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Cost-effectiveness of primary care referral to a commercial provider for weight loss treatment, relative to standard care–a modelled lifetime analysis

Nicholas R Fuller, MND[1], **Hannah Carter, BEcon**[2], **Deborah Schofield, PhD**[2], **Hans Hauner, MD**[4], **Susan A Jebb, PhD**[3], **Stephen Colagiuri, FRACP**[1], and **Ian D Caterson, PhD FRACP**[1]

[1]The Boden Institute, The University of Sydney, Australia

[2]NHMRC Clinical Trials Centre and School of Public Health, The University of Sydney, Australia

[3]MRC Human Nutrition Research, Cambridge, UK

[4]Else Kroener-Fresenius-Centre for Nutritional Medicine, Faculty of Medicine, Technische Universität München, Munich, Germany

Abstract

Background—Due to the high prevalence of overweight and obesity there is a need to identify cost-effective approaches for weight loss in primary care and community settings.

Objective—To evaluate the long-term cost-effectiveness of a commercial weight loss programme (Weight Watchers) (CP) compared with standard care (SC), as defined by national guidelines.

Methods—A Markov model was developed to calculate the incremental cost-effectiveness ratio (ICER), expressed as the cost per quality adjusted life year (QALY) over the lifetime. The probabilities and quality-of-life utilities of outcomes were extrapolated from trial data using estimates from the published literature. A health sector perspective was adopted.

Results—Over a patient's lifetime, the CP resulted in an incremental cost saving of AUD 70 per patient, and an incremental 0.03 QALYs gained per patient. As such, the CP was found to be the dominant treatment, being more effective and less costly than SC (95% confidence interval: dominant to 6 225 per QALY). Despite the CP delaying the onset of diabetes by approximately 10 months, there was no significant difference in the incidence of type 2 diabetes, with the CP achieving less than 0.1% fewer cases than SC over the lifetime.

Conclusion—The modelled results suggest that referral to community based interventions may provide a highly cost-effective approach for those at high risk of weight-related co-morbidities.

Keywords

Markov model; overweight; obesity; type 2 diabetes

Correspondence Ian D Caterson, The Boden Institute, Medical Foundation Building K25, The University of Sydney, NSW 2006 Australia. Phone: +61 2 9036 3105 Fax: +61 2 9036 3176 ian.caterson@sydney.edu.au.

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INTRODUCTION

The prevalence of overweight and obesity is placing a substantial burden on health care resources, particularly in developed countries [1]. Due to limited health care budgets, policy makers are seeking evidence of the cost-effectiveness of interventions before publicly subsidising programmes. It is therefore imperative that obesity management programmes which are both efficacious and cost-effective are identified and implemented.

A partnership between primary care providers and commercial organisations presents a practical approach for a population based weight loss programme, whereby participants can benefit from early lifestyle intervention for weight management. Our recent randomised controlled trial (RCT) involving three countries (Australia, UK and Germany) showed that referral to a commercial weight loss community intervention programme (Weight Watchers) (CP) produced greater weight loss over 1-year than standard care (SC) [2]. These results confirmed observational data [3, 4] that a shared care approach between primary care providers and commercial organisations has the potential to deliver weight management programmes scalable to a national level in a community setting.

Importantly, this shared care approach was shown to be cost-effective based on a prospectively designed within-trial analysis [5]. The key strengths of the within-trial cost-effectiveness analysis were the certainty of the results as they were based directly on observed trial cost and efficacy data. The limitations were the short time horizon for analysis (1-year), the assumption that all weight loss was maintained, and that several cost-offsets including reduced rates of obesity-related disease were not captured [5]. Collection of follow-up data at 2-years has since been performed [6] which enables us to report on weight regain statistics after cessation of the weight loss intervention.

Previous estimates of the cost of the CP have been reported, but were based on small studies with limited data [7]. The aim of this study was to develop a decision analytic model to estimate the long-term effectiveness and cost-effectiveness of the CP compared to SC in reducing rates of obesity and obesity-related disease in a population of overweight and obese adults. The model builds on our within-trial cost-effectiveness analysis [5] by extrapolating costs and outcomes from the 2-year randomised controlled trial [6] to the lifetime of the trial population.

METHODS

A decision model was developed to estimate the lifetime costs and health outcomes of the CP compared to SC in a simulated cohort of overweight and obese patients. The baseline characteristics of the modelled cohort and the weight loss results for the initial 2-years of the model were imputed directly from data collected in the RCT [2, 6].

The net effectiveness of each strategy was quantified in terms of quality adjusted life years (QALYs). This involved weighting the time spent in each health state by the health related quality of life value (utility) associated with that state (where 0=death and 1=full health). Incremental cost-effectiveness was measured in terms of the cost per QALY gained. A

health sector perspective was adopted and an annual discount rate of 3.5% was applied to all future costs and health outcomes.

Randomised Controlled Trial

A multicentre RCT was undertaken whereby overweight and obese adults were recruited by their general practitioners (GPs) and randomised to receive 1-year of access to either the CP or SC by a primary care provider in Australia, UK, and Germany [2]. Participants randomised to the CP group received vouchers to attend a weekly community CP meeting (Weight Watchers). Those randomised to SC received weight loss advice delivered by a GP/primary care professional at their local medical practice. The frequency of SC visits was at the discretion of the GP and the participant. All participants were aged ≥18 years with a body mass index (BMI) of 27-35 kg/m^2, and had at least one risk factor for obesity-related disease. Risk factors included central adiposity (waist circumference >88cm in women and >102cm in men); type 2 diabetes without insulin treatment; family history of type 2 diabetes; previous gestational diabetes; impaired glucose tolerance or impaired fasting glycemia, mild to moderate dyslipidemia (defined by national guidelines), or treatment for dyslipidemia; treatment for hypertension; polycystic ovarian syndrome or infertility without apparent cause other than weight; lower-limb osteoarthritis; or abdominal hernia. A full list of inclusion and exclusion criteria, as well as a more in-depth description of the two intervention groups are reported with the primary findings from the study [2]. After the 1-year intervention, participants were then followed-up at 18 and 24 months, during which time they could self-select their method of weight management, or do nothing [6].

Model Structure

The Markov process defines a set of discrete health states associated with overweight and obesity, and a set of probabilities that governs the likelihood of transitioning from one state to another at the end of each 1-year cycle (see Figure 1) [8]. Each health state was assigned an estimate of the cost required to provide typical health care over the cycle and a utility weighting that reflected the QALYs gained per cycle (defined under “Resource Use and Costs”). A half-cycle correction was used in the Markov process. The model was constructed using TreeAge Pro Suite 2008 with links to Excel.

Transition Probabilities and Health State Utilities

All transition probabilities and health state utilities are listed in Table 1. Consistent with the baseline data collected in the RCT, patients entering the model had an average age of 47 years [2] and were assigned to begin the model in either an overweight, obese or type 2 diabetes health state. All patients remained in the model until death or until they reached the age of 99 years.

Trial data were used to assign the probabilities of transitioning between health states at the end of the intervention period (1-year), and at the end of follow-up (2-years). Based on the 2-year follow-up trial data at 1-year post completion of the interventions, patients experienced an average weight regain equivalent to 0.09 BMI-point per month for the CP group and 0.03 BMI-point per month for the SC group. As the entry criteria for the study

was a BMI of 27-35 kg/m^2, those with a BMI of < 27 kg/m^2 (< 26.55 kg/m^2) at the end of the intervention and at the end of follow-up were considered to be in a normal BMI range.

Based on a meta-regression performed by Dansinger et al [9] (whereby at 5.5 years post-intervention, no residual weight loss remained) it was assumed that participants in both groups had a weight regain of 0.03 BMI-point per month after the end of the 2-year follow-up. In our study, this was equivalent to ~ 1 kg per year. When applied from the conclusion of the trial follow-up, this assumption resulted in participants in the CP group being projected to regain all their weight loss by approximately 5-years post-intervention, compared to 4-years post-intervention for participants in the SC group. It was assumed for both groups that no residual weight loss remained indefinitely.

Comparing our methodology used to other literature, this was seen to be a conservative weight regain approach post 2-year follow-up. Ara and colleagues [10] reported an increase in BMI of 0.175 per year for women for an equivalent non-diabetic cohort, which is less than the increase in BMI that we modelled (0.36 BMI units per year). Furthermore, as shown by the results from the 10-year Diabetes Prevention Program (DPP) Outcomes Study [11], weight regain is shown to slow down over time (after 2-years) for a similar cohort of patients. Data from the DPP shows that a 2 kg weight loss is maintained up to 10-years [11], however this was not assumed for our study.

The probabilities of developing type 2 diabetes for those with normal, overweight, and obese BMI ranges were sourced from the 2005 AusDiab Report [12]. Age-specific annual mortality rates for patients with and without type 2 diabetes were sourced from Magliano *et al* (2008) (also reported by Keating et al [13]) which combined data from the AusDiab study with national Australian mortality data [14].

Utility values for each health state in the Markov model were based on patient responses to the Impact of Weight on Quality of Life Questionnaire-Lite (IWQOL-Lite) [15, 16] which was collected as part of our trial on 5 occasions over 2-years (baseline, months 6, 12, 18 and 24). A utility score was derived from the patient responses to the questionnaire using the algorithm described by Brazier *et al* (2004) [17].

Resource Use and Costs

All resource use and costs are listed in Table 2. Programme costs associated with the CP group were based on the market price of attending the programme and were sourced directly from Weight Watchers Australia (www.weightwatchers.com.au). This consisted of a monthly payment plan and included unlimited access to meetings and online electronic web tools. The cost of the referral visit to the CP was also included in the costing. For the SC group, the cost applied was that of a consultation lasting 20 minutes or less with a GP. There were no programme costs assigned for either group during the follow-up period (beyond 1-year) as the choice of weight loss method, if any, was not recorded.

The mean annual health care costs for patients living with type 2 diabetes were sourced from the Australian Diabetes, Obesity and Lifestyle Study [18]. Average medication costs for those

in each BMI range (healthy, overweight, and obese) were from a study by Colagiuri and colleagues [19].

All costs were measured in Australian dollars (AUD). Costs sourced from alternative years were presented in 2010-11 values by applying the relevant price inflators or deflators [20].

Uncertainty Analysis

A probabilistic sensitivity analysis was undertaken to examine the effect of multi-parameter uncertainty around estimates of costs, utilities and probabilities. A Monte Carlo simulation of the patient cohort with 10 000 iterations was used to estimate the 95% uncertainty interval around the mean ICER as well as probabilities of acceptable cost-effectiveness thresholds.

Scenario Analysis

The cost-effectiveness analysis was based on commercial pricing decisions (prices sourced from Weight Watchers website) as the use of existing market prices is considered the most practical approach in costing analyses [8]. A scenario analysis was performed to examine the cost-effectiveness impacts of reducing programme costs in Australia to the equivalent of those from the UK National Health Service (NHS) Weight Watchers referral scheme (GBP 45 for 12 sessions [4]). As the CP is identical across countries and the cost to deliver the intervention similar, we assumed that this cost would represent the likely Australian government cost of publicly subsidising the programme. The total cost applied was based on an attendance of 36 CP sessions over 12 months (GBP 135 – 12 session cost multiplied by 3). The Weight Watchers NHS referral scheme was used as it is a system currently in place.

Sensitivity Analysis

A sensitivity analysis was performed to estimate the cost-effectiveness of the CP when including the costs associated with patient travel to attend either CP or SC consultations. The number of participant visits to their primary care provider for weight loss advice (SC group), or to the CP (CP group), was recorded throughout the 1-year study. Those attending the CP had approximately 3 times more visits over the 1-year treatment period than those receiving SC (Table 2). Patients were assumed to have travelled within a 10 kilometre radius to either their local CP or primary care clinic. Opportunity costs of employment were not considered because participants could attend their intervention outside working hours, during their lunch break, or on weekends. Childcare costs were not considered as children of any age are welcome at the CP meetings and can accompany their parent to a SC visit.

RESULTS

Modelled Results

Using base case assumptions, the CP resulted in an additional 50 life years gained per 1000 patients treated, and an additional 50 years spent in a normal BMI range per 1000 patients (Table 3). The average onset of type 2 diabetes in the CP group was delayed by 10.29 months (0.85 years) when compared with patients in SC. However, there was no statistically significant difference (<0.1%) in the probability of developing type 2 diabetes over the

remainder of the patient's lifetime (34.95% and 34.99% for the CP and SC groups respectively).

After discounting costs and benefits by 3.5%, the CP cost an additional AUD 123 over the first five years post treatment. This produced an incremental cost-effectiveness ratio (ICER) of AUD 11 260 per QALY. Over a patient's lifetime, the CP resulted in an incremental cost saving of AUD 70 per patient, and an incremental 0.03 QALYs gained per patient. As such, the CP was found to be the dominant treatment, being more effective and less costly than SC. The 95% confidence interval ranged from dominant to 6 225 per QALY.

Probabilistic Sensitivity Analysis

The results of the Monte Carlo analysis for the cost-effectiveness of the CP relative to SC are presented on a cost-effectiveness plane in Figure 2. Based on this analysis, the probability of the CP being a cost-effective treatment at an ICER of AUD 50 000 was 77.9%.

Scenario Analysis

When the programme costs of the CP in Australia were reduced to the equivalent of the Weight Watchers NHS referral scheme, our base case results were strengthened and the CP remained the dominant intervention.

Sensitivity Analysis

When including the costs associated with patient travel in our analysis, programme costs increased to AUD 1 170 and AUD 508 for the CP and SC groups respectively. This resulted in an ICER of AUD 6 389 per QALY (95% uncertainty interval: CP dominant to 10 925 per QALY) for the CP relative to SC.

DISCUSSION

Although the CP was associated with a higher initial cost than SC, these extra costs were offset by the longer term health benefits associated with an increased rate of weight loss (and therefore lower healthcare resource use) when patients were followed over the lifetime. The CP was therefore a dominant intervention (i.e. both more effective and less costly than SC). The lifetime analysis presented here extrapolates from the results of the within-trial cost-effectiveness analysis conducted alongside the RCT, where an ICER of AUD 18 085 per QALY was reported [5].

When the commercial price of the CP was re-evaluated in accordance with the likely costs of the programme if it were to be funded through the health system, the base case result was strengthened and the CP remained the dominant option. The costs of patient travel were estimated in a separate sensitivity analysis as those attending the CP had more frequent visits than those receiving SC (approximately 3 times more visits over the 1-year), which may have had a large contribution to the success of the CP. When these costs were included in the analysis the CP became more expensive than SC, but remained highly cost effective with an ICER of AUD 6 389 which was well below the commonly accepted threshold of

$50 000 per QALY [21-23]. It may be argued that patient time to attend the CP or GP consultations should also be included, however a large benefit of these services is that they are available at lunchtimes, after work hours, and on weekends, thereby minimizing the opportunity costs of paid employment.

When GPs are given adequate support services such as those in the SC arm of our study, as well as the Counterweight Programme in the UK [24], they have been found to achieve a weight loss of 3 kilograms at 1-year. While this approach is cost-effective when compared to background rates of population weight gain [25], our results indicated that the CP provided a relatively more effective and less costly long-term approach. Despite the higher initial program costs associated with the CP, and no significant difference in overall incidence of type 2 diabetes between groups (<0.1%), the quality of life benefits and lower levels of resource use associated with patients being in a healthier BMI range resulted in the CP being cost saving over the lifetime. Importantly, this shared care approach has the potential to be delivered on large scale and in community settings. This suggests that we should be using the CP as a cost-effective means for community weight control and it is a suitable support resource for general practitioners to refer patients to. However, the CP may be beyond the financial reach of a substantial portion of the population, particularly those who need it most [26].

While other studies have reported on the cost-effectiveness of the CP, these were small in scale and reliant on several assumptions [7]. However, cost-effectiveness ratios for other adult weight loss interventions that incorporated dietary and exercise counselling have been published. The DASH and low-fat diet programmes (as reported by Forster et al [27]) were found to have incremental cost-effectiveness ratios of AUD 12 000 and AUD 13 000 per disability adjusted life year, respectively, when patient time and travel were not included [27]. An economic evaluation of weight loss interventions in overweight and obese women found the most cost-effective option to be a diet, exercise, and behavioural modification programme at a cost of USD 12 600 per QALY [28]. While there are challenges in comparing with previous cost-effectiveness analyses for reducing overweight and obesity in an adult population (including differences in costing perspectives, timeframe for outcomes measured, modeling methods, discounting rates, and assumptions around the sustainability of intervention effects), the CP, being a cost saving intervention, is highly favorable when compared to other diet and exercise interventions.

Previous studies have found surgically induced weight loss to be a cost-effective approach for managing obesity and remission of type 2 diabetes [13, 29, 30]. Compared with nonsurgical management of obesity this was found to produce an ICER of GBP 11 000 per QALY [30], with a more recent systematic review confirming these results [29]. However, the majority of ICERs reported for bariatric surgery are higher than those for other obesity management approaches. In this context, it would be a better use of government resources to support approaches such as those reported here, which are low cost programmes that help promote weight loss and delay the onset of type 2 diabetes.

The strength of the methodology applied in this study lies in its ability to synthesise trial evidence of efficacy, resource use, and patient preferences associated with weight loss

interventions in an explicit and transparent manner. This modelling approach allows us to extrapolate 2-year follow-up results from a robust community intervention to project the outcomes for patients over a lifetime. The estimates of the cost-effectiveness are robust. This is unsurprising as minimal assumptions were required within the model and all the transition probabilities applied were based on the highest levels of evidence (randomised controlled trials and meta-analyses).

A limitation of our study was that only one clinical outcome (type 2 diabetes) was assessed. We chose to model the impacts on this condition alone as it was the only condition for which we had baseline prevalence rates, and because the link between BMI and type 2 diabetes has been well established. Exclusion of other obesity-related diseases where the evidence of the association with BMI is scarcer would have required more assumptions and hence have produced greater uncertainty in the cost-effectiveness estimates. However, if additional obesity-related diseases were to be included in the model, it is likely that our existing conclusions would be strengthened further.

Conclusion

The CP was found to be a more effective and less costly intervention than SC in overweight and obese individuals. It also delayed the onset of type 2 diabetes. This suggests that a greater emphasis on referral to commercial weight loss programs may provide a highly cost-effective approach for those at high risk of weight-related co-morbidities.

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Conflicts of Interest NRF and IDC have received research grants for other clinical trials funded by Sanofi-Aventis, Allergan, Eli Lilly, and Novo Nordisk. IDC was a board member for the SCOUT trial, is on the EXSCEL Operations Committee and has received payment for lectures from iNova Pharmaceuticals, Pfizer Australia, and Servier Laboratories (Australia). SAJ has received research grants for other clinical trials from Sanofi-Aventis and Coca Cola, and is a member of the Tanita Medical Advisory Board and receives a fee for nutrition articles and lectures for Rosemary Conley Enterprises. HH is on the Advisory Board for Weight Watchers International and has received payment for lectures from Sara Lee, Novartis, Sanofi Aventis, and Bristol-Myers Squibb.

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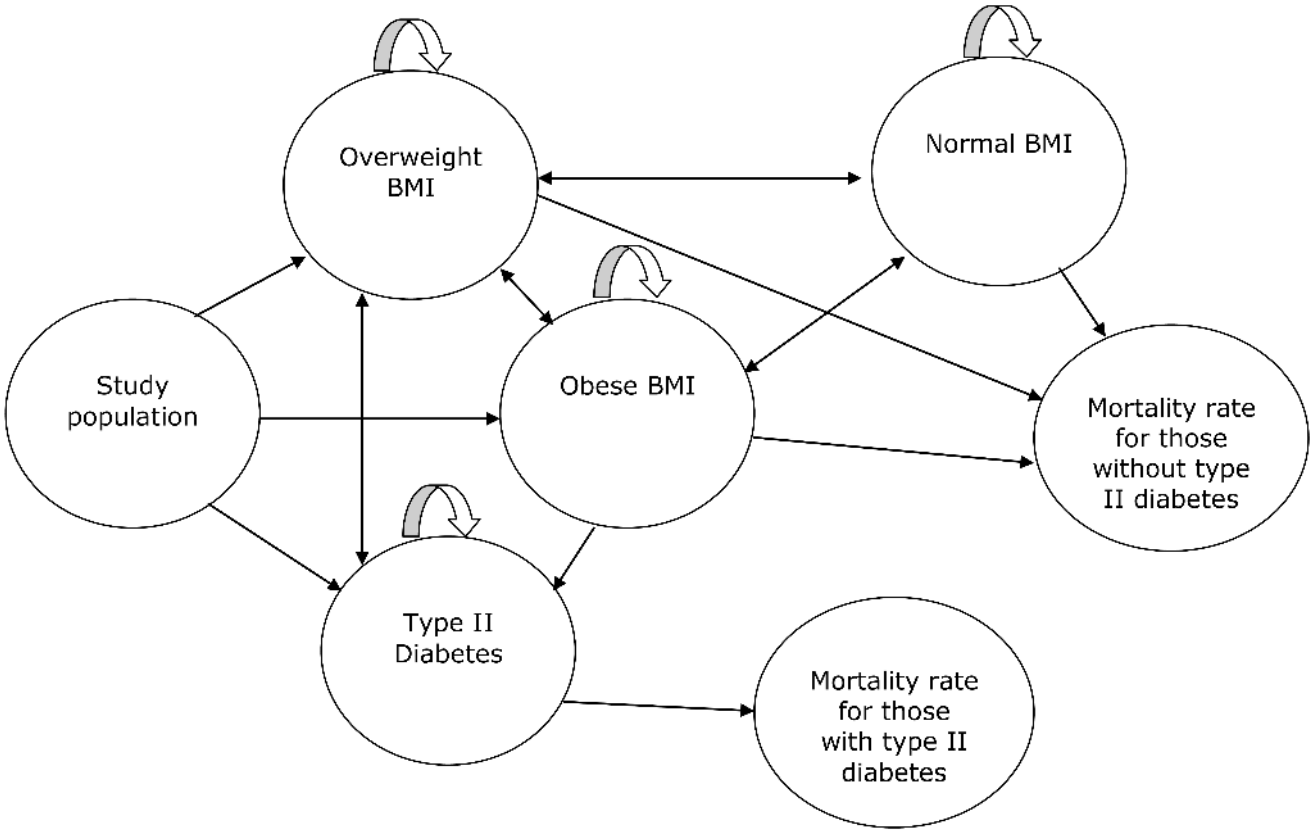

Figure 1.

Health states included in the Markov model following a commercial programme versus standard care for weight loss treatment

Circular arrows indicate that individuals can remain in this health state; BMI – Body Mass Index

All individuals began the model in either an overweight BMI range, obese BMI range, or type 2 diabetes health state. The likelihood of moving from one state to another at the end of a cycle was governed by a series of annual probabilities. At the end of each cycle individuals could transition to a normal BMI range, overweight BMI range, obese BMI range, or a type 2 diabetes health state. However, it was assumed that no additional individuals would transition to a normal BMI range after the first 2-years post intervention. Once diagnosed with type 2 diabetes, individuals could remain living with the disease for the next cycle or die from type 2 diabetes. Individuals could die from non-diabetes related causes at any point in the model. All patients remained in the model until death or until they reached the age of 99 years.

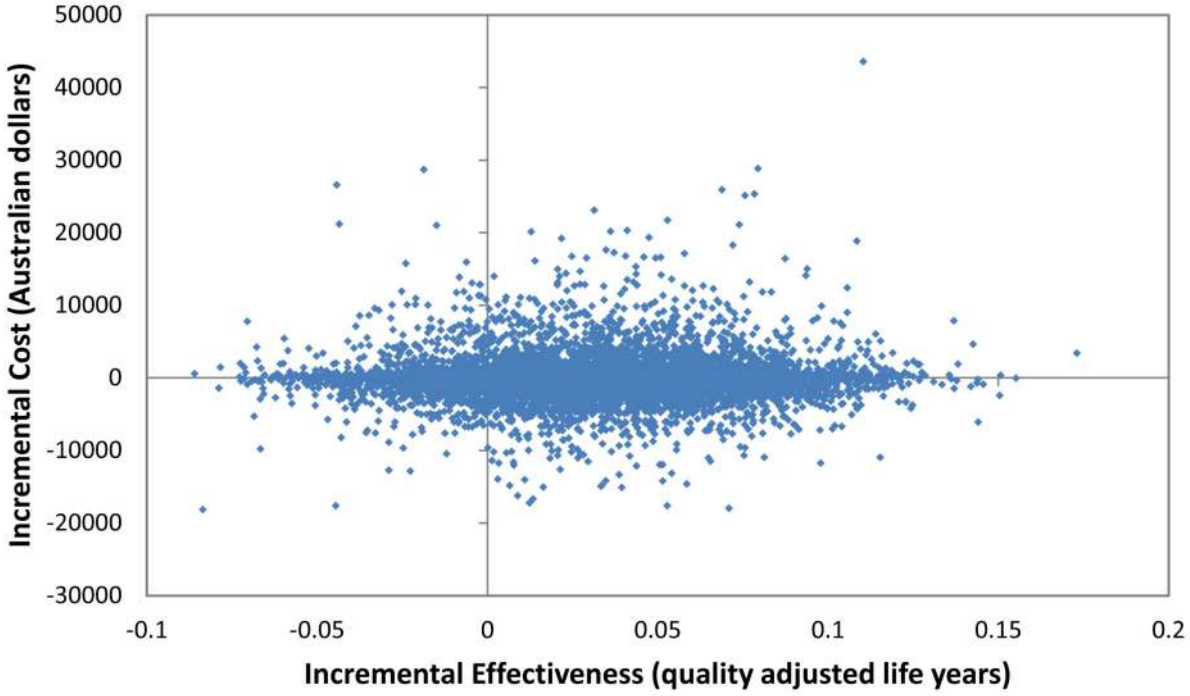

Figure 2.
Incremental cost effectiveness scatterplot of the commercial weight loss programme vs. standard care

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Table 1

Annualised parameter estimates used in Markov model

Parameter	Annual Probabilities		Source
	Standard Care	*Commercial Program*	
Probability of developing diabetes for normal health state	0.004 (0.002)	0.004 (0.002)	AusDiab Report 2005 [12]
Probability of developing diabetes for overweight health state	0.008 (0.003)	0.008 (0.003)	AusDiab Report 2005 [12]
Probability of developing diabetes for obese health state	0.016 (0.004)	0.016 (0.004)	AusDiab Report 2005 [12]
Mortality rate for those with type 2 diabetes (age 47-99 years)	0.008-0.328	0.008-0.328	Magliano et al [14], Keating et al [13]
Mortality rate for those without type 2 diabetes (age 47-99 years)	0.002-0.332	0.002-0.332	Magliano et al [14], Keating et al [13]
Probability of healthy BMI range (start of trial)	0	0	RCT
Probability of overweight BMI range (start of trial)	0.331	0.331	RCT
Probability of obese BMI range (start of trial)	0.603	0.603	RCT
Probability of type 2 diabetes (start of trial)	0.066	0.066	RCT
Probability of obese BMI range at start of trial to overweight BMI range at 12 months	0.201 (0.375)	0.439 (0.305)	RCT
Probability of overweight BMI range at start of trial to healthy BMI range at 12 months	0.188 (0.639)	0.414 (0.398)	RCT
Probability of healthy BMI range at 12 months to overweight BMI range at 24 months	0.320 (0.680)	0.509 (0.346)	RCT
Probability of overweight BMI range at 12 months to obese BMI range at 24 months	0.099 (0.889)	0.286 (0.571)	RCT
Probability of diabetes remission at 12 months	0.074	0.167	RCT
Quality of life adjustments			
Normal health state	0.81(0.07)	0.81(0.07)	RCT
Overweight health state	0.81 (0.06)	0.81 (0.06)	RCT
Obese health state	0.78 (0.07)	0.78 (0.07)	RCT
Type 2 diabetes	0.75 (0.10)	0.75 (0.10)	RCT
Start age	47.4	47.4	RCT [2]

Values are presented as mean (SD). SD – standard deviation; as tested in the probabilistic sensitivity analysis. RCT – randomised controlled trial; BMI – Body Mass Index

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Table 2

Cost inputs for Markov model

Resource	Unit cost (AUD)	Average number of visits over 12 months/Annual units	12 month cost[a]	Source
Commercial Programme				
WW attendance	$59.95 per month	33.0	$719.40	www.weightwatchers.com.au
Primary care referral	$34.90 per participant	1.0	$34.90	MBS [31] - Item 23
Patient travel[b]	$12.60 per round trip	33.0	$415.80	ATO [32]
Standard Care				
General Practitioner (GP) consult	$34.90	10.7	$373.43	MBS [31] - Item 23
Patient travel[b]	$12.60 per round trip	10.7	$134.82	ATO [32]
Health care costs				
Normal health state[c]	$1 749 (5 667)	1	$1 749 (5 667)	Colagiuri et al [19]
Overweight health state[c]	$2 159 (5 885)	1	$2 159 (5 885)	Colagiuri et al [19]
Obese health state[c]	$2 598 (5 654)	1	$2 598 (5 509)	Colagiuri et al [19]
Type 2 diabetes health state[c]	$4 491 (5 669)	1	$4 491 (5 669)	Australian Diabetes, Obesity and Lifestyle Study [18]

WW – Weight Watchers; AUD – Australian Dollar; MBS – Medicare Benefits Schedule; ATO – Australian Taxation Office

[a]The CP and SC costs only apply to the 12-month intervention period. There were no programme costs during the 24-month follow-up period.

[b]This cost was only included in the sensitivity analysis.

[c]Costs are reported as mean (standard deviation).

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Table 3

Markov model results (5 year and lifetime means per patient)

	After 5 years (Age < 53 years)		Lifetime (Age = 99 years)	
	CP	**SC**	**CP**	**SC**
Cumulative incidences				
Total life years	6.94	6.94	34.64	34.59
Years spent in normal health state	0.28	0.16	0.49	0.44
Years spent in overweight health state	2.51	2.29	10.24	9.66
Years spent in obese health state	3.50	3.80	16.22	16.55
Developing type 2 diabetes	7.77%	8.02%	34.95%	34.99%
Mortality rate for those with type 2 diabetes	0.49%	0.53%	39.59%	40.34%
Cost effectiveness analysis				
QALYs discounted	4.87	4.86	15.31	15.28
Cost discounted	AUD 16 667	AUD 16 544	AUD 55 511	AUD 55 581
Incremental efficacy	CP = 0.01 QALYs		CP = 0.03 QALYs	
C/E	AUD 3 422	AUD 3 405	AUD 3 625	AUD 3 638
ICER	CP = AUD 11 260 per QALY		CP dominant	
QALYs undiscounted	5.48	5.46	27.11	27.04
Cost discounted	AUD 18 676	AUD 18 586	AUD 100 379	AUD 100 626
Incremental efficacy	CP = 0.01 QALYs		CP = 0.07 QALYs	
C/E	AUD 3 410	AUD 3 401	AUD 3 703	AUD 3 721
ICER	CP = AUD 7 349 per QALY		CP dominant	

CP = commercial programme; SC = standard care; BMI = body mass index; QALY = quality adjusted life year; C/E = cost effectiveness; ICER = incremental cost effectiveness ratio; AUD = Australian dollar