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Comparing Behavioral Weight Loss Modalities: Incremental Cost-effectiveness of an Internet-based Versus an In-Person Condition

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Abstract

The objective of this study was to assess the costs associated with a group behavioral weight loss intervention and compare cost-effectiveness based on treatment delivery modality (in-person versus Internet). A randomized controlled trial examined efficacy of a group behavioral obesity intervention across in-person and Internet treatment modalities. Participants (N=323, 93% women, mean body mass index=35.8) from two centers were randomized to treatment modality, and contact time was matched between conditions. Primary outcome was weight loss. Cost-effectiveness measures calculated life years gained (LYG) from changes in weight at 6 months, based on excess years of life lost algorithm and the cost of the two modalities. In-person participants had significantly greater weight losses (-8.0 ± 6.1 kg) than Internet participants (-5.5 ± 5.6 kg), whereas differences in LYG were insignificant. Estimated LYG was 0.58 (95% CI: 0.45, 0.71) and 0.47 (95% CI: 0.34, 0.60) for the in-person and internet condition respectively. Total cost of conducting the In-person condition was \$706 per person and the Internet condition was \$372 per person with the difference mainly due to increased travel cost of \$158 per person. The incremental cost effectiveness ratio was \$2,160 per (discounted) LYG for the Internet modality relative to no intervention/no weight loss and \$7,177 per (discounted) LYG for the in-person modality relative to the internet modality. Participant time costs are recognized as an important cost of medical and behavioral interventions. When participant time costs are included in an economic evaluation of a behavioral weight loss intervention, internet-based weight loss delivery may be a more cost-effective approach to obesity treatment.

As obesity rates in the United States continue to rise (1), the rates of obesity-related chronic diseases are also rising (2). These obesity-related conditions place an enormous financial burden on the health care system (3). Effective in-person obesity interventions have been developed, and evidence-based behavioral weight loss programs can induce clinically significant weight losses of approximately 7–10% (4, 5). Despite the demonstrated efficacy of behavioral weight loss programs, such programs are not widely implemented. Broader reach and greater cost efficiency of delivering the programs might support greater dissemination. One of the reasons that internet-based weight management programs offer

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appeal is that the internet may provide a cost-effective way of delivering behavioral obesity treatment.

Internet-based behavioral weight control programs have demonstrated significant weight loss, with later generation programs achieving superior losses, as evidence on essential treatment components emerges and web-delivered programs become more sophisticated (6–8). However, while there has been recent growth in Internet-based weight loss interventions and some demonstrated success (6–8), there is limited research on the cost-effectiveness of this treatment modality (9). Indeed, evidence on the cost-effectiveness of in-person, face-to-face behavioral weight loss programs is relatively sparse (10–13). Further, there is no available economic analysis of a successful internet-delivered behavioral weight control program in comparison with in-person delivery of a comparable program. Such a comparison would inform critical policy decisions about the cost-effectiveness of different modalities of disseminating effective behavioral weight control to the large population of overweight and obese individuals.

There have been some authors who have made assumptions that internet-based treatment is more cost effective than in-person delivery of various behavioral interventions (see Griffiths and colleagues (14) for a review). Such assumptions are likely predicated on beliefs that the internet is less costly because of the reduction in time required by participants to access the intervention. Participant time is now recognized as a direct cost of participating in an intervention and needs to be included as a cost in cost-effectiveness analysis (15). Internet-delivered interventions also offer the prospect of greater reach and therefore are worthy of continued exploration.

A recent review of the cost-effectiveness of internet-delivered interventions for behavioral conditions identified only eight studies that met criteria for inclusion (16). Most of the studies included in the review had significant shortcomings. Only one study was identified that examined the cost-effectiveness of an internet-based intervention for weight loss, and this study compared the internet weight loss program to usual primary care (9), with neither group demonstrating clinically significant weight losses. Further, the study included the development costs (typically referred to as ‘sunk costs’) for the internet intervention and compared the intervention to usual care without considering the costs associated with development of the usual care intervention. Development costs are typically included when the study evaluates whether to provide the intervention at all, rather than when deciding whether to implement a previously developed technology (15). Thus, it could be argued that an incremental cost-effectiveness evaluation of in-person to internet interventions should ignore sunk costs and focus on implementation costs, such an approach has been adopted in other cost-effectiveness evaluations (17).

Since the review article by Tate and colleagues, another study examining the cost-effectiveness of an internet-based behavioral weight loss intervention compared to usual primary care has been reported (18). While Rasu and colleagues concluded that the behavioral internet treatment was more cost-effective than usual care, the weight losses achieved in both the usual care and the internet-based intervention were quite small (i.e., –0.6 kg and –1.3 kg, respectively). Evaluation of the cost-effectiveness of an internet-based behavioral weight control programs capable of producing clinically significant weight losses of 5–10% is a crucial next step.

The current study seeks to examine the incremental cost-effectiveness of a group internet-based weight loss intervention compared to an identical intervention conducted in-person. We hypothesized that the internet-based intervention may be more cost-effective relative to the in-person intervention because of lower costs associated with travel and materials. Data

were extracted from a randomized controlled trial (19) which examined the weight loss efficacy of three approaches to delivering a comparable group-based behavioral weight control program (in-person delivery, internet-based, and a combination condition that included some in-person with predominantly online delivery). The combination group presented no advantages over the other two modalities with respect to weight loss and presents some logistic challenges and therefore is not recommended for broad implementation (19). We elected to focus on the in-person and internet conditions for this cost-effectiveness comparison, as these are the programs most likely to be of interest to evidence-based medicine practitioners and to policy makers more generally. The in-person and internet group intervention methods have been described in greater detail elsewhere (19)

Methods

Participants

Overweight and obese adult volunteers for the randomized clinical trial were recruited in two clinical centers (Burlington, VT and Little Rock, AR) by advertisements placed in local newspapers, emailed notices, community events and word-of-mouth. To be eligible, individuals were required to be over 18 years of age, be overweight or obese as defined by body mass index (BMI) between 25 and 50, be generally healthy, able to walk for exercise and have access to a computer with an Internet connection. Participants were also required to live within 30 miles of one of the clinical centers to facilitate attendance at in-person intervention sessions and had to be willing to accept randomization. Individuals were excluded if they reported a history of major medical problems for which weight loss was contraindicated, were currently engaged in other weight loss treatment, had a history of gastric bypass surgery, or reported recent significant weight loss or other conditions which might make study participation problematic. Pregnancy within the previous 6 months and current breast-feeding were also exclusion criteria, as was a plan to move from the area during the study period. The study was approved by the Committee on Human Research in the Behavioral Sciences at the University of Vermont and the Institutional Review Board at the University of Arkansas for the Medical Sciences.

Measures

Body Weight—Weight was measured in street clothes, without shoes, on a calibrated digital scale. Weight was measured at baseline and 6-months.

Height—Height was measured using a wall-mounted stadiometer (Seca Corporation, Hanover, MD) at baseline. BMI was calculated as weight (kg) / height (m²).

Costs—Costs were calculated from both the payer perspective and the participant perspective (15) to reflect that the participant burden differs if enrolled in the in-person program rather than the internet-based modality. Total “payer” intervention costs for the full six months of intervention were calculated by summing all direct costs associated with delivering the intervention, similar to previous research (12, 20). Direct costs were defined as aspects that would be required to replicate the program: personnel costs and program materials (e.g., pedometer, photocopying, calorie counter book, self-monitoring journal printing). Personnel time was estimated by sampling a typical week for actual time spent in intervention delivery activities, after substantial implementation experience upon which to base estimates and while blinded to weight loss outcomes. Tasks performed by intervention staff (i.e., registered dietitians, health educators, and clinical psychology fellows) as well as those performed by administrative staff were considered in the estimates. Intervention activities included program initiation activities and weekly group facilitation and management (i.e., session preparation, “weigh in” of participants prior to session [for in

person], conducting the group session, review of self-monitoring journals, periodic contact of participants who might miss sessions or who have questions, posting on the bulletin board [for internet] and record keeping), as well as the activities of the webmaster [for internet] in establishing each group, performing website maintenance, trouble-shooting participant computer problems, and closing out each group. Personnel costs were calculated based on the average hourly wage (with benefits) of the actual program staff.

Participant costs that differed between conditions (i.e., travel) were also calculated. Average travel time was calculated for the participants in the In-person condition based on the mean round-trip distance for participants, as calculated from a subset of 20% of the sample ($M=19.8$ minutes). Travel time was converted to cost using median wage rates for the state of Arkansas and Vermont (\$12.88 and \$15.31 per hour, respectively), weighted according to the proportion of participants from each state. We did not include participant time costs associated with the intervention group sessions or other intervention related tasks (e.g. self monitoring journal, physical activity) as the treatment recommendations for the in-person and internet interventions were equivalent.

Intervention development costs were not included in our calculations, as the intervention materials [for both in-person and internet] and website [for internet] were developed based on years of obesity treatment research. We assumed that the average per person cost for intervention development measured across the life of the intervention materials would be negligible and not likely to affect relative cost-effectiveness (15). Development costs need to be calculated over the life of the intervention, not just the particular project, and once available, no additional costs are incurred for the further deployment of the intervention.

We included in the estimates of intervention costs the fixed costs for space and utilities, as well as equipment costs. Space and utility costs were based on an approximately 1,000 square foot room at each of the two sites for the in-person group intervention, as well as for a small office to provide space for the webmaster and for two small offices for the interventionists at each site, one for internet and one for in-person. Equipment costs for the internet site were calculated by estimating the rental cost of a dedicated server and the cost of a computer for an internet interventionist at each site. No costs were included at the participant level to account for internet access or having a personal computer in the home as the intervention was targeted at households with access to a computer and internet.

Intervention efficacy—We calculated changes in body weight from baseline to 6-months for participants in each treatment condition. To generate a measure that could be used in a cost-effectiveness analysis, we first calculated BMI for participants in each treatment condition at baseline and follow-up and then related the individual BMI to gender, age, and race-specific years of life lost (YLL) using the data generated by Fontaine and colleagues (21), assuming that weight change is comparable to the differences between BMIs. Differences in YLL were calculated from baseline to follow-up and averaged by condition. Following the methods of Gustafson and colleagues (12), we assumed BMI and YLL were unchanged from baseline for subjects lost to follow-up. The average difference in YLL represents the life years gained (LYG) associated with each treatment condition. Gaining a life year occurs in the future, and thus is typically valued less than the life years gained in the present. Therefore, differences in LYG were discounted at a rate of 3% for a period of 33.8 years representing the difference in the average age of the participants and life expectancy for the average person. This approach is consistent with previous cost-effectiveness analyses for other interventions (12, 22, 23).

Cost-effectiveness—An incremental cost-effectiveness analysis was performed that compared the in-person modality to the internet modality. The study did not include a no-

treatment arm, so the cost-effectiveness analysis assumed that the null case of no intervention would be consistent with no cost and no weight loss. Incremental cost effectiveness ratios were calculated by ranking the two interventions by cost and then comparing the incremental costs and LYG of the higher cost modality to the average cost-effectiveness ratio of the lower cost modality. For comparability purposes, our base case cost-effectiveness analysis followed the assumption from Gustafson et al (12) that weight lost during the intervention was lost indefinitely. We then conducted a sensitivity analysis to assess cost-effectiveness assuming regain of weight loss in two scenarios. In scenario 1, we assumed all participants returned to their pre-intervention weight after one year (i.e., one year of full benefit), consistent with one set of assumptions modeled by Gustafson and colleagues (12). We extended the sensitivity analysis to measure cost-effectiveness in each subsequent year and ending with the assumption of indefinite weight loss. In scenario 2, we calculated cost-effectiveness with weight regain assumptions based on the trajectory of weight regain following behavioral treatment in the absence of a formal weight maintenance program as reported by Perri and colleagues (24). Specifically, we assumed that the participants regained half of their weight loss in the year following the intervention (i.e., 75% of one year of benefit) and then assumed that they would regain weight with each subsequent year until all weight was regained by the end of the time horizon.

Intervention

Participants randomized to in-person behavioral weight control attended group sessions at the clinical site, starting with a cohort of 12–18 members who remained in that group throughout 6 months with no change in group membership. In-person group sessions lasted for 60 minutes and occurred weekly. Those randomized to the internet condition attended virtual group sessions in the form of a synchronous interactive “chat” on a secure website, starting with a cohort of 12–18 members who had also been randomized to the internet condition and tracking with that group throughout 6 months with no change in group membership. All interaction with the group leader was done electronically for internet participants. Intervention “chats” lasted for 60 minutes and also occurred weekly. Both conditions had 24 intervention sessions over a 6-month period.

Both treatment conditions offered the same behavioral weight control program content with the same dietary and physical activity goals and the same behavioral strategies to achieve the targeted habit changes. Identical calorie and dietary fat intake goals and physical activity goals of 200 minutes per week of moderate to vigorous physical activity were prescribed to all participants. Self-monitoring daily in a pencil-and-paper diary (in-person condition) or an online diary (internet condition) was a central focus of the interventions and weekly self-weighing was recommended. The intervention components have previously been described in greater detail elsewhere (19).

Statistical analysis

Due to the nested nature of the data (i.e., recruitment wave within site), mixed model analyses of variance were used for comparing the treatment conditions on weight loss. The models for weight loss included treatment and site as fixed main effects, wave within site as a random main effect and the associated interactions of the main effects. For missing values, using intent-to-treat analysis, we assumed no change from baseline values.

For the cost-effectiveness analysis, we compared differences in BMI and YLL between the in-person and internet modalities. YLL were assessed using adjusted and un-adjusted models controlling for age, gender, race and modality. Statistical procedures were conducted using SAS Version 9.1 (SAS Institute: Cary, NC).

Results

Three hundred and twenty-three overweight individuals were randomized to either the internet (n= 162) or in-person (n=161) condition. One participant in the internet and three participants in the in-person condition withdrew from the study prior to starting intervention and were not included in the analyses; thus, 161 participants in the internet condition and 157 participants in the in-person condition are included in the current analyses. Participants were predominantly female (93%) and obese (mean BMI= 35.8), with 28% self-identifying as African Americans. There were no baseline differences between treatment conditions on baseline measures of sociodemographic characteristics or weight (Table 1). Retention at the 6-month assessment was 95% (n=303).

Intervention Efficacy

Weight losses differed significantly between conditions ($p < .01$), with a greater mean weight loss achieved in the in-person condition than in the internet condition. In-person participants lost an average of 8.0 ± 6.1 kg at 6 months; participants in the Internet condition lost an average of 5.5 ± 5.6 kg. Table 2 shows the effectiveness measures and YLL reductions. Despite significant differences in BMI change, there was only a small incremental difference in YLL between the interventions.

Costs

Component costs contributing to the total intervention costs per participant and the total intervention costs per kilogram lost are presented in Table 3. The internet-delivered condition had markedly lower intervention costs relative to the In-person modality. The in-person modality cost \$88.31 per kilogram lost compared to the internet modality which cost \$67.74 per kilogram lost. The difference in costs between the internet and in-person modalities was mainly due to increased travel cost of \$158 per person in the in-person condition and the additional time required for the “start-up” task of creating participant binders containing all of the program materials. The internet program also had lower materials costs and lower personnel costs.

Table 4 reports LYG, discounted LYG, and the cost-effectiveness ratios for the internet and in-person modalities, as well as the incremental difference between the two modalities. Based on discounted LYG of 0.173 years and an intervention cost of \$373 per subject, the cost-effectiveness ratio for the internet modality compared to no intervention was \$2,160 per life year gained. The incremental cost of the in-person modality was \$333 and resulted in a statistically insignificant increase in LYG of 0.126 discounted to 0.046. The incremental discounted cost-effectiveness ratio for the in-person modality relative to the internet modality was \$7,177 per life year gained. Because the 95% confidence interval for the estimated LYG crosses zero, we estimated 80% confidence intervals that ranged between \$3,055 and \$60,291.

Sensitivity Analyses

Figure 1 (top panel) provides cost-effectiveness ratios by year of weight regain under the assumption that participants return to their baseline weight *after* one year, two years, and so on. In this scenario, if participants only receive one year of benefit from the intervention, the average cost-effectiveness ratio is \$73,005 per discounted LYG for the internet intervention and \$111,736 per discounted LYG for the in-person intervention. Cost-effectiveness ratios rapidly drop in value (signifying better value for money spent) as the amount of time increases before weight is regained. In scenario 2, we assume that participants will regain half of the weight they originally lost *within* one year and then assume they regain the remaining weight lost over the time horizon. Under this scenario, the cost-effectiveness

ratios range from \$148,981 per discounted LYG for the in-person intervention at year 1 to \$6,602 per discounted LYG for the internet intervention at the end of the time horizon (Figure 1, bottom panel). Cost-effectiveness rapidly improves with each additional year of weight maintenance, but less rapidly than under assumptions used in scenario 1.

Discussion

As demonstrated in other studies, an internet-delivered behavioral obesity treatment program can achieve clinically significant weight losses (6–8) and the current study indicates that this modality of administration appears to be relatively more cost-effective than in-person delivery of the same behavioral intervention. This superior cost-effectiveness with the internet-delivered program compared with in-person delivery provides a different perspective on the benefits of internet-based intervention than did a direct comparison of the weight loss outcomes between the two modalities (19). Although in-person group behavioral weight control produced significantly greater weight loss than internet-delivered group behavioral weight loss, the weight losses achieved with the Internet-based intervention were clinically significant (25), and this treatment modality was relatively more cost-effective than the in-person modality. Thus, on a population level, greater emphasis on disseminating behavioral weight management via synchronous internet-based group formats merits continued exploration. Not only may this avenue of treatment delivery prove to be more cost-effective, it may increase access. There are many barriers to participation in face-to-face delivered programs, specifically the availability of such programs in some geographic areas, proximity to the intervention site, transportation concerns, and time constraints. Internet delivery of behavioral obesity programs has the potential to reduce some of these treatment barriers, particularly among populations at high-risk for obesity (e.g., minority, lower income, and rural populations) who may be more likely to experience some of these barriers.

Few studies provide cost information with which to compare either of the treatment modalities offered in the current study. Gustafson and colleagues estimate the in-person Weight Wise program cost \$242 per person for the 16-week group behavioral intervention and resulted in a mean weight loss of 4.4 kilograms, or approximately \$55 per kilogram lost (12). These slightly lower costs for in-person weight control than we found (\$88 per kilogram lost) in the current study can likely be accounted for by the markedly shorter program (16 weeks compared with 24 weeks in the current study) and the inclusion of only direct costs (i.e., using the payer perspective) and not participant costs (i.e., travel). The large, multi-site Diabetes Prevention Program reported a cost of \$3540 per person from a society perspective for a behavioral lifestyle intervention over a 3- year period using individual visits to deliver the in-person program (11) rather than group visits as used in the present analysis. Taken together, these two studies would suggest that the costs associated with the in-person program in the current study are reasonable compared to those incurred by other research groups.

Similarly, there are few data available on costs associated with internet delivery of behavioral obesity interventions with which to compare the costs in the current study. In their 24-week asynchronous behavioral internet treatment, Rasu and colleagues (18) reported a cost of \$25.92 per kilogram of weight lost compared with \$67.74 per kilogram in this study. However, the average weight loss in this predominantly asynchronous program was minimal (1.3 kg) and costs included data collection, one time staff development costs and other costs not considered in the current report (e.g., office supplies, gifts to participants to retain them in the study, questionnaires not used in the intervention). It is difficult, therefore, to make direct cost comparisons between the two studies. In addition, McConnon et al. (9), in their asynchronous behavioral internet treatment, reported a cost of

approximately \$1479 per person compared with \$706 per person in this study. However, as noted previously, minimal weight loss (1.3 kg) was achieved in the McConnon et al. study and the development costs of the internet program were included in this cost-effectiveness analysis limiting comparisons with the current study.

This current report is the first study to examine the relative cost-effectiveness of an internet-based modality relative to in-person group behavioral weight loss program. This study of the incremental cost-effectiveness of these two modalities for providing a similar weight loss treatment has several strengths. Previous research has not evaluated comparable interventions that differed by modality of delivery only, allowing isolation of the treatment delivery modality rather than confounding treatment approach with delivery modality. Further, previous research has not accounted for the differential costs incurred by both participants and payers based on these two delivery modalities. The large sample size, multi-site recruitment and the racially-diverse population studied, as well as the randomized study design, are additional study strengths.

Several limitations should be considered when interpreting these findings. First, cost evaluations were not a primary focus of the trial initially and therefore several estimates were made retrospectively (e.g., distance traveled, staff time estimates); thus, it would be beneficial for future research to monitor intervention costs proactively in efforts to determine cost-effectiveness of interventions. Furthermore, these analyses underestimate the costs incurred by participants in this study because the costs to adhere to treatment recommendations (e.g., clothes, gym memberships, time costs for physical activity, additional time for food preparation) were not included. However, these participant-related costs are likely to be similar across modality, and thus do not detract from the comparative cost-effectiveness findings from this research. In addition, the generalizability of these findings are limited to the sample enrolled in this study (i.e., generally healthy adults who lived within 30 miles of the two intervention sites and who had access to a computer with an Internet connection) and to the internet-based behavioral weight control program utilized in this study. Additionally, it is important to acknowledge that, consistent with the approach used in previous research (12), the assumption was made that weight change is comparable to BMI change. Finally, these results are also limited by our inability to take a full societal perspective on the costs associated with the intervention implementation and lack of information on downstream medical costs or mortality. It is possible that the downstream medical costs or mortality could be lower for participants in the in-person modality, which would alter estimated cost-effectiveness. Further research that includes these outcomes, as well as examines gains in quality-adjusted life years, will inform the important dialogue on the cost-effectiveness of behavioral obesity treatment.

Sustained weight maintenance following behavioral weight control is also a critical factor to consider in the cost-effectiveness of different treatment delivery approaches. We provide a wide range of cost-effectiveness estimates based on differing assumptions about weight regain following the initial intervention. The findings suggest that interventions with rapid weight regain are unlikely to be cost-effective; however, relatively small increments in weight loss maintenance greatly improve the cost-effectiveness profile. Thus, further research is needed to determine whether internet-based group behavior weight control programs will be beneficial in sustained weight losses over longer periods of time and whether this delivery modality is more cost effective than in-person delivery over longer time horizons. Nonetheless, these initial findings indicate promise for the ability for internet delivered behavioral programs to produce clinically significant weight losses in a cost-effective manner. Furthermore, an internet-based approach to behavioral weight control treatment may represent a significant opportunity to reach populations who would have

previously experienced significant barriers to accessing treatment to address obesity and reduce chronic health risk factors.

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References

1. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States. *J Am Med Assoc.* 2006; 295(13):1549–55.
2. Bray GA. Medical consequences of obesity. *J Clin Epidemiol Metab.* 2004; 89(6):2583–9.
3. Wang Y, Beydoun M, Liang L, Caballero B, Kumanyika S. Will all Americans become overweight or obese? Estimating the progression and cost of the US obesity epidemic. *Obesity.* 2008; 16:23–30. [PubMed: 18223607]
4. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *New Engl J Med.* 2002; 346(6):393–403. [PubMed: 11832527]
5. Look AHEAD research group. . Reduction in weight and cardiovascular disease risk factors in individuals with type 2 diabetes. *Diabetes Care.* 2007; 30(6):1374–83. [PubMed: 17363746]
6. Gold BC, Burke S, Pintauro S, Buzzell P, Harvey-Berino J. Weight loss on the web: a pilot study comparing a structured behavioral intervention to a commercial program. *Obesity.* 2007; 15(1):155–64. [PubMed: 17228043]
7. Micco N, Gold B, Buzzell P, Leonard H, Pintauro S, Harvey-Berino J. Minimal in-person support as an adjunct to internet obesity treatment. *Ann Beh Med.* 2007; 33(1):49–56.
8. Tate D, Jackvony E, Wing R. A randomized trial comparing human e-mail counseling, computer-automated tailored counseling, and no counseling in an internet weight loss program. *Arch Intern Med.* 2006; 166:1620–5. [PubMed: 16908795]
9. McConnon A, Kirk SFL, Cockcroft JE, et al. The Internet for weight control in an obese sample: results of a randomised controlled trial. *BMC Health Serv Res.* 2007; 7:206. [PubMed: 18093289]
10. Sherwood NE, Jeffery RW, Pronk NP, et al. Mail and phone interventions for weight loss in a managed-care setting: weigh-to-be 2-year outcomes. *Int J Obes.* 2006; 30(10):1565–73.
11. Diabetes Prevention Program Research Group. Costs associated with the primary prevention of type 2 diabetes mellitus in the Diabetes Prevention Program. *Diabetes Care.* 2003; 26:36–47. [PubMed: 12502656]
12. Gustafson A, Khavjou O, Stearns SC, et al. Cost-effectiveness of a behavioral weight loss intervention for low-income women: The Weight-Wise Program. *Prev Med.* 2009; 49(5):390–5. [PubMed: 19747937]
13. Pavlovich WD, Waters H, Weller W, Bass EB. Systematic review of literature on the cost-effectiveness of nutrition services. *J Am Diet Assoc.* 2004; 104(2):226–32. [PubMed: 14760571]
14. Griffiths F, Lindenmeyer A, Powell J, Lowe P, Thorogood M. Why are health care interventions delivered over the Internet? A systematic review of the published literature. *Journal of Medical Internet Research.* 2006; 8(2):e10. [PubMed: 16867965]
15. Luce, BR.; Manning, WG.; Siegel, JE.; Lipscomb, J. Estimating Costs in Cost-Effectiveness Analysis. In: Gold, MR.; Siegel, JE.; Russell, LB.; Weinstein, MC., editors. *Cost-Effectiveness in Health and Medicine.* New York, Oxford: Oxford University Press; 1996. p. 176-213.
16. Tate DF, Finkelstein EA, Khavjou O, Gustafson A. Cost effectiveness of internet interventions: review and recommendations. *Ann of Beh Med.* 2009; 38(1):40–5.
17. Olmstead AT, Ostrow CD, Carroll KM. Cost-effectiveness of computer-assisted training in cognitive-behavioral therapy as an adjunct to standard care for addiction. *Drug Alcohol Depend.* 2010; 110:200–207. [PubMed: 20392575]
18. Rasu RS, Hunter CM, Peterson AL, Maruska HM, Foreyt JP. Economic evaluation of an internet-based weight management program. *Am J Manag Care.* 2010; 16(4):e98–e104. [PubMed: 20370312]

19. Harvey-Berino J, West D, Krukowski R, et al. Internet delivered behavioral obesity treatment. *Prev Med.* 2010; 51(2):123–128. [PubMed: 20478333]
20. Siegel JE, Weinstein MC, Russell LB, Gold MR. Recommendations for reporting cost-effectiveness analyses. *Am Med Assoc.* October 23; 1996 276(16):1339–41.
21. Fontaine KR, Redden DT, Wang C, Westfall AO, Allison DB. Years of life lost due to obesity. *J Am Med Assoc.* 2003; 289:187–93.
22. Craig BM, Tseng DS. Cost-effectiveness of gastric bypass for severe obesity. *Am J Med.* 2002; 113(6):491–8. [PubMed: 12427499]
23. Finkelstein EA, Khavjou O, Will JC. Cost-effectiveness of WISEWOMAN, a program aimed at reducing heart disease risk among low-income women. *J Women's Health.* 2006; 15(4):379–89.
24. Perri MG, Nezu AM, McKelvey WF, Shermer RL, Renjilian DA, Viegner BJ. Relapse prevention training and problem-solving therapy in the long-term management of obesity. *Journal of Consulting and Clinical Psychology.* 2001; 69(4):722–6. [PubMed: 11550740]
25. Institute of Medicine. *Weighing the Options: Criteria for Evaluating Weight- Management Programs.* Washington, DC: National Academy Press; 1995.

Figure 1.
Sensitivity Analyses

Table 1

Baseline Characteristics

Variable	Internet (n=161)	InPerson (n=157)
Female	92%	94%
African American	31%	28%
Married	68%	68%
College graduate	69%	62%
Age (years; mean± SD)	46.3± 9.8	46.9± 10.3
Weight (kg; mean±SD)	97.5± 18.7	97.5± 18.5
BMI (kg/m ² ; mean± SD) *	35.7± 5.7	36.0± 5.7

* Body Mass Index; Calculated as weight in kilograms divided by the square of height in meters.

Table 2

Effectiveness measures

	Internet Baseline	Internet 6- Months	Internet Change Baseline to 6 Months (unadjusted)	In-person Baseline	In-person 6- Months	In-person Change Baseline to 6 Months (unadjusted)	Difference in Change between In-Person and Internet (unadjusted)	Difference in Change between In-Person and Internet (adjusted)
BMI (kg/m²)	35.64	33.66	-1.98	35.99	33.19	-2.8	-0.82	-0.81
95% CI			(-2.28, -1.68)			(-3.15, -2.45)	(-0.36, -1.28)	(-0.37, -1.24)
Range (kg/m²)	25.30-48.60	22.3-48.37	- 8.95 - 2.43	25.30-48.70	21.49-48.12	- 9.49 -2.31		
Years of Life Lost to Obesity (YLL)	1.55	1.08	-0.47	1.63	1.05	-0.58	-0.11	-0.13
95% CI			(-0.60, -0.34)			(-0.71, -0.45)	(-0.29, 0.07)	(-0.30, 0.04)

Table 3

Internet and In-Person Program Modality Costs.

Cost Item	Internet		In-Person	
	Total Cost	Per Person Cost	Total Cost	Per Person Cost
Travel				
One way cost			\$4.65	
Mean number of sessions attended by participants			17.04	
Total Travel Time Cost			\$25,521.40	\$158.52
Materials				
Binder			\$642.39	\$4.25
Tabs			\$127.19	\$0.84
Pedometer	\$2,254.00	\$14.00	\$2,254.00	\$14.00
Calorie Counter			\$1,447.39	\$8.99
Self-monitoring Journal			\$4,286.40	\$26.62
Xerox Lessons			\$2,318.40	\$14.40
Total Materials	\$2,254.00	\$14.00	\$11,075.77	\$68.79
Personnel Costs				
Group start up	\$528.55	\$3.28	\$1,020.00	\$6.34
Conduct Group	\$53,200.00	\$330.43	\$65,721.00	\$408.20
Total Personnel Costs	\$53,728.55	\$333.72	\$66,741.00	\$414.54
Fixed Costs				
Space	\$1,100.00	\$6.83	\$9,900.00	\$61.49
Utilities	\$200.00	\$1.24	\$500	\$3.11
Equipment	\$2,700.00	\$16.77		
Total Fixed Costs	\$4,000.00	\$24.84	\$10,400.00	\$64.60
Total Costs	\$59,982.55	\$372.56	\$113,738.17	\$706.45

Table 4

Internet, In-person and Incremental Cost-Effectiveness Results.

	Internet	Internet CI's ^d	In-person	In-Person CI's	Incremental	Incremental CI's
Cost	\$373		\$706		\$333	
LYG ^a (YLL ^b undiscounted obesity)	0.469	(0.343, 0.596)	0.580	(0.449, 0.710)	0.126	(0.015, 0.296)
LYG (YLL discounted 3% obesity)	0.173	(0.126, 0.219)	0.214	(0.165, 0.261)	0.046	(0.006, 0.109)
C-E ^c ratio: \$/undiscounted LYG obesity	\$795	(\$1087, \$626)	\$1,217	(\$1572, \$994)	\$2,643	(\$22,200, \$1125)
C-E ratio: \$/discounted LYG obesity	\$2,160	(\$2953, \$1700)	\$3,306	(\$4270, \$2701)	\$7,177	(\$60,291,\$3055)

^aLife Years Gained;

^bYears of Life Lost;

^cCost-effectiveness;

^dConfidence interval;

* Confidence interval for lower limit based on 80% because the 95% interval crosses zero (at which point the cost-effectiveness ratio does not exist