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Want to Lose Weight?
Comparing the Efficacy of Commercial Weight Loss Programs versus Primary Care
Interventions for Weight Loss and Weight Loss Maintenance

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Want to Lose Weight? Comparing the Efficacy of Commercial Weight Loss Programs versus Primary Care Interventions for Weight Loss and Weight Loss Maintenance

By Katherine Chui and Jessica Jacobson

ABSTRACT

Context Overweight and obesity rates are on a continuous incline in the United States leading to increased rates of diabetes, cardiovascular disease and death. Much of the healthcare costs are going into treating this disease; therefore, it is vital to find effective weight loss treatments in both the primary care and community settings to reduce the prevalence of overweight and obesity and subsequent healthcare costs.

Objective To assess whether primary care-based therapy or commercial weight loss programs help overweight and obese patients lose 5% of their weight from baseline.

Design, Setting and Participants A systematic review of four randomized control trials of weight loss in overweight and obese adults (mostly women, ≥ 18 years of age) each conducted for at least one year.

Intervention Commercial weight loss programs (Weight Watchers and Jenny Craig), which incorporate behavioral skills, nutritional plans and/or prepackaged meals, activity plans, group support and counseling. All commercial weight loss resources were provided free of charge. Participants assigned to primary care received weight loss and diet advice based upon their national clinical guidelines for treatment and behavioral skills (such as self-monitoring, goal setting and relapse prevention) during a select number of one-on-one or group sessions with a general practitioner. All sessions with the general practitioner were provided free of charge.

Main Outcome Measure Weight change over one year

Results All those allocated to Weight Watchers had a statistically significant decrease in weight from baseline; whereas some allocated to primary care achieved statistically significant decrease in weight from baseline. Not all studies revealed that there were significant differences between treatment groups for the percent of participants who achieved a 5% weight loss.

Conclusion Compared to primary care, Weight Watchers was the most effective treatment modality, which resulted in the greatest weight loss and best weight loss maintenance.

INTRODUCTION

Obesity is a global epidemic. In 2014, more than 1.9 billion (39%) adults, 18 years and older, were overweight with 600 million (13%) of these adults being classified as obese.¹ In the United States, 153 million (69%) adults, 20 years and older, were overweight with 78 million (35.1%) of them being classified as obese in 2011-2012; the US classifies overweight and obesity in terms of Body Mass Index (BMI) – overweight: 25-29.9 kg/m², obesity: 30-39.9 kg/m².^{2,3} Excess weight accounts for 58% of the global burden of diabetes and 21% of ischemic heart disease along with an increased risk for hypertension, dyslipidemia, gallbladder disease, sleep apnea and osteoarthritis.⁴ Because of these comorbid conditions, use of health care services and costs have increased among obese patients.

“Persons who are obese have medical costs that are \$1,429 higher than those of normal weight”.⁵ The said individual cost explains the \$147 billion the United States spent in medical costs in 2008.^{6,7} “The annual nationwide productive costs of obesity-related absenteeism range between \$3.38 billion (\$79 per obese individual) and \$6.38 billion (\$132 per obese individual)”.^{7,8} Obesity is reversible; therefore, it is vital to find an effective intervention to treat this problem in order to avoid unnecessary costs, but most importantly, to lower the increased risk for death associated with this disease.

As a way to combat increasing obesity rates and future healthcare costs, screening and counseling for obesity, under the preventative services benefit of the Affordable Care Act (2010), is now covered with no patient cost-sharing by most insurers.⁹ “It is anticipated that 3.7 million Americans with obesity will enroll in health marketplaces exchanges, where they will be entitled to intensive behavioral counseling for obesity, and at least one prescription drug for obesity treatment”.⁹ And as of 2014, all private insurance plans began covering intensive behavioral counseling for obesity in adults.⁹ The goal of the Affordable Care Act for obesity is to prevent it, but it does not address how to treat it.

According to the Food and Drug Administration (FDA), a weight loss of 5-10% has clinically significant health benefits, including a reduction in risk factors for diabetes and cardiovascular disease, which are some of the leading causes of death among obese adults.^{10,11} The United States Preventative Services Task Force (USPSTF) recommends clinicians offer or refer adults aged 18 years or older with a body mass index (BMI) of ≥ 30 kg/m² to intensive, multicomponent behavioral intervention.¹¹ Primary care-based therapy and commercial weight loss management programs, such as Weight Watchers (WW) and Jenny Craig, are examples of multicomponent behavioral interventions.

In 2010, 55.5% of physician office visits were to a primary care provider, making primary care an important setting in which to tackle the obesity epidemic.¹² The United Kingdom realized the importance of primary care in weight management; therefore, they started *The Counterweight Programme* to improve the management of obesity in primary care. This program provides workshops aimed to increase physician confidence in raising the subject of weight up when speaking to an obese patient, encourages co-facilitation between clinics and specialists (i.e. dieticians) to better manage patients and encourages the implementation of screening and treatment plans consistent with national and international evidence-based guidelines for obesity.¹³ *The Counterweight Programme* trains primary care providers around core competencies for evidence-based approaches to weight management using an interactive model of communication.¹³ This interactive model of communication has proven significance in empowering patients, which has increased patient participation, patient control and patient education, thus leading to better weight management outcomes.¹³

WW is a lifestyle-based weight loss program focused on modifying one’s diet and increasing physical activity to produce weight loss. To assist their customers, WW provides online services, meetings led by successful completers of the program and one-on-one coaching. Some of the online resources provide 24/7 expert chat, recipes and customized meals, skills and strategies to overcome obstacles in weight loss and a way to connect with others across the country to share ideas,

encouragement and advice. Coaching includes unlimited one-on-one sessions and customized action plans.¹⁴ Like WW, Jenny Craig lifestyle-based group that offers a variety of programs varying in intensity and duration. Within these programs, Jenny Craig provides a low-energy density diet via prepackaged foods, exercise counseling, one-on-one weekly consultations and a customized weight management plan.¹⁵ Both of these commercial programs are all encompassing; however, the most effective method of weight loss still remains unclear.

We compared the efficacy of primary care education and counseling to commercial weight-loss programs, specifically WW, by examining weight change amongst overweight and obese adults in addition to the cost effectiveness of each approach.

PICO

Population: overweight or obese adults
Intervention: commercial weight loss programs
Comparison: primary care interventions
Outcome: weight loss and maintenance

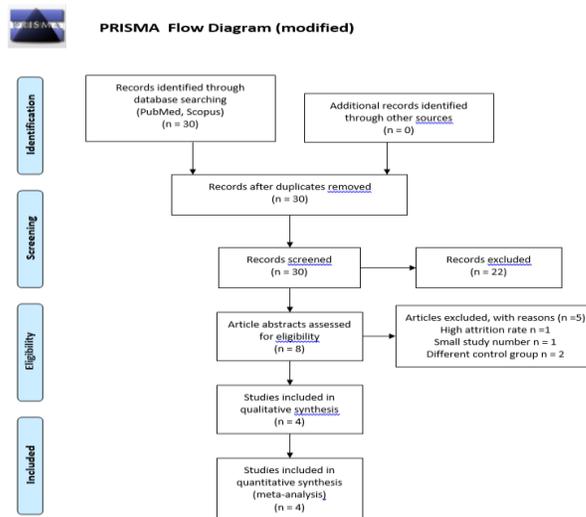
Clinical Question

Among overweight or obese adult patients, do commercial weight loss programs compared to primary care interventions help patients lose more weight and better maintain that weight loss in the future?

METHODS

A search on PubMed was conducted in September 2015 using the terms “commercial” and “obesity/therapy” MESH term. Filters were applied to include only randomized controlled trials, English language, and publication date after 2005. This search yielded 30 studies. A search on Scopus with similar search terms yielded no additional studies. Screening the titles of the publications excluded 22 studies that did not pertain to our clinical question. This left 8 articles and their abstracts were assessed for eligibility with one study excluded for high attrition rate, one study excluded for small sample population, and two studies excluded for not matching our clinical question. In the end, four studies were included in this systematic review (Figure 1).

Figure 1. PRISMA flow diagram outlining database search



RESULTS

Study #1

Primary Care Referral to a Commercial Provider for Weight Loss Treatment versus Standard Care: A Randomized Controlled Trial, Jebb et al.¹⁶

Objective: Examined whether a primary care referral to a commercial program (Weight Watchers) or standard care were effective means for weight loss and associated risk factors in overweight and obese adults at 12 months.

Study Design

This was a non-blinded, randomized control trial in which 1,010 overweight and obese adults were recruited over 14 months from 70 primary care practices in Australia, 39 practices in Germany and six practices in the United Kingdom (UK). Of the 1,010 participants assessed for eligibility, 772 were enrolled (268 Australia, 268 Germany, 236 UK). Table 1 outlines the inclusion and exclusion criteria.

Table 1: Inclusion and Exclusion Criteria for Jebb et al.¹⁶

| INCLUSION CRITERIA | EXCLUSION CRITERIA |
|---|---|
| <ul style="list-style-type: none">• Age ≥ 18 years• BMI of 27-35 kg/m² with at least one additional risk factor for obesity-related disease which include:<ul style="list-style-type: none">▪ Central adiposity (waist circumference >88 cm in women or >102 cm in men)▪ Type II diabetes without insulin treatment▪ Family history of diabetes▪ Previous gestational diabetes▪ Impaired glucose tolerance or impaired fasting glycaemia▪ 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▪ Abdominal hernia | <ul style="list-style-type: none">• Weight loss of 5 kg or more in the previous 3 months• History of a clinically diagnosed eating disorder• Orthopedic limitations preventing participation in regular physical activity• Untreated thyroid disease or more than one change in thyroid treatment in the previous 6 months• Receiving treatment with effects on weight or appetite• Gastrointestinal disorders• Previous surgical procedure for weight loss• Major surgery in the previous 3 months• Pregnancy or lactation• Insulin-treated diabetes• Diabetes diagnosis in the previous 6 months• HbA1C of at least 75 mmol/mL (9.0%)• Heart problems in the previous 3 months• Uncontrolled hypertension• New prescription drug for a chronic disorder in the previous 3 months or change in dose in the previous 1 month• History of presence of cancer, with the exception of completely resected basal or squamous cell carcinoma if treatment completed 6 months before enrollment or if treatment was stable• Participation in another clinical trial in the previous 30 days |

Participants were randomized using STATA version 9 by APM, a computer generated randomizing sequencer, which took into account each participant's country, sex, and diabetes status. Filemaker Pro 9, version 3, an online database, was then used to conceal which treatment each participant was allocated to: 12 months of standard care, as defined by the three participating country's national treatment guidelines, or 12 months of free access to a commercial program (Weight Watchers). 395 participants were allocated to standard care and 377 to the commercial program. Table 12 contains the baseline characteristics of the participants. Not mentioned within the table is the number of participants on antihypertensive medication: 99 (25%) participants in the standard care group and 96 (25%) in the commercial program group.

Those allocated to the standard care group received weight loss advice from a primary care physician at their local general practitioner's office. Each physician was encouraged to use their national clinical guidelines for treatment. Those allocated to the commercial program were given access to internet-based systems which included: progress monitoring, community discussion boards, recipes and meal ideas. The participants in the commercial program were asked not to reveal their participation in the study to the group leader or other attendees.

The primary outcome was weight change from baseline to 12 months. The bodyweight of participants in the UK and Australia was measured with a Tanita BC-418 Segmental Body Composition Analyzer; whereas the participants in Germany were measured at a general practitioner's office with standard scales. The Tanita BC-418 Segmental Body Composition Analyzer measures weight, body fat percentage, body fat mass, BMI, fat free mass, estimated muscle mass, total body water and basal metabolic rate via electrodes, which show separate body mass readings for the right arm, left arm, trunk, right leg and left leg. Weight change was analyzed at baseline, and at two, four, six, nine and 12 months by intention to treat, which included all randomized participants with the last observation carried forward (LOCF) for missing data. Linear regression with fixed effects (intervention group, country and baseline measurements) was used to analyze weight change at 12 months. Linear regression consists of finding the best-fitting straight line through a set of points using the variable that is being predicted, in this case weight change at 12 months, verse the variable the prediction is based on, in this case the fixed effects. The linear regression line allows one to determine error of prediction by calculating the distance between the plotted points and the line. No country-by-treatment interactions were identified ($p > 0.10$); therefore, the findings were pooled. By using the same fixed effects model as above, weight change was also analyzed with baseline observation carried forward (BOCF), which enabled the results from this study to be compared to results from other studies.

Changes in fat mass, waist circumference, blood pressure and biomarkers of cardiovascular disease risk were the secondary outcomes. These were analyzed concurrently with weight change. In all three countries, fat mass was measured with the Tanita BC-418; whereas the measurement of blood pressures depended on local standard operating procedures. Fasting blood glucose, insulin, lipids and HbA1c represented the biomarkers of cardiovascular disease risk, which were analyzed like weight change by regression-based methods as mentioned above. In addition, participants self-reported at each assessment on the following: number of appointments or meetings attended with their health-care provider or commercial program, dietary intake, eating behavior, physical activity and quality of life.

Study Results

Of the 395 participants allocated to standard care, 214 (54%) completed the 12-month study; whereas 230 (61%) of the 377 participants allocated to the commercial program completed the study; therefore, a total of 328 (42%) of participants withdrew from the trial with the greatest attrition rate occurring in the UK (150 [64%]) then Australia (111 [41%]) and finally Germany (67 [25%]). Though there were differences in completion rates, the weight loss among participants in the commercial program

was significantly greater than those in the standard care group in each country in all analyses (data was not shown).

Overall, both treatment groups lost weight, but those in the commercial program, on average, lost twice as much weight as those in the standard care group over the 12 months. In addition to weight loss, commercial program participants had greater reductions and improvements in waist circumference and fat mass. Table 2 shows the changes in clinical outcomes between baseline and 12 months.

Table 2: Changes in clinical outcomes (mean; standard deviation) between baseline and 12 months (Jebb et al.)¹⁶

| | N | Standard Care | Commercial Program | Adjusted difference (95% CI)* | p value |
|---------------------------------|-----|---------------|--------------------|-------------------------------|---------|
| Bodyweight (kg) | | | | | |
| LOCF | 772 | -2.25 (0.21) | -5.06 (0.31) | -2.77 (-3.50 to -2.03) | <0.0001 |
| BOCF | 772 | -1.77 (0.19) | -4.06 (0.31) | -2.29 (-2.99 to -1.58) | <0.0001 |
| Completers | 444 | -3.26 (0.33) | -6.65 (0.43) | -3.16 (-4.23 to -2.11) | <0.0001 |
| Waist circumference (cm) | | | | | |
| LOCF | 760 | -3.16 (0.28) | -5.60 (0.37) | -2.39 (-3.28 to -1.51) | <0.0001 |
| BOCF | 760 | -2.34 (0.26) | -4.05 (0.35) | -1.72 (-2.56 to -0.88) | 0.0001 |
| Completers | 429 | -4.34 (0.43) | -6.86 (0.50) | -2.36 (-3.65 to -1.08) | 0.0004 |
| Fat mass (kg) | | | | | |
| LOCF | 695 | -1.85 (0.19) | -4.23 (0.28) | -2.32 (-2.96 to -1.68) | <0.0001 |
| BOCF | 695 | -1.34 (0.17) | -3.21 (0.27) | -1.84 (-2.45 to -1.23) | <0.0001 |
| Completers | 397 | -2.54 (0.30) | -5.36 (0.38) | -2.52 (-3.45 to -1.60) | <0.0001 |

*Adjusted for baseline observation and country. LOCF = Last Observation Carried Forward, BOCF = Baseline Observation Carried Forward

As for changes in biomarkers of cardiovascular disease risk, the only significant improvement was seen in insulin and ratio of total to HDL cholesterol amongst those in the commercial program compared to those in standard care. There were only slight improvements in glucose, and HDL and LDL cholesterol in the commercial group; these differences did not reach significance. Table 3 represents the biomarkers of cardiovascular disease that showed significant improvements between treatment groups.

Table 3: Significant changes in biomarkers of cardiovascular disease (mean; standard deviation) between baseline and 12 months (Jebb et al.)¹⁶

| | N | Standard Care | Commercial Program | Adjusted difference (95% CI)* | p value |
|--|-----|---------------|--------------------|-------------------------------|---------|
| Insulin (pmol/L) | | | | | |
| LOCF | 749 | -0.65 (0.95) | -3.89 (0.97) | -2.89 (-5.47 to -0.31) | 0.0284 |
| BOCF | 749 | -0.45 (0.89) | -3.66 (0.87) | -3.04 (-5.44 to -0.64) | 0.0132 |
| Completers | 423 | -0.84 (1.67) | -6.15 (1.44) | -5.74 (-9.86 to -1.61) | 0.0065 |
| Total cholesterol:HDL | | | | | |
| LOCF | 760 | -0.11 (0.03) | -0.18 (0.03) | -0.09 (-0.17 to -0.01) | 0.0270 |
| BOCF | 760 | -0.07 (0.02) | -0.17 (0.03) | -0.12 (-0.18 to -0.05) | 0.0001 |
| Completers | 428 | -0.13 (0.05) | -0.29 (0.04) | -0.17 (-0.28 to -0.06) | 0.0004 |
| *Adjusted for baseline observation and country | | | | | |

A mean of one appointment per month with their healthcare provider was reported by those allocated to the standard care group; whereas a mean of three meetings per month in the UK and Australia and two meetings per month in Germany were reported by those allocated to the commercial program.

Study Critique

Strengths

The patient sample was clearly defined by the thorough inclusion and exclusion criteria listed in Table 1. The inclusion criteria outlined a person more likely to be obese with a high risk for cardiovascular diseases; whereas the exclusion criteria were very thorough as to avoid bias.

The duration of follow-up was sufficient, because participants from both study groups at two months had already noticed weight changes; therefore, assessing the participants at 12 months solidified which method was better for weight loss. Because the duration of follow up was sufficient, it allowed researchers to gather enough evidence to adequately assess the outcomes of each treatment modality.

The study examined a partnership model; a primary care doctor is aware of the overall health of each of their patients; therefore, all participants had to be referred by their primary care doctor in order to participate in this study. Those that would most likely benefit from early intervention for weight loss were referred to participate in the study, which introduced less bias and ensured the probability of having a positive study outcome.

This study was also very educational and all-encompassing. It acknowledged the affordability of commercial programs verse standard care, and it stated the pro and cons of group treatment verse individual therapy. These are important to consider when conducting further research.

Weaknesses

The most significant weakness in this study was the use of three countries to draw a conclusion. Not only was the delivery of standard care different in each country, but the specifics of standard care differed both between and within the countries. Because there was no consistent model of standard care, there was greater variability in weight loss as opposed to participants in the commercial program.

There was a lack of consistency in the methods used to measure the primary and secondary outcomes among the countries. For example, body weight in Germany was measured using standard scales as opposed to body weight being measured by Tanita BC-418 in Australia and the UK, which introduced the possibility of random error due to not recording body weight to the same division. Fasting blood samples were measured at different places between and within each country, which may have introduced instrumental error caused by poorly calibrated equipment in one lab as opposed to another.

Due to the intervention, participants and providers were not blinded. Participants were not blinded to their treatment allocation, because those allocated to the commercial program were given access to WW online tools unlike those allocated to the standard care group just met with their primary care provider, for example. Providers were not blinded, because they had to report data including weight measurements to the researchers. Because the participants and providers were not blinded, this introduced the possibility of bias.

Weaknesses pertaining to participant selection included: poor representation of males and only representing overweight or moderately obese individuals (BMI 27-35 kg/m²) with limited severity of comorbidities and at low risk of treatment complications. Due to poor representation, the results of this study cannot adequately be applied to males and morbidly obese people.

This study was funded by Weight Watchers, the same commercial program participants were allocated to in this study, which introduces the possibility of bias.

Study #2

*Combining Behavioral Weight Loss Treatment and a Commercial Program: A Randomized Clinical Trial, Pinto et al.*¹⁷

Objective: Tested whether a combined approach, which included the fundamental components of professionally delivered behavioral weight loss (BWL) treatment with Weight Watchers (WW), versus WW alone and BWL alone produced greater weight losses. The hypothesis supported combined therapy (CT) and expected no differences between CT and BWL alone.

Study Design

This was a randomized control trial; the study recruited through newspaper advertisements from the New York City metropolitan area between October 2008 and January 2010. The 625 willing participants that answered the advertisement were screened by phone, in which 363 were eligible and invited to a group orientation meeting. Of the 363 eligible participants, 106 did not attend the orientation and 14 were no longer interested/ineligible; therefore 243 signed consents and were scheduled for a screening visit. Of the 243, 79 did not attend their screening visit and 20 were no longer interested/ineligible therefore leaving 144 participants. The inclusion and exclusion criteria are listed in Table 4.

*Table 4: Inclusion and Exclusion Criteria for Pinto et al.*¹⁷

| INCLUSION CRITERIA | EXCLUSION CRITERIA |
|--|---|
| <ul style="list-style-type: none">• Individuals between the ages of 30-65 who obtained written approval to participate in a weight loss program from their healthcare provider• BMI of 27-50 kg/m² | <ul style="list-style-type: none">• Currently participating in a weight loss program or taking weight loss medication• Participated in weight loss program in the last year• Participated in WW in the last 2 years• Took weight loss medication in the last 6 months• Lost ≥5% of body weight in the last 6 months• Had or were planning to have bariatric surgery for weight loss• Reported contraindications to unsupervised physical activity• Women who were pregnant, lactating, less than 6 months postpartum, or planning to become pregnant• Individuals reporting uncontrolled hypertension, a history of coronary heart disease, stroke, peripheral arterial disease, hepatitis B or C, cirrhosis, HIV, type 2 diabetes requiring medical therapy that increases the risk of hypoglycemia, cancer within the last 5 years or significant psychiatric illness |

The 144 participants were then randomized into three treatment groups: 48 were assigned to BWL, 49 to WW and 47 to CT. Due to the diagnosis of cancer, three participants (two in BWL and one in CT) were later withdrawn during the study period and were not included in the analyses. Overall, participants had a mean age of 49.7 ± 9.2 years and baseline BMI of 36.2 ± 5.5 kg/m² (table 12).

Participants randomized to BWL received group-based BWL treatment for 48 weeks, weight, dietary and physical activity goals. The goal was to lose 1-2 pounds/week, which equated to a total weight loss of 10%. To achieve this goal, a structured protocol was followed for treatment. They met in closed-groups for approximately 15 to 60 minutes once a week for the first 24 weeks then every other week for the following 24 weeks; self-monitoring, goal setting, problem solving, stimulus control and relapse prevention were stressed throughout the 48 weeks. For those ≤ 250 pounds, their set dietary goal was 1,200-1,500 kcal/day; for those ≥ 250 pounds, their set dietary goal was 1,500-1,800 kcal/day with no more than 25% of total daily calories coming from fat for all participants. The physical activity goal was to get up to 200 minutes per week by gradually increasing the activity. In addition, participants kept journals, which were reviewed every week, to record daily food intake, calories and fat and physical activity.

WW is a behavior oriented weight loss program. Within this program, participants were given a food plan, an activity plan, a behavior modification plan that uses cognitive restructuring, and group support. Participants randomized to WW received vouchers to attend WW meetings, which lasted 30-45 minutes in an open-group setting for 48 weeks free of charge; they were able to choose the location and time of said meetings for their convenience, because they were instructed to attend weekly meetings in order to fulfill WW program requirements. Before each meeting, they were weighed in a confidential setting. The meetings were led by a WW Lifetime Member, who has achieved and maintained a BMI of 20-25 kg/m². In addition to the meetings, participants had access to eTools, a supplemental online resource that includes a system for tracking food and activity points and weight, recipe ideas and shopping lists, online discussion boards and articles with weight-related topics. The participants were told not to reveal that they were participating in a research study to the WW staff.

Participants randomized to CT attended 12 weeks of BWL followed by 36 weeks of WW. Like the participants in just the BWL group, these people met in weekly closed-groups for approximately 15 to 60-minutes. Because the time frame for BWL was cut by two-thirds, the CT portion of BWL included only the key behavioral strategies for weight loss, but it still included the same dietary, physical activity and weight loss goals as just BWL. Between group sessions, they were also instructed to keep journals recording daily food intake, calories and fat and physical activity. The final two sessions of the BWL portion of CT was designated for transition into WW, which included a discussion of the similarities and differences between the two approaches of weight loss and an orientation to WW website. Like the participants allocated to the WW only group, participants randomized to CT received vouchers to attend meetings free of charge, access to the eTools online resources for the remaining 36 weeks and were told not to reveal that they were participating in a research study to the WW staff.

The primary outcome was weight change at 24 and 48 weeks. To measure weight, participants remained in their street clothes but were asked to remove their shoes. Their weight was then measured using a calibrated scale called the Tanita, BWB-800. Participant BMI was then computed based upon the initial height measurement that was taken at their screening visit. Linear mixed model analyses were conducted using the Proc MIXED procedure to analyze the effects of treatment across time on weight change. Linear mixed-effects models are extensions of linear regression models. The difference between the two is a mixed-effects model consists of two parts, fixed effects (seen in Study #1) and random effects. The random effects are additional unknown random variables that are assumed to impact the variability of the data (i.e. age, starting weight, gender, etc.); therefore, the mixed-effects model groups data by associating the common random effects to those who have lost a specific amount of weight in a certain period of time, for example. The Proc MIXED procedure fits a variety of these mixed linear

models to data and enables one to use fitted models to make statistical inferences about the data; thus allowing one to model variances and covariances, such as the random effects examples listed above. To analyze the percentage of participants that achieved a 5% or 10% weight loss at 24- and 48-week assessments, Proc GENMOD was used to conduct logistic regression analyses to examine the differences between each treatment group. Logistic regression is a regression model where the dependent variable is categorical, in this case it was BWL, WW and CT. The logistic regression analysis allows one to measure the relationship between the categorical dependent variable and one or more independent variable by estimating probabilities (i.e. what is the *probability* an individual allocated to CT will have a 15% weight loss after 48 weeks).

The secondary outcomes were meeting attendance, daily kilocalories consumed and weekly kilocalorie expended through physical activity at 24 and 48 weeks. Meeting attendance for the BWL group was observed and recorded at each group meeting. Those participating in WW had a program weigh-in booklet that was mandatory for them to bring to each meeting; therefore, at each assessment visit their books were collected to observe attendance. Meeting attendance was also obtained from self-reporting for those WW participants who lost their attendance book; attendance for non-completers was assumed to be 0. Proc MIXED procedure was used to examine group differences across time in percentage of meetings attended within the 0-24 and 25-28 week periods. The Block Food Frequency Questionnaire, which was modified for a 3-month timeframe, was used to measure total daily energy intake in kilocalorie. The Paffenbarger Activity Questionnaire was used to assess physical activity by estimating the amount of kilocalories expended per week. Linear mixed model analyses were conducted using the Proc MIXED procedure to analyze the effects of treatment across time on energy (kcal) intake and energy (kcal) expended through physical activity. Raw values were used to analyze and interpret both energy (kcal) intake and expended through physical activity, because they were not normally distributed.

Use of eTools in the WW and CT groups along with treatment-related costs were also assessed. Frequency of eTools use was analyzed using chi square at each assessment visit via self-reported data from WW participants. Costs of staff time required to deliver BWL treatment and cost of BWL treatment materials were computed for the 48-week BWL program and the 12-week BWL component of the CT program; research-related costs were not included.

Study Results

Overall retention was 93% at 12 weeks, 90% at 24 weeks and 80% at 48 weeks. At 12 and 24 weeks, the retention was lower for BWL compared with WW (85% vs. 98%, $P = 0.021$ and 80% vs. 94%, $P = 0.049$). When compared to CT at 24 weeks, the retention rate was also lower for BWL (80% vs. 96%, $P = 0.024$); no other differences were found in retention rate. Based on baseline characteristics, study completers did not differ from non-completers.

All groups achieved statistically significant weight loss from baseline at 12 weeks with an average weight loss of 4.2 kg, 24 weeks with 5.4 kg and 48 weeks with 5.0 kg. A significant treatment group by time interaction for weight loss showed that the WW group achieved greater weight loss at 48 weeks with an average of 6.0 kg than the CT group with an average of 3.6 kg. Table 5 contains the values for average weight loss from baseline to 12-, 24- and 48-weeks within each treatment group. There were no significant differences for the percent of participants who achieved a 5% weight loss. By week 48, there was a significant difference between participants who lost at least 10% of their starting weight: WW had the greatest percentage with 36.7% compared to BWL with 13.0% and CT with 15.2%. See table 6 for the percentage of participants who achieved 5% and 10% weight loss at 24- and 48-weeks.

Table 5: Average weight loss from baseline with each treatment group (Pinto et al.)¹⁷

| Variable | Group | 12 Weeks | 24 Weeks | 48 Weeks |
|------------------|-------|------------------|------------------|------------------|
| Weight loss (kg) | BWL | 4.8 (4.0 to 5.6) | 6.0 (5.2 to 6.8) | 5.4 (4.6 to 6.2) |
| | WW | 3.8 (3.1 to 4.5) | 5.1 (4.4 to 5.8) | 6.0 (5.2 to 6.8) |
| | CT | 3.9 (3.1 to 4.7) | 4.9 (4.1 to 5.7) | 3.6 (2.8 to 4.4) |

Table 6: Percent of participants achieving 5% and 10% weight loss (Pinto et al.)¹⁷

| | 24 Weeks | | 48 Weeks | |
|-----|----------|------|----------|---------------------|
| | ≥5% | ≥10% | ≥5% | ≥10% |
| BWL | 47.8 | 10.9 | 41.3 | 13.0 |
| WW | 40.8 | 24.5 | 51.0 | 36.7 ^{a,b} |
| CT | 41.3 | 19.6 | 32.6 | 15.2 |

a WW vs. BWL, $p = 0.01$

b WW vs. CT, $p = 0.02$

There were no significant differences in meeting attendance across groups during the first 24 weeks of treatment with an overall mean percent of sessions attended being 62%. From weeks 25 to 48, the mean WW meeting attendance was greater in the WW group (43% of sessions) than in the CT group (28% of sessions). There were no other significant treatment group differences. It was noted, though, that the percent of treatment meetings attended was lower in the second half of the program compared to the first half across all treatment groups.

At 12, 24 and 48 weeks, the daily energy (kcal) intake was significantly reduced from baseline with a mean loss of 524 kcal/day, 509 kcal/day and 479 kcal/day. There were no further changes in energy (kcal) intake across time, and the interaction was not significant. There was a significant increase in weekly energy expenditure (kcal) through physical activity at 12 weeks with a mean of 603 kcal/week, at 24 weeks with 612 kcal/week and at 48 weeks with 275 kcal/week. However, changes in physical activity declined at the end of treatment. Time had no significant impact on the change in energy expenditure across treatment groups.

Between baseline and week 12, 59% of WW group used the online eTools resources at least once a week. Between weeks 13 and 24, 47% of the WW participants used the eTools at least once a week compared to only 24% of the CT participants. Between weeks 25-48, there was no group differences. No relationship was found between the use of eTools and amount of weight loss.

The estimated cost of delivering the 48-week BWL program was \$433.67 per participant (\$12.05 per participant/session); whereas the estimated cost of delivering the 12-week component of the CT program was \$165.04 per participant (\$13.75 per participant/session).

Study Critique

Strengths

The introduction was very strong and supported the reasons for creating a novel treatment combining BWL and WW. Descriptions of BWL and WW were informative and thorough, as was the plan on when and what was going to be measured throughout the experiment. The screening process was rigorous, which included three steps before being assigned to treatment groups. Due to the rigorous screening process, individuals not serious about losing weight dropped-out before the study began; therefore, leading to the high retention rates presented in the study. Both BWL and WW had the same weight loss goal of 1-2 pounds/week, which allowed for the groups to be compared without bias. Duration of follow-up was very sufficient. Because the patients were evaluated after 12- and 24-week stints, this allowed for researchers not only to compile weight loss statistics, but it conditioned the

participants to this healthy lifestyle longer to prevent relapse into their old habits. The inclusion of study costs for the 48-week BWL program, and the 12-week component of the CT program was a strength, because it may have showed some that weight-loss can be affordable.

Weaknesses

The patient sample was not clearly defined. The study lacked specific inclusion criteria such as comorbidities related to obesity (i.e. diabetes, controlled hypertension, dyslipidemia), waist circumference, family history of diabetes, etc.). Race and ethnicity were not broken down, instead only non-white and Hispanics were represented; therefore, it is unknown who specifically this study may benefit. Also, the participants were recruited from the New York City Metropolitan area, but no specific area was named; therefore, it is unknown whether the participants came from an area of poor socioeconomic status or the upper class. The sample size was small leading to limited power to test all effects. The male gender was poorly represented; therefore, introducing gender bias with 90% of the participants being female. Because this study only examined WW commercial program, the results of this study can not be extended to other commercial programs available to the public. BWL group meetings were held by the principal investigator of this study, and she was being paid for these group meetings; therefore, this possibly introduced bias. Participants received \$20 for completing assessment visits, which also possibly introduced bias. With CT, the BWL segment contained the same curriculum as that of the 48 week BWL alone treatment; therefore, the curriculum was more condensed, which does not allow for adequate comparison between the two groups.

Study #3

Comparison of range of commercial or primary care led weight reduction programmes with minimal intervention control for weight loss in obesity: Lighten Up randomized controlled trial, Jolly et al.¹⁸

Objective: Compared four different commercial weight loss programs in the UK to primary care interventions for 3 months with follow up at 1 year for effective weight loss and weight loss maintenance.

Study design

This was a randomized control study of 740 patients recruited from 17 private clinics by referral from their general practitioner in the United Kingdom for participation in a three month weight loss program with follow up at one year. Inclusion and exclusion criteria are outlined in table 7. Recruitment took place from January to May 2009. 8810 Invitation letters to participate in the trial were sent from their general practitioner to qualifying individuals. 7799 did not respond and 271 additional participants were either part of a pilot study or joined after the end of recruitment but were not included in this study.

Table 7: Inclusion and Exclusion Criteria for Jolly et al.¹⁸

| INCLUSION CRITERIA | EXCLUSION CRITERIA |
|--|--|
| <ul style="list-style-type: none"> • Age ≥ 18 years • Raised BMI in their primary care notes within the last 15 months according to the following criteria: <ul style="list-style-type: none"> ▪ White Europeans and all ethnic groups apart from South Asians with no comorbidities and BMI ≥ 30 ▪ White Europeans and all ethnic groups apart from South Asians with comorbidities and BMI ≥ 28 ▪ South Asians with no comorbidities and BMI ≥ 25 ▪ South Asian with comorbidities and BMI ≥ 23 | <ul style="list-style-type: none"> • Unable to understand English • Medical contraindication • Pregnant |

* BMI = body mass index

The 740 participants were randomized to 8 different interventions: Weight Watchers (WW), Slimming World, Rosemary Conley, National Health Service (NHS) Size Down program, general practice, pharmacy, control, and choice. Weight Watchers, Slimming World, and Rosemary Conley (n=100 each) are commercially available programs and participants were given free vouchers to enroll and followed guidance in accordance with the respective organization. Trial participants attended alongside non-trial members but there is no mention of whether program leaders were aware of their participation in a research trial.

The Size Down program by NHS, the publically funded healthcare system of the UK, (n=100) is a group based program led by food advisers recruited from the local community and trained by the dietetics department. Participants attended 6 weekly sessions at local community venues with follow up weighing sessions at 9 and 12 weeks.

Participants randomized to the general practice or pharmacy groups (n=70 each) attended 12 one-on-one sessions in the general practice or pharmacy. The first appointment was scheduled for 30 minutes with each follow up appointment scheduled for 15-20 minutes. Staff delivering these programs had a 3 day training course on weight management in adults by dietitians experienced in obesity management.

The control group (n=100) received 12 free passes to a local gym and were not given any advice or counseling on weight loss. The choice group (n=100) was able to choose any of the above mentioned interventions.

Baseline height and weight were collected at the first session of their weight loss program or at the gym. Some commercial programs collected self-reported heights; height was remeasured using a Seca Leicester portable height measure at the one year follow up. A call center collected baseline data on demographics, current physical activity levels using the International Physical Activity Questionnaire-short form (IPAQ-short) and use of any weight loss drugs.

Primary outcome measured was weight loss at 3 months follow up at the end of each weight loss program. Participants were reweighed at their respective programs. If they were no longer attending their programs, they were contacted to schedule a follow-up at home or another convenient location. If declined, a self-reported weight was recorded. Secondary outcomes measured were changes in self-reported physical activity at three months and one year and weight loss at one year.

IPAQ-short was readministered by phone to all participants at three months. A blinded trained practice nurse, health trainer or researcher did a one-year assessment at the participant's home or general practice. The participant's height and weight were recorded in addition to the IPAQ-short and a questionnaire on their opinion of the weight loss program and whether they tried any other weight loss programs or strategies over the course of the year.

Statistical analysis was done with intention to treat and using STAT v11.0 and SPSS v17.0. If weight at follow up was not available, the baseline weight was used for primary analysis. A sensitivity analysis was also done using the last recorded weight as the follow-up weight.

A least squares linear regression was used on outcomes measured on a continuous scale (weight loss, physical activity). Linear regression is often used to model the effects of a dependent value vs an independent value (in this case, time). Using least squares in the regression increases the accuracy of the approximation if the relationship is not linear though it may disproportionately exaggerate outlying points due to the squared offset. In this study, a least squares linear regression was most appropriate to plot the nonlinear relationship between time and outcomes measured. To adjust for multiple analyses, a Bonferroni correction was applied to maintain a 5% type I error rate across the seven comparisons. The effect of choice was analyzed using a regression model that compared choice vs randomized against the control and also choosing a specific program vs randomized to the same program. They also examined whether any interaction existed between individual programs and choice. Finally a subgroup analysis was done on weight loss in men vs women using a least squares linear regression model, as above, with the group to which they were allocated and age as covariates.

Study Results

At three months, 587 (79.3%) participants were weighed for weight loss with 233 (39.7%) self-reported weights. All groups achieved statistically significant weight loss from baseline with average weight loss ranging from 4.4 kg (Weight Watchers) to 1.4 kg (general practice). Only Weight Watchers and Rosemary Conley groups achieved statistically significant weight loss and percentage weight loss greater than the exercise only control group. These results did not differ when adjusted for baseline weight, age, sex or ethnicity (table 8).

At one year, 503 (68%) participants followed up and were reweighed with 87 (17.3%) self-reported. Statistically significant weight loss from baseline occurred in all commercial program participants (Weight Watchers, Slimming World, Rosemary Conley, Size Down) but not in any of the primary care groups (general practice, pharmacy). The Weight Watchers group had an average weight loss of 3.46 kg while general practice and pharmacy had an average of 0.83 kg and 0.66 kg respectively. Only the Weight Watchers group achieved statistically significant weight loss and percentage weight loss greater than the exercise only control group. These findings did not differ in the sensitivity analyses using the last recorded weight instead of baseline carried forward weight for participants who did not follow up (table 8).

BMI reduction at one year followed a similar trend as weight loss, with all commercial programs having a statistically significant decrease from baseline. Weight watchers had the greatest decrease at 1.17 while general practice and pharmacy had the smallest decreases at 0.32 and 0.31. No analysis is available comparing against the control group for statistical significance (table 8).

Table 8: Mean weight loss and body mass index reduction at program end and one year follow up (Jolly et al)¹⁸

| | Weight Watchers | Slimming World | Rosemary Conley | Size Down | General Practice | Pharmacy | Choice | Exercise (control) |
|---|-----------------------|-----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|------------------------|
| Weight loss at program end (kg) | | | | | | | | |
| BOCF | 4.43 (3.6 - 5.3)** | 3.56 (2.7 - 4.4)** | 4.23 (3.2 - 5.2)** | 2.38 (1.7 - 3.1)** | 1.37 (0.4 - 2.3)* | 2.11 (1.0 - 3.2)** | 3.32 (2.5 - 4.1)** | 2.01 (1.2 - 2.8)** |
| LOCF | 4.71 (3.9 - 5.6)** | 3.76 (2.9 - 4.6)** | 4.37 (3.4 - 5.4)** | 2.37 (1.7 - 3.1)** | 1.13 (0.0 - 2.3) | 2.14 (1.0 - 3.2)** | 3.56 (2.8 - 4.3)** | 1.87 (1.0 - 2.78)** |
| Weight loss at one year follow up (kg) | | | | | | | | |
| BOCF | 3.46 (2.1 - 4.8)** | 1.89 (0.9 - 2.9)** | 2.12 (0.9 - 3.4)** | 2.45 (1.3 - 3.6)** | 0.83 (-0.4 - 2.0) | 0.66 (-0.4 - 1.7) | 2.15 (0.9 - 3.4)** | 1.08 (0.1 - 2.1)* |
| LOCF | 4.35 (3.0 - 5.7)** | 3.28 (2.2 - 4.4)** | 3.17 (1.8 - 4.5)** | 3.10 (1.9 - 4.3)** | 1.13 (-0.1 - 2.4) | 1.85 (0.5 - 3.2)* | 2.96 (1.7 - 4.3)** | 1.33 (0.2 - 2.4)* |
| BMI reduction at one year (kg/m²) | | | | | | | | |
| BOCF | 1.17 (0.7 - 1.7)** | 0.71 (0.4 - 1.0)** | 0.75 (0.3 - 1.1)** | 0.67 (0.3 - 1.0)** | 0.32 (-0.1 - 0.7) | 0.31 (0.0 - 0.7) | 0.90 (0.5 - 1.3)** | 0.45 (0.1 - 0.8)* |

Values are means (95% confidence interval)

BMI=body mass index; BOCF = baseline observation carried forward; LOCF = last observation carried forward

*P<0.05 (paired t test from baseline)

**P≤0.001 (paired t test from baseline)

Among the participants randomized to the choice group, no statistically significant difference in weight loss achieved at program end or at one year follow up was found compared against the participants that were randomized to the same program. 71 participants chose one of the commercial providers, 3 chose general practice, and 10 chose pharmacy. Women were more likely than men to choose one of the commercial providers (81% vs 47%).

In a secondary analysis comparing commercial programs to primary care programs, participants in the commercial program groups lost 2.3kg (P=0.004) more than those allocated to primary care at program end at 3 months. At one year, the difference was 1.7kg (P=0.02).

Self-reported physical activity was statistically significantly increased between baseline and follow-up at three months and one year in all groups. None of the groups had statistically significant increase compared to the control. The increase in activity ranged from 2048 kcal/week and 60 minutes/week (Weight Watchers) to 861 kcal/week and 14 minutes/week (general practice).

The pharmacy and general practice groups were found to have the lowest attendance rates, with 54% and 44% attending less than 25% of sessions. Weight watchers and choice groups had the highest attendance rates, with 70% and 74% attending more than 50% of sessions.

Study Critique

Strengths

The patient sample was large (n=740) and was clearly defined with many demographics analyzed for covariance including gender, age, and ethnicity. This study also examined the mean index of multiple deprivation, a UK qualitative index, that takes into account socioeconomic factors including income, employment, health deprivation and disability, education skills and training, barriers to housing and services, crime, and living environment²⁰ which was not done in other similar studies.

Participants were selected via referral from their general practitioner which generates a less bias group of participants than self-referral from flyers, etc. However the response rate to invitation was only 11.5% and is likely that the most motivated people responded and therefore not reflective of the general population.

The duration of follow-up is another strength of this study. While the weight loss intervention only lasted 3 months, the results at 1 year follow up was significant to examine the impact of different

weight loss programs on long term weight loss. Attrition rate was 11.1% at 3 months and 29.5% at 1 year which is fairly low relative to other similar studies. The study authors attributed the low attrition rate to having only two follow up appointments and was part of their intention when designing the study. Participants lost to follow tend to be younger which is consistent with other similar studies.

Weaknesses

The study was performed in the UK with predominantly British/Irish participants which does not reflect the population seen in the United States. Also, the inclusion criteria based off of NHS criteria for primary care obesity management services is not applicable to the US population since the NHS exists only in the UK. The participants were also predominantly female but this is a common flaw in studies examining weight loss with commercial programs. Surprisingly, weight loss drug use was not part of the exclusion criteria and no analysis or comment was included in the discussion portion of the publication addressing its possible effect.

Providers in the intervention programs were not blinded to study participants since they had to provide data including weight measurements to the researchers. While a double blind is not feasible in this type of study, a single blind on researchers and providers is done in other studies. Leaving the providers unblinded introduces a possible bias.

One weakness in this study is uneven level of interaction with participants across different programs. Primary care practices had a noticeably lower interaction with participants, with only 30 minutes for the first appointment and 15-20 minutes for each follow up compared with commercial programs which ranges from 1 hour to 1.5 hours weekly. In addition, the counseling provided by the pharmacy group was delivered by staff that had attended a three day training course compared to seasoned counselors in the commercial programs that do this regularly as their job.

While the study had 740 participants, each intervention group only had 70-100 participants. The number of interventions compared in this study is a strength but at the cost of reducing the power of the study. In addition, due to cost, the primary care intervention groups were further reduced in size to only 70 participants.

Another weakness is that weight measurements at each follow up were not done by researchers but by the intervention program which may add a degree of a bias especially since the weight loss program is not blinded. In addition, 40% of the measurements were self-reported by the participants if follow up measurements were not available which introduces variables such as over or underreporting their weight, non-calibrated scales, the scales used are different from the ones used at baseline, and the weighing conditions may be different (clothed, unclothed, shoes, etc).

Study #4

Effect of a free prepared meal and incentivized weight loss program on weight loss and weight loss maintenance in obese and overweight women: a randomized controlled trial, Rock et al.¹⁹

Objective: Compared the effectiveness of a free meal replacement weight loss program (Jenny Craig) to standard primary care intervention on weight loss over two years.

Study Design

This was a randomized control study of 446 female participants at 4 study sites over 2 years (University of California, San Diego; University of Arizona, Tucson; University of Minnesota, Minneapolis; Center for Health Research, Kaiser Permanente Center Northwest, Portland, Oregon). Participants were recruited using list serves and flyers distributed by research staff at each site. Inclusion and exclusion criteria are listed in table 9.

Table 9: Inclusion and Exclusion Criteria for Rock et al.¹⁹

| INCLUSION CRITERIA | EXCLUSION CRITERIA |
|--|---|
| <ul style="list-style-type: none"> • Age ≥18 years • Female • BMI 25-40 • Minimum of 15kg over ideal weight as defined by the 1983 Metropolitan Life Insurance tables • Willing to participate in any of the 3 study groups • Willing and able to perform a simple step test for assessing cardiopulmonary fitness | <ul style="list-style-type: none"> • Pregnant or planning to be pregnant in the next 2 years • Eating disorders, food allergies or intolerances • Current active involvement in another diet intervention study or organized weight program • History or presence of a significant psychiatric disorder or any other condition that in the investigator’s judgment would interfere with participation |

564 women were recruited between November 2007 and March 2008 with 118 excluded because they did not meet the criteria. 446 were randomized to three different interventions: center-based commercial program (n=169), telephone-based commercial program (n=164), and usual care group (n=113). Randomization was done using a web-based data application run at each clinical site by research staff. Four participants were found to be ineligible post-randomization due to vegan diet (n=1) and refusal to participate (n=2). Participants were compensated \$25 for each completed clinic visit every 6 months but no reimbursement was provided for counseling sessions.

The center-based and phone-based commercial program received all program materials and free prepackaged prepared foods as part of the Jenny Craig program with weekly one-on-one sessions in-person or over the phone with telephone and e-mail contacts and web site or message board availability. Counselors were not blinded to the identity of study participants.

Usual care participants were provided a 1 hour consultation at baseline with a research staff dietetics professional who provided publicly available print material that described dietary and physical activity guidelines. Participants were provided with an energy intake level to achieve a weight loss of 10% over a 6-month period and followed up with a monthly check-in via email or phone. A follow up 1 hour consultation session at 6 months discussed further strategies and progress.

Primary outcomes measured were weight loss and weight loss maintenance. Height, weight, and waist circumference were measured at baseline and every 6 months for 2 years by un-blinded research staff. Secondary outcomes measured include responses to questionnaires (Beck Depression Inventory, Short Form 36 Quality of Life Questionnaire, and the Eating Disorder Examination Questionnaire), a 3-minute step test, and laboratory measurements including C-reactive protein, leptin, lipid panel, and total carotenoids. The questionnaires assessed quality of life and eating attitudes and behaviors. The 3 minute step test assessed aerobic fitness. C-reactive protein is used as a marker for inflammation, leptin is a marker of satiety, lipid panel is used to assess cholesterol levels, and total carotenoids is a biomarker of intake of fruits and vegetables.

Statistical analysis of anthropometric data was conducted as intention to treat with baseline value substitution if follow up data was unavailable. All analyses were conducted using SAS version 9.2.

Study Results

Participants in the center-based Jenny Craig group lost an average of 10.1kg or 10.9% of initial weight at 12 months and maintained an average weight loss of 7.4 kg or 7.9% of initial weight at 24 months. Participants in the phone-based Jenny Craig group lost an average of 8.5kg or 9.2% of initial weight at 12 months and maintained an average weight loss of 6.2kg or 6.8% weight loss at 24 months. Participants in the usual care group lost an average of 2.4kg or 2.6% of initial weight at 12 months and

maintained an average weight loss of 2.0kg or 2.1% weight loss at 24 months with $P < 0.001$ compared with the intervention groups. 62% of center-based and 56% of phone-based participants had a weight loss of at least 5% at 2 years compared with 29% of usual care participants ($P < 0.001$) (table 10)

Table 10: Mean weight loss, BMI, and waist circumference change (Rock et al.¹⁹)

| | Baseline | 6 months | 12 months | 24 months |
|----------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| Center-based Intervention | | | | |
| Weight, kg | 92.2 (90.7 to 93.7) | 83.0 (81.4 to 84.5) | 82.1 (81.3 to 84.6) | 84.8 (83.0 to 86.5) |
| WC, kg | | -9.2 (-9.9 to -8.4) | -10.1 (-11.2 to -9.0) | -7.4 (-8.7 to -6.1) |
| BMI | 33.8 (33.3 to 34.4) | 30.5 (29.9 to 31.0) | 30.2 (29.6 to 30.8) | 31.2 (30.5 to 31.8) |
| Waist, cm | 108.9 (107.6 to 110.3) | 99.6 (98.2 to 101.0) | 98.0 (96.5 to 99.5) | 101.5 (100.0 to 103.0) |
| Phone-based Intervention | | | | |
| Weight, kg | 92.9 (91.1 to 94.7) | 84.6 (82.8 to 86.4) | 84.4 (82.3 to 86.5) | 86.6 (84.4 to 88.9) |
| WC, kg | | -8.3 (-9.1 to -7.5) | -8.5 (-9.7 to -7.2) | -6.2 (-7.6 to -4.9) |
| BMI | 33.8 (33.3 to 34.3) | 30.8 (30.3 to 31.4) | 30.7 (30.1 to 31.4) | 31.5 (30.4 to 32.2) |
| Waist, cm | 108.5 (106.9 to 110.0) | 100.0 (97.5 to 101.4) | 99.9 (98.5 to 101.6) | 102.0 (100.0 to 103.9) |
| Usual Care | | | | |
| Weight, kg | 91.0 (89.0 to 92.9) | 88.1 (86.0 to 90.2) | 88.5 (86.3 to 90.8) | 89.0 (86.7 to 91.3) |
| WC, kg | | -2.9 (-3.8 to -2.0) | -2.4 (-3.6 to -1.2) | -2.0 (-3.3 to -0.6) |
| BMI | 34.0 (33.4 to 34.6) | 32.9 (32.2 to 33.6) | 33.2 (32.4 to 33.9) | 33.4 (32.5 to 34.2) |
| Waist, cm | 108.3 (106.6 to 110.0) | 104.0 (102.3 to 105.7) | 103.2 (101.4 to 105.0) | 103.7 (101.9 to 105.6) |

Intention to treat analysis

BMI = body mass index; WC = weight change

Table 11: Cardiopulmonary fitness and psychosocial and laboratory measures (Rock et al.¹⁹)

| | Center-based | | | | Phone-based | | | | Usual Care | | | |
|------------------------------------|--------------|---------------|---------------|--------------|-------------|---------------|---------------|--------------|-------------|---------------|--------------|---------------|
| | Baseline | 6 months | 12 months | 24 months | Baseline | 6 months | 12 months | 24 months | Baseline | 6 months | 12 months | 24 months |
| Step test: | 53 | 47 | 47 | 48 | 55 | 48 | 49 | 49 | 54 | 49 | 49 | 50 |
| Heart rate, per 30s | (52-55) | (46-48) | (46-49) | (47-49) | (53-56) | (47-50) | (48-50) | (47-50) | (53-56) | (47-50)** | (47-51)** | (48-52)** |
| Psychosocial measures | | | | | | | | | | | | |
| SF-36 Physical QOL | 84 | 88 | 88 | 85 | 84 | 85 | 84 | 83 | 85 | 83 | 82 | 82 |
| | (82-86) | (86-90)* | (86-90)* | (82-87) | (82-87) | (82-87)* | (82-87)* | (80-86) | (82-87) | (80-86) | (80-85) | (79-85) |
| SF-36 Mental QOL | 80 | 82 | 83 | 79 | 77 | 81 | 76 | 75 | 81 | 79 | 78 | 78 |
| | (78-82) | (80-85)* | (80-85)* | (77-82) | (75-80) | (78-83)* | (73-79)* | (72-79) | (78-83) | (76-82) | (74-81)* | (74-81) |
| Eating Disorder Examination | 2.3 | 2.2 | 2.0 | 2.0 | 2.4 | 2.3 | 2.2 | 2.2 | 2.4 | 2.4 | 2.1 | 2.1 |
| | (2.1-2.4) | (2.1-2.3) | (2.1-2.3) | (1.9-2.2) | (2.2-2.5) | (2.1-2.4) | (2.1-2.4) | (2.0-2.3) | (2.2-2.5) | (2.2-2.6) | (2.0-2.3) | (1.9-2.3)* |
| Beck Depression Inventory | 6.6 | 4.3 | 4.6 | 5.4 | 6.6 | 4.9 | 6.1 | 7.0 | 5.7 | 6.0 | 6.0 | 6.1 |
| | (5.6-7.5) | (3.5-5.1)** | (3.7-5.5)* | (4.3-6.4) | (5.7-7.5) | (4.0-5.8)** | (4.5-7.5)* | (5.7-8.3) | (4.7-6.7) | (4.6-7.5) | (4.5-7.5) | (4.6-7.5) |
| Laboratory measures | | | | | | | | | | | | |
| Total cholesterol, mg/dL | 195 | 187 | 189 | 185 | 194 | 186 | 188 | 181 | 200 | 196 | 192 | 186 |
| | (190-201) | (181-192) | (183-195) | (180-190) | (189-200) | (180-191) | (182-193) | (176-187) | (194-206) | (188-203) | (185-199)* | (176-195)** |
| LDL cholesterol, mg/dL | 117 | 120 | 111 | 116 | 114 | 119 | 119 | 110 | 122 | 127 | 114 | 114 |
| | (112-122) | (114-125) | (106-117) | (110-122) | (110-119) | (114-124) | (103-114) | (104-116) | (116-128) | (122-134) | (108-121)* | (105-122)* |
| HDL cholesterol, mg/dL | 56 | 46 | 57 | 53 | 57 | 45 | 59 | 55 | 54 | 47 | 55 | 51 |
| | (54-59) | (44-48)* | (54-59) | (51-56) | (55-60) | (43-47)* | (56-61) | (53-57) | (51-56) | (44-49)** | (52-58) | (48-54)* |
| Triglycerides, mg/dL | 107 | 106 | 104 | 112 | 112 | 106 | 103 | 119 | 118 | 108 | 114 | 121 |
| | (101-114) | (97-115) | (97-112) | (103-120) | (108-129) | (98-115) | (93-113) | (96-141) | (108-129) | (97-119) | (104-124) | (110-133) |
| Leptin, ng/mL | 37.9 | 23.3 | 23.8 | 28.4 | 38.8 | 24.7 | 26.1 | 30.7 | 37.3 | 31.7 | 32.9 | 32.7 |
| | (35.5-40.3) | (21.4-25.2)** | (21.6-26.0)** | (25.7-31.1)* | (36.2-41.4) | (22.5-26.9)** | (23.5-28.5)** | (27.8-33.6)* | (34.3-40.1) | (28.7-34.7)** | (29.4-36.4)* | (29.3-36.1)** |
| C-reactive protein, mg/L | 3.0 | 2.3 | 1.8 | 2.1 | 3.3 | 2.4 | 1.8 | 1.8 | 2.5 | 2.8 | 2.5 | 2.4 |
| | (1.7-5.9) | (1.2-4.1) | (0.9-4.0)** | (1.0-4.1)** | (2.0-5.2) | (1.4-4.7) | (1.0-3.8)** | (1.0-3.7)** | (1.4-5.7) | (1.1-4.7) | (1.3-5.0) | (1.1-5.7) |

HDL = high-density lipoprotein; LDL = low-density lipoprotein; QOL = quality of life

Values are expressed as mean (95% confidence interval)

*P<0.05

**P≤0.001

All three groups showed improvement in cardiopulmonary fitness assessed using the 3 step test but there was no statistically significant difference between control and interventions. Both intervention groups had statistically significant improvement in physical (86 vs 82; $P = 0.007$) and mental (79 vs 78; $P=0.04$) quality of life at 12 months vs. control. The Eating Disorder Examination Questionnaire scores improved in all three groups but there was no statistically significant difference between control and interventions. Depression scores were statistically significantly improved in intervention groups compared to control at 12 months but not at 24 months (table 11).

At 2 years, CRP levels were lower in the intervention groups (1.9 mg/L) vs control group (2.4 mg/L; $P=0.003$). Total plasma carotenoids increased in the intervention groups (2.1 umol/L) vs control group (1.8 umol/L; $P<0.001$). Total cholesterol levels decreased in all groups but were not statistically significant between groups. Leptin concentrations decreased in the intervention groups (29.5 ng/mL) vs control (32.7 ng/mL; $P=0.02$) (table 11).

There were no observed differences in baseline characteristics across the study groups.

Study Critique

Strengths

The sample groups were clearly defined and represented a diverse range of ethnicities, and educational backgrounds. The study takes place at four different sites around the United States and, with the large sample size of 442 participants, is a good representation of the general American population.

Other strengths of this study include the length of study (2 years), large sample size ($n=442$), low attrition rate (7.9%) and large number of variables examined besides weight loss including physical and mental quality of life and laboratory markers.

Weaknesses

One major weakness is that this study included only female participants. The authors claimed that because men comprise the minority of enrollees in weight loss programs, they were not included in this study. However, this examines only half of the patient population seen in the primary care setting and does not provide a solution for male patients that require weight loss.

In addition, patients were self-referred into the study using flyers passed out on the streets by research staff. This tends to self-select for a highly motivated group of participants compared to participants referred from a primary care provider.

Part of the inclusion criteria for this study was based off of 1983 Metropolitan Life Insurance tables. This data is outdated given that people are now taller and heavier than they were in 1979 (needs reference). It has also been shown that ideal weight based on frame size calculated by width of distal humeral condyles has no published literature support.²¹ Information about comorbidities were also not obtained and may be a significant confounding variable in the data.

The frequency of counseling sessions was also vastly different between control and intervention groups. Control group participants met with a counselor at baseline and at 6 months for 1 hour time with monthly check-ins via email or phone. Intervention groups instead had weekly one-on-one sessions with the option of unlimited email and telephone contact. The additional interaction is likely a confounding variable in the effectiveness of the intervention approach.

In addition, all meals were provided for in the intervention groups while control groups had to cover the cost of their own food. The financial burden on the intervention group versus the control group is drastically different. As outlined in the publication, average weekly costs for food in the intervention groups is \$100 per week. This difference in cost was not accounted for in the control group.

The financial incentive to complete this research study is \$25 for each clinic visit plus, in the intervention groups, the cost of food for one year. This likely attributes to the low attrition rate in this

study but is not representative of reality thus yielding a higher compliance and better results in this study population. The socioeconomic status of the study participants was also not examined. Given the high financial incentive to participate in this study, the patient population may be skewed to a lower socioeconomic status and not representative of the general population, especially since participants were recruited using the self-referral method.

Also, counselors in the intervention group were not blinded to the identity of study participants which may influence the quality of service they provide to the participants. Research staff was also not blinded during the clinical visits where measurements were obtained and questionnaires were administered.

Finally, this study was funded by Jenny Craig and provided program activities, materials, and prepackaged foods. In addition, the primary author, Dr. Rock, served on the Jenny Craig advisory board from 2003-2004.

DISCUSSION

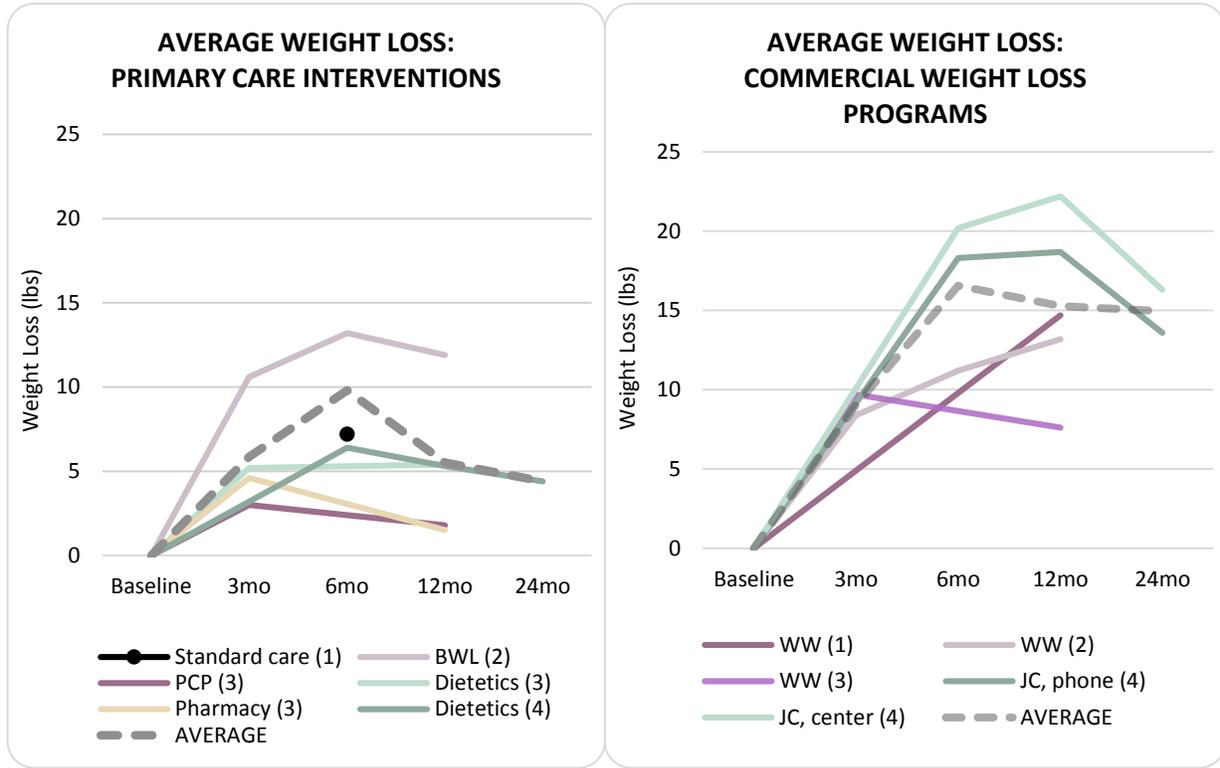
We examined four studies that compared commercial weight loss programs against different primary care interventions for most effective weight loss. Three studies compared Weight Watchers (Jebb et al, Pinto et al, Jolly et al) while the fourth compared Jenny Craig (Rock et al). An overview of the studies with baseline characteristics and interventions is provided (table 12). Across all four studies, participants in commercial weight loss programs consistently had statistically significant greater weight loss than participants in primary care interventions over 3 months, 6 months, 12 months, and 24 months (figure 2). Additionally, Jebb et al found participants from three different countries (UK, Germany, and Australia) in the commercial weight loss program achieved similar weight loss showing effectiveness across multiple countries although the US was not included in the study. Percent of participants in commercial weight loss programs who achieved 5% weight loss, a level correlated with significant medical health improvements, was also consistently higher than primary care interventions in all studies. Of note also is that only Weight Watchers interventions and a dietetics intervention had an increase in number of participants that achieved 5% weight loss between 3 months and 12 months while other interventions had no change or decreased (figure 3).

Table 12: Overview of studies

| | JEBB, ET AL. ¹⁶ | PINTO, ET AL. ¹⁷ | JOLLY, ET AL. ¹⁸ | ROCK, ET AL. ¹⁹ |
|-----------------------------------|--|---|--|---|
| ENROLLMENT METHOD | Screened by primary care provider and a member of the research team | Screened by phone and behavioral interview | Referral from private care practitioner | Self-selected from list serves and flyers |
| #PARTICIPANTS | 772 | 141 | 740 | 442 |
| AGE (YEARS) | 47.4 (34.5 - 60.3) | 49.7 (40.5 - 58.9) | 49.29 | 44.4 |
| BASELINE WEIGHT (LB) | 191.1 | 212.4 | 206 | 203 |
| BASELINE BMI (KG/M ²) | 31.4 (28.8 - 34.0) | 36.2 (30.7 - 41.7) | 33.62 | 33.8 (33.3 - 34.4) |
| DURATION OF STUDY | 12 months | 12 months | <ul style="list-style-type: none"> ▪ 3 months ▪ Follow up at 1 year | 24 months |
| INTERVENTIONS | <ul style="list-style-type: none"> ▪ Standard care, n=395 ▪ Weight Watchers, n=377 | <ul style="list-style-type: none"> ▪ Behavioral weight loss treatment, n=46 ▪ Weight Watchers, n=49 ▪ Combined therapy, n=46 | <ul style="list-style-type: none"> ▪ 12 gym passes, n=100 ▪ General practice, n=70 ▪ Pharmacy, n=70 ▪ Dietetics, n=100 ▪ Weight Watchers, n=100 ▪ Slimming World, n=100 ▪ Rosemary Conley, n=100 ▪ Choice, n=100 | <ul style="list-style-type: none"> ▪ Jenny Craig center-based, n=169 ▪ Jenny Craig telephone-based, n=164 ▪ Dietetics, n=113 |
| SOURCE OF FUNDING | Weight Watchers Int. | <ul style="list-style-type: none"> ▪ Weight Watchers Int. ▪ National Institute of Diabetes and Digestive and Kidney Diseases | NHS South Birmingham | Jenny Craig Inc. |

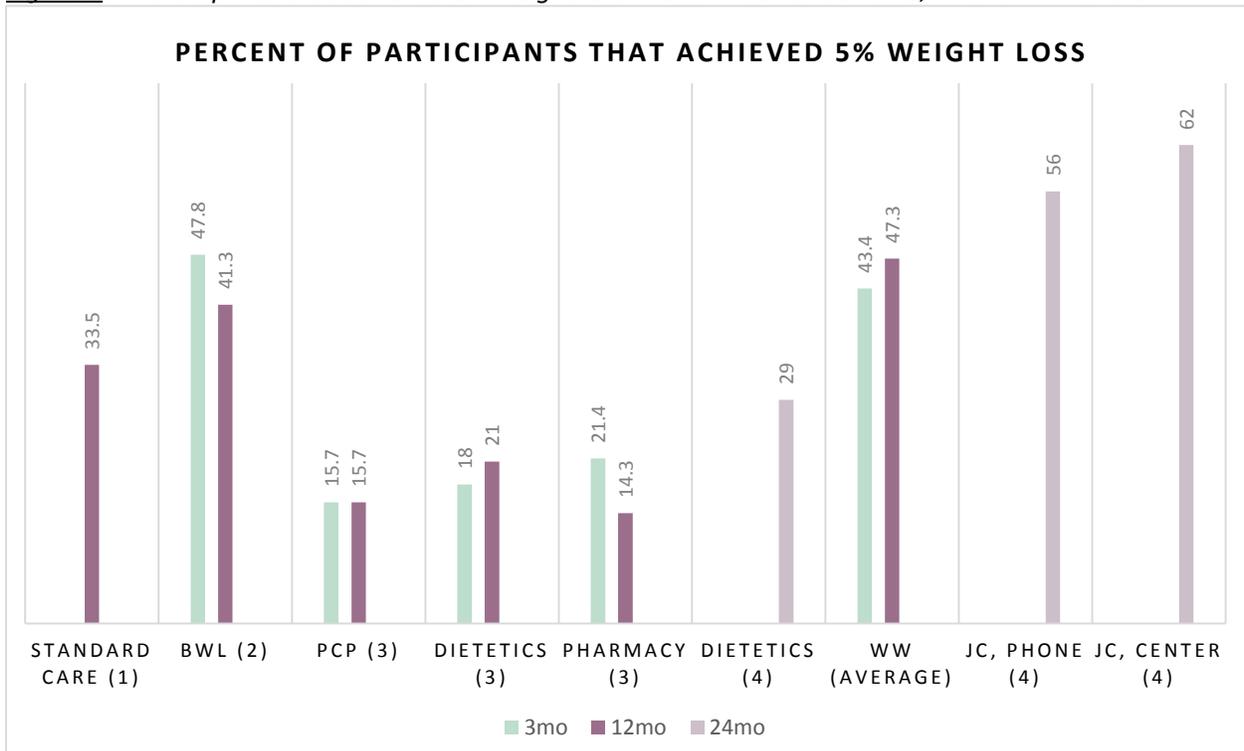
Values listed are means unless otherwise noted (95% confidence interval if available)

Figure 2: Average weight loss in primary care interventions and commercial weight loss programs



PCP = primary care providers; BWL = behavioral weight loss treatment; WW = weight watchers; JC = Jenny Craig

Figure 3: %Participants that achieved 5% weight loss in each intervention at 3, 12 and 24 months



PCP = primary care providers; BWL = behavioral weight loss treatment; WW = weight watchers; JC = Jenny Craig

Jebb et al and Rock et al also examined biomarkers of cardiovascular health. Jebb et al found participants in the commercial program had lower insulin, glucose, HbA1C, triglycerides, LDL, and increased HDL levels however only statistically significant decrease in total cholesterol to HDL ratio and improvements in insulin levels compared to primary care interventions. Rock et al found statistically significant lower C-reactive protein and leptin levels. Total cholesterol levels were also decreased more in the commercial weight loss groups but were not statistically significant. While improvements in many biomarkers were not statistically significant between the two studies, improvements were consistently seen in commercial weight loss programs vs primary care interventions.

Based on the percentage of participants that lost 5% weight in each intervention group, we calculated the number needed to treat (NNT) for 5% weight loss between commercial weight loss programs compared to primary care interventions. At 12 months, NNT ranged between 3.8 and 10.3, meaning 3.8 to 10.3 participants would need to be enrolled in Weight Watchers instead of primary care, pharmacy care, dietetics, or BWL in order for one additional participant to achieve 5% weight loss at 12 months. The lowest NNT was seen in Rock et al comparing Jenny Craig with dietetic counseling at 24 months, showing 3 participants would need to be treated by Jenny Craig program instead of dietetics in order for one additional participant to achieve 5% weight loss at 24 months (Table 13).

Table 13: Number Needed to Treat for 5% Weight Loss

| | |
|--|-------------------|
| WW vs BWL ¹⁷ | 14.3 at 3 months |
| WW vs standard care ¹⁶ | 3.8 at 12 months |
| WW vs pharmacy ¹⁸ | 6.0 at 12 months |
| WW vs PCP ¹⁸ | 6.5 at 12 months |
| WW vs dietetics ¹⁸ | 10.0 at 12 months |
| WW vs BWL ¹⁷ | 10.3 at 12 months |
| JC, phone vs dietetics ¹⁹ | 3.7 at 24 months |
| JC, center vs dietetics ¹⁹ | 3.0 at 24 months |

A correlation between intervention compliance and weight loss was examined by Pinto et al who found that better program attendance was associated with greater weight loss in all interventions at 24 weeks ($p < 0.05$). This correlation in turn affects two other studies that looked at intervention vs compliance. Jolly et al found that participants randomized to pharmacy and general practice counseling groups had the highest proportion of participants who attended less than 25% of sessions and were also the groups that had the smallest average weight loss at 1 year. Participants randomized to Weight Watchers and choice groups had the highest proportion who attended 50% or more sessions and Weight Watchers participants had the highest average weight loss at 1 year. Jebb et al had a similar observation with 61% of participants completing the commercial program and 54% completing the standard care ($p = 0.06$) at one year.

Strengths of these studies include large sample sizes ranging from 141 to 772 participants, long study length ranging from 12 months to 24 months, clear inclusion and exclusion criteria of study participants, and relatively low attrition rate compared to other similar studies except for Jebb et al which had a high attrition rate comparable to other studies. The large sample sizes increased the power of these studies and the long study lengths provides evidence of the long term efficacy of each intervention. The clear inclusion and exclusion criteria outlines the exact population studied and the applicability of the data to the general population.

Shortcomings and Limitations

The greatest weakness in these studies was the strong presence of bias. High rates of bias was found in all the studies ranging from funding source to conflicts of interest. Jebb et al, Pinto et al, and Rock et al had funding for their studies provided by a commercial weight loss program. A significant conflict of interest was found in two studies: the primary author in Pinto et al was also the sole provider of one intervention and the principal investigator in Rock et al had served on the advisory board of the commercial weight loss program in the study for one year.

Other sources of bias included lack of adequate blinding in all four studies. Jebb et al blinded researchers and commercial weight loss program counselors but did not blind primary care providers to research participants. Pinto et al also blinded commercial weight loss program counselors but did not blind researchers including the sole behavioral therapy psychologist (who was also the principal investigator). Jolly et al did not blind any of the intervention counselors nor the researchers in the study as the data was collected by the counselors and sent to the researchers at each time point. Rock et al also did not blind any of the intervention counselors nor research staff who collected data and measurements at each time period. This lack of blinding in all the studies adds significant amount of bias to the data collected. While a double blind is not feasible given the nature of these studies, the providers of each intervention and the research staff collecting data and measurements can be blinded to the identity of research participants.

Another weakness found in several of the studies included unequal intensity of follow up between interventions. In Jebb et al, participants randomized to primary care intervention had one appointment per month while participants randomized to Weight Watchers had on average two to three meetings per month. In Jolly et al, level of interaction with participants across all the interventions varied. Participants in randomized to primary care intervention had 30 minutes first appointment with 15-20 minute follow up weekly appoints compared to participants in commercial weight loss programs who had 1 to 1.5 hour meetings weekly. In Rock et al, participants in the dietetic group met with a counselor at baseline and at 6 months for 1 hour each time with monthly check-ins via email or phone while participants in the Jenny Craig program had weekly one-on-one sessions with the option of unlimited email and telephone contact. In each of the above studies, the commercial weight loss program interventions had a higher intensity of follow up compared to primary care interventions which may skew the result in favor of commercial weight loss programs.

A significant shortcoming among all the studies is the lack of male representation. On average, the percentage of male participants in Jebb et al. and Pinto et al. were 13% and 10%, Jolly et al. with >30% and no male representation in Rock et al. This is significant, because the percentage of obese men and women, in the United States, is almost equal; therefore studying men is crucial in order to bring down the overall obesity rate but also to have data that shows the efficacy of weight loss treatment in men especially because men are more susceptible to cardiovascular disease. As Jolly et al. pointed out, many of the commercial weight loss programs are generally run by and attended by women; therefore, future studies may want to consider making commercial programs more "male friendly" like the study performed by Jolly et al.

The baseline statistics (age, weight, BMI, etc.) differed from study to study, which poses a problem when trying to support the efficacy of a treatment for a particular patient profile. In Jebb et al. the average weight and BMI was 86.7 kg and 31.4 kg/m² whereas the average weight and BMI in Pinto et al. was 96.6 kg and 36.2 kg/m² (table 12). With increasing weight, there is an increased risk for comorbidities; therefore, the outcome of these two studies would differ based upon the presence and status of comorbidity. Unfortunately, Pinto et al. did not include a thorough inclusion criterion, so it is unknown if patients with comorbidities were included in this study. The differing weights and BMIs among the studies could be attributed to the difference in inclusion criteria. The inclusion criteria for BMI was 27-35 kg/m² in Jebb et al. (table 1) whereas the BMI for Pinto et al. was 27-50 kg/m² (table 4).

In order to attract participants and increase compliance, some studies provided financial incentives; whereas others allowed self-referral rather than a referral by a primary healthcare provider to participate in the study. In all four studies, participants were granted access to all benefits within the commercial weight loss program free of charge. Not only does this fail to represent reality outside the study, but it creates the question as to whether the same weight loss results can be extended to those unable to pay for the extra benefits. Other means of gaining participation was through financial incentives. Pinto et al. paid each participant \$20 for completing assessment visits, and Rock et al. covered the cost for a year's supply of food plus \$25 for each assessment visit. These financial incentives introduced the possibility of bias. In addition to the above, the participants in Pinto et al., Jolly et al. and Rock et al. were self-selected. This is a significant weakness, because these people sought out the study, because they wanted to lose weight; therefore, they were highly motivated to do such as opposed to the average population or those in Jebb et al. that were physician-referred. Further research should consider the role of motivation and patient empowerment in weight loss.

One limitation of our study was focusing on only two commercial weight loss programs, which have the highest market shares in the United States. Like WW and Jenny Craig, Nutrisystem incorporates goal-setting, self-monitoring, nutritional information and counseling; this program should definitely be considered once more research has been done, but as of right now, there is not enough known about its efficacy. Further analysis should also consider the efficacy of low-calorie meal replacement programs alone, such as Medifast and OPTIFAST, to offer more weight loss options for the general consumer.

CONCLUSION

Among overweight or obese adult patients, do commercial weight loss programs compared to primary care interventions help patients lose more weight and better maintain that weight loss in the future?

Commercial weight loss programs were found to be more effective for weight loss and weight loss maintenance in all the studies we examined though keeping in mind the weaknesses in the studies as stated above in Discussion section; Weight Watchers specifically showed the greatest weight loss and best weight loss maintenance compared to primary care interventions. Jenny Craig also has evidence of long-term efficacy; however, the highly biased study by Rock et al has us questioning the results and further research needs to be done. Part of the success of the Weight Watchers program may be due to its high intensity weekly counseling sessions and higher attendance and compliance rates of participants randomized to this program compared to other interventions.

Further research is required to address the gaps in knowledge that existed in the analyzed studies in order to assess the efficacy of weight loss treatment. It is vital that men are equally represented in future studies otherwise we are only fixing the problem for half the population. Socioeconomic status should also be evaluated because the obesity rate among lower-income individuals is greater compared to higher-income individuals, especially women. Overweight and obesity is not only prominent among adults, it has become an increasing problem in children, too. As of 2013, 42 million children under the age of 5 years were overweight or obese and they are at increased risk of adult obesity.²² Further studies should also consider the efficacy of other commercial weight loss programs such as Nutrisystem or low-calorie meal replacement programs such as Medifast and OPTIFAST to offer more weight loss options for patients. Long term studies are also needed to compare the effectiveness of commercial weight loss programs in weight loss maintenance. A 5 year study may show the effectiveness of weight loss maintenance as it has been shown that if individuals maintain the weight loss for that time period, the chance of long-term success greatly increases.²³

A major concern for patients and clinicians considering different weight loss programs is cost. The absolute cost of each intervention is examined in several studies (table 14). Of the interventions examined, Weight Watchers was the most cost effective program compared to primary care interventions and Jenny Craig. Jenny Craig was the most expensive intervention because it included the cost of buying their meal replacements. However, if the average weekly cost of food was taken into account, Jenny Craig becomes an even more economic choice compared to Weight Watchers. Of note, the cost of commercial weight loss programs are often not covered by insurance companies while primary care interventions are covered. This results in a lower cost to patients to participate in primary care interventions even though it is less effective and has a higher absolute cost overall. Looking towards the future, the cooperation of policy makers, insurance companies, and providers will be key to providing the best and most cost efficient weight loss management options for patients.

Table 14: Costs of interventions per participant per week as reported by each study

| Intervention | Provider's costs (US dollars) |
|--|--------------------------------------|
| Weight Watchers ¹⁷ | 9.92 |
| BWL treatment ¹⁷ | 12.05 |
| Publically available BWL, estimated ¹⁷ | 10.00-35.00 |
| Weight Watchers ¹⁸ | 6.32* |
| NHS Size Down ¹⁸ | 8.05* |
| Pharmacy counseling ¹⁸ | 10.40* |
| General Practice counseling ¹⁸ | 10.45* |
| Jenny Craig with suggested meal replacements ¹⁹ | 131.41 (6.41 fee plus 125 on meals) |
| Average weekly cost of food (as per Consumer Expenditure Survey ²⁴) | 129.98 |

*Dollar amounts converted from British pounds at conversion rate 1 £ = \$1.50

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