

Economic Evaluation of an Internet-Based Weight Management Program

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Objective: To determine whether a behavioral Internet treatment (BIT) program for weight management is a viable, cost-effective option compared with usual care (UC) in a diverse sample of overweight (average body mass index = 29 kg/m²), healthy adults (mean age = 34 years) serving in the US Air Force.

Study Design: Two-group parallel randomized controlled trial.

Methods: Participants were randomly assigned into 2 groups: UC (n = 215) and UC plus BIT (n = 227). Baseline and 6-month assessments were included in the analyses. Primary outcome measures (changes in body weight, percent body fat, and waist circumference) and secondary outcome measures (Weight Efficacy Lifestyle [WEL] questionnaire) were included in an incremental cost-effectiveness analysis (ICEA) model. Costs were computed using the perspective of an agency wanting to replicate the intervention. Sensitivity analyses were performed to measure the robustness of models.

Results: Overall cost for BIT intervention was \$11,178.40, or \$49.24 per BIT participant. Total staff-time cost was \$14.03 per BIT participant. Intervention cost was \$25.92 per kilogram of weight loss and \$28.96 per centimeter of waist-circumference loss. The cost was \$37.88 for each additional point gained on the WEL subscale, where increasing scores indicate increased confidence in managing social pressures to eat.

Conclusions: The BIT program is a cost-effective choice for weight management. It may cost more initially, but it results in long-term cost savings. Such cost-effective, Internet-based behavioral interventions for weight management could provide a valuable tool for preventive care aimed at improving individual and societal health.

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Obesity and overweight generate a large amount of societal and personal cost in the form of reduced social status, reduced employment opportunities, and increased morbidity and mortality.¹ Despite the assumption that active-duty military members are normal weight and fit, the US military is struggling with escalating rates of overweight and obesity.² For example, according to 2005 data, about 60% of United States Air Force (USAF) personnel were overweight, and 13.4% were obese.² Also, similar to civilian populations,³ weight gain among USAF personnel averages 1 to 2 lb per year.^{4,5} In addition to health and social costs, the increasing proportion of health-care dollars required to deal with the weight increase is of concern. One study estimated that the sum of direct expenses for increased medical care and indirect costs associated with lost work days that were directly attributable to excess body weight for the USAF was nearly \$23 million annually.⁶

An Internet-based weight management program was implemented in a trial for USAF personnel.⁴ In this trial, participants using the program had significant body-composition changes compared with a usual care (UC) program. The participants in the Internet program had greater changes in body weight (kilograms and percent lost from baseline), percent body fat, and waist circumference.⁵ The Internet was an especially attractive intervention option for the military because of its flexibility and the ability of participants to access the program whenever it best suited their schedule.⁵

Although start-up costs are considerable and require consideration in relation to a program's efficacy, Internet-based interventions may be more economical in the long term. An Internet intervention also can reduce the amount of professional contact time needed per person compared with a face-to-face intervention.⁵ A cost evaluation of weight management intervention may highlight the cost-benefit issues and help point the way to further efficiencies. However, published information is lacking on the economical effectiveness of Internet-based behavioral weight management programs. We evaluated the cost-effectiveness of a behavioral Internet treatment (BIT) program for weight management compared with UC in a diverse sample of primarily overweight adults in the USAF.

METHODS

Study Population

This study involved 446 healthy individuals, including

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222 men and 224 women, who were on active duty in the USAF. A more detailed description of this intervention trial was previously published.⁵ Participants had a mean body mass index of 29 kg/m² and a mean age of 34 years. Study recruitment began in June 2003 and concluded in October 2005. All

participants came from 3 military bases in San Antonio, Texas: Lackland Air Force Base, Randolph Air Force Base, and Brooks City-Base. At the time of the study, approximately 17,000 active-duty military personnel served at those 3 bases. Individuals were recruited by flyers as well as e-mail advertisements, and initial eligibility was determined over the telephone, followed by an in-person assessment.

Inclusion criteria required that participants be 18 to 65 years of age, have Internet access, have no plans to relocate in the next year, and be above the USAF-sanctioned maximum allowable weight or within 2 kg of their maximum allowable weight (equates approximately to a body mass index of >25 for women and ≥ 27.5 for men).⁵ Exclusion criteria included the loss of 4 kg or more within the last 3 months, use of any weight-reduction medications within the last 6 months, limitations in physical activity, pregnancy, plans to become pregnant soon, nursing, or a medical history consisting of myocardial infarction, stroke, cancer, diabetes, angina, thyroid issues, or orthopedic problems.⁵

Intervention

The study was a 2-group parallel randomized controlled trial. Individuals in the trial completed a baseline assessment in which they gave informed consent, completed assessment questionnaires, and also had their height, weight, blood pressure, waist circumference, and body-fat percentage measured. Individuals in the study were blocked by their sex and then randomized to UC or UC plus BIT. All body measurements performed previously were repeated at 6 months into the trial for postintervention assessments.

Procedures for Usual Care

As part of UC, individuals had access to standard face-to-face nutrition-based weight management programs and physical fitness programs, an annual fitness assessment, and a yearly preventive health checkup with their healthcare provider available at every base. Individuals in UC were evaluated at baseline and at 6 months.

Procedures for Behavioral Internet Therapy

The BIT participants had access to both UC services and BIT services. All BIT subjects had access to our Internet com-

Take-Away Points

A behavioral Internet treatment (BIT) program for weight management was compared with usual care in a diverse sample of overweight, healthy adults serving in the US Air Force.

- The BIT weight management program was shown to be a cost-effective (only \$25.92/kg of weight lost) alternative.
- This program is especially attractive considering its flexibility and improved retention rates and outcomes compared with pharmacotherapy.

puter program, and they attended an in-person treatment orientation meeting. In this meeting, study participants learned about the various components of the weight-loss treatment, including how to calculate calories and energy expenditures, how to utilize electronic diaries for food intake and exercise habits, when they would receive weekly counselor feedback on their diaries, and finally, how to establish goals for weight loss and calorie intake. The BIT program was an interactive Internet-based approach that focused on improved weight management, which included preventing weight gain and/or losing small-to-moderate (2-6 kg) amounts of weight. Each participant had weekly assigned readings on the Internet for 24 weeks. These assignments were designed to be short, interactive lessons that built on the materials from the previous week. The BIT participants also completed daily food and physical activity diaries online and received individual feedback on these diaries from a weight counselor each week. Individuals in the study were given the LEARN Manual for Weight Control,⁷ which has lessons that complemented the weekly lessons on the Web. In addition, all participants were scheduled for 2 short telephone calls at 4 and 8 weeks into the trial. A motivational interviewing (MI) approach was utilized^{5,8,9} in these short phone calls.

Economic Evaluation

Cost Estimation Methodology. Costs of the intervention were computed by using the perspective of an agency wanting to replicate the intervention.¹⁰ Included in the intervention cost were costs for recruiting and training the counselors; this consisted of orientation, baseline, and follow-up appointments, including consent, paperwork, and measures of height, weight, blood pressure, and waist circumference. This economic evaluation did not include research costs (eg, costs associated with planning, developing, and evaluating the intervention, and conducting the research project). The costs of the BIT intervention were computed using the direct expenses for the intervention and the time costs associated with implementing the intervention. Detailed expenses for the BIT group included the following: the costs of BIT distribution materials and letterhead; the cost of training sessions; the costs of educational materials, equipment, supplies, and other items (Web site, computer costs); the cost of materials; and office supplies.

The time costs associated with implementing the intervention were costs for employees (project staff) while they worked on the orientation sessions; baseline and follow-up appointments (measuring weight and height); and MI telephone calls. The staff costs consisted of salaries and fringe benefits paid to the staff for the time spent (in minutes) on each activity for the intervention. Yearly staff salary and fringe benefits were obtained in 2006 for the employees, and the study computed the cost per minute for each staff member. Per-minute costs for staff were computed by considering an average of 40 hours a week for 48 weeks a year, or 115,200 minutes per year.¹⁰ The yearly costs were then divided by 115,200 minutes to obtain costs per minute. The mean duration (in minutes) of each activity was multiplied by cost per minute to calculate the total cost for each activity for the intervention group. The total time costs for the intervention were obtained by adding all the time costs for each activity.

Cost Data Collection

Direct Expenses. Direct expenses for the whole intervention were recorded by the project administrator. The project administrator collected invoices, budgets, and records of supply orders to document direct expenses. Computer and telephone bills were not included, as this equipment had fixed monthly expenses and also was used for other administrative purposes not relevant to this study.

Time Costs. A list of all activities related to the BIT intervention was created. Time costs were calculated using the mean duration of time spent on each listed activity by all 3 employees (project staff). For example, time costs included the average staff time spent in baseline and follow-up appointments measuring weight and height.

Patient Time Costs. The study included an assessment of patient time spent on the BIT program. Total time spent, on average, for each BIT participant was 4.5 hours over a 6-month period. Due to USAF computer-use policy, it is assumed that participants accessed the Internet during their off-duty or break times. Therefore, we did not include lost work time in this model.

Total Costs. Total costs were obtained by adding direct expenses and time costs. The study also calculated total per-participant cost by dividing the total cost by 227 BIT participants.

Outcomes

The primary outcome measures were change in body weight (kilograms and percent weight lost from baseline), a weight change of 5% or more (percent yes), and waist circumference. Secondary outcome measures were differences on the Weight Efficacy Lifestyle (WEL) questionnaire. These measures were

taken by study personnel at baseline and postintervention (6 months after baseline). Statistically different outcomes⁴ (at baseline and at 5 months) were as follows: a weight change of 5% or more, change in waist circumference, change in body weight, and differences on WEL measures.

Sensitivity Analysis

The sensitivity analysis estimates the robustness of the evaluation.¹¹ The analysis described how costs per participant varied based on increasing and reducing specific costs. In scenario 1, it was assumed that a staff person at the administrative level carried out all the activities required for the intervention. In scenario 1, per-minute cost for the BIT intervention was obtained by using the administrative salary and fringe benefits (increased compensation) rather than per-minute cost for the assistant-level staff (decreased compensation). In scenario 2, we excluded direct expenses (LEARN Manual for Weight Control and computer).

Cost-Effectiveness Analysis

In investigating the cost-effectiveness of the BIT intervention, we considered costs from the agency's perspective, as used in other economic evaluations.¹¹ Only the statistically significant outcomes⁴ mentioned above were included in the model.

RESULTS

Costs

Direct Expenses. Direct expenses for the BIT intervention are shown in **Table 1**. The total direct cost for the BIT intervention was \$7993.32, the largest component of which was \$3427.00 for the LEARN manuals. The total direct cost per BIT participant (n = 227) was \$35.21. Other expenses included MI books (2 books for staff), MI tapes (5.5 hours total), the MI workshop (average cost of 1- to 2-day workshop was \$229 per person), and Web site creation and maintenance costs.

Time Costs. The total staff-time cost was \$3185.08, and average staff-time cost per BIT participant (n = 227) was \$14.03. **Table 2** has a detailed description of each activity. Per-minute cost for staff was about \$0.22 for each employee. The highest staff-time cost was for MI phone calls (\$758.35).

Total Cost. The total cost for the BIT intervention was \$11,178.40. The total cost per BIT participant (n = 227) was \$49.24. These costs are broken down further in **Table 3**.

Sensitivity Analysis

Cost comparisons for different intervention scenarios are shown in **Table 4**. In the first scenario, in which a staff person at the administrative level (increased compensation) carried out all the activities required for the intervention, the total

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cost per BIT intervention participant was approximately \$20.00 higher than that in the basic scenario. In the second scenario, which excluded direct expenses for the LEARN manuals (\$3427.00), the total cost per BIT intervention participant was \$15.09 lower than that in the basic scenario.

Cost-Effectiveness Analysis

Incremental Cost-Effectiveness Analysis for Weight Measurements. Results of an incremental cost-effectiveness analysis (ICEA) and sensitivity analysis for weight and quality-of-life measurements are shown in **Table 5**. The incremental costs consisted of total BIT intervention costs only. The ICEA (basic scenario) indicated that the costs for USAF personnel to lose 1 additional kilogram of weight, lose 1 additional centimeter of waist circumference, and make 1 additional 5% or more weight change were \$25.92, \$28.96, and \$3.12, respectively. In the sensitivity analysis, favorable incremental cost-effectiveness ratios were for scenario 2.

The incremental cost per BIT participant was \$49.24. On the WEL subscales, the cost was \$37.88 for each additional point gain on the Social Pressure subscale, where increasing scores indicate increased confidence in managing social pressures to eat. Similarly, the cost for 1 additional point on the Positive Activity subscale was \$32.83 among overweight and healthy adults of the USAF. In the sensitivity analysis, favorable incremental cost-effectiveness ratios were for scenario 2.

DISCUSSION

A BIT program for weight management is a viable, cost-effective option in a diverse sample of overweight, healthy adults.

Table 1. Direct Expenses for BIT Intervention

Type of Expense	Amount, \$
Orientation for employees (one-time event for 3 employees)	362.06
Training (2 employees)	
MI books	33.34
MI tapes	66.00
MI workshop	229.00
Mileage, 6 months (for 3 employees)	696.50
Web site	
Cartoon license	700.00
Computer server	180.00
Security certificate	50.00
Domain	17.50
Office supplies	370.67
Postage	5.67
Incentives for subject retention (eg, T-shirts, magnets, mouse pads)	741.00
Food frequency questionnaire (dietary assessment)	252.00
LEARN manuals	3427.00
Photocopies (\$0.04 a page)	862.00
Total direct costs	7993.32
Total direct costs per BIT participant	35.21

BIT indicates behavioral Internet treatment; MI, motivational interviewing.

Table 2. Time Log and Time Costs for Intervention^a

Staff Activity	Minutes per Person (Total Minutes for 227 Subjects)	Total Costs, \$
Screening	5 (1135)	252.78
Scheduling for orientation	3 (681)	151.67
Orientation	10 (2270)	505.57
Weekly diary review	10 (2270)	505.57
E-mail reminder for diaries when needed	2 (454)	101.11
MI call at 4 weeks	15 (3405)	758.35
MI call at 8 weeks	15 (3405)	758.35
Scheduling for 6-month follow-up	3 (681)	151.67
Total staff time and cost	(14,301)	3185.08
Total cost per BIT participant		14.03

BIT indicates behavioral Internet treatment; MI, motivational interviewing.

^aBased on staff costs of \$0.22 per minute.

This study demonstrated that Internet-based behavioral therapy may be costly initially, but can be more cost-effective over time. The study showed that BIT cost was \$25.92 per kilogram of additional weight loss, \$28.96 per centimeter of waist circumference loss, and \$3.12 per additional 5% or more weight change. The total intervention cost was \$11,178.40. The benchmark

■ **Table 3.** Total BIT Cost and Total Cost per BIT Participant (n = 227)

Cost	Basic Scenario, \$
Total direct cost	7993.32
Total staff-time cost	3185.08
Total cost	11,178.40
Total cost per BIT intervention participant	49.24

BIT indicates behavioral Internet treatment.

for cost-effective ratios was set to \$30,000 when the results of a school-based weight-reduction program were analyzed.¹² Other behavioral studies have demonstrated similar favorable results. For example, behavioral therapy for melanoma patients was more expensive per minute compared with a standard care group, but it was shown to reduce healthcare costs by reducing distress.¹³ Use of behavioral therapy for weight loss is a cost-effective strategy.

One of the most prominent issues associated with implementing a BIT weight management intervention program is the start-up and sustainability costs. These include expenses for training, mileage, Web site upkeep, office supplies, incentive for participation, and training manuals. These direct costs are common expenses for a variety of companies, programs, and organizations. For this particular program, the total direct cost was \$7993.32 and the cost per BIT participant was \$35.21. Initially, direct costs will be inflated because of the computer equipment required for an Internet-based implementation. But over time, these costs could be paid with the money saved from the lack of facility costs. In addition to this cost-saving aspect of the program, the fewer personnel hours requirement and constant accessibility of the Internet make this service cost-effective.

In addition to the benefits of the Internet component of this program, there also are advantages to its utilization of behavioral therapy. One study that demonstrated this point is Planet Health, a middle-school intervention program. It re-

sulted in significant cost savings, with \$4305 saved per quality-adjusted life-year, and a \$7313 net saving.¹⁴ The program cost was \$17 per student each year, with a total intervention cost of \$33,677.¹⁴ In relation to other types of therapy, these results are adequate and economical. Investing in prevention is a sound economic solution to healthcare costs induced by obesity and overweight.¹⁴

In the past, most weight management economical studies have involved the use of prescription drugs.¹⁵ Our BIT program is an especially attractive economic option due to its flexibility and the reduction of professional consultation costs in the long run with behavioral change. One study examining the cost-effectiveness of prescribing sibutramine for individuals with weight problems found that the most notable cost difference was associated with the number of physician visits.¹⁵ These visits generated a median cost of \$166.46, compared with \$82.42 for individuals not taking sibutramine.¹⁵ The study found that the individuals taking sibutramine had higher healthcare costs due to the physician visits plus the cost of sibutramine itself.¹⁵ Overall, the study found that when sibutramine was added to a weight management program, the cost was an additional \$44 per pound lost; with all healthcare costs considered, the cost per pound lost was \$194.¹⁵ Our intervention's ICEA finding of only \$25.92 per kilogram clearly makes the BIT program an efficient, cost-saving intervention. Moreover, behavioral interventions may have more modest initial results that are retained longer, and individuals show better outcomes compared with those who use pharmacotherapy interventions.¹⁶

Use of the Internet means fewer work hours for personnel, resulting in substantial cost savings. There also is widespread access to the Internet, and it offers a more comfortable environment for patients due to fewer face-to-face interactions.⁵ With technology constantly changing and medical professionals continually multitasking, use of the Internet is an economically sound choice. In addition, using the Internet will allow healthcare providers to more efficiently adapt weight management programs to fit society as it evolves over time.

■ **Table 4.** Total BIT Costs and Sensitivity Analysis

Cost	Basic Scenario, \$	Scenario 1, \$ ^a	Scenario 2, \$ ^b
Total direct cost	7993.32	7993.32	4566.32
Total staff-time cost	3185.08	7722.54	3185.08
Total cost	11,178.40	15,715.86	7751.40
Total cost per BIT intervention participant	49.24	69.23	34.15

BIT indicates behavioral Internet treatment.
^aFor scenario 1, it was assumed that a staff person at the administrative level carried out all the activities required for the intervention (\$0.54/minute).
^bFor scenario 2, LEARN Manual for Weight Control costs (\$3427.00) were excluded.

Table 5. ICEA and Sensitivity Analysis for Weight Measurements and Quality-of-Life Measurements^a

Outcomes	Outcomes, ^b Mean ± SD		Incremental Outcomes	ICEA, \$		
	BIT	UC		Basic Scenario	Scenario 1	Scenario 2
Weight, kg	-1.3 ± 4.1	0.6 ± 3.4	1.9	25.92	36.44	17.97
Waist circumference, cm	-2.1 ± 4.3	-0.4 ± 3.8	1.7	28.96	40.72	20.09
Weight change of 5% or more	22.6%	6.8%	15.8	3.12	4.38	2.16
WEL subscale						
Social Pressure	2.5 ± 6.6	1.3 ± 7.1	1.3	37.88	53.25	26.27
Positive Activity	2.3 ± 5.7	0.8 ± 5.5	1.5	32.83	46.15	22.77
Availability	3.2 ± 7.0	2.2 ± 7.0	1.0	49.24	69.23	34.15

BIT indicates behavioral Internet treatment; ICEA, incremental cost-effectiveness analysis; UC, usual care; WEL, Weight Efficacy Lifestyle Questionnaire.
^aIncremental costs per participant for the basic scenario were \$49.24.
^bOutcomes were taken from a previously published article.⁵

A BIT program could be an effective method of preventive care, which would greatly benefit the healthcare system and reduce medical costs.¹⁷ Studies report that 900,000 people die every year from preventable conditions resulting from poor medical choices.^{17,18} Future studies are needed to evaluate the economic impact of Internet-based behavioral programs and to assess compliance and long-term costs.

A possible limitation for generalizability of the study results is related to the study participants, because this study was conducted with the USAF personnel, not civilians. The behaviors and perceptions of USAF personnel could be different from those of civilians. However, this study assessed and provided valuable information on implementing a BIT intervention for weight reduction, which may help policymakers to make an informed decision about incorporating this tool into managed care programs.

CONCLUSION

Favorable results from our study demonstrate that BIT is a cost-effective choice for weight management. Implementation of cost-effective Internet-based behavioral interventions for weight management would provide a valuable tool for preventive care. Managed care decisionmakers can consider this as a viable option for improving the present and future health of individuals and society.

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