010). Economic implications of obesity among people with atherothrombotic disease. *International Journal of Obesity*. 34 (8):1284-1292.

48 Australian Institute of Health and Welfare. *AIHW health expenditure database 2010-11*.

49 IbisWorld (2015). *Weight loss services in Australia*.

50 Australian Institute of Health and Welfare (2010). *Weight loss surgery in Australia*. Cat. no. HSE 91. Canberra: AIHW. Retrieved March 2015 from http://www.aihw.gov.au/publication-detail/?id=6442472385

51 Korda et al (2012). Inequalities in bariatric surgery in Australia: findings from 49 364 obese participants in a prospective cohort study. *Medical Journal of Australia*. 197 (11): 631-636

52 Australian Institute of Health and Welfare (2010). *Weight loss surgery in Australia*. Cat. no. HSE 91. Canberra: AIHW. Retrieved March 2015 from http://www.aihw.gov.au/publication-detail/?id=6442472385

included separately in cost estimates. However, the individual costs associated with these procedures of $97 million or 30 per cent of the total do not appear to be included in referenced overall individual contribution national hospital care expenditure averages and so these costs have been added to overall individual obesity costs.

Individuals who receive private health insurance funding for bariatric procedures are also likely to pay higher than average insurance premiums as such procedures are not covered by some basic hospital covers. BUPA, the second largest private health insurer in Australia, provides rebates for bariatric procedures in their standard and top hospital cover,[53] while HCF provides such cover in their top hospital cover.[54] As a result, individuals who receive private insurance funding for bariatric procedures are estimated to pay 8 per cent higher private health insurance premiums, which amounts to a total additional cost of $1.4 million per year (2014-15 dollars) to individuals.

The total cost for weight loss interventions, including bariatric procedures and weight loss goods and services is $368 million (excluding government and private health insurance contributions to bariatric procedures).

3.8 Public obesity interventions

It is assumed that there is an annual government spend of $145 million per year ($154 in 2014-15 dollars) for obesity prevention based on the $872 million made available from 2009-10 to 2014-15 through the National Partnership Agreement on Preventive Health to address obesity and overweight, physical inactivity and poor diet.[55]

53 BUPA. *Compare health cover*. Retrieved from http://www.bupa.com.au/health-insurance/compare-health-covers

54 HCF. *Health insurance that puts you first*. Retrieved from http://www.hcf.com.au/pdf/hcf_health_insurance_brochure.pdf

55 Australian Government (2010). *Taking Preventative Action – A Response to Australia: The Healthiest Country by 2020*. The Report of the National Preventative Health Taskforce. Retrieved from http://www.preventativehealth.org.au/internet/preventativehealth/publishing.nsf/Content/6B7B17659424FBE5CA25772000095458/$File/tpa.pdf

4 Indirect costs

The indirect, or hidden, costs of obesity include productivity losses through absenteeism and presenteeism and the cost of government transfers in the form of subsidy payments and forgone tax revenue.

4.1 Absenteeism

Absenteeism is decreased worker productivity through absences from work and has been linked to obesity in Australia. The Australian Work Outcomes Research Cost–Benefit study found that absenteeism is associated with an adjusted relative risk ratio of 1.05 for obesity.[56]

A previous National Health Survey based on 2001 results found that obese employees were 17 per cent more likely to have been absent from work than non-obese employees.[57] Additionally, for those who were absent for personal illness or injury, the average absence was longer for obese employees (3.8 days) than non-obese employees (3.0 days).

The 2011-12 survey results in Table 4.1.1 shows that people are more likely to have been absent from school or work in the last two weeks as BMI levels increase. This data was used to estimate absenteeism levels for the obese population in Australia which led to an estimate of $477 million for absenteeism in 2011-12 due to obesity.

Table 4.1.1 Absence from work or school, 2011-12

Category (measured BMI)	Had time away from school/study or work in the last 2 weeks due to own illness or injury
Not overweight	10.9%
Overweight	11.1%
Obesity class I	12.1%
Obesity class II	15.3%
Obesity class III	14.7%

Source: Australian Bureau of Statistics (2015). Customised report. *Australian Health Survey 2011-12: Health Service Usage and Health Related Actions, 2011–12 — Australia.*

4.2 Presenteeism

Presenteeism is defined as the lost productivity that occurs when employees come to work but, as a consequence of illness or other medical conditions, are not fully functioning. The Australian Work Outcomes Research Cost–Benefit study found that presenteeism is associated with an adjusted relative risk ratio of 1.15.[58]

In 2007, Econtech undertook a study to estimate the cost to the Australian economy of productivity losses due to presenteeism in the workplace, considering 12 different medical

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56 Holden et al (2011). Which Health Conditions Impact on Productivity in Working Australians? *Journal of Occupational and Environmental Medicine*. 53(3): 253-357.

57 Australian Institute of Health and Welfare (2005). *Obesity and workplace absenteeism among older Australians*. Bulletin No. 31. AIHW Cat. No. AUS 67. Canberra: AIHW

58 Holden et al (2011). Which Health Conditions Impact on Productivity in Working Australians? *Journal of Occupational and Environmental Medicine*. 53(3): 253-357.

conditions, including five that have clear links to obesity: cancer, diabetes, heart disease, hypertension, and back, neck or spinal problems.[59] Using the estimates from this report, along with estimates on the extent to which high BMI was responsible for burden of disease, it is estimated that 0.94 per cent of total labour productivity loss due to presenteeism is attributable to obesity. This results in a total obesity cost of presenteeism of $544 million in 2011-12.

4.3 Government subsidies

Although government subsidies are not formally included in a cost benefit analysis of this kind, they form a valuable decision-making evidence base for government when considering new/refined policies. As such, we have included these costs as part of the economic analysis, noting that these indirect costs make up less than 4% of the total costs associated with obesity in Australia.

4.3.1 Disability payments

There is a strong correlation between obesity and disability; extreme levels of obesity can lead to impaired functionality, and at the same time, certain disabilities may lead to obesity through limited mobility and other side effects. This relationship was formally recognised in December 2014 when the Court of Justice of the European Union ruled that obesity could be categorised as a disability if it impacts the individual's performance at work.[60]

Results from the 2012 Ausdiab study show that the prevalence of disability in respondents aged 60 years and over was 46 per cent for obese individuals, more than double the rate for normal BMI respondents.[61] Although there is a clear correlation between obesity and disability, it is difficult to ascertain causality and identify the level of disability that is directly related to obesity. However, using the National Disability Support Pension Guidelines and Characteristics report,[62] results from the 2012 Disability, Ageing and Carers, Australia Summary of Findings,[63] and obesity relative risk ratios for main conditions such as diabetes, heart disease[64] and lower back pain,[65] it was estimated that 1.5 per cent of people under 65 years identified as having class III obesity receive the disability support pension due to obesity. This leads to an additional cost of $133 million to the federal government.

4.3.2 Carer costs

Additionally, it is likely that at home support is needed for the morbidly obese population that have severe mobility issues or a disability because of obesity (e.g. complications from multiple comorbidities). This care could be delivered informally by a family member or formally through services such as Home and Community Care. In either situation, caring services can lead to additional costs associated with obesity. However, there was insufficient information to estimate the additional carer costs due to obesity in Australia. Although carer costs have not been monetised in this analysis, there are a number of costs that impact both

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59 Econtech (2007). Economic Modelling of the Cost of Presenteeism in Australia. Prepared for Medibank Private.

60 Reuters (2014), Obesity can be deemed a disability at work: EU court. Retrieved from http://www.reuters.com/article/2014/12/18/us-eu-courts-obesity-idUSKBN0JW11620141218

61 Australian Diabetes, Obesity and Lifestyle (AusDiab) study 2012.

62 Australian Government Department of Social Services (2013). Characteristics of Disability Support Pension Customers.

63 Australia Bureau of Statistics (2013). *Disability, Ageing and Carers, Australia: Summary of Findings,* 2012, cat. no. 4430.0, Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4430.02012?OpenDocument

64 Australian Institute of Health and Welfare (2003). *The burden of disease and injury in Australia 2003*. Cat. no. PHE 82. Canberra: AIHW.

65 Queensland Health. Burden of disease: a snapshot in 2013

an individual and the government, including out-of pockets costs for carer support, the foregone time for carers to provide this support, and access to government subsidies, such as the carer payment.

Some context on the magnitude of these costs is provided through a study by Colagiuri et al which found that about 10 per cent of survey respondents with type 2 diabetes reported having a carer.[66] The majority of these people received care from a family member. The study also found that there was a large range in the weekly hours, with a mean of 36 hours per week. Although the majority of carers (63 per cent) appear to have been collecting a pension of some kind, it is unclear how much of government funding would go to support these carers for just the diabetes related care. Further, it appears that the major cost was in terms of time, (which is borne by the family members who provide the care), with only one per cent of carers nominating themselves as professional carers, 12 per cent receiving the Carer Payment and 14 per cent receiving Carer Allowance.

4.3.3 Unemployment

Severe obesity impacts people's mobility and ability to work. Aside from the estimated 1.5 per cent of people who are assumed to be on disability pension, obesity is thought to considerably impact people's ability to participate in the workforce.[67] Labour force data from the 2011-12 Australian Health Survey shows that the unemployment rates for obese and non-obese are very similar at around 3.9 per cent.[68] However, supplementary data from a study by Colagiuri et al.[69] showed that people at class III obesity (albeit small sample sizes) were much more likely to collect unemployment subsidies than non-obese individuals and individuals classified as having class I or II obesity. Additionally the class I and II obese populations had on average lower unemployment benefit costs than non-obese. This shows that the additional obesity class III unemployment costs could be hidden when looking at overall obesity averages which will be brought down by class II and III costs. Based on data from the Colagiuri study, it is estimated that the obesity class III population has on average 231 per cent higher unemployment costs than non-obese leading to an additional cost of $190 million to the Commonwealth government.

4.4 Foregone earnings

The Australian Health survey shows that obese people have, on average 4.4 per cent lower labour force participation and 4.2 per cent lower employment rates than non-obese people.[70] In theory this is indicative of additional foregone earnings cost to the individual stakeholder group, who are not working because of their obesity. Forgone earnings due to obesity may be generated because a person is too physically or mentally impaired to work productively, or it may come in the form of employment or education discrimination against obese individuals. There are various international studies that show obesity can have an impact on people's

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66 Diabetes Australia (2003). Assessing the burden of Type 2 Diabetes in Australia, Diabetes Australia. Canberra: Diabetes Australia.

67 Morris S. (2004). The Impact of Obesity on Employment in England.UK: Tanaka Business School.

68 Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12*, 'Table7.3 Body Mass Index by selected population characteristics, Proportion of persons', cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

69 C Colagiuri, S., Lee, C.M., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264.

70 Australian Bureau of Statistics (2013*), Australian Health Survey: Updated Results, 2011-12*, 'Table7.3 Body Mass Index by selected population characteristics, Proportion of persons', cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

ability to be employed[71] and the Business Council of Australia found that there is a clear link between increasing chronic disease and decreasing workforce participation.[72]

Based on an average salary in Australia in 2011-12 of $75,237 (2014-15 dollars, minus tax and disability payments for the population receiving that benefit) there is a potential foregone earnings cost of $11.8 billion. This is likely to be a conservative estimate because it does not include the effects of educational and workplace discrimination on the working obese population's salary potential.

As noted in section 2.2, there is insufficient information about potential subsidies or other support to reliably estimate the cost of these forgone earnings, however, there is evidence that it presents a considerable additional cost of obesity to the individual stakeholder group.

4.5 Foregone taxes

As discussed in section 4.4, obese people have on average lower labour force participation and employment rates. The government is not collecting income tax on this obese population that are not participating in the workforce. Based on the lower workforce participation rate of 4.4 per cent, as well at the 1.5 per cent of obese (class III under 65) assumed to be collecting disability pension, there is an estimated $3.4 billion in foregone tax costs to government. To complete this analysis we have drawn on average wage and tax information. Given the prevalence of obesity impacts more so on lower socio economic areas, this estimate may overstate the impact of foregone tax.

[71] Morris S. (2004). The Impact of Obesity on Employment in England.UK: Tanaka Business School; Klarenbach S., Padwal S., Chuck A., Jacobs P. (2006). Population-Based Analysis of Obesity and Workforce Participation. *Obesity*. 14:920–927.

[72] Mitchell Institute (2014), Chronic diseases in Australia: the case for changing course, Background and policy paper, Australia: *Mitchell Institute*. Retrieved from http://www.mitchellinstitute.org.au/wp-content/uploads/2014/10/Chronic-diseases-in-Australia-the-case-for-changing-course-sharon-willcox.pdf

5 Health and wellbeing costs

Obesity clearly has a negative impact on an individual's health and wellbeing, with direct links to health care complications, lower quality and length of life, and mental wellness issues. An estimate based on the 2013 Herald/Age Lateral Economics Index of Australia's Wellbeing found that obesity costs Australia $120 billion in collective wellbeing a year.[73] This figure includes many measures outside of the scope of this analysis and cannot be considered for direct comparison; however, it illustrates the negative impact obesity has on health and wellbeing for Australia.

5.1 Disability adjusted life years

The impacts of obesity on wellbeing include premature mortality and the incidence of multiple co-morbidities, which create a complex situation with negative impacts on health and quality of life. A disability adjusted life year (DALY) is a measure of the burden of disease, which captures these impacts, where a DALY is the loss of one year of healthy life. It is calculated for a disease by summing the years of life lost (YLL) due to premature mortality in the population and the years lost due to disability (YLD).[74]

With respect to premature mortality, one meta-analysis of international studies found that all-cause mortality is 1.22 times higher for obese people than for those of normal weight.[75] Another international study found that mortality increases with the level of severity, with those having a BMI of 40-45 and BMI of 55-60 losing an estimated 6.5 and 13.7 years of life respectively.[76]

In Australia, the AIHW found that high BMI was responsible for 7.2 per cent (or around 9,500 deaths) of total deaths in Australia in 2003,[77] and obesity is now thought to be one of the leading causes of premature mortality in Australia.[78]

There is a similarly large body of evidence that attributes obesity to chronic disease.

- An AIHW report found that in 2003, high body mass was responsible for:
  - 19.5 per cent of the cardiovascular disease burden of disease in Australia
  - 54.7 per cent of the type 2 diabetes burden of disease in Australia
  - 3.9 per cent of the cancer burden of disease in Australia.[79]

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73 The Sydney Morning Herald (2013). Obesity costs drag down national good'. *The Sydney Morning Herald.* Retrieved from http://www.smh.com.au/national/health/obesity-costs-drag-down-national-good-20130308-2frob.html

74 World Health Organization. Metrics: Disability-Adjusted Life Year (DALY). Retrieved from http://www.who.int/healthinfo/global_burden_disease/metrics_daly

75 McGee, D.L. (2005). Body mass index and mortality: a meta-analysis based on person-level data from twenty-six observational studies. *Annals of Epidemiology*. 15(2): 87-97.

76 Kitahara et al. (2014). Association between Class III Obesity (BMI of 40-59 kg/m^2) and Mortality: A Pooled Analysis of 20 Prospective Studies. *PLoS Medicine*. 11 (7). art. no. e1001673.

77 Australian Institute of Health and Welfare (2003). *The burden of disease and injury in Australia 2003*. Cat. no. PHE 82. Canberra: AIHW.

78 The Age (2010), Obesity is now more deadly than smoking. *The Age*. Retrieved from http://www.theage.com.au/lifestyle/diet-and-fitness/obesity-is-now-more-deadly-than-smoking-20100408-rv5l.html

- One study found that the odds of developing arthritis or osteoarthritis were up to seven times higher for obese individuals, compared with those classified as underweight/normal weight.[80]
- A NSW retrospective study found a clear link between and BMI and sleep apnoea events.[81]

Considering both premature mortality and reduced quality of life, the AIHW found that high BMI was responsible for 7.5 per cent of the attributable burden of disease or about 200,000 DALYs in Australia in 2003.[82] A 2013 report by Queensland Health found that the leading risk factors for the burden of disease in Australia were dietary risks (10.5 per cent) and high body mass (8.4 per cent). Further, it found that 10.4 per cent of low back pain, the leading causes of years lost due to disability in 2010, is attributed to high body mass.[83]

To estimate the DALYs lost for 2011-12, the AIHW estimate from 2003 was taken as a basis and updated with a risk factor of 8.4 per cent for high body mass and the respective population level. The result was 258,573 DALYs lost in 2011-12 due to obesity, with an estimated economic cost of $47.4 billion (using a value of statistical life year of $183,000).[84]

5.2 Depression

There is a clear link between obesity and mental health. Results from the 2012 Ausdiab study show that the prevalence of depression in obese people was almost twice as high as those who are not obese.[85] Like the Ausdiab study, many studies have shown that obese people are more likely to be depressed. However, causality is not always clear; in some cases, depression may lead to obesity.

The estimate of the health and wellbeing costs of obesity may partially account for depression experienced as a result of obesity; however, there are likely additional costs that are not included in the calculation.

5.3 Discrimination

There is strong international research that shows people with obesity are discriminated against in many areas including education, employment and medical interactions. The stigma around obesity may lead to poorer mental health outcomes[86] and increased obesity for patients.[87]

The Australian literature shows that the international trend of obesity discrimination is relevant for Australians, particularly women. An Australian study found that obese women

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79 Australian Institute of Health and Welfare (2003). *The burden of disease and injury in Australia 2003*. Cat. no. PHE 82. Canberra: AIHW.

80 Ackerman, I.N. and Osborne, R.H. (2012). Obesity and increased burden of hip and knee joint disease in Australia: Results from a national survey. *BMC Musculoskeletal Disorders*, p. 254. Article in Press.

81 Ozeke, Ozcan et al. (2011). Chronic intermittent hypoxia caused by obstructive sleep apnea may play an important role in explaining the morbidity-mortality paradox of obesity. *Medical Hypotheses*. 76(1):61–63.

82 Australian Institute of Health and Welfare (2003). *The burden of disease and injury in Australia 2003*. Cat. no. PHE 82. Canberra: AIHW.

83 Queensland Health. *Burden of disease: a snapshot in 2013*.

84 Based on Department of the Prime Minister and Cabinet (2014), *Best Practice Regulation Guidance Note: Value of statistical life*.

85 Australian Diabetes, *Obesity and Lifestyle (AusDiab) study 2012*.

86 Puhl RM, Heuer CA (2010). Obesity stigma: important considerations for public health. *American Journal of Public Health*, 100(6):1019-28.

87 Sutin AR, Terracciano A (2013) Perceived Weight Discrimination and Obesity. *PLoS ONE*, 8(7): e70048. doi:10.1371/journal.pone.0070048.

applying for a job were discriminated against when compared to non-obese applicants.[88] Another study found that participants felt an increasing culture of blame around obesity and had been humiliated by health professionals because of their weight.[89]

To the extent that obese people are not employed as a result of discrimination, this cost is partially included in the cost estimates of forgone taxes and earnings for obese people who are not working. However, the costs of discrimination clearly exceed these estimates including the potential for lower earnings resulting from educational discrimination and fewer job promotions.

88 O'brien, K., Latner, J., Ebneter, D., & Hunter, J. (2013). Obesity discrimination: The role of physical appearance, personal ideology, and anti-fat prejudice. *International Journal of Obesity*, 455-460.

89 Thomas S.L., Hyde J., Karunaratne A., Herbert D., Komesaroff P.A. (2008). Being 'fat' in today's world: A qualitative study of the lived experiences of people with obesity in Australia. *Health Expectations*. 11:321-30.

6 Obesity interventions

Highlighted obesity interventions

There is significant existing research that has outlined the various behavioural, pharmacological, surgical or environmental interventions that can be used to take on obesity. Potential options for Australia are well documented in the '*Obesity in Australia: A Need for Urgent Action'* report as part of the *Australia: the healthiest country by 2020* strategy from the then Australian Preventative Health Taskforce. Additionally in 2009, the Standing Committee on Health and Ageing released the *Weighing it up: Obesity in Australia* which includes a discussion of potential intervention options and 20 official recommendations. In 2010, the Boden Institute issued a report[90] that looked at interventions to address obesity on a population level and in 2013 a review[91] by the Sax institute assessed whole of government obesity prevention interventions. The 2010 ACE-Prevention[92] report analysed the cost effectiveness of non-communicable diseases prevention interventions for Australia.

The Lancet published its second series on obesity in early 2015 and some examples of the interventions that are being tried globally include: restriction of the marketing of food aimed at children, regulation of food nutritional quality and availability in schools, labelling of the front of packages with nutritional values, taxes on sugar-sweetened beverages, mass media campaigns, provision of financial incentives to improve food retail environments, private–public partnerships to encourage food industry reformulation, and inclusion of health-in-all-policies approaches by governments. [93]

A set of potential obesity interventions for this analysis were identified based on a high level literature scan. PwC did not conduct a cost effectiveness analysis of all of potential obesity interventions. The key sources used as a basis for potential cost effective intervention options were the ACE report and a recent economic analysis of obesity interventions by McKinsey Global Institute[94]. Both reports have strengths and limitations. The authors needed to rely on the best evidence available and sometimes speculative analysis as population wide interventions are difficult to evaluate. Potential interventions identified in the ACE and McKinsey reports were then further discussed and selected with Obesity Australia and subject matter experts based on potential cost effectiveness, feasibility and strength of evidence under the four major categories shown in figure 6.1:

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90 National Health and Medical Research Council (NHMRC) (2010). *A "state of the knowledge" assessment of comprehensive interventions that address the drivers of obesty: A Rapid Assessment.* University of Syndey. Retrieved from https://www.nhmrc.gov.au/_files_nhmrc/file/your_health/obesity/boden_report_rapid_assessment_december_2010.pdf

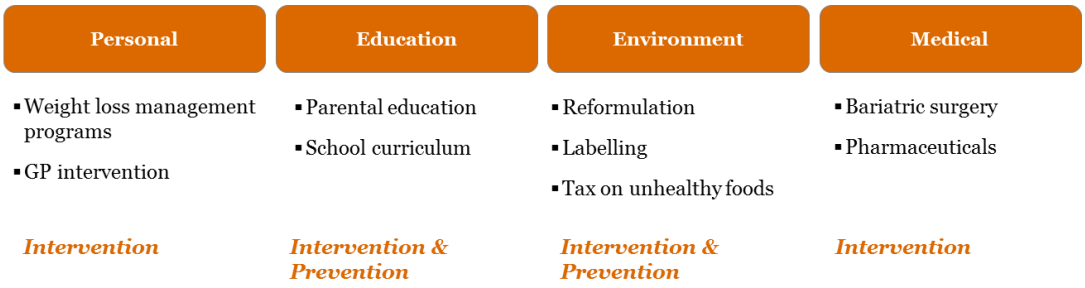
91 Gill, T., Hector, D., Rissel, C., Trieu, K., Zhong, A., O'Hara, B., and Bauman A. (2013). Whole of government obesity prevention interventions. *Sax Institute.* Retrieved from https://www.saxinstitute.org.au/publications/whole-of-government-obesity-prevention-interventions/

92 Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention.* Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

93 The Lancet (2015), *Obesity 2015*. Retrieved from http://www.thelancet.com/series/obesity-2015

94 McKinsey Global Institute (2014). *Overcoming Obesity: An initial economic analysis.* Retrieved from http://www.mckinsey.com/~/media/McKinsey/dotcom/Insights/Economic%20Studies/How%20the%20world%20could%20better%20fight%20obesity/MGI%20Obesity_Full%20report_November%202014.ashx.

Figure 6.1 Obesity interventions and categories



The selected interventions are meant to highlight a variety of cost effective options and provide a scale of potential impact. This is not a comprehensive list of options and it is not the intention of this report that one intervention or category be prioritised over others. A selection of the best interventions for Australia is outside the scope of this project and as mentioned above, has been thoroughly covered in previous evaluations. Many reports[95] on nation-wide obesity strategies suggest a comprehensive and integrated range of interventions and as previously mentioned, some interventions will be more appropriate for some target groups than others.

6.1 Benefits from interventions

Implementing the set of selected obesity interventions to 2025 would cost $1.3 billion and lead to a savings of $2.1 billion to society (in that ten years, in 2015 present value terms) showing a BCR of 1.7. With a conservative approach and with a relatively short term cost benefit analysis of ten years, the results of this analysis shows that cost effective obesity interventions would be a positive investment and break even after six years.

95 National Health and Medical Research Council (NHMRC) (2010). *A "state of the knowledge" assessment of comprehensive interventions that address the drivers of obesty: A Rapid Assessment.* University of Syndey. Retrieved from https://www.nhmrc.gov.au/_files_nhmrc/file/your_health/obesity/boden_report_rapid_assessment_december_2010.pdf; McKinsey Global Institute (2014). *Overcoming Obesity: An initial economic analysis.* Retrieved from http://www.mckinsey.com/~/media/McKinsey/dotcom/Insights/Economic%20Studies/How%20the%20world%20could%20better%20fight%20obesity/MGI%20Obesity_Full%20report_November%202014.ashx; Roberto, C.A., Swinburn, B., Hawkes, C., Huang, T.T., Cost, S.A., Ashe, M., Zwicker, L., Cawley, J.H., and Brownell, K.D. (2015). Patchy progress on obesity prevention: emerging examples, entrenched barriers, and new thinking. *The Lancet.* 385(9985):2400-2409. Retrieved from http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(14)61744-X.pdf

Table 6.1.1 The impact of a set of interventions on the 2025 obese population and cost and benefit between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Change in number of obese by 2025	-100,750	-100,700	-48,150	-249,600
Per cent change in number of obese by 2025	-2.4%	-5.8%	-3.6%	-3.4%
Benefit of interventions between 2015-16 and 2024-25 ($ million)	$750	$790	$550	$2,080
Cost of interventions between 2015-16 and 2024-25 ($ million)	$600	$330	$320	$1,250
BCR				**1.7**

The collective impact from the interventions, however, will not be sufficient to meet the WHO target. Further options and innovations need to be explored and assessed to reach this target, some initial ideas are discussed in section 6.7.

The following sections highlight the assessed interventions and potential impacts. It is assumed that the interventions are in addition to obesity initiatives that are already taking place in Australia. It is important to note that there are continuous enhancements and independent advancements in the extent and effectiveness of obesity related interventions. This research estimates the impact of interventions based on the information known at the time of publication (end of 2015).

Assumptions on intervention impact, cost and weight regain were made using publicly available research results and insights from subject matter experts. The level of evidence available varied greatly between the intervention categories, for example there were many studies that assessed the effectiveness of medical interventions and very few on environmental interventions. Australian studies were prioritised when available and where research is lacking, assumptions were developed using the best available evidence. More detail on the intervention assumptions used for this report can be found in Appendix C. Actual real world impact for obesity interventions will depend on the target groups, participation rates, regain rates, stakeholder buy in, level of investment and support.

6.2 *Personal interventions*

In this category of interventions, weight loss management programs and a GP standard care program that target behaviour change through education and support around healthy eating and physical activity have been selected as part of this scenario.

Weight loss management programs are often commercial, group centred programs. Based on an Australian study it is assumed that the majority of participants lose 9 per cent of body weight in the first year (with varying levels of recidivism in following years).[96]

In a GP standard care program, obese individuals will receive weight loss advice from GPs through multiple visits based on the national clinical guidelines for treating obesity. This consists of regular GP visits to develop a weight loss program and monitor weight loss. It is assumed that the majority of participants lose 5 per cent of body weight in the first year (with varying levels of recidivism in following years) based on the same Australian study. The following table shows the potential impact over 10 years with about 157,400 obese people (between 2 and 3 per cent of obese population each year) participating each year.

Table 6.2.1 Personal interventions impact on the 2025 obese population and cost and benefit between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Change in number of obese by 2025	-87,350	-86,450	-3,100	-176,900
Per cent change	-2.1%	-5.0%	-0.2%	-2.4%
Benefit of interventions between 2015-16 and 2024-25 ($ million)	$640	$680	$30	$1,350
Cost of interventions between 2015-16 and 2024-25 ($ million)	$480	$190	N/A	$670
BCR				**2.0**

Personal interventions are found to be cost effective in the 10 year scope with a BCR of 2.0 and a breakeven point of about 3 years. There will continue to be benefits after the ten year model period. This is estimated to be $14.1 million of benefits per year from 2025 for the first year cohort who participate in personal interventions.

96 Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9

Patient example profile 4 – BCR 0.9

Lauren - 60 years old

BMI 41 (158cm/102 kg) – obesity class III

Lauren works long hours and has gained a lot of weight over last 30 years. As a child and teenager she used to be very active and healthy. Lauren wants to lose a bit of weight to be healthier as a her GP mentioned even a 5 to 10 per cent weight loss would be beneficial.

Additional Costs:
Lauren has higher GP, allied health, hospital outpatient, weight loss intervention and productivity costs.

Interventions to support Lauren
Lauren joins a weight management program and finds the group atmosphere fun and motivational. She learns to manage her cravings when working long hours by selecting healthier foods and was able to lose almost 10 per cent of her weight with help from the program. Lauren's healthcare and productivity costs reduce for a little while before she gains the majority of weight back over a few years.

Impact on Lauren
Although Lauren had a difficult time maintaining the weight loss after leaving the weight loss management program, she has a better understanding of what is healthy. This knowledge helps her from gaining any more weight in the long term.

Patient example profile photo sourced from the Canadian Obesity Network Image Bank

6.3 Educational interventions

In this category of interventions, parental education and school curriculum programs have been selected as part of this scenario. The selected education interventions focus on children but the category could also be relevant for the adult workplace. Although the scope of this report is on adult obesity, it is important to note that childhood obesity is also an issue. Results from the 2007-08 National Health Survey showed that one in four children are overweight or obese. Intervention and prevention during childhood may be one of the most effective ways to prevent adult obesity as 57 per cent of childhood obesity results in adult obesity.[97]

Education interventions also target behaviour change through education and support around healthy eating and physical activity. Parental education programs target families with overweight and obese children and include family therapy sessions conducted by the paediatrician and allied health clinicians. It is assumed that the majority of participants lose 10 per cent of body weight in the first year (with varying levels of recidivism in following years) based on an Australian study.[98]

School curriculum programs mostly target all children at a certain grade or age bracket in schools and so can be a method of intervention and prevention. It is assumed that the majority of participants lose 7 per cent of body weight in the first year (with varying levels of recidivism in following years) based on the ACE childhood obesity report.[99]

The childhood weight loss from these interventions is assumed to be maintained for some participants and prevents obesity or increased obesity severity in adult years. The ten year model only includes two years of intervention and benefit from education interventions as it is assumed that children participate in these programs at aged 10 thus it takes eight years for the first cohorts to become adults at 18. The following table shows the potential impact over

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97 Venn, AJ, Thomson, RJ, Schmidt, MD, Cleland, VJ, Curry, BA, Gennat, HC, and Dwyer, T (2007). Overweight and obesity from childhood to adulthood: a follow-up of participants in the 1985 Australian Schools Health and Fitness Survey. *The Medical Journal of Australia*. 186 (9)

98 Magarey, AM, Perry, RA, Baur, LA, Steinbeck, KS, Sawyer, M, Hills, AP, Wilson, G, Lee, A, and Daniels, LA (2011). A Parent-led Family-focused Treatment Program for Overweight Children Aged 5 to 9 years: The Peach RCT. *The American Academy of Pediatrics*. 127(2):214-22

99 Victorian Government Department of Human Services (2006). *Assessing Cost-Effectiveness of obesity interventions in children and adolescents: Summary of Results'*. ACE-Obesity.

10 years (two years of intervention) with about 155,000 ten year old children (obese and non-obese) participating each year and 29,000 ten year old overweight or obese children benefiting from this program. Per cent reduction and intervention costs and benefits have not been explicitly outlined in the table below as they account for only two years of intervention and so are not directly comparable with the other interventions.

Table 6.3.1 Educational interventions impact on the 2025 obese population and cost and benefit between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Reduction in number of obese by 2025	-750	-800	-1,750	-3,300
BCR				**0.2**

Educational interventions have a BCR of 0.2 and a breakeven point of about 19 years. There will continue to be benefits after the ten year model period. This is estimated to be $3.5 million of benefits per year from 2025 for the first year cohort who participate in educational interventions.

The BCR and break-even point makes it seem that education interventions are not effective which is not the case. There are only two years of intervention impact in the model and the benefits only materialise (in the model) after the impacted children are adults. Education interventions are therefore a longer term prevention investment.

Patient example profile 2 – BCR 1.7

Michael - 35 years old

BMI 32 (185cm/110 kg) – obesity class I

Michael considers himself fit, well and happy. He recently got married, has a child and both he and his wife work full time and often eat out. He works long hours and would like to be healthier. Michael had to visit his GP a few times this year where he found out that he has high cholesterol and blood sugar levels. He was overweight as a child, has tried his whole life to be more healthy and goes to the gym regularly.

Additional Costs:

Michael has slightly higher GP, allied health, hospital outpatient and weight loss intervention costs than the non-obese average.

Interventions to support Michael

Michael's GP suggests a standard care program and helps him with guidelines, coaching and advice throughout the year. This helps Michael achieve a 7 per cent weight loss (drops into overweight) for two years. He regains half of the weight he lost by year 5. Michael had participated in a healthy school education program when he was 9 which helped him from becoming an obese child – this prevented Michael from being obesity class 2 at his age.

Impact on Michael

Despite the weight regain, Michael is still in better health than before the GP program, feels happier and has more energy. He and his wife are now paying more attention to what they eat and cooking more at home.

Patient example profile photo sourced from the Canadian Obesity Network Image Bank

6.4 Medical

In this category of interventions, bariatric surgery and pharmaceuticals have been selected. Medical interventions are considered mostly cost effective with strong evidence for bariatric surgery and mixed results for the currently available pharmaceuticals.[100]Both options are

[100] International Diabetes Foundation. A position statement from the International Diabetes Federation Taskforce on Epidemiology and Prevention. *Bariatric Surgical and Procedural Interventions in the Treatment of Obese Patients with Type 2 Diabetes*. Retrieved from http://www.bakeridi.edu.au/Assets/Files/IDF-Position-Statement-Bariatric-Surgery.pdf ; Vos, T., Carter, R.,

generally not covered through healthcare reimbursement in Australia (unless there are special circumstances). Recognising obesity officially as a disease could potentially help increase coverage in these areas.

The results for pharmaceuticals and bariatric surgery are presented separately as the investments and benefits are so different. However, both are considered to be higher risk than the other interventions because of the potential health complications.

6.4.1 Bariatric surgery

Bariatric surgery is the most effective intervention for severe obesity. The UK National Bariatric Surgery Registry 2014 report[101] found that patients on average lost almost 60 per cent of their excess weight in the first year and by the second year 65 per cent of those with diabetes type 2 no longer had indications of the disease and could stop medication. An Australian study[102] found similar results on a study of public bariatric surgeries, where more than half of patients experienced resolution of comorbidities including type 2 diabetes, hypertension, dyslipidaemia and obstructive sleep apnoea by 18 months. The majority of bariatric surgeries are currently performed in private hospitals and this research shows that the publicly funded procedures are also effective. The intervention effectiveness and the link between obesity and lower socioeconomic status[103] suggest that an increase in publicly funded bariatric surgeries may be worth considering. In the 2014-2015 budget[104] the ACT Government committed $1.03 million over four years for publicly funded bariatric surgeries.

Bariatric surgery is for class III obese and class II people with comorbidities. It is assumed that with public funding that the current number of surgeries per year will increase by 30 per cent and patients will lose on average about 25 per cent of their baseline body weight in the first year (with varying levels of recidivism in following years) based on a five year prospective study.[105] The following table shows the potential impact over 10 years with about 4,200 obese people (less than 0.1 per cent of obese population) participating each year.

Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention; McKinsey Global Institute (2014). *Overcoming Obesity: An initial economic analysis.* Retrieved from http://www.mckinsey.com/~/media/McKinsey/dotcom/Insights/Economic%20Studies/How%20the%20world%20could%20better%20fight%20obesity/MGI%20Obesity_Full%20report_November%202014.ashx

101 Wellbourn, R., Small, P., Finlay, I., Sareela, A., Somers, S., Mahawar, K., Walton, P., and Kinsman R., (2014). Second Registry Report. *The United Kingdom National Bariatric Surgery Registry.* Retreived from http://nbsr.co.uk/wp-content/uploads/2014/11/Extract_from_the_NBSR_2014_Report.pdf

102 Lukas, N., Franklin, J., Lee, C.M.Y., Taylor, C.J., Martin, D.J., Kormas, N., Caterson, I.D., and Markovic, T.P. (2014). The efficacy of bariatric surgery performed in the public sector for obese patients with comorbid conditions. *The Medical Journal of Australia*. 201 (4):218-222

103 National Health Performance Authority (2013). Healthy Communities: Overweight and obesity rates across Australia, 2011-12. *In Focus*.

104 ACT Legislative Assembly Hansard (2014, August 6). *Debates Weekly Hansard,* p. 2140.

105 Magro, D.O., Geloneze, B., Delfini, R., Pareja, B.C., Callejas, F., and Pareja, J.C .(2008). Long-term weight regain after gastric bypass: a 5-year prospective study. *Obes Surg*. 18(6):648–651

Table 6.4.1 Medical interventions (bariatric surgery) impact on the 2025 obese population and cost and benefit between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Change in number of obese by 2025	21,850	-350	-25,900	-4,400
Per cent change	+0.5%	-0.0%	-1.9%	-0.1%
Benefit of interventions between 2015-16 and 2024-25 ($ million)	-$110	$10	$270	$170
Cost of interventions between 2015-16 and 2024-25 ($ million)	N/A	$80	$270	$350
BCR				**0.5**

The bariatric surgery intervention is the most costly and therefore in the 10 year model it has a BCR of 0.5. The break-even point is at 13 years (per cohort). There will continue to be benefits after the ten year model period. This is estimated to be $5.2 million of benefits per year from 2025 for the first year cohort who participate in bariatric surgery. Bariatric surgery leads to an overall increase in the obesity class I population because people who had bariatric surgery from class II and III lost enough weight to drop into class I.

Bariatric surgery costs and current procedure volumes are discussed in more detail in section 3.7.

Patient example profile 2 – BCR 5.6

Jeff - 48 years old

BMI 47 (180cm/152 kg) – obesity class III

Jeff has struggled with his weight for years and has experienced depression and discrimination. As a result, he is in and out of the workforce and has difficulty finding a long term position job. He is also often ill and has diabetes and high blood pressure.

Additional Costs:

Jeff has much higher GP, allied health, hospital inpatient, specialist, pharmaceutical, foregone tax and Government subsidy costs than the non-obese average.

Interventions to support Jeff

Jeff's GP suggests he goes for bariatric surgery to reduce his weight to a healthier level. This helps Jeff achieve a 26 per cent weight loss within 4 years of the procedure. Jeff maintains this weight loss by taking more walks and watching his diet by using the new front of package food labels to make better food choices.

Impact on Jeff

Jeff feels happier and healthier after having undergone the surgery. He no longer feels depressed about his weight, thus he no longer visits allied health professionals and visits specialists less as his high blood pressure is now under control.

Patient example profile photo sourced from the Canadian Obesity Network Image Bank

6.4.2 Pharmaceuticals

There are two pharmaceutical products currently available in Australia for weight loss therapies Orlistat (Xenical®) and Phentermine (Duromine® or Metermine®). Some studies found that Orlistat is not cost effective[106] and there is very little research available on Phentermine effectiveness, a product that has been on the market since the 1960s. However, pharmaceuticals can also potentially play a role in better weight loss maintenance, some studies have found that patients taking pharmaceuticals were much more likely to maintain weight loss after a year than those just on lifestyle programs.[107,108]

Orlistat is available over the counter and there are no limitations on the duration of treatment. Phentermine is one of the most popular weight loss medications in the US[109] and according to IMS estimates, it accounts for about 80 per cent of the Australian weight loss medication volumes in 2014. Phentermine is prescription controlled and approved for a duration of 12 weeks in Australia. It is assumed that the majority of participants lose 8-10 per cent of body weight in the first year (with varying levels of recidivism in following years) based on various studies.[110] The following table shows the potential impact over 10 years with about 41,000 obese people (less than 0.8 per cent of obese population) participating each year.

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[106] Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention.* Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

[107] Wadden, T.A., Butryn, M.L, and Wilson, C. (2006). Lifestyle Modification for the Management of Obesity. *Gastroenterology.* 132 (6). Retrieved from http://www.gastrojournal.org/article/S0016-5085(07)00578-1/fulltext?refuid=S0002-8223(08)02204-9&refissn=0002-8223&mobileUi=0#sec6.5.2

[108] Douketis JD, Macie C, Thabane L, Williamson DF (2005). Systematic review of long-term weight loss studies in obese adults: clinical significance and applicability to clinical practice. *Int J Obes* (Lond). 29:1153-1167

[109] Hendricks, E.J., Greenway, F.L., Westman, E.C., and Gupta, A.K. (2011). Blood pressure and heart rate effects, weight loss and maintenance during long-term phentermine pharmacotherapy for obesity. *Obesity (Silver Spring).* 19(12):2351–2360

[110] Yanovski, S.Z. and Yanovski, J.A. (2014). Long-term Drug Treatment for Obesity: A Systematic and Clinical Review. *The Journal of the American Medical Association.* 311(1):74-86. ; Davidson, M.H., Hauptman, J., DiGirolamo, M., Foreyt, J.P., Halsted C.H., Heber, D., Heimburger, D.C., Lucas, C.P., Robbins, D.C., Chung, J., and Heymsfield, S.B. (1999). Weight control and risk factor reduction in obese subjects treated for 2 years with orlistat: a randomized controlled trial. *The Journal of the American Medical Association.* 281(31):1174; Douglas, I.J., Bhaskaran, K., Batterham, R.L., and Smeeth, L. (2015). The effectiveness of pharmaceutical interventions for obesity: weight loss with orlistat and sibutramine in a United Kingdom population-based cohort. *British Journal of Clinical Pathology*. 79(6):1020-7.; Munro, J.F., MacCuish, A.C., Wilson, E.M., and Duncan, L.J. (1968). Comparison of Continuous and Intermittent Anorectic Therapy in Obesity. *British Medical Journal.* 1(5588):352-354.; Goldstein, D.J., and Potvin, J.H. (1994). Long-term weight loss: the effect of pharmacologic agents. *The American Journal of Clinical Nutrition.* 60(5):647-57.

Table 6.4.2 Medical interventions (pharmaceuticals) impact on the 2025 obese population and cost and benefit between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Change in number of obese by 2025	-12,650	-4,250	-10,350	-27,250
Per cent change	-0.3%	-0.2%	-0.8%	-0.4%
Benefit of interventions between 2015-16 and 2024-25 ($ million)	$110	$30	$160	$300
Cost of interventions between 2015-16 and 2024-25 ($ million)	$60	$20	$20	$110
BCR				**2.7**

Pharmaceuticals are found to be cost effective in the 10 year scope with a BCR of 2.7 and a breakeven point of about 2 years per cohort. There will continue to be benefits after the ten year model period. This is estimated to be $2.0 million of benefits per year from 2025 for the first year cohort who participate in pharmaceutical interventions.

Patient example profile 1 – BCR 2.5

Anna - 26 years old

BMI 38 (166cm/105 kg) - obesity class II

Anna has struggled with her weight her whole life, she was obese as a child. She is successful in her career and works long hours. Anna spends a lot of money on weight loss products and struggles with depression because she is not very happy with her weight. Her doctor recently informed her that she is pre-diabetic.

Additional Costs:

Anna has higher GP, allied health, hospital outpatient, specialist, weight loss intervention and presenteeism costs than the non-obese average.

Interventions to support Anna

Anna joined weight watchers and this helped her achieve a weight loss of 10 per cent at one year. She is really pleased with herself and starts taking Orlistat to try and help maintain this loss.She has started using the new front of package food labels to help her make better choices in the grocery store.

Impact on Anna

Anna feels that she has more control over her own health and food choices. She is much happier, has started walking everyday and feels much more energised at work. She doesn't need to visit allied health professionals as often which saves her time and money.

Patient example profile photo sourced from the Canadian Obesity Network Image Bank

6.5 Environmental

There is very little research linking population wide interventions directly to reduced BMI levels. However, there is some evidence that they can support behaviour change such as lower average calorie consumption or making healthier food choices. According to the Lancet 2011 Obesity series, policy and regulatory actions were identified as the most effective and cost effective means of taking on obesity.[111] The McKinsey *Overcoming Obesity* report[112] also found that environmental interventions that rely less on will power would lead to the largest impact across the population. South Australia is cited in many recent obesity reports as a step in the right direction for its health-in-all-policies approach meaning that health and wellbeing aspects are considered for all policy development. Some interventions that may be difficult to implement on a national scale could be considered for workplace or school environments. Other potential environment examples include: media restrictions, portion control, restricting availability of unhealthy foods, active transport, price promotions, public health campaigns etc.

In this category of interventions, the three environmental interventions that were included in this analysis are reformulation, labelling and a tax on unhealthy foods as part of this scenario. Due to the relative lack of evidence, a combined assumption was made for all three interventions on the national impact. It is assumed that a combination of these interventions will lead to a reduction of 0.5 per cent in the obese population and a reduction of 1 per cent in the overweight population (supporting obesity prevention). This assumption was developed using available research as context. The following table shows the potential impact over ten years with a reduction of 3,814 obese persons each year. Further research, ideally in consultation with governments and industry, is required to validate these assumptions for Australian conditions.

Table 6.5.1 Environmental interventions impact on the 2025 obese population and cost and benefit between 2015-16 and 2024-25 (2015 present value terms)

	Obesity class I	Obesity class II	Obesity class III	Total
Change in number of obese by 2025	-21,850	-8,850	-7,050	-37,750
Per cent change	-0.5%	-0.5%	-0.5%	-0.5%
Benefit of interventions between 2015-16 and 2024-25 ($ million)	$120	$60	$80	$260
Cost of interventions between 2015-16 and 2024-25 ($ million)	$50	$20	$10	$80
BCR				**3.2**

[111] Gortmaker, S.L., Swinburn, B.A., Levy, D., et al. (2011). Changing the future of obesity: science, policy, and action. *Lancet*. 378:838–47.

[112] McKinsey Global Institute (2014). *Overcoming Obesity: An initial economic analysis*. Retrieved from http://www.mckinsey.com/~/media/McKinsey/dotcom/Insights/Economic%20Studies/How%20the%20world%20could%20better%20fight%20obesity/MGI%20Obesity_Full%20report_November%202014.ashx

The environmental interventions have a BCR of 3.2 and a breakeven point of about 4 years per cohort. When taking into consideration the impact on the whole cohort who was exposed to these programs, it is estimated that environmental programs will generate $7.9 million of benefits per year from 2025.

6.5.1 Reformulation

Reformulation is improving the nutrient content of processed foods available by reducing unhealthy contents (e.g. sugar, salt, fat) or increasing healthier ingredients. A 2012 review by the National Heart Foundation of Australia found that:

- Reformulation of processed foods provides a realistic opportunity to improve the health of a population.
- The health and economic benefits of population level campaigns to reduce dietary intake of sodium, saturated fat and trans fat is established.
- A mandatory and incremental (gradual changes to support consumer acceptance) approach is likely to be most effective.[113]

The intervention would be a government push to increase reformulation of unhealthy processed foods. Reformulation would mean costs to the food industry. One report found that if these changes were gradual then these costs could be limited and built into regular reformulation cycles.[114]

6.5.2 Labelling

The Australian Health Star Rating System was launched in June 2014 as a voluntary front-of-pack labelling program. Effective labelling has been shown to help some shoppers select the healthiest product options.[115] An Essential Research nationwide poll released results in early 2015 that showed 77 per cent feel that the Health Star Rating System should be compulsory for all packed food.[116] The intervention would be a Government push to increase Health Star rating uptake by 30 per cent.

6.5.3 Tax on unhealthy foods

Tax on unhealthy foods is a complex area with limited and inconsistent evidence and variations in impact between different countries. However, we also note that there appears to be significant community support for taxes on some unhealthy food, and that some experts support this. Price increases on unhealthy foods have been shown to decrease calorie and unhealthy product consumption in some cases[117] but may also just lead to product

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[113] Heart Foundation (2012), *Rapid Review of the Evidence of food reformulation as a strategy to improve population health.* Retrieved from http://www.heartfoundation.org.au/SiteCollectionDocuments/RapidReview_FoodReformulation.pdf

[114] Webster, J. (2009), *Reformulation food products for health: context and key issues for moving forward in Europe.* Retrieved from http://ec.europa.eu/health/nutrition_physical_activity/docs/ev20090714_wp_en.pdf

[115] PwC (2014). *Health Star Rating System: Cost Benefit Analysis.* Retrieved from http://www.health.gov.au/internet/main/publishing.nsf/Content/CF7E670597F383ADCA257BF0001BAFF5/$File/Health%20Star%20Rating%20Cost%20Benefit%20Analysis%20Report.pdf

[116] Consumers Health Forum of Australia (2015, January 20). *Media Release*. Retrieved from https://www.chf.org.au/pdfs/chf/20150120-Junk-Food.pdf

[117] Duffey, K.J., Gordon-Larsen, P., Shikany J.M., Guilkey, D., Jacobs, D.R. Jr., and Popkin, B.M. (2010). Food price and diet and health outcomes: 20 years of the CARDIA Study. *Archives of Internal Medicine*. 170(5); Young, A. (2015, July 15). Here's how much a sugary beverage tax dropped consumption of sugar-sweetened drinks in Mexico. *International Business Times.* Retrieved from http://www.ibtimes.com/heres-how-much-sugary-beverage-tax-dropped-consumption-sugar-sweetened-drinks-mexico-1970091

substitution in others.[118] A tax on unhealthy foods may be difficult to implement and has been criticised as potentially impacting lower socio-economic status families disproportionately.[119] However, some Australian experts believe that a carefully designed tax program on specific products could be effective in shifting eating patterns.[120] Also, Australian consumers may be more open to such taxes than previously expected. The Essential Research nationwide poll found[121] that 50 per cent of respondents were in favour of a tax on some unhealthy foods (similar to the support for taxes on alcohol and tobacco). The ACE Prevention report[122] estimated that a 10 per cent tax on unhealthy foods might lead to $3.5 billion in health system cost savings and 170,000 DALYs.

A tax on foods deemed unhealthy could also encourage industry to produce or reformulate towards healthier options however acknowledging that some industry players are already moving in this direction.

6.6 Future innovations could get us to a better BCR by 2025

More targeted, comprehensive or innovative solutions may need to be considered to meet the WHO targets and help people maintain weight loss more effectively. Some initial ideas are outlined below.

Workplace wellness initiatives are not separately included in the benefit analysis as they can include a combination of personal, educational and environmental approaches and may have additional motivators such as rewards and incentives for participation. These combinations have been shown to be very effective at reducing obesity levels in a targeted population. The Western Australian Department of Commerce piloted a wellness program that included health and environment assessments, wellness campaigns, exercise options and ongoing support. After one year there was a reduction in obesity levels of 12 per cent.[123] For these initiatives to be successful, employers need to support and invest in reducing obesity.

Internet, mobile applications and gamification approaches are emerging innovations that hold promise for sustained behavior change and benefit. These represent an opportunity area to better inform people, empower patients, track progress, provide support, and maintain weight loss through making the approach to weight loss more engaging and enjoyable. New technologies mean that weight management programs don't necessarily have to be face to face and clinicians can track their patient's outcomes remotely. 'Gamification' is a method of applying game elements and design techniques to an aspect of health to attempt to achieve a change outside of the game environment (e.g. a change in eating habits, exercise, medication adherence or learning). Games in health have been shown through various case studies to help with positive patient outcomes and games have been successfully used to promote

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[118] Fletcher, J.M., Frisvold, D.E.,Tefft, N. (2014). Non-Linear Effects of Soda Taxes on Consumption and Weight Outcomes. *Health Economics*.5: 566–582

[119] Powell LM, and Chaloupka FJ. (2009). Food prices and obesity: evidence and policy implications for taxes and subsidies. Milbank Q;87:229–57.

[120] Kaldor, J.C., Magnusson, R.S., and Colagiuri, S. (2015). Government action on diabetes prevention: time to try something new. *Medical Journal of Australia*. 202(11).

[121] Consumers Health Forum of Australia (2015, January 20). *Media Release*. Retrieved from https://www.chf.org.au/pdfs/chf/20150120-Junk-Food.pdf

[122] Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention.* Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention. Noting that the report found that a tax on unhealthy foods 'may be effective' due to the lack of evidence available.

[123] Gill, T., Hector, D., Rissel, C., Trieu, K., Zhong, A., O'Hara, B., and Bauman A. (2013). Whole of government obesity prevention interventions. *Sax Institute*. Retrieved from https://www.saxinstitute.org.au/publications/whole-of-government-obesity-prevention-interventions/

behavioural changes necessary for maintaining a healthy lifestyle, including changes in diet and physical activity.[124]

In early 2014 the National Health and Medical Research Council hosted a round table to discuss New Insights into the Biology of Obesity[125] and areas of focus included genetics, epigenetics, neurobiology and the microbiome. One potential area of intervention would be to focus on women considering having children, prior to pregnancy as there seems to be a link to maternal obesity and metabolic health of offspring. Another area of interest is gut microbiota (formerly called gut flora) and the role that it plays in overall health and metabolism. As the biology of obesity is better understood, there may be more targeted and successful intervention options to choose from.

Behavioural insights concepts (how people make decisions in practice) may be able to help people make healthier choices, needing less willpower. These concepts might be especially relevant for the success of potential environmental interventions.[126]

In the next ten years there will likely be new pharmaceutical options that target obesity coming on the market in Australia. These new products may support improved weight loss and maintenance. Some are already available overseas and are shown to be effective in clinical trials.

A further area with potential value is the development of integrated intervention programs at a whole-of-system level that seek synergies between component interventions. In this report we have assumed additivity of effect of multiple interventions. Systems theory shows that combining interventions appropriately could potentially yield effects that exceed the sum of the parts.

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124 Health Informatics Society of Australia. HISA launches the 2014 Health Apps Challenge. 2014 Winners

125 Australian Government National Health and Medical Research Council (2014, April). *CEO Roundtable: New Insights into the Biology of Obesity Roundtable Report.* Retrieved from https://www.nhmrc.gov.au/_files_nhmrc/file/media/events/2014/obesity_ceo_rountable_140617.pdf

126 Liu, P. J. (2014). Using behavioral economics to design more effective food policies to address obesity. *Applied economic perspectives and policy : AEPP, 36*(1).

Appendices

Appendix A Analysis approach

1 Project scope

Obesity Australia contracted PwC to develop a cost/benefit framework which included identification of the costs of obesity and potential benefits of reducing obesity, based on consultation and literature. The framework was used to identify relevant stakeholders and develop and agree a set of measures to be used in the cost/benefit analysis. Using the framework, PwC developed an economic model to estimate the annual cost of obesity to Australia and the potential benefits of intervention.

The approach used to complete this cost benefit analysis is completed in line with the best practice guidance provided by the Australian Government (Office of Best Practice Regulation) and the Victorian Government (Department of Treasury and Finance).

This report outlines an analysis of the costs of obesity and the benefits of reducing the increase in the rates of obesity in Australia through a set of specific interventions. It presents estimates of the costs of obesity in Australia, incorporating direct, indirect and health and wellbeing costs.

As shown in Table A.1, this report expands the work presented in three previous estimations of the cost of obesity in Australia, by using a bottom-up approach to estimate medical costs and including three types of costs (direct, indirect and health and wellbeing). Estimation of the costs of obesity can be done either by a top-down analysis, which attributes a portion of national costs for certain co-morbidities to obesity, or by a bottom-up analysis, which calculates a cost per obese person and extrapolates this to a national figure. The bottom-up method is typically preferred if the data is available because it incorporates a more comprehensive range of costs and accounts for the costs incurred by obese people for both acute and chronic episodes.

Table A. 1 Comparison of estimation approaches

Report	Bottom-up estimation	Direct costs	Indirect costs	Health and wellbeing costs
The growing cost of obesity in 2008 (Access Economics 2006/2008)	✗	✓	✓	✓
Obesity in Australia: financial impacts and cost benefits of intervention (Medibank 2010)	✗	✓	✓	✓
The cost of overweight and obesity in Australia (Colagiuri et al. 2010)	✓	✓	✗	✗
This report	✓	✓	✓	✓

2 Project approach

The project involved four steps.

1. The first step was a **literature scan** to inform development of the benefits realisation framework and assumptions incorporated into the estimation of the

costs of obesity. The literature scan focused on a set of search terms defined as obesity in addition to the following broad categories: medical costs, non-medical government costs, productivity losses, societal costs, health and wellbeing, and mental health impacts (see Appendix D).

2. The step was the development of a **benefits realisation framework** that identifies the main benefits and costs of a set of defined obesity interventions. This framework lays the foundation for the economic analysis, capturing the capabilities developed through obesity interventions, the related costs and benefits, and the main stakeholders of obesity interventions in terms of who generates and who receives the benefits.

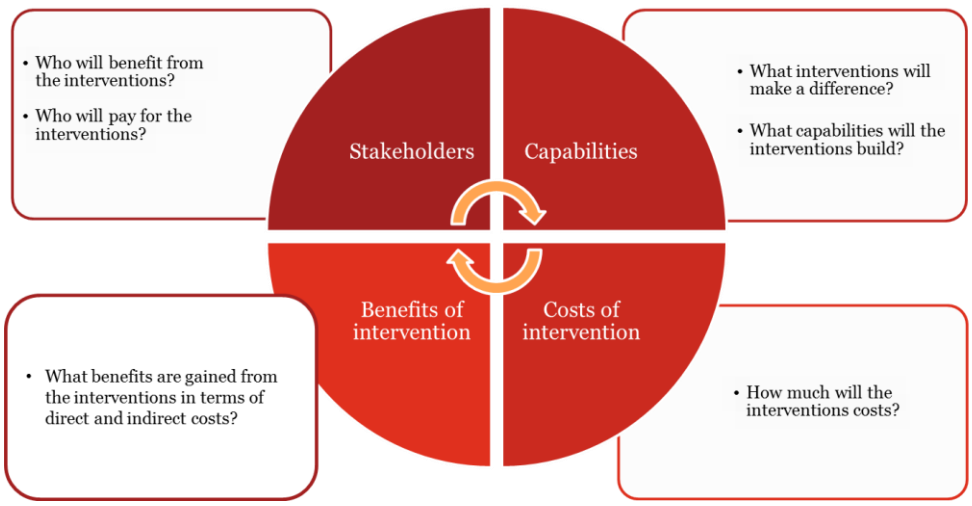
3. The third step was **prioritisation of metrics** to estimate the cost of obesity in Australia. The metrics were selected according to their perceived importance, the extent to which they reflect the value of obesity interventions, and their ability to be measured. Prioritisation was based on the literature scan, PwC experience, and consultation with Obesity Australia and academic experts.

4. The last step of the project was **modelling** the costs of obesity in Australia and the benefits of a set of potential interventions. This involved collecting relevant data on the direct and indirect costs of obesity and the impact of the set of interventions, drawing on the literature to develop assumptions for input into the economic model. The assumptions were tested with clinical and academic experts.

3 Analysis framework

The purpose of the benefits realisation framework is to identify and categorise the benefits that could be achieved through reductions in the rate of obesity, while also acknowledging the interventions, costs and stakeholders that will help to generate these benefits.

Figure A. 1 High-level benefits realisation framework



The four dimensions of the benefits realisation framework, as shown in the Figure above are as follows:

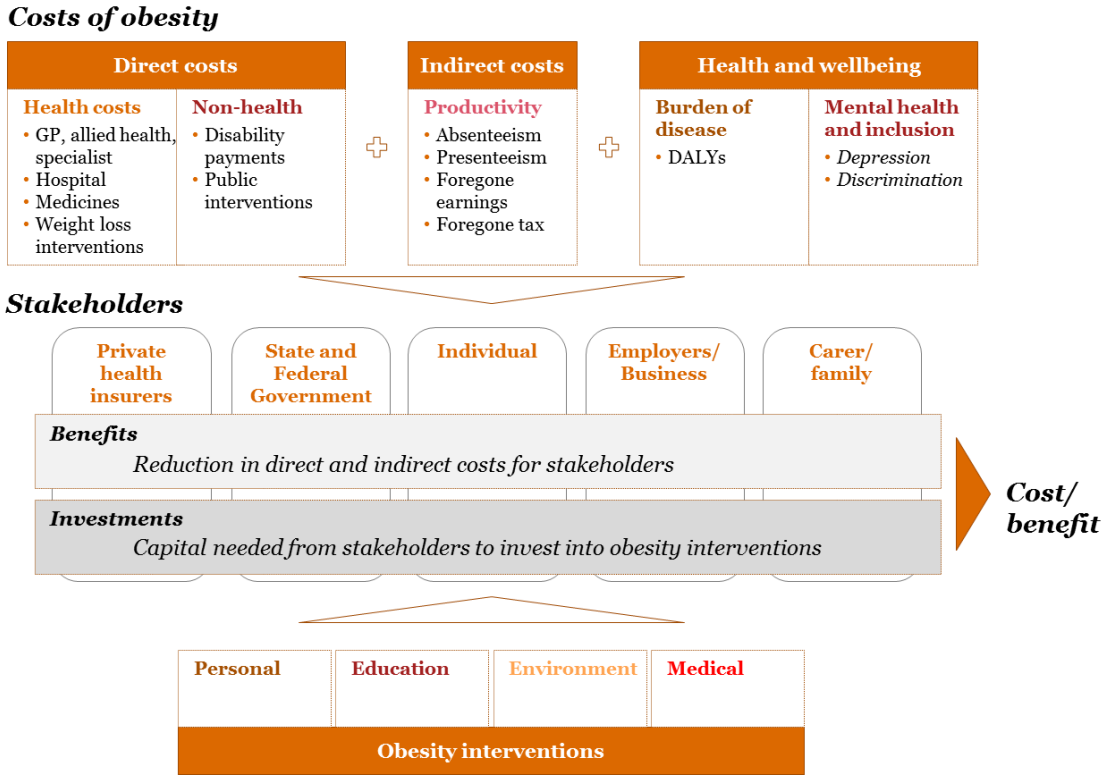
- Stakeholders — This refers to the people or entities that generate and receive the benefits of intervention. It need not be the same group on the giving and receiving side.
- Capabilities — This component examines what the interventions build for stakeholders, in terms of personal and environmental changes.

- Costs — The costs of intervention include the financial and time costs invested by stakeholders in the interventions.
- Benefits — The benefits of the interventions are directly related to the current costs of obesity, whereby the cost of the condition represents the savings that could be generated through interventions to reduce the rates of obesity.

4 Detailed framework

Below is an adapted version of the framework used for this project.

Figure A. 2 Benefits realisation framework



5 Developing conservative estimates

The analysis approach for this report was purposely conservative.

Not all benefits are quantified

Lifetime benefits are not included. Many previous cost effectiveness analyses focussed on QALY or DALYs saved, and if the intervention investment costs less than $40,000 - 50,000 per DALY saved,[127] then it is considered cost effective. This report focuses on the net present value of costs saved verses dollars invested in a ten year span. Additionally, the ten year model has an intervention cost for each year meaning that there are ten 'cohort groups' that are modelled to receive interventions. The first cohort group has nine years of benefit included in the model while the second cohort has the same costs but on eight years of benefit in the model and so on. The investment for the last few years' cohorts reduces the overall BCR as there is very little or no benefit from these groups included in the model.

[127] Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention.* Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

Not all costs have been included

Not all of the costs outlined in section 2 have been included in the analysis, principally because of limited available evidence to estimate costs. Childhood obesity is out of scope but has been shown to lead to additional costs such as healthcare spending.[128] Additionally, in some cost estimates there needed to be a comparison of obese data to population average data (which include obese values) and so in these cases the estimated difference in costs is underestimated.

The analysis is based on estimates of obesity prevalence in class levels I, II, and III from the National Health Survey data and so individual level data and BMI information is not included. Costs and benefits were estimated based on the averages across the three classes. This categorical approach means that in some cases, small changes in BMI would lead to large cost changes (if the target group was at the low end of a BMI class) or large changes in BMI lead to no change in costs (if the target group was at the high end of the BMI class).

Research was used to develop cost and impact assumptions but actual societal impacts will likely vary outside of controlled environments. In some areas such as weight regain (post intervention), there was limited evidence available to make robust assumptions and estimates were based on the best available evidence and insight from subject matter experts.

Further, there may be a synergistic effect between interventions in the real world for example the total effect of a set of interventions may exceed the simple sum of estimates for each and the potential for this is not captured in the model. There is potential to research such system-level approaches to interventions in the future.

[128] Au, N. (2012). 'The health care cost implications of overweight and obesity during childhood', Health Services Research, 47 (2):655-676

Appendix B Modelling the cost of obesity

1 Overview

The model provides an estimate of the annual marginal cost of adult obesity in Australia in the base year of 2011-12, presented in 2014-15 dollars, where an adult is defined as 18 years and older.

Obesity prevalence is based on the Australian Health Survey: Updated Results, 2011-12. The foundation of the model uses the following age brackets: 18–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, 65–74 years and 75 years and above. Where possible, it distinguishes costs for the three classes of obesity, defined in Table 1.1.1. In 2011-12, there were 3,157,858 people categorised in class I, 1,135,824 people in class II, and 541,421 people in class III.

A key concept underlying the model is that the costs of obesity refer to additional costs incurred by obese people relative to non-obese people. For example, people of all weights incur medical costs and the model incorporates the difference between the medical costs for non-obese people and the medical costs for obese people. This difference is assumed to be the impact due to obesity.

All cost assumptions have been adjusted to reflect nominal and/or real values (2014-15 dollars) to ensure consistent treatment of cost estimates across the study period. Health services costs incurred by individuals and private health insurance have been inflated based on the consumer price index for the health sector which is approximately 4.8 per cent per annum between 2003-04 and 2013-14. Government contribution to health services cost is assumed to inflate by the overall consumer price index which is approximately 2.8 per cent per annum over the same period, as MBS fees since 2005 have been indexed by a rate lower than the health CPI.[129] Non-health costs such as value of statistical life have been inflated based on overall consumer price index. Average salary or earnings have been inflated based on the wage price index. Both consumer price index and wage price index have been sourced from ABS.

In some cases, the only data available is based on a comparison of obese individuals to the whole of society. These instances are indicated below and represent a conservative assumption because the average result for society includes obese results and thus will be higher than the result for non-obese individuals making the difference between the average and obese populations smaller than the difference between non-obese and obese populations.

As a result of limitations in data availability, the model incorporates a number of assumptions that are outlined below. Where possible, the assumptions are informed by previous Australian research studies. Otherwise, international literature is used to establish the assumptions.

[129] Australian Medical Association, *Medicare patient rebates failing to keep pace with the true value of quality medical care,* https://ama.com.au/media/medicare-patient-rebates-failing-keep-pace-true-value-quality-medical-care

2 Assumptions for direct cost metrics

2.1 Cost of GP visits

Government contribution

Individual contribution

Assumption	Rationale
Average excess government contributions are $40.01 ($31) for obesity class I, $47.75 ($37) for obesity class II and $77.43 ($60) for obesity class III in 2014-15 prices (originally in 2004-05 prices).	Based on non-published data from Colagiuri S, Lee CM, Colagiuri R, Magliano D, Shaw JE, Zimmet PZ, and Caterson ID (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264
Average patient contribution per GP visit was $29.85 in 2011-12 (2014-15 prices, originally 26.97 in 2011-12 prices).	Annual Medicare Statistics[130]
20 per cent of GP visits in 2011-12 were patient billed visits.	Annual Medicare Statistics[131]
Obese individuals have 0.98 (obesity class I)/ 1.17 (obesity class II)/ 1.89 (obesity class III) more GP visits per year than non-obese individuals.	Calculation based on Annual Medicare Statistics[132], ABS[133], and excess government contribution to GP visits per obese person relative to non-obese person sourced from detail data underpinning Colagiuri, S., Lee, C.M.Y., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). 'The cost of overweight and obesity in Australia, *The Medical Journal of Australia*, 192 (5):260-264.

[130] Australian Government Department of Health, *Annual Medicare Statistics - Financial year 2007-08 to 2013-14*. Retrieve on March 2015 from http://health.gov.au/internet/main/publishing.nsf/Content/34A89144DB4185EDCA257BF0001AFE29/$File/MBS%20Statistics%20Financial%20Year%202013-14%20external%2020140718.xlsx

[131] Ibid.

[132] Ibid.

[133] Australian Bureau of Statistics (2015), *Australian Demographic Statistics, June 2014*, cat no. 3101.0. Retrieved May 2015 from http://www.abs.gov.au/AUSSTATS/ABS@Archive.nsf/log?openagent&3101059.xls&3101.0&Time%20Series%20Spreadsheet&7A8582884A7CC018CA257E6E0011A054&0&Dec%202014&25.06.2015&Latest

2.2 Cost of allied health

Government contribution

Individual contribution

Assumption	Rationale
Average excess government contributions are $21.94 ($17) for obesity class I and II, and $49.04 ($38) for obesity class III in 2014-15 prices (originally in 2004-05 prices).	Based on non-published data from Colagiuri, S., Lee, C.M.Y., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). 'The cost of overweight and obesity in Australia, *The Medical Journal of Australia*, 192 (5):260-264.
Average patient contribution per visit to an allied health practitioner was $36.40 in 2011-12 (2014-15 prices, originally $32.89 in 2011-12 prices).	Annual Medicare Statistics[134]
28 per cent of visits to allied health practitioners in 2011-12 were patient billed visits.	Annual Medicare Statistics[135]
Obese individuals have 0.07 (obesity class I)/ 0.07 (obesity class II)/ 0.15 (obesity class III) more visits per year than non-obese individuals.	Calculation based on Annual Medicare Statistics[136], ABS[137], and excess government contribution to GP visits per obese person relative to non-obese person sourced from detail data underpinning Colagiuri S, Lee CM, Colagiuri R, Magliano D, Shaw JE, Zimmet PZ, and Caterson ID (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264

134 Australian Government Department of Health, *Annual Medicare Statistics - Financial year 2007-08 to 2013-14*. Retrieve on March 2015 from http://health.gov.au/internet/main/publishing.nsf/Content/34A89144DB4185EDCA257BF0001AFE29/$File/MBS%20Statistics%20Financial%20Year%202013-14%20external%2020140718.xlsx

135 Ibid.

136 Ibid.

137 Australian Bureau of Statistics (2015), *Australian Demographic Statistics, June 2014*, cat no. 3101.0. Retrieved May 2015 from http://www.abs.gov.au/AUSSTATS/ABS@Archive.nsf/log?openagent&3101059.xls&3101.0&Time%20Series%20Spreadsheet&7A8582884A7CC018CA257E6E0011A054&0&Dec%202014&25.06.2015&Latest

2.3 Cost of specialist care

Government contribution

Individual contribution

Assumption	Rationale
Average excess government contributions are $46.46 ($36) for obesity class I, $38.72 ($30) for obesity class II and $94.21 ($73) for obesity class III in 2014-15 prices (originally in 2011-12 prices).	Based on non-published data from Colagiuri, S., Lee, C.M.Y., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). 'The cost of overweight and obesity in Australia, *The Medical Journal of Australia*, 192 (5):260-264.
Average patient contribution per visit to an allied health practitioner was $58.77 in 2011-12 (2014-15 prices, originally $53.10 in 2011-12 prices).	Annual Medicare Statistics[138]
72 per cent of visits to allied health practitioners in 2011-12 were patient billed visits.	Annual Medicare Statistics[139]
Obese individuals have 0.25 (obesity class I)/ 0.21 (obesity class II)/ 0.51 (obesity class III) more visits per year than non-obese individuals.	Calculation based on Annual Medicare Statistics[140], ABS[141], and excess government contribution to GP visits per obese person relative to non-obese person sourced from detail data underpinning Colagiuri, S., Lee, C.M.Y., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). 'The cost of overweight and obesity in Australia, *The Medical Journal of Australia*, 192 (5):260-264.

[138] Australian Government Department of Health, *Annual Medicare Statistics - Financial year 2007-08 to 2013-14*. Retrieve on March 2015 from http://health.gov.au/internet/main/publishing.nsf/Content/34A89144DB4185EDCA257BF0001AFE29/$File/MBS%20Statistics%20Financial%20Year%202013-14%20external%2020140718.xlsx

[139] Ibid.

[140] Ibid.

[141] Australian Bureau of Statistics (2015), *Australian Demographic Statistics, June 2014*, cat no. 3101.0. Retrieved May 2015 from http://www.abs.gov.au/AUSSTATS/ABS@Archive.nsf/log?openagent&3101059.xls&3101.0&Time%20Series%20Spreadsheet&7A8582884A7CC018CA257E6E0011A054&0&Dec%202014&25.06.2015&Latest

2.4 Cost of hospital care

Government contribution

Table B. 1 Additional spend per obese person on various types of public and private hospital episodes in 2015 prices (originally in 2008 prices)

	Obesity class I		Obesity class II		Obesity class III	
Type of episode	**18-44 years**	**45+ years**	**18-44 years**	**45+ years**	**18-44 years**	**45+ years**
Inpatient	$157 ($135)	$461 ($396)	$446 ($384)	$1,313 ($1,128)	$574 ($493)	$1,688 ($1,451)
Outpatient	$66 ($56)	$193 ($166)	$122 ($105)	$358 ($307)	$156 ($134)	$460 ($395)
Emergency department	$5 ($4)	$13 ($12)	$14 ($12)	$40 ($35)	$18 ($15)	$52 ($45)

Notes:
1) Additional spend for people aged 45 years and older based on Buchmueller, T.C., Johar, M. (2015). 'Obesity and Health. Expenditures: Evidence from Australia', *Economics and Human Biology*.
2) These estimates were derived based on data sourced between 2006 and 2010. It has been assumed that estimates from data are 2007-08 prices and inflated to 2014-15 prices. Estimates reported in the table are in 2014-15 prices and estimates in brackets are originally 2007-08 estimates.
3) The comparison here is obese versus normal weight (excluding overweight and underweight). Expenditure is based on people with positive hospital expenditure only.
4) Average health expenditure for adults aged 25 – 44 years are approximately 34 per cent of inpatient expenditures for adults aged 45 years and above.[142]
5) Obese class II and III estimates have been estimated assuming obese class III estimates are 25 per cent higher than obese class II based on Arterburn, D.E., Maciejewski, M.L., and Tsevat, J. (2005).

Table B. 2 Proportion of obese person by class who had a hospital episode

Type of episode	**Percentage of obesity class I people who have hospital episode**	**Percentage of obesity class II people who have hospital episode**	**Percentage of obesity class III people who have hospital episode**
Inpatient	14.5%	17.7%	20.9%
Outpatient	9.0%	10.0%	14.9%
Emergency department	11.5%	14.2%	19.4%

Notes:
1) Percentage of obese people who have hospital episode taken from *Australian Health Survey: Health Service Usage and Health Related Actions, 2011-12*.

[142] Australian Institute of Health and Welfare (2014) *Australia's health 2014*. Australia's health series no. 14. Cat. no. AUS 178. Canberra: AIHW. AIHW (2008-09). http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129547594.

Individual contribution for all hospital use

Table B. 3 Additional contribution and rate of use for obese individuals

	Additional spend per obese I person all ages	Additional spend per obese II person all ages	Additional spend per obese II or II person all ages
All hospital	$24	$55	$71

1) Additional spend for people based on AIHW health expenditure database, table on average individual recurrent health expenditure per person, showing average annual expenditure per person of $127 in 2014-15 prices (originally $122 in 2012-13).
2) Annual spending for adults who are obese class I (II/III) is 19 per cent (50 per cent) higher than those with normal BMIs. From Buchmueller, T.C., Johar, M. (2015).
3) Obese class II and III spending have been estimated assuming obese class III individuals spend 25 per cent more than obese class II, which indicates that annual spending for obese class II and III is 44 per cent and 56 per cent higher than those with normal BMI. This assumption is based on Arterburn, D.E., Maciejewski, M.L., and Tsevat, J. (2005).
4) The comparison here is obese versus average.
5) All monetary estimates are in 2014-15 prices.

Private health insurance contribution for hospitals and ancillary care

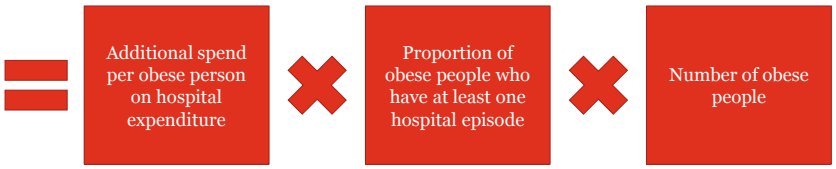


Table B. 4 Additional spend and rate of use for obese individuals

	Additional spend per obese I person all ages	Additional spend per obese II person all ages	Additional spend per obese III person all ages	Percentage of obese people who have hospital + ancillary private health insurance
All hospital	$123	$283	$364	43.6%

Notes:
1) Additional spend for people based on AIHW health expenditure database, table on health expenditure funded by private health insurer, showing average annual expenditure per person of $1,144 in 2014-15 prices (originally $1,102 in 2012-13 prices) and 56 per cent of this expenditure are attributable to hospital expenditure.
2) Annual spending for adults who are obese class I (II/III) is 19 per cent (50 per cent) higher than those with normal BMIs. From Buchmueller, T.C., Johar, M. (2015).
3) Obese class II and III spending have been estimated assuming obese class III individuals spend 25 per cent more than obese class II, which indicates that annual spending for obese class II and III is 44 per cent and 56 per cent higher than those with normal BMI. This assumption is based on Arterburn, D.E., Maciejewski, M.L., and Tsevat, J. (2005).
4) The comparison here is obese versus average.
5) Percentage of obese people who have private health insurance taken from ABS (2013), *Australian Health Survey: Health Service Usage and Health Related Actions, 2011-12*.
6) All monetary estimates are in 2014-15 prices.

2.5 Cost of pharmaceuticals

Government contribution

Table B. 5 Additional spend per obese person on pharmaceuticals

Assumption	Obese I person	Obese II person	Obese III person
Additional spend on pharmaceutical cost per person who used pharmaceuticals (18-44 years)	$129 ($111)	$229 ($197)	$294 ($254)
Additional spend on pharmaceutical cost per person who used pharmaceuticals (45+ years)	$378 ($325)	$675 ($580)	$868 ($746)
Percentage of obese people who had used pharmaceuticals	74%	78%	

Notes:

1) Additional spend for people aged 45 years and older based on Buchmueller, T.C., Johar, M. (2015). Obesity and Health. Expenditures: Evidence from Australia. *Economics and Human Biology*.
2) Obese class II and III spending have been estimated assuming obese class III individuals spend 25 per cent more than obese class II, which indicates that annual spending for obese class II and III is 44 per cent and 56 per cent higher than those with normal BMI. This assumption is based on Arterburn, D.E., Maciejewski, M.L., and Tsevat, J. (2005).
3) These estimates were derived based on data sourced between 2006 and 2010. It has been assumed that estimates from data are 2007-08 prices and inflated to 2014-15 prices. Estimates reported in the table are in 2014-15 prices and estimates in brackets are originally 2007-08 estimates.
4) The comparison here is obese versus normal weight (excluding overweight and underweight). Expenditure is based on people with positive hospital expenditure only.
5) Average health expenditure for adults aged 25 – 44 years are approximately 34 per cent of inpatient expenditures for adults aged 45 years and above.[143]

Individual contribution

Assumption	Rationale
Average contribution per person for pharmaceuticals was $80.28 in 2014-15 prices (originally $70 in 2010-11 prices).	AIHW - Health expenditure Australia 2010-11. http://www.aihw.gov.au/publication-detail/?id=10737423009
Obese individuals spend between 23 to 54 per cent more on pharmaceuticals than normal weight individuals, depending on obesity class levels)	Estimated based on: • Buchmueller, T.C., Johar, M. (2015). 'Obesity and Health. Expenditures: Evidence from Australia', *Economics and Human Biology*. • Arterburn, D.E., Maciejewski, M.L., and Tsevat, J.

[143] Australian Institute of Health and Welfare (2014) *Australia's health 2014*. Australia's health series no. 14. Cat. no. AUS 178. Canberra: AIHW. AIHW (2008-09). http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129547594.

Assumption	Rationale
	(2005), 'Impact of morbid obesity on medical expenditures in adults', *International Journal of Obesity*.
Proportion of obese people who had used pharmaceuticals are 74 per cent for obesity class level I people and 78 per cent for obesity class level II/III people.	Buchmueller, T.C., Johar, M. (2015). 'Obesity and Health. Expenditures: Evidence from Australia', *Economics and Human Biology*.

2.6 Cost of weight loss interventions

Bariatric surgery: government, individual and private health insurance contributions

Calculations for bariatric surgery are based on the following approach:

- Government contribution - captured in total *cost of hospital care*
- Private health insurance contribution - captured in total *cost of hospital care*
- Individual contribution

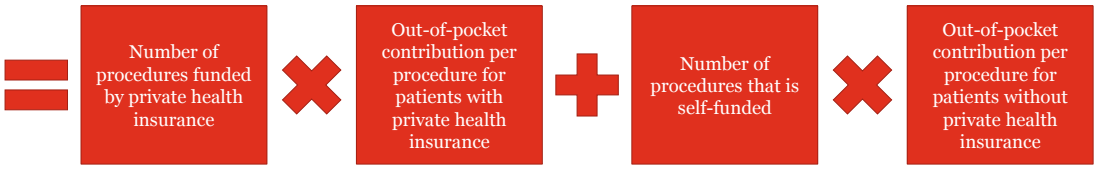


Table B. 6 Procedure by funding type[144]

	Percentage of bariatric procedures that are undertaken in public hospitals	Percentage of bariatric procedures that are funded by private health insurance	Percentage of bariatric procedures that are self-funded
Procedure distribution by funding type	6%	82%	11%

Assumption	Rationale
Cost of public patients in public hospitals are fully government funded	Australian Bureau of Statistics (2012), *Year Book Australia, 2012*, cat.no. 1301.0. Retrieved March 2015 from http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1301.0~2012~Main%20Features~Health%20care%20delivery%20and%20financing~235

[144] Australian Institute of Health and Welfare (2010). Weight loss surgery in Australia. Cat. no. HSE 91. Canberra: AIHW. Retrieved March 2015 from http://www.aihw.gov.au/publication-detail/?id=6442472385

Assumption	Rationale
National efficient price of major procedures for obesity with/without complication are estimated as $17,931.91 /$8,714.50 per procedure in 2012-13.	Estimated based on National Efficient Price price weights (AR-DRG: K04A, K04B and K07Z) and $4,808 per National Weighted Activity Unit (2012-13). Data has been sourced from Independent Hospital Pricing Authority (2012). *National Efficient Price Determination 2012-13*. Retrieved from http://www.ihpa.gov.au/internet/ihpa/publishing.nsf/Content/nep-determination-2012-13.htm
This cost is assumed to be captured in government contribution to 'cost of hospital care' thus it has been excluded from this metric.	Hospital cost estimates include total hospital care costs based on Buchmueller, T.C., Johar, M. (2015). Obesity and Health Expenditures: Evidence from Australia. *Economics and Human Biology*. Retrieved from http://dx.doi.org/10.1016/j.ehb.2015.01.001.

Table B. 7 Procedure cost for private health insurance and self-funded patients

MBS item type	MBS item number	Number of claims	Total cost	MBS schedule fee (benefits)[145]	Private health insurance (PHI) contribution	Individual contribution with PHI (without PHI)
Placement of adjustable gastric band	31569	3817	$13,000	$849.55 (75%, $637.16)	$9,000[146]	$3,363 ($12,363)[147]
Gastric bypass by Roux-en-Y	31572	819	$17,000	41045.4 (75%, $784.05)	$12,000[148]	$4,216 ($16,216)[149]
Sleeve gastrectomy	31575	8375	$17,000	$849.55 (75%, $637.16)	$12,000[150]	$4,636 ($16,363)[151]

[145] Australian Government Department of Health. *MBS Online*. Retrieved March 2015 from http://www.mbsonline.gov.au

[146] Calculated based on difference in out of pocket cost for patients with and without PHI sourced from Bariatric Surgery Source. *Weight Loss Surgery Australia: Complete Reference Guide*. Retrieved March 2015 from http://www.bariatric-surgery-source.com/weight-loss-surgery-australia.html

[147] Calculated based on out of pocket cost for patients with and without PHI sourced from Bariatric Surgery Source. *Weight Loss Surgery Australia: Complete Reference Guide*. Retrieved March 2015 from http://www.bariatric-surgery-source.com/weight-loss-surgery-australia.html; and Medicare rebate sourced from Australian Government Department of Health. *MBS Online*. Retrieved March 2015 from http://www.mbsonline.gov.au

[148] Calculated based on difference in out of pocket cost for patients with and without PHI sourced from Bariatric Surgery Source. *Weight Loss Surgery Australia: Complete Reference Guide*. Retrieved March 2015 from http://www.bariatric-surgery-source.com/weight-loss-surgery-australia.html

[149] Calculated based on out of pocket cost for patients with and without PHI sourced from Bariatric Surgery Source. *Weight Loss Surgery Australia: Complete Reference Guide*. Retrieved March 2015 from http://www.bariatric-surgery-source.com/weight-loss-surgery-australia.html; and Medicare rebate sourced from Australian Government Department of Health. *MBS Online*. Retrieved March 2015 from http://www.mbsonline.gov.au

[150] Calculated based on difference in out of pocket cost for patients with and without PHI sourced from Bariatric Surgery Source. *Weight Loss Surgery Australia: Complete Reference Guide*. Retrieved March 2015 from http://www.bariatric-surgery-source.com/weight-loss-surgery-australia.html

[151] Calculated based on out of pocket cost for patients with and without PHI sourced from Bariatric Surgery Source. *Weight Loss Surgery Australia: Complete Reference Guide*. Retrieved March 2015 from http://www.bariatric-surgery-source.com/weight-loss-surgery-australia.html; and Medicare rebate sourced from Australian Government Department of Health. *MBS Online*. Retrieved March 2015 from http://www.mbsonline.gov.au

MBS item type	MBS item number	Number of claims	Total cost	MBS schedule fee (benefits)[145]	Private health insurance (PHI) contribution	Individual contribution with PHI (without PHI)
Surgical reversal of adjustable gastric banding, gastric bypass, gastroplasty, or biliopancreatic diversion	31584	3259	$25,0238[152]	$1539.1 (75%, $1,154.33)	$17,667[153]	$6,207 ($23,874)[154]
Adjustment of gastric band as an independent procedure	31587	96630		$97.95 (75%, $73.46)	$40	$40[155] ($0)
Adjustment, repair or replacement of gastric band reservoir	31590	659		$251.7 (75%, $188.78)	$40	$40[156] ($0)

Notes:
1) Number of claims excludes public patients in public hospital
2) Gastroplasty (MBS item: 31578) and gastric bypass (MBS item: 31581) are excluded from this analysis as there is lack of publicly available cost data on these procedures.
3) It has been assumed that adjustment of gastric band and adjustment, repair or replacement of gastric band reservoir out-of-pocket cost (excluding MBS claims) are fully covered by private health insurance for patients with private health insurance.
4) All monetary values are in 2014-15 prices.

Individual contribution to private health insurance premium that provides bariatric surgery coverage

Assumption	Rationale
There are 14,346 bariatric surgical procedures in 2011-12.	This is calculated based on the number of MBS claims for bariatric surgical procedures and the proportion of procedures that are funded by private health insurance providers (82 per cent of total procedures) as discussed above. The procedures captured in this cost estimate include placement of adjustable gastric band, gastric bypass by Roux-en-Y, sleeve gastrectomy, and surgical reversal of adjustable gastric banding, gastric bypass, gastroplasty and biliopancreatic.

152 Approximated based on MBS rebate for reversal of bariatric surgery and gastric bypass.

153 Ibid.

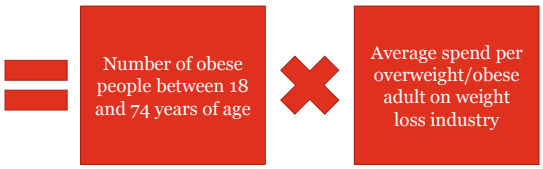
154 Ibid.

155 LAP Surgery Australia,.*Weight Loss Solutions*. Retrieved March 2015 from http://www.lapsurgeryaustralia.com.au/weight-loss-solutions/lap-band#costs.

156 Ibid.

Assumption	Rationale
The average private health insurance premium for hospital cover is $1,258 per person with 2011-12 (2014-15 prices, originally $1,136 in 2011-12 prices).	Calculated based on total hospital insurance premium revenue in Australia in 2011-12 and the number of people with hospital cover in 2011-12. Data has been sourced from the Private Health Insurance Administration Council's *The Operations of Private Health Insurers: Annual Report 2011-12*. http://phiac.gov.au/wp-content/uploads/2013/02/Annual-Report-on-Operations-2011-12-web-version.pdf
Proportion of excess insurance premium paid by an individual with the intention to undertake a bariatric surgical procedure is 8 per cent.	Calculated based on the minimum insurance premium for a hospital cover policy that covers bariatric surgical procedures from the three largest private health insurance providers in Australia (i.e. Medibank Private Limited,[157] BUPA,[158] and HCF[159]). The specifications used are: single, 50 years of age (which is the average age of obese people), base tier salary (as the average salary in Australia is under $90,000 per annum), and with government rebates applied. The weighted average premium of these three providers has been calculated based on the number of people with hospital covers with the specified providers and compared against the average hospital cover premium to estimate the proportion of excess cost.

Individual expenditure on weight loss industry



Assumption	Rationale
Average spend per overweight/obese adult on weight loss industry is $47.22 per annum	Calculations based on Australia's total amount spent on the weight loss industry sourced from IbisWorld (2015). Australians set to spend $6.6 billion to battle the bulge. *Media Centre*. Retrieved from http://media.ibisworld.com.au/2013/10/31/australians-set-spend-6-6-billion-battle-bulge/ It has been assumed that 80 per cent of total spending on weight loss counselling services and products is from overweight or obese individuals who are between the age of 18 and 75. It has been assumed that people age 75 and above are much less likely to spend on weight loss services or products.

[157] Medibank Private Limited. *Health Insurance:Hospital Only*. Retrieved from https://www.medibank.com.au/health-insurance/hospital-cover/. Note that it has been assumed that 'Top hospital essentials' is the MPL policy that covers bariatric surgery with minimum premium due to the lack of publicly available data.

[158] BUPA. *Compare Health Covers*. Retrieved from http://www.bupa.com.au/health-insurance/compare-health-covers.

[159] HCF. *Tailor my own cover*. Retrieved from http://www.hcf.com.au/healthinsurance/get-a-quote/

Individual expenditure on weight loss pharmaceuticals

Assumption	Rationale
Pharmaceuticals costs $100 per unit/per month.	Online pharmacy pricing (Chemist Warehouse)
Over 600,000 monthly packs of weight loss medications were sold in 2014.	IMS Australia estimates
Number of weight loss medication sold per year increases based on obese population under 75 years.	PwC assumption based on the number of obese people and number of packs sold in 2014.

2.7 Cost of public interventions

Government contribution

Assumption	Rationale
Annual government spend of $145 million per year for obesity prevention (2011-12 prices).	Spending through the National Partnership Agreement on Preventative Health to address obesity and overweight, physical inactivity and poor diet

3 Assumptions for indirect cost metrics

3.1 Cost of absenteeism

Employer contribution

Assumption	Rationale
Obese people were absent from work on average an additional 4 hours per year than non-obese people	Based on calculations using the following inputs/assumptions: • 13.1 per cent (11 per cent) of obese (non-obese) people had time away from school/study or work in the last 2 weeks due to own illness or injury.[160] • People who had time away had one day absent in

[160] Australian Bureau of Statistics (2013). *Australian Health Survey: Health Service Usage and Health Related Actions, 2011-12*, 'Table 5.3 Selected health risk factors by health service usage and health actions taken, Proportion of estimate', cat. no. 4364.0.55.002, Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0022011-12?OpenDocument

Assumption	Rationale
	the fortnight. • There were 25 working fortnights in the year. • There are 7.5 working hours in a day.
The average hourly wage was $39.15 in 2011-12 (2014-15 prices, originally $35.99 in 2011-12 prices).	Calculated from Australian Bureau of Statistics (2015). *Average weekly earnings, Australia, Nov 2014*. cat. no. 6302.0. Retrieved March 2015 from http://www.abs.gov.au/ausstats/meisubs.NSF/log?openagent&6302003.xls&6302.0&Time%20Series%20Spreadsheet&AC182578EB9C49A9CA257DF7000BA5EB&0&Nov%202014&26.02.2015&Latest
65 per cent of obese people are employed in 2011-12.	Calculated based on Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12,* cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

3.2 Cost of presenteeism

Employer contribution

Table B. 8 Average productivity loss due to presenteeism from obesity co-morbidities

Medical condition	Labour productivity loss due to presenteeism (% per year)	Percentage of high body mass was responsible for burden of disease of condition	Labour productivity loss due to presenteeism (% per year) resulting from obesity
Diabetes	0.23%	54.7%	0.13%
Heart disease	0.05%	19.5%	0.01%
Hypertension	0.35%	19.5%*	0.07%
Cancer	0.11%	3.9%	0.004%
Back, neck or spinal problems	0.20%	10.4%**	0.02%
Total obesity co-morbidities	**0.94%**		**0.23%**

Sources: Econtech (2007). *Economic Modelling of the Cost of Presenteeism in Australia*. Prepared for Medibank Private; Australian Institute of Health and Welfare (2003). *The burden of disease and injury in Australia 2003*. Cat. no. PHE 82. Canberra: AIHW.
Notes:
* There is no figure for hypertension, so it is assumed to have the same contribution as heart disease
** from Queensland Government Department of Health (2013). *Burden of disease: a snapshot in 2013.*

Assumption	Rationale
65 per cent of obese people are employed in 2011-12.	Calculated based on Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12,* cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

3.3 Cost of government subsidies

Government contribution on disability payment

Assumption	Rationale
1.5 per cent of individuals under 65 classified as class III obesity collect disability payments.	Based on Department of Social Services claims totals for relevant disease categories, adjusted for per cent of these categories with obesity co-morbidities and relative risk from obesity.[161,162]
Disability pension is $776.70 per fortnight (2014-15 prices).	Australian Government Department of Human Services. *Disability Support Pension*. Retrieved March 2015 from http://www.humanservices.gov.au/customer/services/centrelink/disability-support-pension

Government contribution on unemployment benefit

Assumption	Rationale
Obesity class III persons receive an average of $432 (2014-15 prices, originally $335 in 2004-05 prices) more unemployment benefit per person relative to non-obese people.	Based on non-published data from Colagiuri S, Lee CM, Colagiuri R, Magliano D, Shaw JE, Zimmet PZ, and Caterson ID (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264.

[161] Queensland Government Department of Health (2013). *Burden of disease: a snapshot in 2013.*

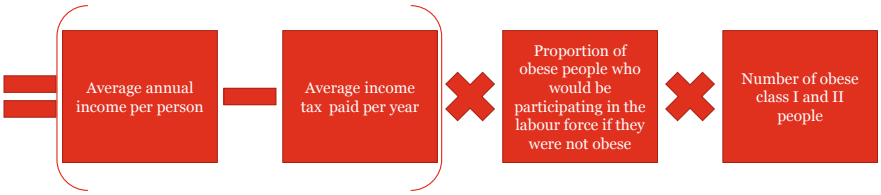
[162] Australian Institute of Health and Welfare (2003). *The burden of disease and injury in Australia 2003*. Cat. no. PHE 82. Canberra: AIHW.

Assumption	Rationale
Only persons under the Age pension age (i.e. 65 years) are eligible for Newstart Allowances (i.e. unemployment benefit).	Australian Government Department of Human Services[163]

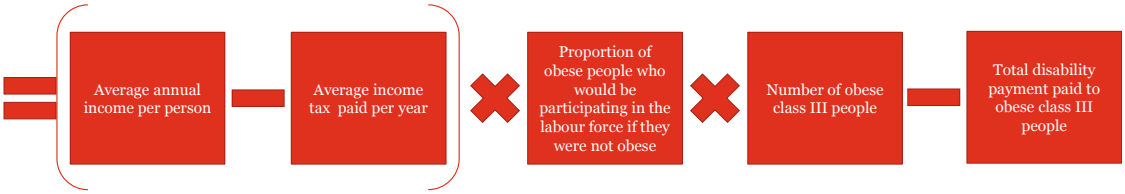
3.4 Cost of forgone earning

Individual contribution

Obesity class level I and II



Obesity class level III



Assumption	Rationale
Proportion of obese people who are not in the labour force due to being obese is 4.5 per cent for obese type I and II individuals and 6 per cent for obese type III individuals.	Calculated based on the labour force participation rate of obese (67.5 per cent) and non-obese (72 per cent) people. Data sourced from ABS (2013) *Australian Health Survey*.[164] Estimates for obese type III individuals include an additional 1.5 per cent of obese type III individuals under 65 on top of the difference of labour participation rate. This corresponds with the proportion of obese type III individuals estimated to claim disability pensions based on Department of Social Services claims totals for relevant disease categories, adjusted for per cent of these categories with obesity co-morbidities and relative risk from obesity.[165]

[163] Australian Government Department of Human Services. *Eligibility of Newstart Allowance.* Retrieved March 2015 from http://www.humanservices.gov.au/customer/enablers/centrelink/newstart-allowance/eligibility-for-newstart-allowance

[164] Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12,* 'Table7.3 Body Mass Index by selected population characteristics, Proportion of persons', cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

[165] Australian Institute of Health and Welfare (2003). The burden of disease and injury in Australia 2003. Cat. no. PHE 82. Canberra: AIHW

Assumption	Rationale
Average salary per person was $75,237 (2014-15 prices, $69,165 in 2011-12 prices) in 2011-12.	ABS (2015), *Average Weekly Earnings, Australia, Nov 2014*[166]
Income tax for the average earnings was $16,787 in 2014-15 prices ($15,432 in 2011-12 prices).	PwC calculations based on average wage ($75,237 in 2014-15 prices, originally $69,165 per year in 2011-12 prices) in 2011-12 and tax rates.
Total disability payment estimated in *cost of government subsidies* above is excluded from foregone earnings	Disability payments are excluded as the foregone income for people receiving disability payments is offset by disability payment received

3.5 Cost of forgone tax

Government contribution

Assumption	Rationale
Proportion of obese people who are not in the labour force due to being obese is 4.5 per cent for obese type I and II individuals and 6 per cent for obese type III individuals.	Calculated based on the labour force participation rate of obese (67.5 per cent) and non-obese (72 per cent) people. Data sourced from ABS (2013) *Australian Health Survey*.[167] Estimates for obese type III individuals include an additional 1.5 per cent of obese type III individuals under 65 on top of the difference of labour participation rate. This corresponds with the proportion of obese type III individuals estimated to claim disability pensions based on Department of Social Services claims totals for relevant disease categories, adjusted for per cent of these categories with obesity co-morbidities and relative risk from obesity.[168]
Income tax for the average earnings was $16,787 in 2014-15 prices ($15,432 in 2011-12 prices).	PwC calculations based on average wage ($75,237 in 2014-15 prices, originally $69,165 per year in 2011-12 prices) in 2011-12 and tax rates.

166 Australian Bureau of Statistics (2015). *Average weekly earnings, Australia, Nov 2014*. cat. no. 6302.0. Retrieved March 2015 from http://www.abs.gov.au/ausstats/meisubs.NSF/log?openagent&6302003.xls&6302.0&Time%20Series%20Spreadsheet&AC182578EB9C49A9CA257DF7000BA5EB&0&Nov%202014&26.02.2015&Latest

167 Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12,* 'Table7.3 Body Mass Index by selected population characteristics, Proportion of persons', cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

168 Australian Institute of Health and Welfare (2003). The burden of disease and injury in Australia 2003. Cat. no. PHE 82. Canberra: AIHW

4 Assumptions for health and wellbeing cost metrics

4.1 Cost of disease burden

Individual contribution

Assumption	Rationale
The burden of disease attributable to obesity was 258,573 DALYs in 2012	Based on calculations from Queensland Government Department of Health (2013). *Burden of disease: a snapshot in 2013* and AIHW (2003). *The burden of disease and injury in Australia 2003*. Cat. no. PHE 82. Canberra: AIHW
Value of statistical life per year estimated to be $183,203 in 2014-15 prices (originally $182,000 per year in 2013-14 prices)	Based on Australian Government Department of the Prime Minister and Cabinet (2014), *Best Practice Regulation Guidance Note: Value of statistical life*.

Appendix C Modelling scenarios

1 Overview

The model considers the cost of obesity under three scenarios:

1. **Base case or *status quo***, which presents a scenario assuming obesity increases at its current rate and no additional intervention/prevention programs are introduced

2. **A set of obesity intervention programs are introduced or expanded**, which presents the reduction in obesity prevalence, related benefits and cost attributed to these programs

3. **Meeting the WHO target by 2025**, which presents the scenario of halting the prevalence rate of obesity to that of 2010 (estimated 26 per cent)

The approach and assumptions used to measure the cost of obesity under the three scenarios has been discussed in Appendix B. The difference in cost of obesity across the three scenarios is driven by the difference in obesity prevalence and population. Thus, this appendix describes the approach and assumptions used to estimate obese population under each scenario.

Scenario 2 and 3 has been assessed based on the reduction in cost of obesity (cost savings) generated, due to fewer obese people, relative to the base case. Cost savings have been assessed in present value terms, whereby a 5 per cent discount rate has been applied to cost estimates over the 10 year period to convert values into 2015 present value terms.

The set of intervention/prevention programs are further assessed based on the cost effectiveness of each program, whereby cost effectiveness is measured based on a comparison of cost savings and intervention cost of the program in a ten year scope. This is discussed in more detail in section 4 of this appendix.

The model assessed these scenarios for a 10 year period from 2015-16 to 2024-25. All costs have been estimated by the three obesity class levels, stakeholders and by the following age brackets: 18–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, 65–74 years and 75 years and above.

The assumptions underpinning these estimates were drawn from Australian literature, where available, and international literature, where local data was limited. Since this approach differentiates cost of obesity by obesity class levels, literature which demonstrates the impact of intervention/prevention programs on BMI was focussed on, which can be translated into change in obesity levels.

2 Base case/Status quo

The base case estimates the cost of obesity in the scenario where no additional intervention/prevention programs are introduced or expanded and obesity prevalence continues to increase based on historical trends.

The base case obese population has been developed based on data sourced from:

- ABS (2015), *Australian Demographic Statistics, June 2014,* cat. no. 3101.0, 'Table 59. Estimated Resident Population By Single Year of Age, Australia';

- ABS (2013), *Population Projections, Australia, 2012,* cat.no. 3222.0, 'Table B9. Population projections, By age and sex, Australia – Series B';
- ABS (2013), Australian Health Survey: Updated Results, 2011-12, cat. no. 4364.0.55.003; and
- Walls, H.L., Magliano, D.J., Stevenson, C.E., Backholer, K., Mannan, H.R., Shaw, J.E., Peeters, A. (2013). Projected progression of the prevalence of obesity in Australia. *Obesity*. 20 (4):872-878.

The base case obese population has been developed, first, with projections of Australian adult population by age bracket from 2011-12 to 2024-25. Actual population data[169] was used up to 2013-14 and population projection data[170] was used from 2014-15 to 2024-25.

Then, the forecast obesity prevalence has been applied to the population projection to estimate the obese population up to 2024-25. Walls et al (2012) forecasted obesity prevalence in 2025 to be:

- 29 per cent of adult age 25-44,
- 37 per cent of adult age 45-64 and
- 37 per cent of adult age 65 and over.

For the purpose of this study, it is assumed that adults aged 18-24 have the same prevalence as adults aged 25-44.

The table below reports obesity prevalence in 2011-12 and 2024-25, where obesity prevalence in 2011-12 was sourced from ABS (2013), *Australian Health Survey*. Obesity prevalence between 2011-12 and 2024-25 was extrapolated assuming a constant growth rate.

Table C.1 Obesity prevalence in 2011-12 and 2024-25

Age bracket	Obesity prevalence (%)	
	2011-12[171]	2024-25[172]
18–24	15%	29%
25–34	21%	29%
35–44	28%	29%
45–54	32%	37%
55–64	37%	37%
65–74	35%	37%
75+	25%	37%

Note that Walls et al (2013) projected obesity prevalence for 2015, 2020 and 2025. However, the 2015 and 2020 estimates present an inconsistent trend when compared against ABS's 2011-12 Australian Health Survey obesity prevalence estimates. Thus, only the 2025 obesity prevalence estimate from Walls et al (2013) was applied.

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169 Australian Bureau of Statistics (2015), *Australian Demographic Statistics, June 2014*, cat no. 3101.0. Retrieved May 2015 from http://www.abs.gov.au/AUSSTATS/ABS@Archive.nsf/log?openagent&3101059.xls&3101.0&Time%20Series%20Spreadsheet&7A8582884A7CC018CA257E6E0011A054&0&Dec%202014&25.06.2015&Latest

170 Australia Bureau of Statistics (2013). *Population Projections, Australia, 2012,* cat. no. 3222.0. Retrieved May 2015 from http://www.abs.gov.au/AUSSTATS/ABS@Archive.nsf/log?openagent&3222ob9.xls&3222.0&Time%20Series%20Spreadsheet&8A9D565F34C50410CA257C310019EB9C&0&2012%20(base)%20to%202101&29.11.2013&Latest

171 Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12*, cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

172 Walls, H.L., Magliano, D.J., Stevenson, C.E., Backholer, K., Mannan, H.R., Shaw, J.E., Peeters, A. (2012). Projected progression of the prevalence of obesity in Australia. *Obesity*. 20 (4):872-878

Obesity prevalence was applied to the projected population to estimate obese population between 2011-12 and 2024-25. Then, the obese population was distributed across the three obesity class levels of obesity based on the forecast distribution of obese people across obesity class levels I, II and III.

The distribution of obesity class levels I, II and III individuals has been forecast up to 2024-25 based on the year-on-year change in distribution observed in Australian Health Survey between 2007-08 and 2011-12. The distribution drawn from the Australian Health Survey is presented in the table below.

Table C.2 Distribution of obese population by age bracket and obesity class levels I, II and III in 2007-08 and 2011-12

Age bracket	2007-08			2011-12		
	Obese class I	Obese class II	Obese class III	Obese class I	Obese class II	Obese class III
18–24	62%	29%	9%	58%	29%	12%
25–34	66%	21%	13%	65%	23%	11%
35–44	64%	26%	10%	61%	25%	13%
45–54	69%	22%	9%	68%	20%	12%
55–64	68%	24%	8%	67%	24%	9%
65–74	73%	23%	4%	64%	22%	13%
75+	73%	21%	5%	73%	22%	5%
Overall	**68%**	**24%**	**9%**	**65%**	**23%**	**11%**

Our forecast distribution of obese population for 2015-16 and 2024-25 is presented in the table below.

Table C.3 Forecast distribution of obese population by age bracket and obesity class levels I, II and III in 2015-16 and 2024-25

Age bracket	2015-16			2024-25		
	Obese class I	Obese class II	Obese class III	Obese class I	Obese class II	Obese class III
18–24	54%	30%	15%	46%	32%	22%
25–34	64%	26%	9%	62%	33%	5%
35–44	59%	25%	16%	55%	23%	22%
45–54	67%	18%	15%	66%	13%	21%
55–64	66%	24%	10%	64%	24%	13%
65–74	55%	22%	23%	35%	21%	44%
75+	72%	23%	4%	71%	26%	3%
Overall	**63%**	**23%**	**14%**	**58%**	**24%**	**18%**

Based on the approach and assumptions discussed above, the estimated obese population in year 2015-16 and 2024-25 is shown in the table below:

Table C.4 Actual and forecast obese population by obesity class levels in the base case

Obese class	2011-12	2015-16	2024-25
Obese class I	3,157,858	3,484,424	4,186,468
Obese class II	1,135,824	1,298,187	1,722,898
Obese class III	541,421	749,060	1,337,091
Total obese population	**4,835,102**	**5,531,672**	**7,246,457**

We have estimated that obese population will reach 7.2 million by 2025, which is a year-on-year growth of 3.2 per cent from 2011-12.

3 Set of intervention and prevention programs

This scenario considers the impact of a set of intervention programs on obesity prevalence and cost of obesity.

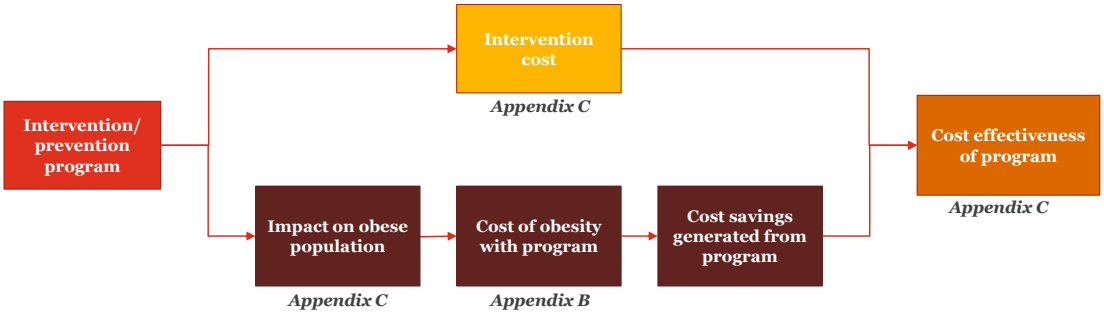
We have shortlisted nine intervention/prevention programs which fall into the following 4 categories:

- Personal: weight loss program and GP standard care program;
- Medical: bariatric surgery and pharmaceuticals;
- Education: parental education and school programs; and
- Environment: reformulation, taxes on unhealthy food and labelling.

These programs have been shortlisted from McKinsey Global Institute (2014), *Overcoming obesity: An initial economic analysis* and the ACE report *Assessing Cost-Effectiveness in Prevention* on the basis that they have a large impact across the population and are potentially cost-effective, and had some evidence to support these estimates.

In addition to estimating cost savings generated from these intervention/prevention programs, these programs were evaluated based on the cost effectiveness of each program. Cost effectiveness is measured by comparing the cost savings generated from the program relative to cost of the intervention in a ten year period, as demonstrated in the diagram below.

Figure C.1 Framework for evaluating intervention and prevention programs



Cost savings is estimated by comparing the cost of obesity in the case with the intervention/prevention program relative to the base case. Approach and assumptions used to estimate the cost of obesity are discussed in Appendix B.

The difference in cost of obesity between the case with intervention/prevention program and the base case is driven solely by the difference in obese population.

Thus, this section will first discuss the approach used to estimate cost effectiveness and these programs' impact on obese population, as a uniform approach has been applied across programs. The next section will then discuss intervention/prevention program specific assumptions underpinning the obese population impact estimates and assumptions used to estimate intervention cost.

3.1 Overall Approach

3.1.1 Measuring cost effectiveness

The cost effectiveness of the identified interventions is assessed in terms of this:

- Net Present Value (NPV), which aggregates the present value intervention cost and cost savings. A positive NPV indicates that the investment will generate a positive return over the 10 year duration.
- Benefit-Cost ratio (BCR), which compares cost savings generated by the program against the cost. A BCR above 1 indicates the program is cost effective as a $1 investment will generate more than $1 in return.

One of the challenges of a ten year assessment period is that longer term benefits beyond the 10 year assessment period are not captured, resulting in some programs being deemed not cost effective. Thus these programs were modelled in two scenarios:

- 10 year program analysis – This scenario assumes the intervention/prevention programs continue for 10 years over the entire assessment period. The scenario presents the economic feasibility of a ten year program within a ten year assessment period.
- 1 year cohort impact analysis – This scenario presents the benefit realised by one cohort assuming that the intervention runs for one year. The purpose of this analysis is to demonstrate the benefits realised by one cohort of participants over ten years.

3.1.2 Measuring impact on the obese population

The impact of intervention/prevention programs on the obese population can be categorised as direct and indirect impact. Direct impact captures the weight reduction experienced by participants of a program and indirect impact captures the avoided progression of current overweight and obesity class I and II individuals to a higher obesity class level. This study estimates both direct and indirect impact of these intervention/prevention programs.

Direct impact

Our approach takes into consideration the following features of measuring impact of intervention/prevention programs:

- Every year, new participants will participate in the program. This approach tracks the progress of participants based on the year they start participating in the program.
- Within each cohort, participants may experience different rates or levels of weight reduction over time. For example, 20 per cent of participants may be able to maintain their weight loss in the long run while other participants will regain their weight loss by the fifth year. This approach allows for different weight reduction impacts for each cohort.

Direct impact of these programs has been estimated with a six step approach:

1. **Distribute base case obese population by BMI units** –Direct impact has been estimated by BMI level. In this step, population in the three obesity class levels are evenly distributed across the BMI ranges within the obesity class. For example, obesity class level II individuals are evenly distributed across BMI 35 to 39. For obesity class level III, a maximum BMI of 44 is assumed. This provides the base case obese population estimate by BMI units.
2. **Estimate the number of new participants commencing the program each year** –Participation rate is applied to the 2024-25 base case obese population (prepared in step 1) to estimate the total number of participants in the 10 year period. The total number of participants is subsequently distributed across the 10 year period to estimate the number of new participants each year. The distribution takes into consideration the benefits ramp up profile. The benefit ramp up profile assumes that in the first year of the

programs (2015-16) only 50 per cent of annual benefits are realised. From the second year onwards, 100 per cent of annual benefits are realised.

3. **Separate participants into 'impact' groups based on varying levels of weight loss over time** – Participants commencing the program each year are separated into a few 'impact' groups. Each 'impact' group is assumed to realise and maintain different degrees of weight loss relative to their initial weight over the assessment period. This enables the analysis to capture impact of weight regain on some program participants.
4. **Estimate change in BMI over time by 'impact' group and initial BMI** – For each 'impact' group, the change in BMI due to weight reduction is measured for each initial BMI level. This allows us to track the change in BMI of a participant group over the ten year assessment period, for each given initial BMI level. This also allows us to estimate the number of obese people that remain in each obesity class (based on their change in BMI) after the program.
5. **Apply step 3 and 4 to each year of intervention** – The revised BMI of each cohort of new participant is calculated for each year within the assessment period.
6. **Aggregate the reduced obese population by obesity class levels and cohorts over the ten year period** – This provides the total obese population in the case with the intervention/prevention program, which captures the impact of all cohorts.

This approach is applied to all intervention/prevention programs with the exception of environmental programs. Environmental programs' impact on obese population has been estimated as a proportion reduction of the base case obese population.

Indirect impact

The indirect impact of intervention has been measured by obesity class levels based on the reduction in obese population in the lower obesity classification (prevention of people moving from a lower BMI class to a higher one based on progression assumptions). For example, the indirect impact on obesity class level III is measured based on the reduction in obesity class level II population attributed to the direct impact of the program.

Indirect impact is estimated based on the following function:

$$Indirect\ impact_{t,x,Program\ case} = \left(Obese\ population_{t-1,x-1,Program\ case} - Obese\ population_{t-1,x-1,Base\ case}\right) \times Progression\ rate_{t-1,x-1,Base\ case}$$

$where\ t = year$, x = obesity class level

Indirect impact is estimated as the reduction in obese population (in the lower obesity class level) relative to the base case in the year before, multiplied by the base case progression rate. The base case progression rate is the proportion of people within an obesity class level who would progress to the next obesity class level of obesity next year (without intervention).

3.2 Intervention/prevention program specific assumptions and approach

For each intervention/prevention program, this section discusses:

- the assumed program description;
- program impact assumptions used to estimate reduced obese population; and
- intervention cost's approach and assumptions.

3.2.1 Personal

Weight loss management

Description

Government subsidises 50 per cent of the cost of weight loss management programs for obesity class levels I and II individuals for one year.

Impact of intervention/prevention program

Assumption	Source
Direct impact (obesity class levels I and II)	
Participation rate – 16 per cent of obesity class I and II individuals under 65 years of age are likely to participate in this program.	Assumption based on Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9 The 2014 study found that 65 per cent of participants in Australia completed the 12 month program when the program was free and participants were directly referred to the program. The 65 per cent rate is estimated from a sample of participants who initially agreed to participate in the study. As this does not take into consideration the proportion of people who would agree to participate in the program, the participation rate was reduced to 16 per cent, which is 25 per cent of participants who completed the 12 month program. This is a conservative estimate.
Weight loss impact – All participants are estimated to lose 9 per cent of weight in the first year.	Australian participants who complete the 12 months program experienced an average weight reduction of 7.75kg. Participants' mean weight before the program was 86.9kg. This indicates an average of 9 per cent weight loss within 12 months. Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9
Long term impact – • 5 percent of participants lose 9 per cent of weight in the first year and maintain 9 per cent weight loss in the long run. • 45 per cent of participants lose 9 per cent of their weight in the first year, regains 70 per cent of their weight loss by the fifth year and maintains this weight in the long run.	Assumptions are based on longer term weight loss studies and discussion with subject matter experts Franz, M.J., VanWormer, J.J., Crain, A.L., et al. (2007). Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. Journal of American Dietetic Association. 107:1755–1767 Ulen, C.G., Huizinga, M.M., Beech, B., and Elasy, T.A. (2008). Weight Regain Prevention. *Clinical Diabetes*. 26(3), Retrieved from http://clinical.diabetesjournals.org/content/26/3/100.full

Assumption	Source
• 50 per cent of participants lose 9 per cent of their weight in the first year and regains all weight by the fifth year.	

Cost of intervention/prevention program

Intervention program administration cost - Commonwealth government

Assumptions	Source
The program's administration cost is $1 million per year (2015 prices)	Estimates based on PwC knowledge and the intervention estimates from the ACE Prevention study: Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

Subsidisation cost - Commonwealth government

Assumptions	Source
Number of participants is estimated as 16 per cent of obesity class I and II individuals under 65 years.	Refer to *Impact of intervention/prevention program* above.
Weight loss management program costs $726.60 per year in 2013 prices.	Weightwatchers cited in Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9
50 per cent of this cost is subsidised for obesity class I and II participant.	

Commercial program cost - Individual

Assumptions	Source
Number of participants is estimated as 16 per cent of obesity class I and II individuals under 65 years.	Refer to *Impact of intervention/prevention program* above.
Weight loss management program costs $726.60 per year in 2013 prices.	Weightwatchers cited in Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9
50 per cent of this cost is paid by individuals	

GP standard care program

Description

Commonwealth government promotes GP standard care program through a campaign to increase public awareness of the availability of such services as well as encourage GPs proactively provide such care to obese patients.

In this intervention, GP are expected to provide standard care advice based on existing Clinical Practice Guidelines.

Impact of intervention/prevention program

Assumption	Source
Direct impact (Obesity class levels I and II)	
Participation rate – 13 per cent of obese class I and II individuals of all ages are likely to participate in the program.	Assumption based on Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9 This study found that 51 per cent of participants completed the 12 month program when the program was free and participants were directly referred to the program. The 51 per cent rate is estimated from a sample of participants who initially agreed to participate in the study. As this does not take into consideration the proportion of people who would agree to participate in the program, the participation rate was reduced to 13 per cent, which is 25 per cent of participants who completed the 12 month program. This is a conservative estimate.

Assumption	Source
Weight loss impact – All participants will lose approximately 5 per cent of their weight in 12 months of participating in the program.	Australian participants who complete the 12 months program experienced an average weight reduction of 4.2kg. Participants' mean weight before the program was 86.5kg. This indicates an average 5 per cent weight loss. Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9
Long term impact – • 5 per cent of participants lose 5 per cent of weight in the first year and maintain 5 per cent weight loss in the long run. • 45 per cent of participants lose 5 per cent of their weight in the first year, regains 70 per cent of their weight loss by the fifth year and maintains this weight in the long run. • 50 per cent of participants lose 5 per cent of their weight in the first year and regains all weight by the fifth year.	Assumptions are based on longer term weight loss studies and discussion with subject matter experts Franz, M.J., VanWormer, J.J., Crain, A.L., et al. (2007). Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. Journal of American Dietetic Association. 107:1755–1767 Ulen, C.G., Huizinga, M.M., Beech, B., and Elasy, T.A. (2008). Weight Regain Prevention. *Clinical Diabetes*. 26(3), Retrieved from http://clinical.diabetesjournals.org/content/26/3/100.full

Cost of intervention/prevention program

Intervention program campaign and administration cost - Commonwealth government

Assumptions	Source
The initial set up and campaign cost is $5 million in the first year. The program's ongoing campaign and administration cost is $1 million per year (2015 prices)	Estimates based on PwC knowledge and the intervention estimates from the ACE Prevention study: Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

GP visit cost - Commonwealth government

Assumptions	Source
Number of participants is estimated as 13 per cent of obesity class I and II individuals of all ages.	Refer to *Impact of intervention/prevention program* above.
GP visits costs $37.05 per visit (2015 prices)	MBS, GP visit level B
Each participant will have an additional 10.7 visits during the 12 months of the program.	Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9

3.2.2 Education

Considering that this study measures the impact on adult obesity, education programs will not appear cost effective as an investment on children (assuming these children are aged 10 in 2015-16) today is going to take at least eight years before the benefits appear (as a reduction in adult obesity). For this reason, we have evaluated both education programs assuming that these programs only run for 2 years. Within a 10 year assessment period, this will mean that 2 cohorts of 10 year old children will benefit from this program (i.e. 10 year old children in 2015-16 and 2016-17) and their benefits will be realised from when they turn 18 in 2023-24 and 2024-25.

This approach is undertaken solely for the purpose of the evaluation and to avoid generating a more skewed cost effectiveness estimate for education programs (if there were ten years of cost and two years of benefit). It is not in the intention to suggest that this program should only run for 2 years.

Parental education

Description

The Commonwealth government promotes parental 'healthy lifestyle' sessions amongst parents with obese or overweight children aged seven to ten from 2015-16.

The program consists of eight therapy sessions in six months which includes recommendations on specific core food servings; practical skills for healthy eating, reduced sedentary behaviours, increased activity; monitoring of lifestyle behaviours and roles and responsibilities around eating, managing appetite, self-esteem and teasing.

These therapy sessions are fully subsidised by the Commonwealth.

Impact of intervention/prevention program

Assumption	Source
Direct impact (Obesity class levels I, II and III)	
37 per cent of obese adults were overweight or obese as children.	Venn, A.J., Thomson, R.J., Schmidt, M.D., Cleland, V.J., Curry, B.A., Gennat, H.C., and Dwyer, T. (2007). Overweight and obesity from childhood to adulthood: a follow-up of participants in the 1985 Australian Schools Health and Fitness Survey. *The Medical Journal of Australia*. 186 (9)
Participation rate of parents with overweight/obese children is assumed to be 50 per cent.	PwC assumption, feasibility discussed with experts
Participation rate - As this study measures the impact of adult obesity, this program is estimated to affect 19 per cent of obese adults as they were obese or overweight as children and can benefit from this program.	Estimated based on the assumption above. 37% x 50% = 19%
Lag effect - Impact is only measured from 2023-24 onwards.	This assumes that the program begins in 2015-16 for children aged 10. This cohort will turn 18 in 2023-24. Thus, any benefit from this program will only be estimated in this study from 2023-24, when the first group of children to benefit from this program turns 18.
Weight loss impact - Overweight/obese children who participated in the program experienced a weight loss of approximately 10 per cent.	Magarey, A.M., Perry, R.A., Baur, L.A., Steinbeck, K.S., Sawyer, M., Hills, A.P., Wilson, G., Lee, A., and Daniels, L.A. (2011). A Parent-led Family-focused Treatment Program for Overweight Children Aged 5 to 9 years: The Peach RCT. *The American Academy of Pediatrics*. 127(2):214-22 This study found an average of 10 per cent weight loss for children aged 5 to 9 within the first 6 months of the program. The study found that by 12 months the average weight reduction was 11 per cent and 14 per cent at 24 months. However, the conservative estimate of 10 per cent as a long term weight reduction impact was taken. We have been assumed that this is impact is similar for children at age 10.
Long term impact – • 5 per cent of participants lose 10 per cent of weight in the first year and maintain 10 per cent weight loss in the long run. • 45 per cent of participants lose 10 per cent of their weight in the first year, regains 70 per cent of their weight loss by the fifth year	Assumptions are based on longer term weight loss studies and discussion with subject matter experts Franz, M.J., VanWormer, J.J., Crain, A.L., et al. (2007). Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. Journal of American Dietetic Association. 107:1755–1767 Ulen, C.G., Huizinga, M.M., Beech, B., and Elasy, T.A. (2008). Weight Regain Prevention. *Clinical Diabetes*. 26(3), Retrieved from http://clinical.diabetesjournals.org/content/26/3/100.

Assumption	Source
and maintains this weight in the long run. • 50 per cent of participants lose 10 per cent of their weight in the first year and regains all weight by the fifth year.	full
Participants and the impact realised by participants are assumed to be evenly distributed across the three obese classes.	PwC assumption

Cost of intervention/prevention program

Intervention program campaign and administration cost - Commonwealth government

Assumptions	Source
The initial set up and campaign cost is $5 million in the first year. The program's ongoing campaign and administration cost is $1 million per year (2015 prices)	Estimates based on PwC knowledge and the intervention estimates from the ACE Prevention study: Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010), *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

Cost of healthy lifestyle sessions – Commonwealth government

Assumptions	Source
Participants are 50 per cent of overweight or obese children.	PwC assumption, as above.
Number of potential overweight or obese children participants = the number of children impact as adults x 2.3	Overweight/obese children who become obese adults make up 44 per cent of total overweight/obese children, which indicates that total overweight/obese children are 2.3 times (i.e. 1/44 per cent) of those who become obese adults. This is applied to the estimated number of obese adults who were overweight/obese as children (estimated as 37 per cent of obese adults who turned 18 each year) Assumptions based on Venn, A.J., Thomson, R.J., Schmidt, M.D., Cleland, V.J., Curry, B.A., Gennat, H.C., and Dwyer, T. (2007). Overweight and obesity from childhood to adulthood: a follow-up of participants in the 1985 Australian Schools Health and

Assumptions	Source
	Fitness Survey. *The Medical Journal of Australia*. 186 (9)
Each participating parent is expected to attend 8 dietetic group sessions within 6 months.	Magarey, A.M., Perry, R.A., Baur, L.A., Steinbeck, K.S., Sawyer, M., Hills, A.P., Wilson, G., Lee, A., and Daniels, L.A. (2011). A Parent-led Family-focused Treatment Program for Overweight Children Aged 5 to 9 years: The Peach RCT. *The American Academy of Pediatrics*. 127(2):214-22
Each session is assumed to cost $20 (2015 prices).	MBS, item 81125 – Dietetics Services – Group service. MBS subsidises 85 per cent of fee. It is assumed that 100 per cent of fee is subsidised.

School curriculum

Description

The Commonwealth government funds school program which consists of 13 to 17 hours of nutrition and health education per year, four to six hours of teaching on physical fitness per year and parental involvement with annual school meetings. It also includes two physical exercise classes per week (45 minutes per class) during the academic year. This program would be implemented for students in Grade 1 to 4, i.e. children aged seven to ten.

Impact of intervention/prevention program

Assumption	Source
Direct impact (Obesity class levels I, II and III)	
37 per cent of obese adults were overweight or obese as children.	Venn, AJ, Thomson, RJ, Schmidt, MD, Cleland, VJ, Curry, BA, Gennat, HC, and Dwyer, T (2007), *Overweight and obesity from childhood to adulthood: a follow-up of participants in the 1985 Australian Schools Health and Fitness Survey,* The Medical Journal of Australia, Vol 186 (9).
35 per cent of children aged 7 to 10 will have the opportunity to participate in this program	PwC assumption, feasibility discussed with experts
Participation rate - This program is estimated to affect 13 per cent of obese adults as they were obese or overweight as children and can benefit from this program.	Estimated based on the assumption above. 37% x 35% = 13%
Lag effect - Impact is only measured from 2023-24 onwards.	This assumes that the program begins in 2015-16 for children aged 10. This cohort will turn 18 in 2023-24. Thus, any benefit from this program will only be estimated in this study from 2023-24, when the first group of children to benefit from this program turns 18.
Weight loss impact - Overweight/obese children who participated in the program experienced a weight loss of approximately 7 per cent.	Manios, Y., Moschandreas, J., Hatzis, C., and Kafatos, A. (1999). Evaluation of a Health and Nutrition Education Program in Primary School Children of Crete over a Three-Year Period. *Preventive Medicine*. 28(2):149-59 This study found that children who have been through the program experience a lower increase in BMI relative to

Assumption	Source
	children who have not experienced the program by 1.1 units. The average BMI is 16 before the program. This indicates that children who have been through the program are likely to have 7 per cent lower BMI.
Long term impact – • 5 per cent of participants lose 7 per cent of weight in the first year and maintain 7 per cent weight loss in the long run. • 45 per cent of participants lose 7 per cent of their weight in the first year, regains 70 per cent of their weight loss by the fifth year and maintains this weight in the long run. • 50 per cent of participants lose 7 per cent of their weight in the first year and regains all weight by the fifth year.	Assumptions are based on longer term weight loss studies and discussion with subject matter experts Franz MJ, VanWormer JJ, Crain AL, et al. (2007). Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. Journal of American Dietetic Association. 107:1755–1767 Ulen, C.G., Huizinga, M.M., Beech, B., and Elasy, T.A. (2008). Weight Regain Prevention. *Clinical Diabetes*. 26(3), Retrieved from http://clinical.diabetesjournals.org/content/26/3/100.full
Participants and the impact realised by participants are assumed to be evenly distributed across the three obesity classes.	PwC assumption

Cost of intervention/prevention program

Intervention program campaign and administration cost - Commonwealth government

Assumptions	Source
The initial set up and campaign cost is $5 million in the first year.	Estimates based on PwC knowledge and the intervention estimates from the ACE Prevention study:
The program's ongoing campaign and administration cost is $1 million per year (2015 prices)	Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010), *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

Cost of healthy lifestyle sessions – Commonwealth government

Assumptions	Source
Number of children aged 10 in 2015-16 is 304,051 and in 2016-17 is 307,528.	Data sourced from ABS (2013), *Population Projections, Australia, 2012,* cat. no. 3222.0, Table B9. Population projections, By age and sex, Australia – Series B. For simplicity, it is assumed that all participating children are aged 10.
35 per cent of children will participate in this program	PwC assumption (as above)
This program costs $32 per child per year. (2013 prices)	Based on the Energized Program in New Zealand. Sourced from Obesity Australia (2013), *Obesity Australian Action Agenda April 2013,* pg 7.

3.2.3 Medical

Bariatric surgery

Description

The State Government funds bariatric surgery for obesity class II patients with comorbidities and obese class III patients, under 75 years.

The cost of the procedure and follow-up visits for gastric band adjustments are fully subsidised by public hospitals.

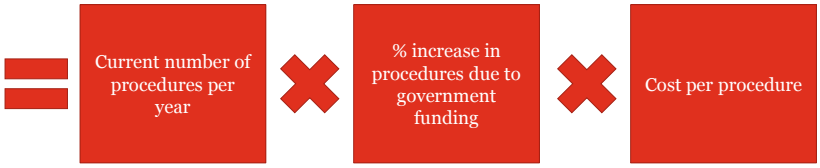
Impact of intervention/prevention program

Assumption	Source
Direct impact (Obesity class levels II and III)	
Number of bariatric surgical procedures increases by 30 per cent due to this program	PwC assumption, feasibility discussed with experts
Additional number of bariatric procedures are evenly distributed across obese class II individuals with comorbidities and obese class III individuals	PwC assumption
20 per cent of obese class II individuals have comorbidities and are eligible for this program.	Assumption based metabolic syndrome and chronic disease understanding and studies Jordan, H.T., Tabaei, B.P., Nash, D., Angell, S.Y., Chamany, S., and Kerker, B. (2012). Metabolic syndrome among adults in New York City, 2004 New York City Health and Nutrition Examination Survey.

Assumption	Source
	Preventing Chronic Disease. 9:100260 Nguyen, N.T., Magno, C.P., Lane, K.T., Hinojosa, M.W., and Lane, J.S. (2008). Association of hypertension, diabetes, dyslipidemia, and metabolic syndrome with obesity: findings from the National Health and Nutrition Examination Survey, 1999 to 2004. Journal of American College of Surgeons. 207(6):928–34
Weight loss impact – All participants will lose 25 per cent of initial weight in the first year and 26 per cent of initial weight in the second year.	Weight loss and maintenance assumptions based on literature where and discussions with subject matter experts Magro, D.O., Geloneze, B., Delfini, R., Pareja, B.C., Callejas, F., and Pareja, J.C .(2008). Long-term weight regain after gastric bypass: a 5-year prospective study. *Obes Surg*. 18(6):648–651 National Bariatric Surgery Register (2014). The National Bariatric Surgery Register 2014. Retrieved from http://nbsr.co.uk/
Long term impact – • 80 per cent of patients gradually regain approximately 8 per cent of their minimum weight by the fifth year. This weight is maintained for the patient's lifetime. • 10 per cent of patients regain all their weight by the fifth year. • 10 per cent of patients maintain their weight loss of 26 per cent from the second year in the long run.	

Cost of intervention/prevention program

Surgical procedure and follow-up visit cost - State Government



Assumptions	Source
Number of additional procedures that will be funded due to this program is estimated as 30 per cent of existing number of procedures. These include surgical procedures as well as follow-up gastric band adjustment visits.	PwC assumption, feasibility discussed with experts
Cost to public hospital is assumed to be 30 per cent lower than private hospital fees.	Based on input from subject matter experts and the Obesity Australia Action Agenda Report (April 2013) retrieved from http://www.obesityaustralia.org/publications-documents
Average cost per bariatric surgical procedure is $10,987 per procedure (2015 prices).	This cost is estimated as 70 per cent of private hospital fees, estimated as an aggregate of private health insurance, MBS and individual contribution. Cost estimates based on data sourced from Bariatric Surgery Source. *Weight Loss Surgery Australia: Complete Reference Guide*. Retrieved March 2015 from http://www.bariatric-surgery-source.com/weight-loss-surgery-australia.html and Medicare rebate sourced from Australian Government Department of Health. *MBS Online*. Retrieved March 2015 from http://www.mbsonline.gov.au
Average cost per follow up visit is $124 per visit (2015 prices).	This cost is estimated as 70 per cent of private hospital fees, estimated as an aggregate of private health insurance, MBS and individual contribution. Cost estimates based on data sourced from LAP Surgery Australia, *Weight Loss Solutions*. Retrieved from http://www.lapsurgeryaustralia.com.au/weight-loss-solutions/lap-band#costs; and Medicare rebate sourced from Australian Government Department of Health. *MBS Online*. Retrieved March 2015 from http://www.mbsonline.gov.au

Pharmaceuticals

Description

The Commonwealth government fully subsidises Orlistat (no prescription required) and Phentermine (prescription required) medication for obesity class I, II and III individuals under 65 years.

Orlistat can be taken in the long term while Phentermine should only be taken for a maximum duration of three months. It is assumed that all medication is fully subsidised (unless they drop into the overweight category and then it is assumed funding stops).

Impact of intervention/prevention program

Assumption	Source
Direct impact for Orlistat (Obesity class levels I, II, III)	
Participation rate – 1 per cent of obesity class I, II and III individuals of under 65 years are likely to start taking Orlistat.	Based on IMS Health 2014 volumes estimates and estimated increased use
Weight loss impact – Successful participants lose 8.5 per cent to 10 per cent of weight in the first year while unsuccessful participants do not lose any weight.	Weight loss and maintenance assumptions were based on averages from available literature and discussions with subject matter experts. There is very limited research on weight loss intervention impacts after 2-3 years. Placebo effect results were not be subtracted from the total weight loss impact estimates Yanovski, S.Z. and Yanovski, J.A. (2014). Long-term Drug Treatment for Obesity: A Systematic and Clinical Review. *The Journal of the American Medical Association*. 311(1):74-86 Davidson, M.H., Hauptman, J., DiGirolamo, M., Foreyt, J.P., Halsted C.H., Heber, D., Heimburger, D.C., Lucas, C.P., Robbins, D.C., Chung, J., and Heymsfield, S.B. (1999). Weight control and risk factor reduction in obese subjects treated for 2 years with orlistat: a randomized controlled trial. *The Journal of the American Medical Association*. 281(31):1174. Douglas, I.J., Bhaskaran, K., Batterham, R.L., and Smeeth, L. (2015). The effectiveness of pharmaceutical interventions for obesity: weight loss with orlistat and sibutramine in a United Kingdom population-based cohort. *British Journal of Clinical Pathology*. 79(6):1020-7.
Long term impact – • 90 per cent of participants lose 8.5 per cent of weight in the first year and regain all weight by the fifth year (these participants are assumed to take the medication for an average duration of 6 months). • 5 per cent of participants lose 10 per cent of their weight in the first year and maintains this weight in the long run (these participants are assumed to take the medication for an average duration of 2 years). • 5 per cent of participants did not lose any weight in the first year (these participants are assumed to take the medication for an average of 6 months).	
Direct impact for Phentermine (Obesity class levels I, II, III)	
Participation rate – 6 per cent of obesity class I, II and III individuals of under 65 years are likely to start taking Phentermine.	Weight loss and maintenance assumptions were based on averages from available literature and discussions with subject matter experts. There is very limited research on weight loss intervention impacts after 2-3 years.

Assumption	Source
Weight loss impact – Successful participants lose 10 per cent of weight in the first year while unsuccessful participants do not lose any weight.	Placebo effect results were not be subtracted from the total weight loss impact estimates Munro, J.F., MacCuish, A.C., Wilson, E.M., and Duncan, L.J. (1968). Comparison of Continuous and Intermittent Anorectic Therapy in Obesity. *British Medical Journal*. 1(5588):352-354.
Long term impact – • 20 per cent of participants lose 10 per cent of weight in the first year and regain most their weight loss by the fifth year. It is assumed they maintain 1.5 per cent of initial weight loss from the fifth year onwards. • 75 per cent of participants lose 8 per cent of weight in the first year and regain all their weight loss in the second year. • 5 per cent of participants lose 10 per cent of their weight in the first year and maintains this weight in the long run. (Note: all participants are assumed to take the medication for 3 months)	Goldstein, D.J., and Potvin, J.H. (1994). Long-term weight loss: the effect of pharmacologic agents. *The American Journal of Clinical Nutrition*. 60(5):647-57. Weintraub, M., Sundaresan, P.R., Schuster, B., Averbuch, M., Stein, E.C., Cox, C., et al. (1992). Long-term weight control study. IV (weeks 156 to 190). The second double-blind phase. Clin *Pharmacology & Therapeutics*. 51(5):608–14

Cost of intervention/prevention program

Orlistat subsidisation cost - Commonwealth government

Assumptions	Source
1 per cent of obesity class I, II and III individuals will participate in this program	Based on IMS Health 2014 volumes estimates and estimated increased use
Average duration of participation– • 95 per cent of participants take the medication for an average duration of 6 months • 5 per cent of participants take the medication for an average duration of 2 years.	Estimates based on private market research
Orlistat medication cost per month is $100 (2015 prices)	Online pharmacy pricing (Chemist Warehouse)

Phentermine subsidisation cost - Commonwealth government

Assumptions	Source
7 per cent of obesity class I, II and III individuals will participate in this program	Based on IMS Health 2014 volumes estimates and estimated increased use
All participants take medication for 3 months	Based on prescription guidelines (some will take it for longer and some will take it for a shorter period)
Orlistat medication cost per month is $100. (2015 prices)	Online pharmacy pricing (Chemist Warehouse)

3.2.4 Environment

Description

This program captures a combination of the following three environmental intervention/prevention programs:

- Reformulation, which consists of voluntary or mandatory reformulation of processed food;
- Labelling, including increased use of the HSR system which was launched in 2014; and
- Food and beverage tax on unhealthy foods.

Due to limited evidence on the impact of each of these programs, the programs have been grouped together and assessed as one program to provide a stronger basis for impact estimates.

For the purpose of this analysis, it is assumed that the government will invest in these environmental programs on an ongoing basis over the ten year assessment period.

Impact of intervention/prevention program

Assumption	Source
Direct impact (Overweight and obesity class levels I, II and III)	
Number of obese individuals will reduce by 0.5 per cent across all obesity classes. Number of overweight individuals will reduce by 1 per cent.	While there is no direct research to support these programs, we have considered the following studies when developing the assumption: • The few available studies suggest that higher prices of sugar sweetened beverages may lead to modest reductions in weight in the population.[173] • A Dutch study estimated that a comprehensive national approach, which included social

[173] Cabrera Escobar MA, Veerman JL, Tollman SM, Bertram MY, Hofman KJ. Evidence that a tax on sugar sweetened beverages reduces the obesity rate: a meta-analysis. BMC Public Health. 2013;13:1072. doi:10.1186/1471-2458-13-1072.

Assumption	Source
	marketing, support groups, screening and high participation rates, would lead to a reduction of 1.2 per cent of obese population and 1.6 per cent of overweight population.[174] • Portion control can reduce total BMI burden of disease by 4 per cent.[175] To take a conservative estimate, we have assumed a 0.5 per cent reduction in obese population and 1 per cent reduction in overweight population relative to the base case.

Cost of intervention/prevention program

Intervention program campaign and administration cost - Commonwealth government

Assumptions	Source
The initial campaign cost for government is $17 million, which consists of $15 million for the tax program and $2 million for reformulation (2015 prices) Campaign cost for labelling is assumed to have already been incurred.	Based on: • Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010), *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention • PwC (2014). *Health Star Rating System: Cost Benefit Analysis*.
The program's ongoing cost is $1.75 million per year, which consists of $250,000 per year for tax and $1.5 million per year for labelling. (2015 prices)	Based on: • Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010), *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention • PwC (2014). *Health Star Rating System: Cost Benefit Analysis*.

Intervention program campaign and administration cost - Industry

Assumptions	Source
The initial set up for industry is $8 million, which consists of $5 million for the tax program and $3 million for reformulation (2015 prices)	Based on: • Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010), *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

[174] Moodie, R., et al. (2009). Australia: the healthiest country by 2020.Technical Report No 1. Obesity in Australia: a need for urgent action, Australian Government: Preventative Health Taskforce

[175] McKinsey Global Institute (2014). *Overcoming Obesity: An initial economic analysis*. Retrieved from http://www.mckinsey.com/~/media/McKinsey/dotcom/Insights/Economic%20Studies/How%20the%20world%20could%20better%20fight%20obesity/MGI%20Obesity_Full%20report_November%202014.ashx

Assumptions	Source
	• PwC (2014). *Health Star Rating System: Cost Benefit Analysis.*
The program's ongoing cost is $7.25 million per year, which consists of $750,000 per year for tax, $2 million per year for reformulation, and $4.5 million per year for labelling. (2015 prices)	Based on: • Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010), *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention • PwC (2014). *Health Star Rating System: Cost Benefit Analysis.*

4 Meeting the WHO target

This scenario estimates the cost of obesity and the total obese population assuming we meet the WHO target by 2025, which aims to reduce obesity prevalence to the 2010 prevalence rate.

The ABS (2013) Australian Health Survey, reported that obesity prevalence was 25 per cent in 2007-08 and 28 per cent in 2011-12. We have estimated 2010's obesity prevalence to be the mid-point of the two prevalence rates, i.e. 26 per cent.

To estimate the change in the obese population, we assumed that obese population will start to converge to the target obesity prevalence rate of 26 per cent from 2015-16 and reach the target prevalence rate in 2024-25.

At a 26 per cent prevalence rate, the obese population in 2024-25 is estimated to be 5.7 million people. To arrive at this obese population by 2024-25, we estimated the annual growth rate between 2014-15[176] and 2024-25 to be 0.6 per cent per annum. This growth rate has been applied to the 2014-15 obese population to estimate obese population for the full 10 year period.

The estimated obese population in this scenario is presented in the table below.

Table C.5 Actual and forecast obese population by obesity class levels in the scenario where the WHO target is met

Obesity class	2011-12	2015-16	2024-25
Obesity class I	3,157,858	3,422,163	3,580,645
Obesity class II	1,135,824	1,263,173	1,334,036
Obesity class III	541,421	697,857	769,745
Total obese population	**4,835,102**	**5,383,192**	**5,684,426**

[176] Note that the growth rate was estimated for a full 10 year period assuming population growth begins to slow down from 2015-16.

Appendix D Literature scan on obesity costs

1 Overview

This appendix summarises the literature scan completed to inform PwC's estimation of the current costs of obesity in Australia, commissioned by Obesity Australia. Following advice from Obesity Australia, the cost estimation focuses on obesity, defined as a body mass index of 30 or above, as distinct from overweight. The literature summarised below, however, includes some estimates on the overweight population where analogous information on just the obese population is not available.

The literature scan reviewed both Australian and international sources on a comprehensive list of search terms. This appendix, however, presents information contained only within Australian sources. In doing so, it highlights significant gaps in the current Australian literature.

The appendix is set up as follows:

- The remainder of this section summarises the literature on the prevalence and costs of obesity.
- Section 2 presents information on the direct costs of obesity.
- Section 3 summarises information on the indirect costs of obesity.
- Section 4 reports on the impacts of obesity on individual health and wellbeing.

Throughout the document, information pertaining to children is reported in red text and information regarding adults is in black text. Each source is referred to by a number, which is included in square brackets at the end of each citation.

Obesity in Australia

The literature shows that the prevalence of obesity in Australia has increased in the last 15 years, from estimates of 9.5 per cent of the adult population in 1990[177] to a recent estimate of 27.5 per cent from the Australian Health Survey (2011-12).[178] Projections to 2025 estimate a continued increase in obesity levels (and severity) for Australian adults, which would lead to considerable burden of disease costs and impacts for the country. These current and future prevalence estimates highlight the need take action on a national level. Additionally, Australia is one of the most obese nations, competing with the US and UK on prevalence levels.[179]

The table below summarises the literature on the expected increases in obesity in the future.

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177 Atlantis, E. (2009). *Chronic disease trends due to excess body weight in Australia* (Vol. 10, pp. 543-553). Oxford, UK: Blackwell Publishing.

178 Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results 2011-12*, cat. no. 4364.0.55.003, 'Table 5.1 Body Mass Index, Proportion of persons - Australia'. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

179 Wang, Y Claire et al (2011). Health and economic burden of the projected obesity trends in the USA and the UK. *The Lancet*. 378(9793):815–825.

Finding	Notes	Source
• Between 2000 and 2025, prevalence of obesity is predicted to rise from 20.5 per cent to 33.9 per cent of adult population (25 years and older). • If the rates of weight gain observed between 2000 and 2005 are maintained, obesity prevalence will have increased by 65 per cent by 2025.	Estimated the future obesity prevalence in Australian adults using measures of overweight and obesity incidence from AusDiab (baseline 2000, follow-up 2005). Estimates based on the most recent measures of weight change (instead of just extrapolating past prevalence of obesity).	2
• Prevalence of overweight and obesity in Australia will increase between 0.4 per cent and 0.8 per cent per year. • By 2025, 83 per cent of males and 75 per cent of females aged 20 years and older will be overweight or obese. • By 2025, 37 per cent of males and 33 per cent of females aged 5 to 19 years will be overweight or obese. • By 2025, an estimated one third of Australian children will be overweight and obese.	Data were drawn from 11 cross-sectional national or state population surveys conducted in Australia between 1969 and 2004. Multiple linear regression analyses of measured log-transformed BMI data were conducted to determine the independent effects of age and year of birth (cohort) on ln(BMI) for males and females, respectively.	3

Total costs of obesity

There have only been a few studies on the total costs of obesity in Australia, including the direct costs, indirect costs (such as productivity loss for obese individuals and their carers) and the loss of wellbeing. One systematic review[180] found that there is a lack of international literature that examines the full scope of costs associated with overweight and obesity.

The two major Australian reports on the total cost of obesity, both conducted by Deloitte Access Economics, show that the overall costs to Australia are large and the majority of costs come from indirect and lost wellbeing costs.

Finding	Notes	Source
The total financial cost of obesity in 2005 was estimated as $3.767 billion. • Of this, productivity costs were estimated as $1.7 billion (45 per cent), health system costs were $873 million (23 per cent) and carer costs were 804 million (21 per cent). • DWL from transfers (taxation revenue foregone, welfare and other government payments) were $358 million (10 per cent) and other	Access Economics report utilises the prevalence (annual costs) approach to estimating the costs of obesity. Prevalence rates in Access Economics (2006) were based on Australian measured anthropomorphic data from AusDiab (2000), the National Nutrition Study (1995) and the NSW Schools Physical Activity and Nutrition Survey (SPANS, 2004) study for children. Based on those definitions and data, 3.24 million Australians (15.9 per cent)	7

[180] Dee et al.: The direct and indirect costs of both overweight and obesity: a systematic review. BMC Research Notes 2014 7:242.

Finding	Notes	Source
indirect costs were $40 million (1 per cent). The net cost of lost wellbeing (the dollar value of the burden of disease, netting out financial costs borne by individuals) was valued at a further $17.2 billion, bringing the total cost of obesity in 2005 to $21.0 billion.	were estimated to be obese in 2005.	
Financial benefits of achieving realistic prevention goals (3 per cent reduction in prevalence) for obesity are $82m in total production (Frictional Cost Approach) and $90m in Health sector offsets.	Estimates of health impact, economic benefit and financial benefit were derived from a literature review on each risk factor, consultation with external and independent experts, direct use of databases from the Australian Bureau of Statistics (ABS) and use of attributable risk estimates and data from the 2003 Australian Burden of Disease (BoD) study. The target for reductions in behavioural risk factors for BMI was a reduction in prevalence by 3 per cent.	8
Using the new obesity prevalence estimates, attributable fractions, and unit cost data, the financial cost of obesity in 2008 was estimated as $8.283 billion. • Of this, productivity costs were estimated as $3.6 billion (44 per cent), health system costs were $2.0 billion (24 per cent) and carer costs were $1.9 billion (23 per cent). • Dead weight losses from transfers (taxation revenue forgone, welfare and other government payments) were $727 million (9 per cent) and other indirect costs were $76 million (1 per cent). The net cost of lost wellbeing (the dollar value of the burden of disease, netting out financial costs borne by individuals) was valued at a further $49.9 billion, bringing the total cost of obesity in 2008 to $58.2 billion.	Second Access Economics report seeks to utilise new data that have become available subsequently to update the estimates of the prevalence, attributable fractions, and cost of obesity for the year 2008. In 2005, the economic costs were significantly lower at $21.0 billion, including $3.8 billion in financial costs and $17.2 billion in net cost of lost wellbeing. The increase of economic costs is due to a combination of factors such as cost inflation, population growth and change in methodology in relation to VSLYs and AFs.	9

2 Direct costs of obesity

There is some variation in the literature on what is included in direct costs; at a minimum, all studies consider the medical expenses generated as a result of obesity.

Total direct costs of obesity

There are various approaches to estimate the total direct costs of obesity in the literature. Given this, there are a wide range of estimates, depending on what variables are included in the analysis.

Finding	Notes	Source
• The annual total direct cost (health care, non-health care and government subsidies) in 2004-05 was $7,190 per obese person (this compares to $4,105 per normal weight person). • The total direct cost of obesity (health care, non-health care and government subsidies) in 2005 was $21.9 billion.	Direct health care cost, direct non-health care cost and government subsidies associated with overweight and obesity, analysis of 5-year follow-up data from the Australian Diabetes, Obesity and Lifestyle study, collected in 2004-05.	10
The direct cost of obesity to the Australian economy in 2008-09 was $1.3 billion.	Based on KPMG Econtech's MM2 model. Direct costs are associated with four comorbidities: cardiovascular disease, type 2 diabetes, osteoarthritis and some forms of cancer.	11

Medical costs of obesity in aggregate

Direct medical costs can be estimated using two different methods:

- Top down method - where by national health costs are allocated to specific diseases, such as obesity and its co-morbidities
- Bottom-up approach - where per person costs are estimated and extrapolated to calculate a society estimate.

In considering the medical costs of obesity, some studies look at health care use by some measure of weight, such as body mass index (BMI) or waist circumference. Others consider health care use for different obesity comorbidities and attribute a portion of costs for those diseases to obesity.

These studies tend to assume that the medical costs for obese people are generated in large part by treatment necessary to address their chronic comorbidities. A recent Australian study on obesity and health expenditures, however, shows that obesity also increases the cost of recovery from acute health shocks.[181]

Some literature presents the results of health expenditure use by obese people in aggregate, while others provide information on individual components of health care use. The table below presents the evidence on medical costs in aggregate. The following sections present the evidence on the individual components of direct medical costs and the medical costs of different comorbidities.

[181] Buchmueller, T.C., Johar, M. (2015). Obesity and Health Expenditures: Evidence from Australia, *Economics and Human Biology* (2015), http://dx.doi.org/10.1016/j.ehb.2015.01.001.

All sources listed below consider a specific cohort groups and show that obesity leads to considerably higher medical costs in Australia, with rates ranging from 10 per cent-51 per cent above the costs of normal weight people.

Finding	Notes	Source
People identified with BMI and waist-circumference-defined overweight and obesity had annual total direct health costs $838 higher than the analogous costs for normal weight people.	Direct health care cost, direct non-health care cost and government subsidies associated with overweight and obesity, analysis of 5-year follow-up data from the Australian Diabetes, Obesity and Lifestyle study, collected in 2004-05.	10
• Class I obese adults (BMI 30 – 35) 45 years and over had health expenditures 19 per cent higher than those of normal weight. • Class II obese adults (BMI greater than 35) 45 years and over had health expenditures 51 per cent higher than those of normal weight.	Analysis is based on a random sample survey of more than 240,000 adults aged 45 and over that is linked at the individual level to comprehensive administrative health care claims for the period 2006–2009.	20
One-year management of the health consequences of overweight and obesity among adolescents will increase Medicare expenditure on this group by at least 48 per cent.	15-19-year-old Australian males and females	12
• In 2024-25, $51.5 million (in 2004-05 dollars) could be saved if further gains in obesity in the younger birth cohort are halted. • If gains in obesity continue, there will be a more than doubling in costs (in 2004-05 dollars) compared with the younger cohort.	Comparison of two birth cohorts, one aged 45-54 in 2004-05 and one aged 45-54 in 2024-25. Considered hospital separations, death and direct health system costs.	13
Being overweight at ages 4 and 5 is associated with significantly higher pharmaceutical and medical care costs. • The results imply that for all children aged 4 and 5 in 2004-05, those who were overweight had a combined 5-year Medicare bill that was AUD$9.8 million higher than that of normal weight children. • The mean unadjusted MBS costs for the total 5-year period across all children were $871. • Children who were overweight or obese at ages 4 and 5, holding all child and maternal characteristics constant, had medical costs that were $87 (10 per cent) higher over 5 years period than children of normal weight.	Study on the influence of overweight status on non-hospital Medicare costs incurred by children over a 5-year period was estimated using two-part models and one-part generalized linear models (GLM) using the Longitudinal Study of Australian Children (2004 to 2008) and linked records from Medicare.	14

Medical use and costs of obesity by service type

This section summarises the literature on the use and costs of medical services to address obesity. The primary use and cost estimates in the Australian literature consider hospital services, GP services and pharmaceuticals. For all three categories, obesity is linked to additional services and costs. The severity of obesity (notably BMI higher than 35) plays a role in costs the system and the higher BMI levels lead to increased medical costs.

GP Services

Finding	Notes	Source
On average, obese employees were 28 per cent more likely to have consulted a GP in the two weeks before interview than non-obese employees, after adjusting for age and sex.	NHS survey data from 11,000 survey respondents aged 15–64 who were employed either full-time or part-time was used to examine the relationship between obesity and absenteeism by calculating the proportion of absenteeism among obese employees compared with the proportion of absenteeism among non-obese employees (the relative risk of absenteeism).	15
• GPs managed overweight and obesity during 2,243 encounters, or once per 75 encounters with adults, and once per 43 encounters with overweight or obese adults. • Compared with the average for all adult encounters, those at which overweight or obesity was managed were significantly longer (18.1 vs 15.3 minutes), resulted in significantly fewer prescribed medications and procedural treatments, but significantly more clinical treatments (advice, counselling and education) and pathology ordered. • Encounters involving management of overweight or obesity generated fewer referrals to medical specialists, and more referrals to allied health services, particularly to a dietician/nutritionist.	Cross-sectional study, 2005–2007, of 1,947 general practitioners, randomly drawn from Medicare Australia claims data. Study collected details for 166,670 patient encounters with adults aged 18 or more, including 68,286 sub-sampled encounters with self-reported patient height and weight for BMI calculation.	54

Hospital services / admissions / specialists

Finding	Notes	Source
Severely obese adult patients experience longer hospital stays in some specialties, but shorter in others. Overall, medically managed obese patients stay longer, whereas surgically treated patients stay shorter than other patients. The observed shorter stays for obese patients in some specialties may result from their observed greater likelihood of being transferred to	Administrative patient-level hospital data for 122 Australian public hospitals over the financial year 2005-06 (Victorian Admitted Episodes Data). Obesity was identified by ICD codes E660 – E669, which are based on the treating doctor's visual assessment of a person's weight, rather than measurement. Quantile Regression analysis is used to generate 19	16

Finding	Notes	Source
another hospital.	estimates of the difference between severely obese and other patients across the whole range of length of stay.	
In 2024-25, the projected number of hospitalisations of 45-54 year olds due to ischaemic heart disease, stroke and obesity-related cancers could be more than halved if further gains in obesity in the younger birth cohort are halted.	Comparison of two birth cohorts, one aged 45-54 in 2004-05 and one aged 45-54 in 2024-25. Considered hospital separations, death and direct health system costs.	13
The cost of medical specialist consultations and cost of medical scans were all higher in obese cohorts of defence force personal compared with the normal weight cohort.	Compared the incidence of injury and illness, absenteeism, productivity, health care usage and administrative outcomes among Australian Defence Force personnel with varying BMI. Sample sizes of n=197 for normal weight, n=154 for overweight and n=148 for obese with restricted body fat and n=180 for obese with no restriction on body fat.	17
One in every six days spent in Australian hospitals is related to overweight and obesity among the over-45s, costing the nation nearly $4 billion a year Among 45-79 year olds, overweight and obesity accounts for: • One in eight hospital admissions (13 per cent of admissions) • One in every six days spent in hospital (18 per cent of hospital days) • One in every six dollars spent on hospitalisation (17 per cent of hospital costs. Those with a BMI of 40-50 (extremely obese) had more than double the rate of admissions and days in hospital — and cost the system more than double — than those with a BMI of 23-25 (normal weight).	The research looked at the hospital records of more than 200,000 people aged 45–79 participating in the Sax Institute's 45 and Up Study (Australia)	18
• There were 64,247 inpatient separations attributed to excess body mass in 2011 representing 6.8 per cent of all separations for the year. This resulted in a cost of $249.5 million or 5.9 per cent of all inpatient costs. • There were 8,655 emergency presentations attributed to excess body mass in 2011 representing 1.0 per cent of all presentations for the year. This resulted in a cost of $3.7 million or 1.2 per cent of all	A cost of illness study was performed using 18 harms that are attributable in part, or wholly, to excess body mass. A population-attributable fraction was calculated for each attributable harm to determine the cost from inpatient separations and emergency department presentations attributable to excess body mass.	19

Finding	Notes	Source
emergency costs.		
• Inpatient expenditures were $372 higher for patients classified as obese I, relative to normal weight patients. • Inpatient expenditures were $1300 higher for patients classified as obese II/III, relative to normal weight patients.	Study investigates the relationship between obesity and health care expenditure in Australia. The analysis is based on a random sample survey of over 240,000 adults aged 45 and over that is linked at the individual-level to comprehensive administrative health care claims for the period 2006 to 2009.	20
Mean annual hospital costs of obese patients (adjusted for gender, age, living place, formal education, smoking status, hypertension and diabetes) were not higher for obese patients	Study was on approximately 3,000 people with or at high risk of atherothrombotic disease as part of the nation-wide Australian REACH Registry in 2004.	21

Pharmaceuticals

Finding	Notes	Source
Annual pharmaceutical costs of obese patients (adjusted for gender, age, living place, formal education, smoking status, hypertension and diabetes) were $144 higher than those of the normal-weight patients. Results suggest this is explained by a higher number of drugs used for the same condition for obese people.	Study was on approximately 3,000 people with or at high risk of atherothrombotic disease as part of the nation-wide Australian REACH Registry in 2004.	21
Relative to normal weight adults (does not include overweight and underweight), average annual prescription drugs expenditures are AU$316.4 higher for obese type I individuals and AU$689.4 higher for the obese type II/III category.	Study investigates the relationship between obesity and health care expenditure in Australia. The analysis is based on a random sample survey of over 240,000 adults aged 45 and over that is linked at the individual-level to comprehensive administrative health care claims for the period 2006 to 2009.	20
Average annual direct costs (ambulatory services, hospitalisation, prescription medication and some medically related consumables) per person are $1313 for normal, $1559 for overweight and $2027 for obese. Prescription medications accounted for about 33 per cent of costs	Direct health care cost, direct non-health care cost and government subsidies associated with overweight and obesity, analysis of 5-year follow-up data from the Australian Diabetes, Obesity and Lifestyle study, collected in 2004-05.	10
For pharmacological interventions, the estimated benefit per enrolment of $2,174 is also greater than the expected cost of $1,566, implying a net benefit of $608.	Medibank estimate of the economy-wide impacts associated with obesity in Australia.	11
Children who were overweight or obese at ages 4 and 5, holding all child and maternal characteristics constant, had	Study on the influence of overweight status on non-hospital Medicare costs incurred by children over a 5-year	14

Finding	Notes	Source
pharmaceutical costs that were $35 (59 per cent) higher over 5 years period than children of normal weight. The mean unadjusted PBS costs for the total 5-year period across all children were $75.	period was estimated using two-part models and one-part generalized linear models (GLM) using the Longitudinal Study of Australian Children (2004 to 2008) and linked records from Medicare.	

Bariatric surgery

Bariatric surgery is the surgical treatment of obesity. There are three types of procedures in use: laparoscopic adjustable gastric banding (LAGB), Roux-en-Y gastric bypass (RYGB), and biliopancreatic diversion. A benefit of LAGB is that it is adjustable and removable; this flexibility is comforting to many patients; however, adjustments and removal requires further medical intervention.[182]

Medicare Australia codes these three types of surgery into five items. There is one item number for reversal of the gastric band, and two items for adjustment of the band. The table below shows the number of claims related to bariatric surgery in Australia between July 2013 and June 2014.

Number of MBS claims related to bariatric surgery, July 2013-June 2014

MBS item name	MBS item number	Number of claims
Types of bariatric surgery		
Placement of adjustable gastric band	31569	3,817
Gastric bypass by Roux-en-Y including	31572	819
Sleeve gastrectomy,	31575	8,375
Gastroplasty (excluding by gastric plication)	31578	31
Gastric bypass by biliopancreatic	31581	25
Total		**13,067**
Reversal of bariatric surgery		
Surgical reversal of adjustable gastric banding, gastric bypass, gastroplasty, or biliopancreatic diversion	31584	3,259
Adjustment of gastric banding		
Adjustment of gastric band as an independent procedure	31587	96,630
Adjustment, repair or replacement of gastric band reservoir	31590	659
Total		**97,289**

Source: Australian Government Department of Human Services. Medicare Australia Statistics. Retrieved February 2015 from http://medicarestatistics.humanservices.gov.au/statistics/mbs_item.jsp

Finding	Notes	Source
For bariatric surgery, the expected benefit per enrolment of $7,569 is less than the estimated upfront cost of $10,935, implying a negative net benefit of ($3,366)	Medibank estimate of the economy-wide impacts associated with obesity in Australia.	11

[182] O'Brien, P.E., Brown, W. A., and Dixon, J.B. (2005). 'Obesity, weight loss and bariatric surgery', *Medical Journal of Australia*, vol 183, no. 6.

Finding	Notes	Source
• In 2007–08, 82 per cent of separations for weight loss surgery were for patients with a principal funding source of Private health insurance. Approximately 11 per cent of separations were Self-funded and 6 per cent of separations were for Public patients. • There is an average cost of about $15,500 per surgery. For the 82 per cent with health insurance, there would be a patient out of pocket cost of $4,500 per procedure	Report by AIHW in 2010 on the provision and costs of weight loss surgery in Australia.	58
A total of 312 participants had surgery over 111,757 person-years (py) of follow-up (mean, 2.26; SD, 0.86), giving a rate of 27.92 (95 per cent CI, 24.91– 31.19) per 10,000 py. Of these, only one person was treated as a public patient and four people were treated as DVA patients, with the remainder treated as private patients. Bariatric surgery, an MBS-listed procedure, is currently largely available only to those who can afford PHI and the associated out-of-pocket costs.	Study investigates variation, and quantifies socioeconomic inequalities, in the uptake of primary bariatric surgery in an obese population aged 45 years and above.	57

Weight-loss aids

Finding	Notes	Source
Australians spent $594.8 million on weight-loss counselling services and related low-calorie foods and dietary supplements in 2013-14.	Industry market research	56

Other types of medical costs

Other types of medical costs arising for obese individuals include: hospital equipment, hospital staff, ambulance services, allied health services, and medical aids. The search of the Australian literature did not present any studies on these topics that include tangible estimates of these costs. This represents a gap in the Australian literature.

Co-morbidities of obesity

There is little data on the medical costs of co-morbidities attributable to obesity. Instead, researchers often estimate the relative risk of having certain conditions for people who are obese, compared to those who are not. These figures can be used to estimate the portion of medical costs for certain conditions attributable to obesity.

This section summarises the literature on the medical costs of obesity by co-morbidity, where available. Where there is no information, it presents information on the risk of co-morbidities associated with obesity.

Cardiovascular disease

In this area, the literature scan included information on stroke and heart disease, as well as cardiovascular disease more broadly.

Finding	Notes	Source
Obese individuals are more likely to develop CHD and stroke relative to normal weight individuals: • CHD relative risk: 1.8 for males and 1.2 for females • Stroke relative risk: 1.5 for males and 1.6 for females.	Based on AIHW literature from 1999 for BMI≥30	13
High body mass was responsible for 19.5 per cent of the cardiovascular disease burden of disease in Australia in 2003.	AIHW report (2003)	5
The hazard ratio for each 5 points (kg/m²) of BMI was 1.27 for coronary heart disease and 1.18 for stroke after adjustment for confounders.	Quantified how much of the effects of BMI on coronary heart disease and stroke are mediated through blood pressure, cholesterol and glucose, and how much is independent of these factors.	22
Obesity was involved in 21.3 per cent of cardiovascular disease cases.	Deloitte Access Economics report 2	9
• The adjusted hazard rate of hospitalisation for all cardiovascular disease diagnoses combined increased significantly with increasing BMI. • The hazard ratio of ischaemic heart disease hospitalisation increased by 23 per cent per 5 kg/m² increase in BMI (compared to BMI 20.0–22.49 kg/m²).	The 45 and Up Study is a large-scale Australian cohort study initiated in 2006. Self-reported data from 158 546 individuals with no history of CVD were linked prospectively to hospitalisation and mortality data. Hazard ratios (HRs) of incident hospitalisation for specific CVD diagnoses in relation to baseline BMI categories were estimated using Cox regression.	23
Adjusting for age and sex, elevated blood pressure was independently associated with obesity, with an odds ratio of 1.77.	Using a standardized protocol and the same automated, validated blood pressure monitor, registered nurses recorded the BP and other risk factors for CVD of self-selected volunteers on a single day. A total of 13,825 subjects (55 per cent female, aged 48±16 years) were assessed.	24

Type 2 diabetes

There are an estimated 1 million people aged 2 years or over with diagnosed diabetes in Australia. This, however, is likely to be an underestimate, because for every four adults with diagnosed diabetes, there is estimated to be one with undiagnosed diabetes.[183]

[183] Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12*, cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

Of all people with diabetes, around 85 per cent have type 2 diabetes and 12 per cent have type 1 diabetes.[184] Over 90 per cent of those with type 2 diabetes are overweight or obese.[185]

Finding	Notes	Source
• There will be at least 2 million Australian adults with diabetes by 2025. • If obesity and diabetes incidence trends continue upwards, and mortality continues to decline, up to 3 million people will have diabetes by 2025, with the figure closer to 3.5 million by 2033.	Study on the different methods to predict diabetes prevalence for the future.	25
High body mass was responsible for 54.7 per cent of the type 2 Diabetes burden of disease in Australia in 2003.	AIHW report (2003)	5
• Annual direct per person costs in 2005 ranged from $1,898 for those with normal glucose tolerance to $4,390 for those with known diabetes. • The total annual cost of diabetes in 2005 for Australians aged ≥30 years was $10.6 billion ($4.4 billion in direct costs; $6.2 billion in government subsidies).	Collected data on the use of health services and health related expenditure in 2004-05 from the Australian Diabetes, Obesity and Lifestyle study to assess and compare costs associated with diabetes.	26
• Total annual direct diabetes-attributable health-care costs in 2000 in Australia for people >25 years with known type 2 diabetes were estimated at $636 million. • The number of people with type 2 diabetes in 2051 may be 3.5 times higher than in 2000 with a 3.7-fold cost increase.	A bottom-up, prevalence-based approach using diabetes-attributable costs provided average annual per patient health-care costs. Based on 1294 patients with type 2 diabetes who were recruited to the Fremantle Diabetes Study between 1993 and 1996.	27
Obesity was involved in 23.8 per cent of type 2 diabetes cases in Australia.	Deloitte Access Economics report 2	9
• Diabetes is costing Queensland more than $1.1 billion annually in lost economic productivity. • Each case of type 2 diabetes costs approximately $10,000 per year to treat and this is a cost the whole state bears. • By far the largest costs associated with diabetes are hospital costs – 39 per cent of direct health care costs for people with type 2 diabetes are	Report from Diabetes Queensland and Deloitte Access Economics	28

[184] Ibid.

[185] Oguma, Y., Sesso, H.D., Paffenbarger, R.S. Jr, and Lee, I.M. (2005). Weight change and risk of developing type 2 diabetes. Obesity Research. 13(5): 945-95.

Finding	Notes	Source
attributable to hospital care, and 47 per cent for people with type 1 diabetes. • Expenditure for admitted hospital patients has doubled in the eight years between 2000-01 and 2008-09.		

Osteoarthritis

Australian and international literature shows that there is a clear link between increased BMI and joint issues.

Finding	Notes	Source
The odds of arthritis/osteoarthritis were up to 7 times higher for obese individuals, compared with those classified as underweight/normal weight.	National study on 1,157 participants on associations between obesity and the burden of hip and knee joint disease through a mailed questionnaire.	29
Obesity was involved in 24.5 per cent of osteoarthritis cases in Australia.	Deloitte Access Economics report 2	9

Cancer

The literature suggests that obesity is associated with increased risks of cancers of the oesophagus, breast, uterus, endometrium, colon and rectum, kidney, pancreas, thyroid, gallbladder, and possibly other cancer types. There are varying estimates of relative risk rates for each cancer, however uterine cancer seems to consistently have the highest rates relative to other cancers.

Finding	Notes	Source
Obese individuals are more likely to develop cancer relative to normal weight individuals: • Colorectal cancer relative risk: 1.4 for males and 1.4 for females • Kidney cancer relative risk: 1.0 for males and 1.5 for females • Breast cancer relative risk: 1.3 for females • Uterine cancer relative risk: 1.75 for females.	Based on AIHW literature from 1999 for BMI≥30.	13
High body mass was responsible for 3.9 per cent of the cancer burden of disease in Australia in 2003.	AIHW report (2003)	5
About 25 per cent of cancers, or about 43,000 cancers in 2025, can potentially be prevented through improvements to diet and physical activity levels, including through their impact on obesity.	Estimate of the total number of cancers to be diagnosed in 2025, applied specific population projections to current cancer incidence rates, and multiplying the projected numbers of cancers by estimates of population-attributable fractions.	30

Finding	Notes	Source
There was little evidence of regional differences in relative risk of cancer with higher BMI. Hazard ratios for cancer sites with increased mortality risk in obese compared with normal weight participants were: • 1.21 for all-cause cancer (excluding lung and upper aerodigestive tract) • 1.50 for colon cancer • 1.68 for cancer of the rectum • 1.63 for breast cancer in women 60 years or older • 2.62 for ovary cancer • 4.21 for cancer of the cervix • 1.45 for prostate cancer • 1.66 for leukaemia.	Examined associations of adult BMI with cancer mortality (overall and for 20 cancer sites) in geographic populations from Asia and from Australia and New Zealand (ANZ), within the Asia-Pacific Cohort Studies Collaboration. Pooled data from 39 cohorts (recruitment 1961-99, median follow-up 4 years) were analysed for 424,519 participants (77 per cent Asian; 41 per cent female; mean recruitment age 48 years).	31
Obesity was involved in 20.5 per cent of colorectal, breast, uterine and kidney cancer cases in Australia.	Deloitte Access Economics report 2	9

Sleep apnoea

International literature shows that cases of sleep apnoea can be attributed to obesity; however, it also appears that sleep apnoea can lead to weight gain.

Finding	Notes	Source
For every unit increase in BMI, AHI (apnoea-hypopnoea index) increased by 5.5 events/hour for men and by 2.8 events/hour for women. About 80 per cent of the observed variance in AHI over this period was attributable to variance in BMI.	Retrospective observational study of consecutive subjects undergoing initial diagnostic polysomnography for investigation of possible sleep disorders in the Hunter New England region of New South Wales between 1987 and 2007, 14,648 new diagnostic sleep studies were performed.	32

Other comorbidities

Other comorbidities of obesity include: liver disease, kidney disease, gallbladder disease, reproductive disorders and hypercholesterolemia. The literature search included the costs of these conditions attributable to obesity and returned no relevant studies for Australia.

Government spending in non-health sectors on obesity

Government spending in non-health sectors on obesity falls primarily into three categories:

- Spending to support obese individuals, for example, through disability payments
- Workers compensation payments generated by obese individuals themselves or by workers helping obese people, for example, heavy lifting injuries by health care professionals
- Funds allocated to interventions to reduce obesity.

Based on the relevant research, there are no estimates on the magnitude of workers compensation costs arising for obese employees or for employees working with obese individuals. An article based on focus groups with participants from the primary health care sector, ambulance services, fire services and funeral businesses found that the manual handling risks to carers for bariatric patients are significant; however, the study did not quantify these risks or the associated costs.[186]

Australian evidence on government subsidies and intervention costs are presented below.

Disability payments / benefits

The primary benefits potentially available to obese people and their carers because of their obesity include the:

- Disability support pension
- Mobility allowance
- Unemployment benefit
- Carers allowance and payment.

Obese individuals may be eligible for other subsidies whose eligibility is based on other primary characteristics, such as the aged pension and veteran pension.

Finding	Notes	Source
Overweight and obese individuals received $35.6 billion in government subsidies in 2005. These included payments for the aged pension, disability pension, veteran pension, mobility allowance, sickness allowance and unemployment benefit.	Direct health care cost, direct non-health care cost and government subsidies associated with overweight and obesity, Analysis of 5-year follow-up data from the Australian Diabetes, Obesity and Lifestyle study, collected in 2004-05.	10
The prevalence of disability in respondents 60 and over was 45.9 per cent for obese, double the normal BMI respondents with 21.5 per cent prevalence	National Australian longitudinal population-based study to examine the prevalence and incidence of diabetes and its complications, as well as high blood pressure, heart disease and kidney disease. The study began in 1999-2000, with over 11,000 participants. These individuals were invited to take part in two follow-up studies, the first in 2004-2005, and the second in 2011-2012.	59

Spending on obesity intervention

Government spending in this area may be hard to isolate if some interventions target multiple problems. Additionally, relevant initiatives may not be labelled as obesity interventions.

Finding	Notes	Source
The Australian Government made available $872.1 million from 2009-10 to 2014-15	The Report of the National Preventative Health Taskforce	55

[186] Cowley, S.P., and Leggett, S. (2011). Manual handling risks associated with the care, treatment and transportation of bariatric (severely obese) clients in Australia. *Work*. 39 (4):477-483.

Finding	Notes	Source
through the National Partnership Agreement on Preventive Health to address obesity and overweight, physical inactivity and poor diet. In order to drive innovation and ensure outcomes, 50 per cent of funds available to the states and territories for programs through the National Partnership will be paid once they have demonstrated achievement against ambitious weight, physical activity, fruit and vegetables, and smoking targets.		

3 Indirect costs of obesity

The indirect, or hidden, costs of obesity include productivity losses generated due to obesity and societal costs to support individuals with obesity.

There is less literature available on the indirect costs of obesity than the direct costs; however, it appears to be an area of increasing focus for research. In general, indirect cost studies consider productivity losses, premature mortality, disability and other non-medical costs, such as costs arising for additional transportation and incarceration services for obese individuals. To date, there is a relatively limited amount of research on indirect costs of obesity in Australia especially for the more obscure topics such as additional costs to the transport and incarceration systems.

Productivity losses due to obesity may come in the form of sick days, reduced productivity occurring when workers come to work sick (presenteeism) or when workers act as carers for an obese person, lost productivity due to premature mortality, and lower educational attainment due to obesity. The international literature is rich in this area and clearly indicates that obese employees miss more days of work than their normal weight counterparts. The literature in Australia on this topic with exact estimates is slimmer, with no specific estimates of presenteeism, absenteeism, productivity loss due to premature mortality, or educational attainment losses. Nevertheless, there is general agreement in Australian research that the productivity losses of obesity are significant.

Finding	Notes	Source
• The indirect cost of obesity to the Australian economy in 2008-09 was $6.4 billion. • Absenteeism was found to be 14 per cent higher in obese employees compared with normal-weight employees in the working population.	Based on KPMG Econtech's MM2 model. Indirect costs include productivity losses (absenteeism and presenteeism) and premature mortality.	11
The estimated productivity losses from restricted work days were higher in the obese cohort with no restriction on body fat compared with the normal cohort.	Compared the incidence of injury and illness, absenteeism, productivity, health care usage and administrative outcomes among Australian Defence Force personnel with varying BMI. Sample sizes of n=197 for normal weight, n=154 for overweight and n=148 for obese with restricted body fat and n=180 for obese with no restriction on body fat.	17
• 1.24 crude and 1.05 adjusted RRR, increased risk of absenteeism for obesity • 1.66 crude and 1.15 adjusted RRR, increased risk of presenteeism for obesity	The Australian Work Outcomes Research Cost–benefit study cross-sectional screening data set was used to identify health-related productivity losses in a sample of approximately 78,000 working Australians. Data collected with the World Health Organization Health and Productivity Questionnaire were analyzed using negative binomial logistic regression and multinomial logistic regression models for absenteeism and presenteeism, respectively.	60
Estimated productivity losses for diabetes of 0.23 per cent, Heart disease	Study by Econtech to estimate the cost to the Australian economy of	61

Finding	Notes	Source
of 0.05 per cent, hypertension of 0.35 per cent, cancer of 0.11 per cent and Back, neck or spinal problems of 0.20 per cent	productivity losses due to presenteeism in the workplace, considering 12 different medical conditions, including five that have clear links to obesity: cancer, diabetes, heart disease, hypertension, and back, neck or spinal problems	
The productivity costs of obesity in 2008 were $3.6 billion.	Top-down modelling of costs of obesity. Productivity costs include short and long term unemployment, premature mortality and the carers' costs.	9
• People with three or more chronic diseases are only about half as likely to be in the paid workforce as people with no chronic diseases. • The impact of chronic disease extends beyond individuals with a chronic disease (or diseases) to family members who often assume carer responsibilities. • People who are primary carers have workforce participation rates of 39 per cent; those who are non-primary carers have participation rates of 60 per cent; and people who are not carers have participation rates of 68 per cent.	Research summarises the evidence and provides the case for changing course in Australian policies to address the health and non-health factors contributing to the prevalence of chronic diseases.	34
• Overall, obese employees were 17 per cent more likely to have been absent from work than non-obese employees. • There was no significant difference in the absenteeism rate between obese employees aged 55–64 and their non-obese counterparts. • For people who were absent for personal illness or injury, the average absence was longer for obese employees (3.8 days) than non-obese employees (3.0 days).	NHS survey data from 11,000 survey respondents aged 15–64 who were employed either full-time or part-time was used to examine the relationship between obesity and absenteeism by calculating the proportion of absenteeism among obese employees compared with the proportion of absenteeism among non-obese employees (the relative risk of absenteeism).	15
Over the working lifetime of the working-age population in 2008, there were an estimated 141,000 work days lost and almost 700 early retirements due to overweight or obesity.	Estimates of health impact, economic benefit and financial benefit were derived from a literature review on each risk factor, consultation with external and independent experts, direct use of databases from the Australian Bureau of Statistics (ABS) and use of attributable risk estimates and data from the 2003 Australian Burden of Disease (BoD) study. The target for reductions in behavioural risk factors for BMI was a reduction in prevalence by 3 per cent.	8

4 Impacts of obesity on health and wellbeing

In addition to the direct and indirect costs of obesity, there are significant impacts of obesity on individuals' physical and mental health and wellbeing. A large stream of literature measures these impacts by using one of two measures of life quality: disability adjusted life years (DALYs) or quality adjusted life years (QALYs). DALYs measures health loss in the quality of life and QALYs measures the same quality of life in health gain.

Some literature further looks at the risk of death by weight status. As noted above, some literature considers premature mortality to be a key feature of the productivity losses generated by obesity. Other research estimates the risk of death as a measure of health and well-being. The literature further shows that the impacts and prevalence of obesity vary by demographic characteristics, including socio-economic status, gender, education and Indigenous status.

Health and well being

Obesity clearly has a negative impact on individuals' health and wellbeing. This can be measured in a number of ways including mortality and various measures of the quality of life. There are a few Australian sources reporting on DALYs for obesity; however, there are no reliable estimates of QALYs.

DALYs

Multiple estimates for 2003 show that obesity was responsible for about 7.5 per cent of the overall burden of disease and is associated with about 200,000 DALYs. Considering the increase in prevalence and severity of obesity since 2003, estimates for current DALYs to have also increased.

Finding	Notes	Source
High body mass was responsible for 7.5 per cent (or around 196,000 DALYs) of the total burden of disease and injury in Australia in 2003. Of these DALYs, just over three-quarters (77 per cent) were from ischaemic heart disease and Type 2 diabetes.	AIHW 2003 data	5
The attributable fractions used in Access Economics (2006) were: 10.8 per cent for Type 2 diabetes, 13.5 per cent for CVD, 14.0 per cent for osteoarthritis and 14.9 per cent for cancer. These AFs resulted in a total of 114,633 DALYs in 2005.	Deloitte Access Economics report 1	7
The burden of disease attributable to obesity was 197,632 DALYs in 2003. This means that high body mass was responsible for 7.5 per cent of the total burden of disease and injury in Australia in that year, with Type 2 diabetes (78,688 DALYs) and ischaemic heart disease (66,533 DALYs) accounting for almost three quarters of this burden	Deloitte Access Economics report 2	6
Health benefits from reaching ideal prevention targets are 5000 attributable deaths avoided, 25,000 DALYs reduced, 9,000 related illnesses avoided.	Estimates of health impact, economic benefit and financial benefit were derived from a literature review on each risk factor, consultation with external and independent experts, direct use of databases from the Australian Bureau	8

Finding	Notes	Source
	of Statistics (ABS) and use of attributable risk estimates and data from the 2003 Australian Burden of Disease (BoD) study. The target for reductions in behavioural risk factors for BMI was a reduction in prevalence by 3 per cent.	

Other quality of life measures

Studies on obesity's impact on utility, health related quality of life and utility based quality of life are consistent with the studies on DALYs, showing that obesity has a considerable negative impact on quality of life.

Finding	Notes	Source
• Obese men (BMI value≥30) had, on average, a lower utility score (-0.0190) than men within an 'acceptable' BMI range (BMI 18.5 to <25). • Obese women (BMI value ≥30) had, on average, a lower utility score (-0.0338) than women within an acceptable BMI range (18.5 to<25).	Regression analysis was used to examine the relationship between BMI and utility, controlling for a range of obesity-related medical conditions and socio-demographic characteristics. Based on a general and representative sample of respondents 18 – 79 years old who completed the Household, Income and Labour Dynamics in Australia (HILDA) Survey in 2007 and 2009.	35
• Higher weight status categories were associated with lower HRQOL scores (mean PedsQL scores: healthy weight: 79.1, overweight: 77.7 and obese: 73.7). • Relative to the healthy weight group, and after adjustments, obese adolescents reported 5.55 lower HRQOL summary scores.	Study to determine whether the health-related quality of life (HRQOL) of overweight and obese adolescents is significantly lower than that of their healthy weight counterparts. Cross-sectional analysis of 2,890 students participating in the Pacific Obesity Prevention in Communities Project, Australia. HRQOL was measured using the Paediatric Quality of Life Inventory (PedsQL) adolescent module.	36
• The burden of disease cost associated with obesity was estimated to be approximately $30 billion in 2008-09, which captures not only the financial but also the social costs of obesity.	Medibank estimate of the economy-wide impacts associated with obesity in Australia. Not reference to how burden of disease was calculated	11
The wellbeing cost of obesity has risen by nearly $50 billion a year since 2005-06. In that time the number of obese adults has risen from 3.2 million to 5 million, from 20.8 per cent to 28.3 per cent of the population. The index estimates that each one percentage point rise in the obesity rate costs about $4 billion a year in national wellbeing.	The Herald-Lateral Economics Index of Australia's Wellbeing - which uses a range of indicators to measure changes in national welfare - calculates a dollar figure on how obesity has an impact on Australia beyond its narrow economic effect.	37
• On a scale of 0 to 1 (from lowest to highest utility), the mean UQoL for	Findings from the AusDiab study were used to estimate differences in the	38

Finding	Notes	Source
those of normal weight was 0.77. • In comparison, obesity was associated with a decrease of between 0.012 and 0.069 (1.2 per cent to 6.9 per cent reduction) in UQoL depending on severity (class I to III)	utility-based quality of life (UQoL) between obese and normal weight adults in Australia, determined using the SF-6D instrument.	

Mortality

Overall the research shows that obese people are likely to die at younger ages than people of normal weight. However, there are mixed results for the risk of death for older individuals according to weight. There were multiple international studies that discussed the link between older obese people and reduced risk of mortality. It may be the case that some levels of obesity are protective for older people and there should be higher BMI limits for obesity categories among older populations.

Finding	Notes	Source
The risk of death was similar for obese and normal-weight participants and lower for overweight people than normal people. Results suggest the BMI thresholds for overweight and obese are overly restrictive for older people.	The Health in Men Study and the Australian Longitudinal Study of Women's Health based on adults aged 70 to 75, with 4,677 men and 4,563 women recruited in 1996 and followed for up to 10 years.	39
Australians are living longer with obesity, with overweight more frequently beginning in childhood or early adulthood. Those who have been obese for 15 to 24 years have more than twice the risk of diabetes compared with those who have been obese for less than five years, and death from all causes also increases with every additional year lived with obesity.	Report is based largely on the work of Associate Professor Anna Peeters, whose research focuses on chronic disease modelling with supporting work on population distribution and trends in body weight, the health risks associated with obesity, population health implications and health benefits associated with interventions.	40
Class III obesity (BMI 40.0 – 59.9) is associated with substantially elevated rates of total mortality, with most of the excess deaths due to heart disease, cancer, and diabetes, and major reductions in life expectancy compared with normal weight. Compared with normal-weight BMI, years of life lost were higher for obese people: • BMI of 40-44.9 was associated with an estimated 6.5 years of life lost • BMI of 45-49.9 was associated with an estimated 8.9 years of life lost • BMI of 50-54.9 was associated with an estimated 9.8 years of life lost • BMI of 55-59.9 was associated with an estimated 13.7 years of life lost.	Pooled analysis of 20 prospective studies from the United States, Sweden, and Australia, estimated sex- and age-adjusted total and cause-specific mortality rates (deaths per 100,000 persons per year) and multivariable-adjusted hazard ratios for adults, aged 19-83 at baseline, classified as obesity class III (BMI 40.0-59.9).	41

Finding	Notes	Source
• Australians lost on average about 13.6 years due to ill health over a lifetime. Health adjusted life expectancy (HALE) in 2010 was 66.8 years for males (a loss of 12.4 healthy years) and 69.0 years for females (a loss of 14.8 years). The leading risk factor for Australia in 2010 was dietary risks (10.5 per cent), followed by high body mass (8.4 per cent) and smoking (8.3 per cent) • 10.4 per cent of the low back pain burden is attributed to high body mass in Australia	Report from Queensland Health, Data from the Global Burden of Disease study 2010 as well as national and Queensland sources have been used to assess the Australian burden, for comparison, the most recent information for Queensland burden of disease (2007) is included	62

Mental health impacts of obesity

The Australian literature discusses the link between depression and obesity. There were no studies with evidence on the further implications of obesity, including shame and social isolation. These topics are covered in greater details in the international literature.

Depression

The literature suggests there is a link between obesity and depression. Some of the international research also suggests that depression can lead to obesity.

Finding	Notes	Source
Severely obese people (BMI ≥35) with diabetes: • Had higher depression scores than the control group (BMI<35) (median IQR 6.0 versus 5.0) • Were more likely to report moderate-severe depressive symptoms (37 per cent versus 27 per cent for the control group).	Diabetes MILES - Australia was a national survey of 3,338 adults with diabetes that focused on psychosocial issues; 1,795 had type 2 diabetes and reported BMI, extracted data regarding depression (PHQ-9), anxiety (GAD-7), obesity- and diabetes-related comorbidities, and demographics.	42
Men with BMI ≥ 30 had a 31 per cent increase in the risk of depression compared with that of non-obese men.	Study evaluated the association between various measures of obesity and incident depression over a 10-year period in a large cohort of community-based older men.	43
After adjusting for age, gender, perceived social support and physical health quality of life, obesity was not significantly associated with mental health quality of life. The strongest factor influencing mental health was perceived physical health. Mediation analyses suggest that physical health mediates the relationship between obesity and mental health quality of life.	Study was to explore the relationship between severity of obesity and perceived mental health in an Australian community, 118 participants, aged 19 -75 with BMI≥30 returned a completed questionnaire sample.	44

Discrimination

The Australian literature shows that the international trend of obesity discrimination is relevant for Australians as well, particularly women.

Finding	Notes	Source
• Obesity discrimination was displayed across all selection criteria such as starting salary, leadership potential, and likelihood of selection. • Higher UMB subscale scores (distance and negative judgement), authoritarianism, physical appearance evaluation and orientation were associated with greater obesity discrimination.	Study examined whether a recently developed measure of anti-fat prejudice, the universal measure of bias (UMB), along with other correlates of prejudicial attitudes and beliefs (that is, authoritarianism, social dominance orientation; SDO, physical appearance investment) predict obesity discrimination. Under the guise of a personnel selection task, participants (n=102) gave assessments of obese and non-obese females applying for a managerial position across a number of selection criteria.	45
• Almost all participants had experienced stigma and discrimination in childhood (n=36), as adolescents (n=41) or as adults (n=72). • About half stated that they had been humiliated by health professionals because of their weight. • Participants described an increasing culture of 'blame' against people living with obesity perpetuated by media and public health messages.	Qualitative methodology, utilising in-depth semi-structured interviews with a community sample of obese adults (BMI ≥30) to develop an in-depth picture of both lived experience of obesity and the impact of socio-cultural factors on people living with obesity.	46
• Whilst perceptions of discrimination and stigmatisation were common and affected many life situations, they were less prevalent than previous reports. • It appeared that it was not the frequency or number of events which affected an individual but the intensity of the experience. • Younger women reported greater discrimination than older women and felt the social consequences of obesity to a greater extent.	Patients' perceptions about weight-related stigma and discrimination were assessed in 2 groups of patients, obese and laparoscopic adjustable gastric banding (LAGB).	47
• the prevalence of depression in obese people was almost twice as high as those who are not obese	Assuming a continuation of the weight change observed in AusDiab, overweight and obesity for Australian adults with low (secondary), medium (diploma) and high (degree) levels of education between 2005 and 2025.	53

Impacts of obesity by demographic

The incidence of obesity varies systematically by characteristic:

- Indigenous Australians are more likely to be obese than non-indigenous Australians

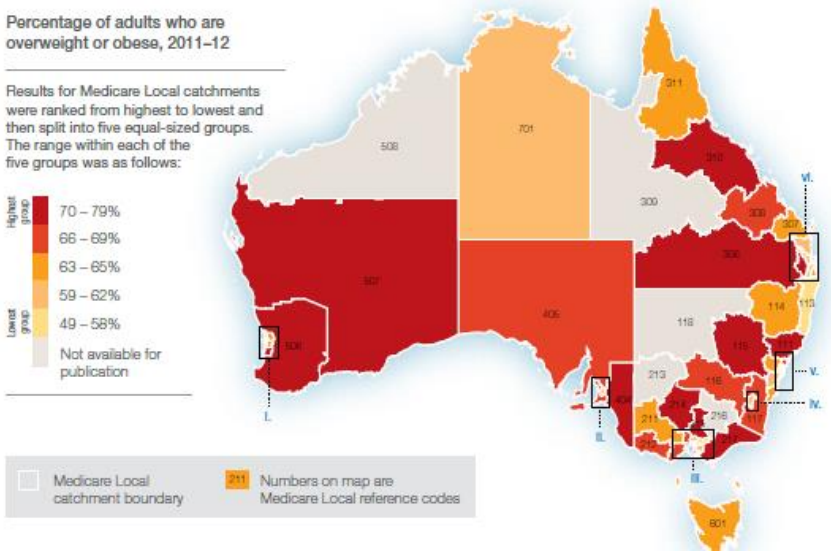
- Individuals with lower levels of education are more likely to be obese than those with higher levels
- People from lower socio-economic backgrounds are more likely to be obese than ones from more affluent backgrounds
- Obesity increases with geographic remoteness.

Different rates of obesity incidence are directly related to the impacts subgroups experience as a result of obesity. Notably, the differences in obesity incidence highlight social inequalities prevalent across society.

The figure below illustrates the distribution of obesity across Australia.[187]

Figure D. 1 Adults who are overweight or obese 2011-12

In 2011–12, the percentage of adults classified as overweight or obese varied across Medicare Local catchments, ranging from 49% to 79%.



Incom/socio-economic status

The literature shows that people from lower socio-economic backgrounds are more likely to be obese.

Finding	Notes	Source
Prevalence of obesity in 2006 was: • 8.4 per cent for low SES • 7.2 per cent for middle SES • 3.7 per cent for high SES. Odds ratios were 2.1 for middle SES and 2.4 for low SES compared to high SES.	Cross sectional surveys conducted in 2000 and 2006 on primary and secondary students from across Australia.	48
High rates of overweight and obesity in Australia occur in all local areas	The data were sourced from the Australian Bureau of Statistics	49

[187] Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results 2011-12*, cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

Finding	Notes	Source
including wealthy inner-city suburbs and rural and disadvantaged communities. The percentage of adults who were overweight or obese increased with geographic remoteness and lower socioeconomic status.	Australian Health Survey 2011–13	

Ethnicity/Aboriginal and Torres Strait Islanders

The literature shows that people from ATSI backgrounds are more likely to be obese, and rates of obesity vary across ethnicities.

Finding	Notes	Source
• Obesity (BMI >30) in Aboriginal participants strongly predicted incident hypertension independently of age or sex (adjusted hazard ratio 2.9).	A follow-up study conducted among 1,831 indigenous population aged 15 years and over without hypertension at baseline from 19 communities in North Queensland between 1997 and 2008.	50
• 5.1 per cent of girls and 5.8 per cent of Indigenous boys in the sample were obese as defined by BMI-for-age.	Data were available for 996 children (from a population of 1,764 in Central Australia) that participated in health checks as part of Healthy School-Aged Kids Program in 2010. The study notes that results appear unlikely to reflect future relative risk of the chronic diseases with which overweight and obesity are associated.	51
• 6.4 per cent of participants in 2000 and 6.8 per cent of participants in 2006 were obese. • Compared to Anglo/ Caucasian children, the odds risk for obesity was: 1.6 times greater for Southern European, 1.8 for Aboriginal, 2.5 for 'Other' participants who were mostly African refugees, 3.0 for Middle Eastern, and 5.5 for Pacific Islander children.	Cross sectional surveys conducted in 2000 and 2006 on primary and secondary students from across Australia.	48
• Obesity in 2006 in boys and girls was 7.5 and 5.8 and in 2012 and 7.1 per cent and 5.6 per cent respectively • Independent predictors of obesity in 2006 and 2012 were being Pacific Islander (odds ratio 5.03, 5.66), Middle Eastern (odds ratio 3.64, 1.50), aboriginal (odds ratio 2.43 in 2012 only), African (odds ratio 1.99 in 2012 only), Southern European (odds ratio 1.75, 1.72), low SES (odds ratio 2.22, 2.20), middle SES (odds ratio 1.52, 1.60), female (odds ratio 0.77, 0.82) and adolescent	Studied the prevalence of obesity, overweight and thinness, by sex, SES and ethnic background in 2006 and 2012. Data based on large national surveys of school students.	52

Finding	Notes	Source
(odds ratio 1.08, 2012 only).		

Education

Finding	Notes	Source
• The prevalence of obesity among individuals with secondary level educational attainment is estimated to increase from 23 per cent in 2000 to 44 per cent in 2025. Among individuals with a degree qualification or higher, it will increase from 14 per cent to 30 per cent. • If all current educational inequalities in weight change could be eliminated, the projected difference in the prevalence of obesity by 2025 between the highest and lowest educated categories would only be reduced by half (to a 6 percentage point difference from 14 percentage points).	Assuming a continuation of the weight change observed in AusDiab, overweight and obesity for Australian adults with low (secondary), medium (diploma) and high (degree) levels of education between 2005 and 2025.	53

Appendix E Bibliography

2013-2014 Australian health budget (2014). http://www.budget.gov.au/2013 14/content/bp3/html/bp3_03_part_2b.htm. [33]

Abdullah, A., Wolfe, R., Stoelwinder, J.U., de Courten, M., Stevenson, C., Walls, H.L., and Peeters, A. (2011). The number of years lived with obesity and the risk of all-cause and cause-specific mortality. *International Journal Epidemiology*. 40(4): 985-996.

Access Economics (2006). The economic costs of obesity. [7]

Access Economics (2008). The growing cost of obesity in 2008: three years on. [9]

Ackerman, I.N. and Osborne, R.H. (2012). Obesity and increased burden of hip and knee joint disease in Australia: Results from a national survey. *BMC Musculoskeletal Disorders*, p. 254. Article in Press. [29]

ACT Legislative Assembly Hansard (2014, August 6). *Debates Weekly Hansard,* p. 2140

Ademi, Z., Walls, H.L., Peeters, A., Liew, D., Hollingsworth, B., Stevenson, C., Steg, P.-G., Bhatt, D.L., Reid, C.M. (2010). Economic implications of obesity among people with atherothrombotic disease. *International Journal of Obesity*. 34 (8):1284-1292 [21]

Aitken, R.J., Allman-Farinelli, M.A., King, L.A., Bauman, A.E. (2009). 'Current and Future Costs of Cancer, Heart Disease and Stroke Attributable to Obesity in Australia - a Comparison of Two Birth Cohorts', Asia Pacific Journal of Clinical Nutrition, (1), 63-70. [13]

Arterburn, D.E., Maciejewski, M.L., and Tsevat, J. (2005). Impact of morbid obesity on medical expenditures in adults. *International Journal of Obesity*. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15685247

Arto T. Toivanen et al. (2010). Obesity, physically demanding work and traumatic knee injury are major risk factors for knee osteoarthritis-a population-based study with a follow-up of 22 years *Rheumatology*. 49 (2): 308-314, first published online November 27, 2009 doi:10.1093/rheumatology/kep388478. [43]

Atlantis, E. (2009). Chronic disease trends due to excess body weight in Australia (Vol. 10, pp. 543-553). Oxford, UK: Blackwell Publishing. [1]

Au, N. (2012). 'The health care cost implications of overweight and obesity during childhood', Health Services Research, 47 (2):655-676. [14]

Australian Bureau of Statistics (2012), *Year Book Australia, 2012*, cat.no. 1301.0. Retrieved March 2015 from http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/1301.0~2012~Main%20Features~Health%20care%20delivery%20and%20financing~235

Australian Bureau of Statistics (2013). *Australian Health Survey: Updated Results, 2011-12,* cat. no. 4364.0.55.003. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4364.0.55.0032011-2012?OpenDocument

Australian Bureau of Statistics (2013). *Australian Health Survey: Health Service Usage and Health Related Actions, 2011–12*, cat. no. 4364.0.55.002. Retrieved March 2015 from http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/03AE249118F2D72FCA257B4B0014C0A1/$File/43640do005_20112012.xls

Australia Bureau of Statistics (2013). *Disability, Ageing and Carers, Australia: Summary of Findings, 2012*, cat. no. 4430.0. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4430.02012?OpenDocument

Australia Bureau of Statistics (2013). *Population Projections, Australia, 2012,* cat. no. 3222.0. Retrieved May 2015 from http://www.abs.gov.au/AUSSTATS/ABS@Archive.nsf/log?openagent&32220b9.xls&3222.0&Time%20Series%20Spreadsheet&8A9D565F34C50410CA257C310019EB9C&0&2012%20(base)%20to%202101&29.11.2013&Latest

Australian Bureau of Statistics (2014). *Australian Aboriginal and Torres Strait Islander Health Survey: Updated Results 2012-13*, cat. no. 4727.0.55.006. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/4727.0.55.0012012-13?OpenDocument

Australian Bureau of Statistics (2015), *Australian Demographic Statistics, June 2014,* cat no. 3101.0. Retrieved May 2015 from http://www.abs.gov.au/AUSSTATS/ABS@Archive.nsf/log?openagent&3101059.xls&3101.0&Time%20Series%20Spreadsheet&7A8582884A7CC018CA257E6E0011A054&0&Dec%202014&25.06.2015&Latest

Australia Bureau of Statistics (2015). *Australian National Accounts: National Income, Expenditure and Product, Dec 2014,* cat. no. 5206.0. Retrieved March 2015 from http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Dec%202014?OpenDocument

Australian Bureau of Statistics (2015). *Average weekly earnings, Australia, Nov 2014.* cat. no. 6302.0. Retrieved March 2015 from http://www.abs.gov.au/ausstats/meisubs.NSF/log?openagent&6302003.xls&6302.0&Time%20Series%20Spreadsheet&AC182578EB9C49A9CA257DF7000BA5EB&0&Nov%202014&26.02.2015&Latest

Australian Bureau of Statistics (2015). Customised report. *Australian Health Survey 2011-12: Health Service Usage* and *Health Related Actions, 2011–12 — Australia.*

Australian Diabetes, Obesity and Lifestyle (AusDiab) study 2012. [59]

Australian Financial Review (2014), 'Fat trucks and big beds: how obesity weighs heavily on the health system', http://www.afr.com/business/health/pharmaceuticals/fat-trucks-and-big-beds-how-obesity-weighs-heavily-on-the-health-system-20140202-iy54i

Australian Government (2010). *Taking Preventative Action – A Response to Australia: The Healthiest Country by 2020*. The Report of the National Preventative Health Taskforce. Retrieved from http://www.preventativehealth.org.au/internet/preventativehealth/publishing.nsf/Content/6B7B17659424FBE5CA25772000095458/$File/tpa.pdf [55]

Australian Government Department of Health, *Annual Medicare Statistics - Financial year 2007-08 to 2013-14.* Retrieve on March 2015 from http://health.gov.au/internet/main/publishing.nsf/Content/34A89144DB4185EDCA257BF0001AFE29/$File/MBS%20Statistics%20Financial%20Year%202013-14%20external%2020140718.xlsx

Australian Government Department of Health. *MBS Online*. Retrieved March 2015 from http://www.mbsonline.gov.au

Australian Government Department of Human Services. *Disability Support Pension*. Retrieved March 2015 from http://www.humanservices.gov.au/customer/services/centrelink/disability-support-pension

Australian Government Department of Human Services. *Eligibility of Newstart Allowance*. Retrieved March 2015 from http://www.humanservices.gov.au/customer/enablers/centrelink/newstart-allowance/eligibility-for-newstart-allowance

Australian Government Department of Human Services. *Medicare Australia Statistics*. Retrieved February 2015 from http://medicarestatistics.humanservices.gov.au/statistics/mbs_item.jsp

Australian Government Department of the Prime Minister and Cabinet (2014), *Best Practice Regulation Guidance Note: Value of statistical life*.

Australian Government Department of Social Services (2013). Characteristics of Disability Support Pension Customers.

Australian Government National Health and Medical Research Council (2014, April). *CEO Roundtable: New Insights into the Biology of Obesity Roundtable Report*. Retrieved from https://www.nhmrc.gov.au/_files_nhmrc/file/media/events/2014/obesity_ceo_rountable_140617.pdf

Australian Institute of Health and Welfare. *2.2. How much does Australia spend on health care?* Retrieved April 2015 from http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129547594

Australian Institute of Health and Welfare (2003). *The burden of disease and injury in Australia 2003*. Cat. no. PHE 82. Canberra: AIHW. [5]

Australian Institute of Health and Welfare (2005). *Obesity and workplace absenteeism among older Australians*. Bulletin No. 31. AIHW Cat. No. AUS 67. Canberra: AIHW [15]

Australian Institute of Health and Welfare (2010). *Weight loss surgery in Australia*. Cat. no. HSE 91. Canberra: AIHW. Retrieved March 2015 from http://www.aihw.gov.au/publication-detail/?id=6442472385 [58]

Australian Institute of Health and Welfare (2014). *Australia's health 2014*. Australia's health series no. 14. Cat. no. AUS 178. Canberra: AIHW. AIHW (2008-09). Retrieved from http://www.aihw.gov.au/WorkArea/DownloadAsset.aspx?id=60129547594

Australian Institute of Health and Welfare. *AIHW health expenditure database 2010-11*.

Australian Institute of Health and Welfare. *Australian Hospital Statistics 2011-2012*.

Australian Institute of Health and Welfare. *AIHW disease expenditure database 2008-09*.

Australian Medical Association (2012, October 16). *Medicare patient rebates failing to keep pace with the true value of quality medical care*. Retrieved from https://ama.com.au/media/medicare-patient-rebates-failing-keep-pace-true-value-quality-medical-care

Baade, P.D., Meng, X., Sinclair, C., Youl, P. (2012). Estimating the future burden of cancers preventable by better diet and physical activity in Australia. *Medical Journal of Australia*. 196 (5):337-340. [30]

Backholer, K., Mannan, H.R., Magliano, D.J., Walls, H.L., Stevenson, C., Beauchamp, A., Shaw, J.E., Peeters, A. (2012). Projected socioeconomic disparities in the prevalence of obesity among Australian adults. *Australian and New Zealand Journal of Public Health*. 36 (6):557-563. [53]

Bariatric Surgery Source. *Weight Loss Surgery Australia: Complete Reference Guide*. Retrieved March 2015 from http://www.bariatric-surgery-source.com/weight-loss-surgery-australia.html

Bendigo Health, *Impact of unhealthy behaviours on our hospital system*. Retrieved from http://docs.health.vic.gov.au/docs/doc/03F3350EB68BF48CCA257D64000E4009/$FILE/John%20Mulder%20Cost%20of%20unhealthy%20behaviours%20.pdf

Booth, M.L., Dobbins, T., Aitken, R., Denney-Wilson, E., Hardy, L.L., Okely, A.D., George, J., Sullivan, D., Cowell, C.T. (2009). Costs of managing conditions associated with obesity among Australian teenagers. *Journal of Paediatrics and Child Health*. 45 (7-8):448-456. [12]

Britt, H., Miller, G.C., Henderson, J., Bayram, C., Valenti, L., Harrison, C., Pan Y., Wong, C., Charles, J., Chambers, T., Gordon, J., and Pollack, A.J. (2014). A decade of Australian general practice activity 2004-05 to 2013-14. General practice series no. 37. Sydney University Press. [6]

Buchmueller, T.C., Johar, M. (2015). Obesity and Health Expenditures: Evidence from Australia. *Economics and Human Biology*. Retrieved from http://dx.doi.org/10.1016/j.ehb.2015.01.001. [20]

BUPA. *Compare health cover*. Retrieved from http://www.bupa.com.au/health-insurance/compare-health-covers

Cabrera Escobar MA, Veerman JL, Tollman SM, Bertram MY, Hofman KJ. Evidence that a tax on sugar sweetened beverages reduces the obesity rate: a meta-analysis. *BMC Public Health*. 2013;13:1072. doi:10.1186/1471-2458-13-1072.

Cadilhac, D.A. et al. (2009). The health and economic benefits of reducing disease risk factors. Melbourne: Deakin University & National Stroke Research Institute. [8]

Carrington, M.J., Jennings, G.L., Stewart, S. (2010). Pattern of blood pressure in Australian adults: Results from a National Blood Pressure Screening Day of 13,825 adults. *International Journal of Cardiology*. 145 (3):461-467. [24]

Colagiuri, S., Lee, C.M., Colagiuri, R., Magliano, D., Shaw, J.E., Zimmet, P.Z., and Caterson, I.D. (2010). The cost of overweight and obesity in Australia. *Medical Journal of Australia*. 192(5): 260-264. [10]

Consumers Health Forum of Australia (2015, January 20). *Media Release*. Retrieved from https://www.chf.org.au/pdfs/chf/20150120-Junk-Food.pdf

Cowley, S.P., and Leggett, S. (2011). Manual handling risks associated with the care, treatment and transportation of bariatric (severely obese) clients in Australia. *Work*. 39 (4):477-483.

Davis, W.A., Knuiman, M.W., Hendrie, D., and Davis, T.M.E. (2006). The obesity-driven rising costs of type 2 diabetes in Australia: Projections from the Fremantle Diabetes Study. *Internal Medicine Journal*, 36 (3):155-161. [27]

Dee et al. (2014). The direct and indirect costs of both overweight and obesity: a systematic review. *BMC Research Notes*. 7:242.

Diabetes Queensland (2015). *Diabetes costing Queensland economy $1.1 billion in lost productivity – the time for action is now*. Retrieved from http://www.diabetesqld.org.au/media-centre/2015/january/diabetes-costing-queensland-economy-$11-billion-in-lost-productivity-%E2%80%93-the-time-for-action-is-now.aspx. [28]

Dixon, J.B., Browne, J.L., Lambert, G.W., Jones, K.M., Reddy, P., Pouwer, F., Speight, J. (2013). Severely obese people with diabetes experience impaired emotional well-being associated with socioeconomic disadvantage: Results from diabetes MILES – Australia. *Diabetes Research and Clinical Practice*. 101 (2):131-140. [42]

Econtech (2007). Economic Modelling of the Cost of Presenteeism in Australia. Prepared for Medibank Private [61]

Davidson, M.H., Hauptman, J., DiGirolamo, M., Foreyt, J.P., Halsted C.H., Heber, D., Heimburger, D.C., Lucas, C.P., Robbins, D.C., Chung, J., and Heymsfield, S.B. (1999). Weight control and risk factor reduction in obese subjects treated for 2 years with orlistat: a randomized controlled trial. *The Journal of the American Medical Association*. 281(31):1174.

Dixon T (2005). *Costs of diabetes in Australia, 2000-01*. Bulletin No. 26. AIHW Cat. No. AUS 59. Canberra: AIHW

Diabetes Australia (2003). Assessing the burden of Type 2 Diabetes in Australia, Diabetes Australia. Canberra: Diabetes Australia

Douglas, I.J., Bhaskaran, K., Batterham, R.L., and Smeeth, L. (2015). The effectiveness of pharmaceutical interventions for obesity: weight loss with orlistat and sibutramine in a United Kingdom population-based cohort. *British Journal of Clinical Pathology*. 79(6):1020-7.

Douketis, J.D., Macie, C., Thabane, L., and Williamson, D.F. (2005). Systematic review of long-term weight loss studies in obese adults: clinical significance and applicability to clinical practice. *Int J Obes* (Lond). 29:1153-1167

Duffey, K.J., Gordon-Larsen, P., Shikany J.M., Guilkey, D., Jacobs, D.R. Jr., and Popkin, B.M. (2010). Food price and diet and health outcomes: 20 years of the CARDIA Study. *Archives of Internal Medicine*. 170(5)

Farias, M.M., Cuevas, A.M.and Rodriguez, F (2011, April). Metabolic Syndrome and Related Disorders. April 2011, 9(2): 85-89. doi:10.1089/met.2010.0090.

Flicker, L., McCaul, K.A., Hankey, G.J., Jamrozik, K., Brown, W.J., Byles, J.E., Almeida, O.P. (2010). 'Body mass index and survival in men and women aged 70 to 75', Journal of the American Geriatrics Society, 58 (2):234-241. [39]

Flinn, R., Langreth, R., and Cortez, M. (2012, January 18). Obesity Rates Plateau in U.S. Since 2000, CDC Report Finds. *Bloomberg*.

Fuller, N.R., Carter, H., Schofield, D., Hauner, H., Jebb, S.A., Colagiuri, S., and Caterson, I.D. (2014). Cost effectiveness of primary referral to a commercial provider for weight loss

treatment, relative to standard care: a modelled lifetime analysis. *International Journal of Obesity*. 38(8):1104-9

Franz, M.J., VanWormer, J.J., Crain, A.L., et al. (2007). Weight-loss outcomes: a systematic review and meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. Journal of American Dietetic Association. 107:1755–1767

Gill, T., Hector, D., Rissel, C., Trieu, K., Zhong, A., O'Hara, B., and Bauman A. (2013). Whole of government obesity prevention interventions. *Sax Institute*. Retrieved from https://www.saxinstitute.org.au/publications/whole-of-government-obesity-prevention-interventions/

Goldstein, D.J., and Potvin, J.H. (1994). Long-term weight loss: the effect of pharmacologic agents. *The American Journal of Clinical Nutrition*. 60(5):647-57.

Gold Coast Bulletin (2014, June 28). Obesity on the Gold Coast costing millions in extra resources for hospitals. *Gold Coast Bulletin*. Retrieved on http://www.goldcoastbulletin.com.au/news/obesity-on-the-gold-coast-costing-millions-in-extra-resources-for-hospitals/story-fnj94j0t-1226969546697

Gortmaker, S.L., Swinburn, B.A., Levy, D., et al. (2011). Changing the future of obesity: science, policy, and action. *Lancet*. 378:838–47.

Haby, M. (2012). Future predictions of body mass index and overweight prevalence in Australia, 2005-2025. *Health Promotion International*. (2):250-260. [3]

Hauck, K., Hollingsworth, B. (2010). The impact of severe obesity on hospital length of stay. *Medical Care*. 48(4): 335-340. [16]

Hayden, M., Dixon, M., Dixon, J., Playfair, J., & O'Brien, P. (2010). 'Perceived Discrimination and Stigmatisation against Severely Obese Women: Age and Weight Loss Make a Difference', Obesity Facts, 7-14. [47]

HCF. *Health insurance that puts you first*. Retrieved from http://www.hcf.com.au/pdf/hcf_health_insurance_brochure.pdf

Health Informatics Society of Australia. HISA launches the 2014 Health Apps Challenge. 2014 Winners

Heart Foundation (2012), *Rapid Review of the Evidence of food reformulation as a strategy to improve population health*. Retrieved from http://www.heartfoundation.org.au/SiteCollectionDocuments/RapidReview_FoodReformulation.pdf

Hendricks, E.J., Greenway, F.L., Westman, E.C., and Gupta, A.K. (2011). Blood pressure and heart rate effects, weight loss and maintenance during long-term phentermine pharmacotherapy for obesity. *Obesity (Silver Spring)*. 19(12):2351–2360.

Holden et al (2011). Which Health Conditions Impact on Productivity in Working Australians? *Journal of Occupational and Environmental Medicine*. 53(3):253-357. [60]

IbisWorld (2015). *Weight loss services in Australia*. [56]

IbisWorld (2015). Australians set to spend $6.6 billion to battle the bulge. *Media Centre*. Retrieved from http://media.ibisworld.com.au/2013/10/31/australians-set-spend-6-6-billion-battle-bulge/

Independent Hospital Pricing Authority (2012). *National Efficient Price Determination 2012-13*. Retrieved from http://www.ihpa.gov.au/internet/ihpa/publishing.nsf/Content/nep-determination-2012-13.htm

International Diabetes Foundation. A position statement from the International Diabetes Federation Taskforce on Epidemiology and Prevention. *Bariatric Surgical and Procedural Interventions in the Treatment of Obese Patients with Type 2 Diabetes*. Retrieved from http://www.bakeridi.edu.au/Assets/Files/IDF-Position-Statement-Bariatric-Surgery.pdf

Jordan, H.T., Tabaei, B.P., Nash, D., Angell, S.Y., Chamany, S., and Kerker, B. (2012). Metabolic syndrome among adults in New York City, 2004 New York City Health and Nutrition Examination Survey. *Preventing Chronic Disease*. 9:100260

Joshy, G., Korda, R.J., Attia, J., Liu, B., Bauman, A.E., Banks, E. (2014). 'Body mass index and incident hospitalisation for cardiovascular disease in 158,546 participants from the 45 and Up Study, International Journal of Obesity, 38 (6):848-856. [23]

Kaldor, J.C., Magnusson, R.S., and Colagiuri, S. (2015). Government action on diabetes prevention: time to try something new. *Medical Journal of Australia*. 202(11).

Keating, C.L., Peeters, A., Swinburn, B.A., Magliano, D.J., and Moodie, M.L. (2013). Utility-Based Quality of Life Associated with Overweight and Obesity: The Australian Diabetes, Obesity, and Lifestyle Study. *Obesity (Silver Spring)*. 21(3):652-655. [38]

Keating, C.L., Moodie, M.L., Swinburn, B.A. (2011). The health-related quality of life of overweight and obese adolescents a study measuring body mass index and adolescent-reported perceptions. *International Journal of Pediatric Obesity*. 6 (5-6):434-441. [36]

Kitahara et al. (2014). Association between Class III Obesity (BMI of 40-59 kg/m2) and Mortality: A Pooled Analysis of 20 Prospective Studies, *PLoS Medicine*, 11 (7), art. no. e1001673. [41]

Klarenbach S., Padwal S., Chuck A., Jacobs P. (2006). Population-Based Analysis of Obesity and Workforce Participation. *Obesity*. 14:920–927.

Knoesen, N.P., Mancuso, S.G., Thomas, S., Komesaroff, P., Lewis, S., Castle, D.J. (2012), Relationship between severity of obesity and mental health: An Australian community survey. *Asia-Pacific Psychiatry*. 4 (1): 67-75. [44]

Korda et al (2012). Inequalities in bariatric surgery in Australia: findings from 49 364 obese participants in a prospective cohort study. *Medical Journal of Australia*. 197 (11): 631-636. [57]

Kortt, M.A., Dollery, B. (2011). Association Between Body Mass Index and Health-Related Quality of Life Among an Australian Sample. *Clinical Therapeutics*. 33 (10): 1466-1474. [35]

LAP Surgery Australia. *Weight Loss Solutions*. Retrieved March 2015 from http://www.lapsurgeryaustralia.com.au/weight-loss-solutions/lap-band#costs

Lee, C.M.Y., Colagiuri, R., Magliano, D.J., Cameron, A.J., Shaw, J., Zimmet, P., Colagiuri, S. (2013). The cost of diabetes in adults in Australia. *Diabetes Research and Clinical Practice*. 99 (3):385-390. [26]

Li, M., McDermott, R. (2104). Obesity, albuminuria, and gamma-glutamyl transferase predict incidence of hypertension in indigenous Australians in rural and remote communities in northern Australia. *Journal of Hypertension*, Article in Press. [50]

Liu, P. J. (2014). Using behavioral economics to design more effective food policies to address obesity. *Applied economic perspectives and policy : AEPP, 36*(1).

Lu Y., Hajifathalian K., Ezzati M., Woodward M., Rimm E.B., Danaei G. (2014). Metabolic mediators of the effects of body-mass index, overweight, and obesity on coronary heart disease and stroke: A pooled analysis of 97 prospective cohorts with 1 million participants. *The Lancet*. (9921): 970. [22]

Lukas, N., Franklin, J., Lee, C.M.Y., Taylor, C.J., Martin, D.J., Kormas, N., Caterson, I.D., and Markovic, T.P. (2014). The efficacy of bariatric surgery performed in the public sector for obese patients with comorbid conditions. *The Medical Journal of Australia*. 201 (4): 218-222

Magarey, A.M., Perry, R.A., Baur, L.A., Steinbeck, K.S., Sawyer, M., Hills, A.P., Wilson, G., Lee, A., and Daniels, L.A. (2011). A Parent-led Family-focused Treatment Program for Overweight Children Aged 5 to 9 years: The Peach RCT. *The American Academy of Pediatrics*. 127(2):214-22

Magliano, D.J., Peeters, A., Vos, T., Sicree, R., Shaw, J., Sindall, C., Haby, M., Begg, S.J., Zimmet, P.Z. (2009). Projecting the burden of diabetes in Australia - What is the size of the matter? *Australian and New Zealand Journal of Public Health*. 33 (6): 540-543. [25]

Magro, D.O., Geloneze, B., Delfini, R., Pareja, B.C., Callejas, F., and Pareja, J.C .(2008). Long-term weight regain after gastric bypass: a 5-year prospective study. *Obes Surg*. 18(6):648–651

Manios, Y., Moschandreas, J., Hatzis, C., and Kafatos, A. (1999). Evaluation of a Health and Nutrition Education Program in Primary School Children of Crete over a Three-Year Period. *Preventive Medicine*. 28(2):149-59

McGee, D.L. (2005). Body mass index and mortality: a meta-analysis based on person-level data from twenty-six observational studies. Ann Epidemiol. 15(2):87-97.

McKinsey Global Institute (2014). *Overcoming Obesity: An initial economic analysis*. Retrieved from http://www.mckinsey.com/~/media/McKinsey/dotcom/Insights/Economic%20Studies/How%20the%20world%20could%20better%20fight%20obesity/MGI%20Obesity_Full%20report_November%202014.ashx

Medibank (2010). Obesity in Australia: financial impacts and cost benefits of intervention. [11]

Medibank Private Limited. *Health Insurance:Hospital Only*. Retrieved from https://www.medibank.com.au/health-insurance/hospital-cover/

Mitchell Institute (2014), Chronic diseases in Australia: the case for changing course, Background and policy paper, Australia: *Mitchell Institute*. Retrieved from http://www.mitchellinstitute.org.au/wp-content/uploads/2014/10/Chronic-diseases-in-Australia-the-case-for-changing-course-sharon-willcox.pdf

Moodie, R., et al. (2009). Australia: the healthiest country by 2020.Technical Report No 1. Obesity in Australia: a need for urgent action, Australian Government: Preventative Health Taskforce. [4]

Morris S. (2004). The Impact of Obesity on Employment in England.UK: Tanaka Business School

Munro, J.F., MacCuish, A.C., Wilson, E.M., and Duncan, L.J. (1968). Comparison of Continuous and Intermittent Anorectic Therapy in Obesity. *British Medical Journal*. 1(5588):352-354.

National Bariatric Surgery Register (2014). The National Bariatric Surgery Register 2014. Retrieved from http://nbsr.co.uk/

National Health and Medical Research Council (NHMRC) (2010). *A "state of the knowledge" assessment of comprehensive interventions that address the drivers of obesty: A Rapid Assessme*. University of Syndey. Retrieved from https://www.nhmrc.gov.au/_files_nhmrc/file/your_health/obesity/boden_report_rapid_assessment_december_2010.pdf

National Health Performance Authority (2013). Healthy Communities: Overweight and obesity rates across Australia, 2011-12. *In Focus*. [49]

Nguyen, N.T., Magno, C.P., Lane, K.T., Hinojosa, M.W., and Lane, J.S. (2008). Association of hypertension, diabetes, dyslipidemia, and metabolic syndrome with obesity: findings from the National Health and Nutrition Examination Survey, 1999 to 2004. Journal of American College of Surgeons. 207(6):928–34

Nurse Uncut (2011, May 3). Bariatric patients: nursing are and specialist equipment. *Nurse Uncut*. Retrieved from http://www.nurseuncut.com.au/bariatric-patients-nursing-care-specialist-equipment/

O'brien, K., Latner, J., Ebneter, D., & Hunter, J. (2013). Obesity discrimination: The role of physical appearance, personal ideology, and anti-fat prejudice. *International Journal of Obesity*, 455-460. [45]

O'Dea, J.A. and Dibley, M.J. (2011). Overweight, obesity, gender, age, ethnicity, and school SES among Australian schoolchildren in studies from 2000 and 2006, Childhood Obesity Prevention: International Research, Controversies and Interventions. [48]

O'Dea, J.A. and Dibley, M.J. (2014). Prevalence of obesity, overweight and thinness in Australian children and adolescents by socioeconomic status and ethnic/cultural group in 2006 and 2012. *International Journal of Public Health*. 59 (5):819-828. [52]

Obesity Australia (2013), *Obesity Australian Action Agenda April 2013*. Retrieved from http://www.obesityaustralia.org/_literature_143441/Obesity_Australia_Action_Agenda_April_2013

Oguma, Y., Sesso, H.D., Paffenbarger, R.S. Jr, and Lee, I.M. (2005). Weight change and risk of developing type 2 diabetes. *Obesity Research*. 13(5):945-95.

Ozeke, Ozcan et al. (2011). Chronic intermittent hypoxia caused by obstructive sleep apnea may play an important role in explaining the morbidity-mortality paradox of obesity. *Medical Hypotheses*. 76(1):61–63. [32]

Parr, C.L., Batty, G.D., Lam, T.H., Barzi, F., Fang, X., Ho, S.C., Jee, S.H., Ansary-Moghaddam, A., Jamrozik, K., Ueshima, H., Woodward, M., Huxley, R.R. (2010). Body-mass index and cancer mortality in the Asia-Pacific Cohort Studies Collaboration: Pooled analyses of 424,519 participants. *The Lancet Oncology*. 11 (8):741-752. [31]

Peake et al. (2012). The health and cost implications of high body mass index in Australian defence force personnel. *BMC Public Health*. 12:451. [17]

Powell LM, and Chaloupka FJ. (2009). Food prices and obesity: evidence and policy implications for taxes and subsidies. *Milbank Q*;87:229–57.

Private Health Insurance Administration Council. *The Operations of Private Health Insurers: Annual Report 2011-12*. Retrieved March 2015 from http://phiac.gov.au/wp-content/uploads/2013/02/Annual-Report-on-Operations-2011-12-web-version.pdf

Puhl RM, Heuer CA (2010). Obesity stigma: important considerations for public health. *American Journal of Public Health*, 100(6):1019-28.

PwC (2014). *Health Star Rating System: Cost Benefit Analysis*. Retrieved from http://www.health.gov.au/internet/main/publishing.nsf/Content/CF7E670597F383ADCA257BF0001BAFF5/$File/Health%20Star%20Rating%20Cost%20Benefit%20Analysis%20Report.pdf

Queensland Government Department of Health (2013). *Burden of disease: a snapshot in 2013*. [62]

Reuters (2014), Obesity can be deemed a disability at work: EU court. Retrieved from http://www.reuters.com/article/2014/12/18/us-eu-courts-obesity-idUSKBN0JW11620141218

Riotact (2009, July 31). ACT Ambulances get a fatter lifter. *Riotact*. Retrieved from http://the-riotact.com/act-ambulances-get-a-fatty-lifter/13133

Roberto, C.A., Swinburn, B., Hawkes, C., Huang, T.T., Cost, S.A., Ashe, M., Zwicker, L., Cawley, J.H., and Brownell, K.D. (2015). Patchy progress on obesity prevention: emerging examples, entrenched barriers, and new thinking. *The Lancet*. 385(9985):2400-2409. Retrieved from http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(14)61744-X.pdf

Sax Institute (2014). Obesity is sending over-45s to hospital - at a cost of $4 billion per year, media release, https://www.saxinstitute.org.au/wp-content/uploads/BMIcostsmediarelease_31Oct.pdf. [18]

Scalley B.,Xiao J., Somerford P. (2013). The cost of excess body mass to the acute hospital system in Western Australia: 2011, Department of Health WA: Perth. [19]

Schultz, R. (2012). Prevalences of overweight and obesity among children in remote Aboriginal communities in central Australia. *Rural and Remote Health*. 12 (1), art. no. 1872. [51]

Singh, J. and Kumar, R. (2015). Phentermine-topiramate: First combination drug for obesity. *International Journal of Applied and Basica Medical Research*. 5(2):157-158. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4456896/

Sutin AR, Terracciano A (2013) Perceived Weight Discrimination and Obesity. *PLoS ONE*, 8(7): e70048. doi:10.1371/journal.pone.0070048.

The Age (2010), Obesity is now more deadly than smoking. *The Age*. Retrieved from http://www.theage.com.au/lifestyle/diet-and-fitness/obesity-is-now-more-deadly-than-smoking-20100408-rv5l.html

The Lancet (2013). *Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis*, for the Global Burden of Disease Study 2013.

The Lancet (2015), *Obesity 2015*. Retrieved from http://www.thelancet.com/series/obesity-2015

The Queensland Times (2010, November 18). Taking weight off ambos. *The Queensland Times*. Retrieved from http://www.qt.com.au/news/taking-weight-off-ambos-ipswich-obesity/700554/

The Sydney Morning Herald (2013). Obesity costs drag down national good'. *The Sydney Morning Herald*. Retrieved from http://www.smh.com.au/national/health/obesity-costs-drag-down-national-good-20130308-2fr0b.html

Thomas S.L., Hyde J., Karunaratne A., Herbert D., Komesaroff P.A. (2008). Being 'fat' in today's world: A qualitative study of the lived experiences of people with obesity in Australia. *Health Expectations*. 11:321-30. [46]

Ulen, C.G., Huizinga, M.M., Beech, B., and Elasy, T.A. (2008). Weight Regain Prevention. *Clinical Diabetes*. 26(3), Retrieved from http://clinical.diabetesjournals.org/content/26/3/100.full

Valenti, L. (2008). *The management of overweight and obesity in adults attending general practice in Australia*, Masters of Medical Studies submitted to Centre for Clinical Epidemiology and Biostatistics (CCEB), University of Newcastle. [54]

Venn, A.J., Thomson, R.J., Schmidt, M.D., Cleland, V.J., Curry, B.A., Gennat, H.C., and Dwyer, T. (2007). Overweight and obesity from childhood to adulthood: a follow-up of participants in the 1985 Australian Schools Health and Fitness Survey. *The Medical Journal of Australia*. 186 (9)

Victorian Government Department of Human Services (2006). *Assessing Cost-Effectiveness of obesity interventions in children and adolescents: Summary of Results'*. ACE-Obesity

Victorian Health Promotion Foundation (2014). *Negative growth: the future of obesity in Australia*, Research highlights. Publication number: P-HE-142. [40]

Vos, T., Carter, R., Barendregt, J., Mihalopoulos, C., Veerman, L., Magnus, A., Cobiac, L., Bertram, M., and Wallace, A. (2010). *Assessing Cost-Effectiveness in Prevention*. Retrieved from http://www.sph.uq.edu.au/bodce-ace-prevention

Wadden, T.A., Butryn, M.L., and Byrne, K.J. (2004). Efficacy of Lifestyle Modification for Long Term Weight Control. *Obesity Research,*Vol 12 (S12). Retrieved from http://onlinelibrary.wiley.com/doi/10.1038/oby.2004.282/pdf

Wadden, T.A., Butryn, M.L, and Wilson, C. (2006). Lifestyle Modification for the Management of Obesity. *Gastroenterology*. 132 (6). Retrieved from http://www.gastrojournal.org/article/S0016-5085(07)00578-1/fulltext?refuid=S0002-8223(08)02204-9&refissn=0002-8223&mobileUi=0#sec6.5.2

Wade, M. (2013, January 1). Obesity costs drag down national good. Retrieved January 1, 2015. Retrieved from http://www.smh.com.au/national/health/obesity-costs-drag-down-national-good-20130308-2fr0b.html. [37]

Walls, H.L., Magliano, D.J., Stevenson, C.E., Backholer, K., Mannan, H.R., Shaw, J.E., Peeters, A. (2012). Projected progression of the prevalence of obesity in Australia. *Obesity*. 20 (4):872-878. [2]

Wang, Y Claire et al (2011). Health and economic burden of the projected obesity trends in the USA and the UK. *The Lancet*. 378(9793):815–825.

Webster, J. (2009), *Reformulation food products for health: context and key issues for moving forward in Europe*. Retrieved from http://ec.europa.eu/health/nutrition_physical_activity/docs/ev20090714_wp_en.pdf

Weintraub, M., Sundaresan, P.R., Schuster, B., Averbuch, M., Stein, E.C., Cox, C., et al. (1992). Long-term weight control study. IV (weeks 156 to 190). The second double-blind phase. Clin *Pharmacology & Therapeutics*. 51(5):608–14

Wellbourn, R., Small, P., Finlay, I., Sareela, A., Somers, S., Mahawar, K., Walton, P., and Kinsman R., (2014). Second Registry Report. *The United Kingdom National Bariatric Surgery Registry*. Retreived from http://nbsr.co.uk/wp-content/uploads/2014/11/Extract_from_the_NBSR_2014_Report.pdf

Willcox, S. (2014). *Chronic diseases in Australia: the case for changing course (Background and policy paper)*. Retrieved from http://www.mitchellinstitute.org.au/wp-content/uploads/2014/10/Chronic-diseases-in-Australia-the-case-for-changing-course-sharon-willcox.pdf [34]

Wing, R.R., Land, W., Wadden, T.A., Safford, M., Knowler, W.C., Bertoni, A.G., Hill, J.O., Brancati, F.L., Peters, A., Wagenknecht, L., and the Look AHEAD Research Group (2011). Benefits of Modest Weight Loss in Improving Cardiovascular Risk Factors in Overweight and Obese Individuals with Type 2 Diabetes. *Diabetes Care*. 34 (7). Retrieved from http://care.diabetesjournals.org/content/34/7/1481.full

World Health Organization (2000). *Technical report series 894: Obesity: Preventing and managing the global epidemic*. Geneva: World Health Organization.

World Health Organization (2013). *Global Action Plan for the prevention and control of noncommunicable diseases 2013-2020*. Retrieved from http://www.who.int/nmh/publications/ncd-action-plan/en/

World Health Organization. *Controlling the global obesity epidemic*. Geneva: World Health Organization. Retrieved from http://www.who.int/nutrition/topics/obesity/en/

World Health Organization. Metrics: Disability-Adjusted Life Year (DALY). Retrieved from http://www.who.int/healthinfo/global_burden_disease/metrics_daly

Yanovski, S.Z. and Yanovski, J.A. (2014). Long-term Drug Treatment for Obesity: A Systematic and Clinical Review. *The Journal of the American Medical Association*. 311(1):74-86

Young, A. (2015, July 15). Here's how much a sugary beverage tax dropped consumption of sugar-sweetened drinks in Mexico. *International Business Times*. Retrieved from http://www.ibtimes.com/heres-how-much-sugary-beverage-tax-dropped-consumption-sugar-sweetened-drinks-mexico-1970091

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