Effect of Internet Support on the Long-Term Maintenance of Weight Loss

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Abstract

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Objective: To investigate the efficacy of an Internet weight maintenance program.

Research Methods and Procedures: Two hundred fifty-five healthy overweight and obese adults (mean ± SD BMI, 31.8 ± 4.1 kg/m^2) men (18%; mean ± SD age, 45.8 ± 8.9 yrs) participated in a 6-month behavioral weight control program conducted over interactive television. Treatment was followed by a 12-month weight maintenance program with three conditions: frequent in-person support (F-IPS), minimal in-person support (M-IPS) and internet support (IS). Main outcome measures included body weight, program adherence, and social influence components.

Results: There were no significant differences among the groups in weight loss (mean ± SD) from baseline to 18 months (7.6 ± 7.3 kg vs. 5.5 ± 8.9 kg vs. 5.1 ± 6.5 kg, $p = 0.23$ for the IS, M-IPS, and F-IPS, respectively).

Discussion: Participants assigned to an internet-based weight maintenance program sustained comparable weight loss over 18 months compared with individuals who continued to meet face-to-face. Therefore, the internet appears to be a viable medium for promoting long-term weight maintenance.

Key words: internet, obesity treatment, weight loss, interactive television

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Introduction

Average weight losses produced with behavioral techniques have increased ~75% over the past 20 years, primarily because of increased treatment length (1). Unfortunately, similar improvements in the maintenance of weight loss have not been realized. Typically, 4 years after behavioral treatment for obesity, weight stabilizes ~4% below baseline levels (2,3). In light of this pattern toward weight recidivism, significant energy is being targeted toward improving the long-term maintenance of weight loss.

Because the evidence clearly suggests that patients do better with extended treatment (4,5), novel approaches are needed to keep subjects engaged and involved in interventions over a longer period of time. In fact, some have argued that a chronic disease model would be more appropriate for the treatment of obesity than an acute care model that employs little or no follow-up (6). Unfortunately, current efforts to extend treatment programs have been largely disappointing. Jeffery et al. found that attendance at monthly meetings after weight loss averaged only 25% (7). Similarly, Wing et al. (8) found attendance during the first 6 months of a 2-year intervention averaged 61%, with only 27% attendance at later sessions. The use of the internet may provide an option for reducing the patient burden associated with perpetual clinic visits.

Rapid increases in access to the internet and the World Wide Web have made it a viable and logical mode for delivering health interventions. Households with personal computers grew from 8% in 1984 to more than 50% by 2001 (9). Recent estimates place from 90 to 120 million internet users in the U.S. (10,11). Additionally, nearly two-thirds of internet users are accessing health information (12). However, despite the proliferation of health intervention and education web sites (13,14), there is limited evidence that computer-based technologies can be used to support behavior change efforts (15). This is particularly true for obesity treatment. Two recent studies examining the effectiveness of weight loss programs conducted over the internet produced equivocal results. Tate et al. (16) found that participants in a 6-month internet behavior therapy program lost significantly more weight than individuals in

an internet education group. This study did not include a follow-up, and weight losses were modest compared with the 9% typically seen in face-to-face interventions. However, the investigators determined the internet to be a viable vehicle for delivering obesity treatment. Harvey-Berino et al. (17) found that subjects randomized to an internet condition gained significantly more weight during a 12-month weight maintenance program than those who continued to meet in person. Therefore, the evidence supporting the use of the internet to produce and sustain weight loss is severely limited and, at best, indeterminate.

The internet has tremendous potential as a public health tool; therefore, further investigation of its reach and potential is warranted. This is particularly true in light of the recent increases in obesity prevalence (18) and the previously cited predictable pattern of weight recidivism after weight loss (2,3). The successful long-term treatment of obesity requires a feasible and acceptable method of delivery. Therefore, the purpose of this study was to test a novel approach to sustaining long-term contact with individuals after participation in a structured behavioral weight loss program. We hypothesized that individuals randomized to an internet condition would maintain more weight loss than individuals in a comparable, in-person condition.

Research Methods and Procedures

Subjects

Two hundred fifty-five (209 women and 46 men) overweight and obese adults were recruited through newspaper advertisements placed in 10 different locations throughout the state. To assess the computer capability of prospective participants, a study web page was developed to facilitate the collection of information regarding subjects' available computer hardware and Internet access. Subjects were required to submit this information to the web site before participating in the study orientation meeting. Interested participants were further screened for eligibility through telephone interviews. Eligibility criteria included age over 18, BMI $\geq$25 kg/m^2, and a computer with at least 32 MB of RAM, a sound card, a CD-ROM drive, 200 MHz, and 22 kps actual connection speed. Subjects were ineligible if they had a history of major medical or psychiatric problems, planned a pregnancy within the next 18 months, or were unable to participate in an exercise program. All participants agreed not to participate in other weight loss treatment programs for 18 months (Figure 1).

Design

Interested individuals were asked to attend an orientation session where the study was described in more detail. Because recruitment was conducted statewide, orientation sessions were held over interactive television (ITV).[1] After attending an orientation session and signing informed consent, all subjects participated in an identical 6-month behavioral weight control intervention conducted over ITV. Only those completing the 6-month weight loss intervention were randomized to a maintenance condition. Subjects in each of the 10 ITV sites were randomly assigned to one of three weight maintenance conditions: 1) internet support (IS; $n = 77$); 2) frequent in-person support (F-IPS; $n = 77$); or 3) minimal in-person support (M-IPS; $n = 78$). All subjects were seen for assessment measures at baseline and at 6, 12, and 18 months. This study was conducted from August 2000 to November 2002 and was approved by the Committee on Human Research at the University of Vermont.

Procedures for Behavioral Weight Loss Program

To expand recruitment efforts, subjects were treated over ITV. Previous research found ITV to be a viable option for the delivery of a behavioral obesity treatment program (19). Ten ITV sites participated. The ITV group site that was closest to the university was used to broadcast the ITV sessions for all meetings. Thus, there was one local ITV site and nine that were distant from the university. These sites were geographically distributed around the state. The group therapist broadcasted treatment sessions from the ITV studio closest to the university with a live group participating in that studio and up to four additional groups simultaneously participating through distant ITV sites. All subjects could see and hear the therapist at all times, and each participant could be heard by all others by speaking into their own microphone. The audio system activated the video system; thus, participants were always on camera and visible when they were speaking.

The weight loss treatment program focused on the modification of eating and exercise habits through the use of behavioral strategies and self-management skills. Subjects met weekly for 1 hour, and printed lessons were given out to reinforce the weekly discussion. Subjects were instructed to reduce their caloric intake to 4186 to 10,465 kJ/d, depending on their baseline body weight. Calorie goals were determined by multiplying baseline weight in pounds by 12 (to get an estimate of current calorie consumption) and subtracting 1000 calories. This method has been used in previous studies and is known to encourage a weight loss of 1–2 lbs/wk (20). Graded goals for programmed activity (i.e., walking) were used throughout the program, and patients were encouraged to expend at least 1000 calories/wk in physical activity. Subjects were instructed to record their dietary intake and the amount of energy expended in physical activity daily. Their self-monitoring diaries were re-

[1] Nonstandard abbreviations: ITV, interactive television; IS, internet support; F-IPS, frequent in-person support; M-IPS, minimal in-person support.

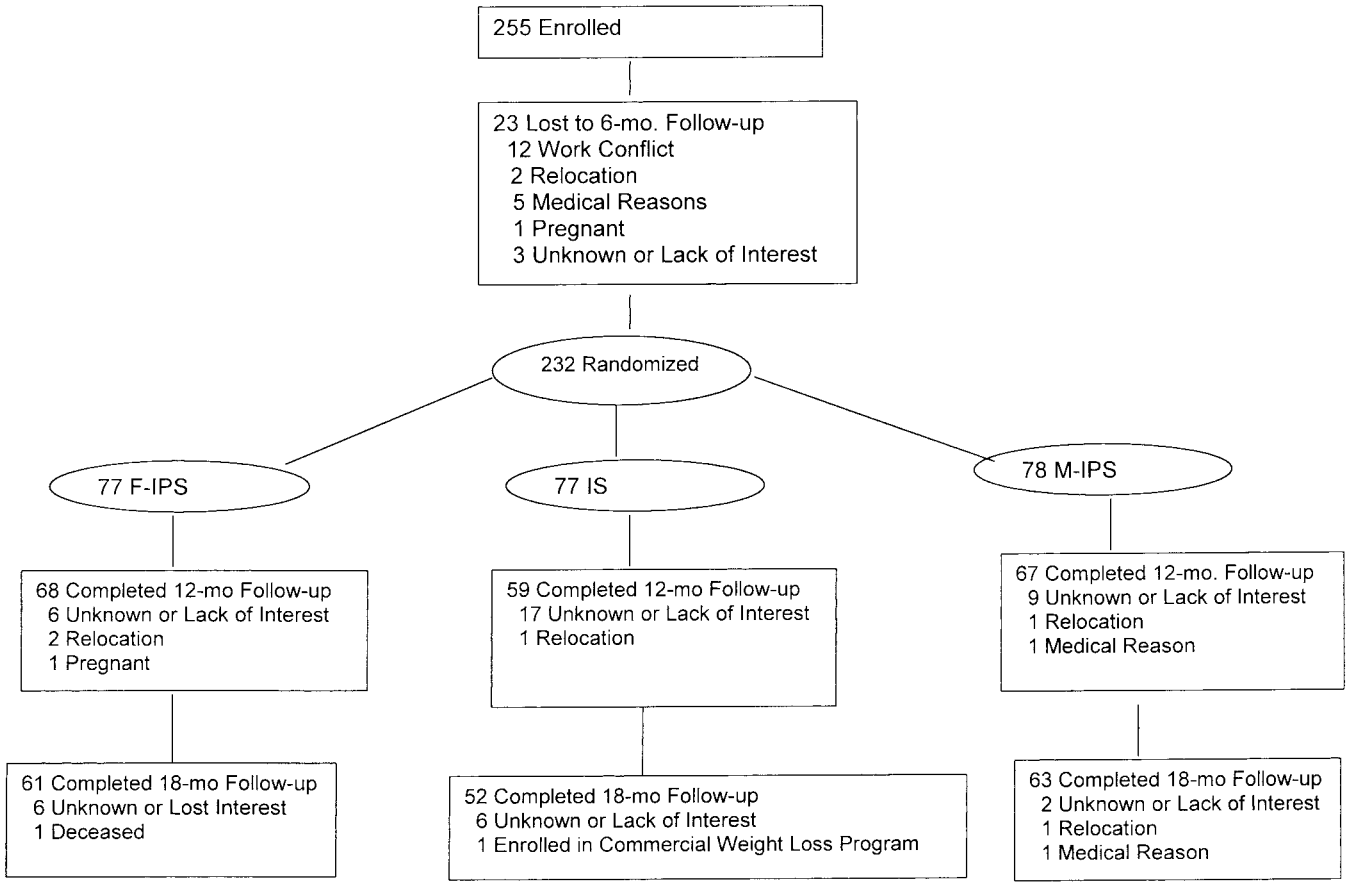

Figure 1: Participant flow.

viewed and advice was given on strategies for lowering caloric intake while maintaining a nutritionally balanced diet.

To facilitate communication, each distant site had a site facilitator. Local health educators and dietitians served in this capacity. The site facilitator weighed participants before each weekly meeting, reviewed self-monitoring diaries weekly for participants of their site, and were generally the local contacts for their group. Whereas site facilitators were trained in how to weigh participants and review self-monitoring diaries, they were not trained behavior therapists and did not deliver any of the weight loss therapy sessions. Generally, site facilitators gave written positive feedback in the self-monitoring diaries regarding healthy food choices, participation in physical activity, and attempts to successfully meet program goals. The same feedback was given by the primary therapist who was responsible for the groups closest to the University.

Maintenance Interventions

During the 12 months of maintenance, subjects were told to continue with their diet and exercise prescriptions. The primary study therapist was a Master's level dietitian trained in behavioral weight control techniques. F-IPS and IS group sessions differed only in the method of delivery.

F-IPS. Both the F-IPS and IS maintenance conditions were based on the multi-component weight maintenance programs of Perri et al. (21) (Table 1). The F-IPS group met in person at their local ITV studio on a bi-weekly basis for 52 weeks. Subjects turned in their self-monitoring diaries, got weighed, and participated in a discussion facilitated by the group therapist. These discussions focused on problem-solving difficult eating and exercise situations. On the weeks when the group was not meeting, subjects received a phone call from the group therapist and submitted their self-monitoring data (energy intake, exercise energy expenditure, and body weight) through postcards supplied by the investigators. Subjects in the IS and F-IPS conditions also participated in a social-influence peer-support program. Every week they had the opportunity to earn points for adhering to the following program goals: 1) staying within their calorie goal; 2) meeting or exceeding their exercise goal; 3) returning their self-monitoring data; 4) attending the group meeting or mailing in their postcard; and 5) initiating contact with group members. These points were converted into lottery tickets (i.e., the more points you earned the greater

Table 1. Maintenance conditions

Frequent in-person support	Internet support
Bi-weekly therapist-led contacts (weigh-ins, group meetings, review of self-monitoring diaries)	Bi-weekly e-mail contact with therapist. Subjects self-reported weight, dietary intake, and exercise data, which were reviewed on-line.
Therapist-led problem solving discussions of difficulties encountered in maintaining eating and exercise behaviors	Therapist-led problem solving discussions of difficulties encountered in maintaining eating and exercise behaviors, conducted via Internet chat sessions.
Peer-initiated phone and group contact to encourage social support	An e-mail discussion group (moderated) was initiated for subjects to converse with each other as often as they would like.
Phone and mail contact during weeks when therapist-led group did not meet.	Brief e-mail contact initiated by the therapist bi-weekly.

your chances of winning), and subjects had the chance to win $25 per week in the lottery.

IS. All participants in the IS condition attended an initial technical orientation session led by one of the study co-authors (P. B. or S. P.). Participants were taught the basic procedures for logging in to the study web site and for accessing the electronic self-monitoring forms and dietary analysis program, and procedures for chat room and bulletin board functions. Each participant was given a unique login name and numerical password, and all Web-based data collected were stored using this numerical password.

Subjects attended bi-weekly maintenance meetings in the form of an internet chat session. Subjects entered the chat room at a prearranged time, and the discussion was facilitated by the group therapist. Before joining the chat room, participants entered their self-monitoring data on a form set up on the study web page. The group therapist then initiated a short introduction of that week's lesson topic. This was done to keep the content of the group discussion as similar as possible between the F-IPS and IS groups. During the weeks when the group was not meeting, subjects received an e-mail from the group therapist, and they had the opportunity to enter their weekly self-monitoring data on the web page form. They similarly participated in the weekly lottery and had the opportunity to earn points for lottery tickets for engaging in the same behaviors as the F-IPS group. Group members could contact each other by e-mail, by posting questions to a bulletin board on the study web site, or by making appointments to chat with each other in the chat room. All investigator-initiated communication with the IS group was done electronically.

M-IPS. Participants randomized to the M-IPS condition continued to meet in-person over ITV, monthly, for the first 6 months of the 12-month weight maintenance condition. At these meetings, weight was measured, and subjects attended an hour-long weight maintenance support group. They were encouraged to continue self-monitoring, although their diaries were not reviewed by the therapist. Subjects in this group were not contacted between monthly meetings, and there was no contact from months 7 to 12.

Assessments

The following measures were obtained at 0, 6, 12, and 18 months at the ITV studios:

1. Body weight was measured on a beam-balance scale, with participants in their street clothes and without shoes. Height was self-reported at baseline.
2. Energy intake was measured using the Block Food Frequency Questionnaire (22) and analyzed using the National Cancer Institute Dietary Analysis System 4.01 software program (National Cancer Institute, Bethesda, MD).
3. Energy expended in physical activity was measured at 0, 6, 12, and 18 months using the Paffenbarger Physical Activity Questionnaire (23).

A number of process measures were used in an effort to identify the mediators of change in weight. These included the following:

1. Computer experience and comfort. At baseline, subjects were asked to choose one of the following statements to describe their computer ability: 1) novice with little or no computer experience; 2) comfortable with basic software applications; 3) comfortable with basic software applications and the internet; 4) hobbyist with more advanced understanding of software and hardware; or 5) computer professional. They were additionally asked to rate their level of comfort with computers and computer technology on a 10-point scale where 1 = profoundly uncomfortable and 10 = extremely comfortable.

2. Attendance at group meetings and chat sessions was recorded.
3. Adherence to self-monitoring was assessed by calculating the number of weeks subjects in the F-IPS and IS groups submitted self-monitoring records. This included data submitted through the study web page by the IS group members and postcard and diary data submitted by the F-IPS group members.
4. Social influence components were assessed in the M-IPS, F-IPS, and IS conditions at the 6- and 12-months assessments and by the F-IPS and IS conditions at the 18-month assessment. The Perceived Social Support Scale (24) was used to measure the degree to which subjects felt supported by their group members. The scale had 20 items, and each item was given one point if the respondent reported feeling supported; therefore, higher scores represented more perceived support. The scale has been shown to have good internal consistency (0.90), good test-retest reliability (0.83), and good predictive validity (24). The quality of the therapist/patient relationship was assessed with the bonding subscale of the Working Alliance Inventory (25). The bonding subscale contained 12 items that were coded on a 7-point scale from 1 = never to 7 = always and has been shown to have good convergent and divergent validity and an internal reliability estimate of 0.85 (25). Higher scores represented better bonding with the group therapist.

Statistical Analysis

All data entry and analysis were completed by staff that was blinded to subject condition. Data were analyzed using SPSS version 10.05 software (SPSS Inc., Chicago, IL). Comparisons of baseline data were performed using a one-way ANOVA. The a priori hypotheses were examined using a two-factor (group $\times$ time) repeated measures ANOVA, and additional analyses were performed using a one-way ANOVA. A χ^2 test was used to assess demographic and distribution patterns for subjects who dropped out and for those who achieved intervention goals. Statistical significance was defined as $p \leq 0.05$. All data were analyzed using intention-to-treat analysis unless otherwise specified. For missing data, we assumed that there was a return to baseline values for weight, exercise, and calorie intake.

A power analysis based on weight loss at 18 months was conducted before recruitment. Using an α level of 0.05 and a power of 87%, a sample size of 60 individuals per group was needed to detect a 2-kg difference between groups. Assuming an attrition rate of 25% (26), a sample of at least 240 subjects was necessary.

Results

Characteristics of study participants at baseline (month 0) and after randomization (month 6) are shown in Table 2 by maintenance group condition. Subjects were between the ages of 20 and 78 years, white, and predominately well educated. The majority of subjects were skilled in basic computer applications and were comfortable using computers. There were no significant baseline differences among groups for any of the dependent variables.

Attrition was 9% after 6 months of treatment and 24% over the 12 months of the maintenance intervention. Sixty-nine percent of participants provided data at all assessment points. Whereas there was no statistically significant difference among treatment groups in the percentage of participants completing assessments (IS, 67%; F-IPS, 79%; M-IPS, 80%; $p = 0.12$), there was a higher attrition rate in the IS group. Participants who did not complete all assessments lost less weight over the first 6 months of treatment (5.2 ± 4.3 vs. 8.4 ± 5.4 kg, $p < 0.01$) and were younger (44.0 ± 9.6 vs. 46.8 ± 8.5 years, $p = 0.04$). However, they did not differ from those who completed measures on baseline BMI, marital status, education, computer comfort or ability, or ratings of perceived support and therapeutic alliance at the 6-month measure. Because attrition seemed to be higher in the IS group, a similar analysis was done to examine possible differences between those who completed assessments in this condition and those who did not. Subjects in the IS group who did not complete assessments were less educated (53% vs. 27% had completed some college or less and 46% vs. 73% had completed college or graduate/professional school, $p = 0.05$). Additionally, those who did not complete assessments lost less weight during the first 6 months of treatment (5.5 ± 4.3 vs. 9.3 ± 6.3, $p < 0.05$). There were no differences by IS group attrition in age, marital status, baseline BMI, reported computer ability or comfort at baseline, or ratings of perceived support and therapeutic alliance at the 6-month measure. Finally, of those in the IS condition with broadband access, 43% dropped out and 57% did not ($p = 0.20$).

Body Weight Change

Mean changes in absolute body weight by treatment group are shown in Figure 2 for the 176 subjects with complete assessment data (52 IS, 61 F-IPS, 63 M-IPS). There was no significant difference among the groups in the amount of weight lost during the initial 24-week treatment, with all conditions combined losing an average of 7.8 ± 5.3 kg (Table 2). Repeated measures ANOVA examining weight showed a significant time effect ($p < 0.001$) but no treatment $\times$ time interaction ($p = 0.51$). Additionally there was no significant difference by condition in the percent of weight loss that was maintained at 18 months (8.2% vs. 5.6% vs. 6.0% for the IS, F-IPS, and M-IPS, respectively, $p = 0.22$), nor was there any difference in the percent of subjects in each condition who were able to sustain at least a 5% weight loss at 18 months (62% vs. 46% vs. 49% for the IS, F-IPS, and M-IPS, respectively, $p = 0.23$). Finally,

Table 2. Characteristics of participants at baseline and after randomization

	Baseline (n = 255)	Internet support (n = 77)	Minimal in-person support (n = 78)	Frequent in-person support (n = 77)
Age (years)	45.8 ± 8.9	46.5 ± 9.8	46.5 ± 7.7	45.2 ± 8.9
BMI (kg/m^2)	31.8 ± 4.1	29.3 ± 5.2	29.0 ± 4.3	28.9 ± 3.8
Weight (kg)	89.4 ± 15.2	82.7 ± 16.3	80.5 ± 14.4	81.2 ± 14.2
Weight Loss (kg)*		8.4 ± 6.1	7.6 ± 4.9	7.6 ± 5.0
Gender				
Women	209 (82)	62 (81)	67 (86)	65 (84)
Men	46 (18)	15 (19)	11 (14)	12 (16)
Education				
High School	24 (9)	9 (12)	8 (10)	6 (8)
Some College	73 (29)	19 (25)	19 (24)	23 (30)
College Degree	75 (29)	22 (29)	26 (33)	22 (29)
Graduate School	83 (33)	27 (35)	25 (32)	26 (34)
Marital Status				
Married	194 (76)	60 (78)	62 (79)	58 (75)
Separated/Divorced/Widowed	34 (13)	11 (14)	11 (14)	8 (10)
Never Married	26 (10)	6 (8)	5 (6)	11 (14)
Computer Ability				
No Experience	5 (2)	3 (4)	0 (0)	1 (1)
Basic Software	10 (4)	4 (5)	4 (5)	1 (1)
Software + Internet	181 (71)	51 (7)	58 (74)	57 (74)
Hobbyist	48 (19)	14 (18)	15 (19)	15 (19)
Professional	12 (5)	5 (6)	1 (1)	3 (4)
Computer Comfort	7.3 ± 1.7	7.2 ± 1.8	7.5 ± 1.6	7.2 ± 1.6

* Weight loss from month 0 to 6.

there was no significant difference in weight loss during treatment (months 0 to 6) by ITV site (7.3 ± 5.8 vs. 8.1 ± 5.1 kg for local and remote ITV sites, respectively, p = 0.33). Therefore, although the IS group sustained a larger weight loss by 18 months (7.6 ± 7.3 vs. 5.1 ± 6.5 vs. 5.5 ± 8.9 kg for IS, F-IPS, and M-IPS, respectively, p = 0.23) and a higher percent of subjects in that condition achieved a long-term weight loss of at least 5%, this difference did not achieve statistical significance. Examining the intention-to-treat analysis revealed the same results, with the IS, F-IPS, and M-IPS groups maintaining similar weight losses (4.7 ± 6.9 vs. 3.9 ± 5.9 vs. 4.2 ± 7.9 kg, respectively, p = 0.77).

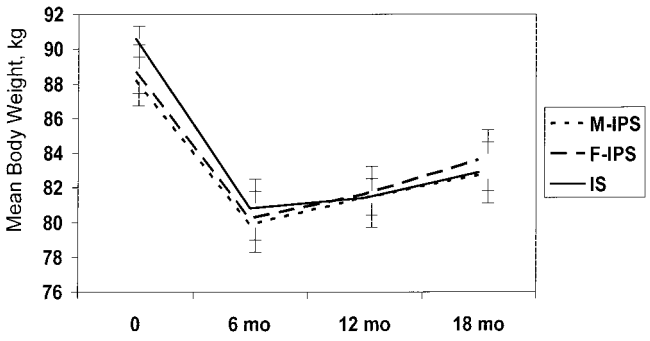

Figure 2: Change in body weight by condition.

Adherence to Treatment Goals

Additional analyses explored differences in adherence to treatment goals by condition. Differences by condition in attendance, submission of weekly self-monitoring diaries, and peer support contacts initiated are presented in Figure 3. Because the M-IPS group met only six times during the 12 months of maintenance and were not required to submit self-monitoring diaries, they were excluded from this analysis. Subjects in the F-IPS condition attended significantly more maintenance group meetings than those in the IS

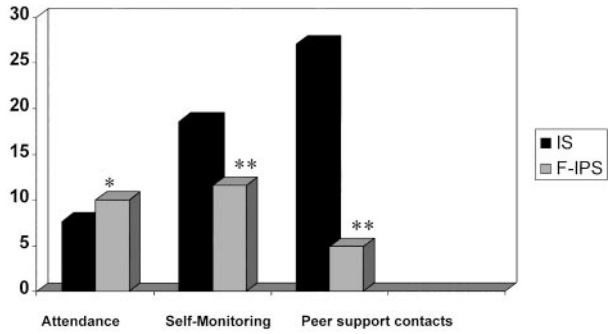

Figure 3: Adherence to treatment goals for the F-IPS and IS conditions.

condition (10 ± 5.1 vs. 7.7 ± 5.3 meetings attended, $p = 0.02$). Subjects in the IS condition submitted self-monitoring diaries more frequently (18.6 ± 13.2 vs. 11.6 ± 13.2 weeks for the IS and F-IPS, respectively, $p < 0.01$) and reported significantly more peer support contacts than those in the F-IPS condition (27.1 ± 58.2 vs. 4.9 ± 17.4 for the IS and F-IPS conditions, respectively, $p < 0.01$). Both attendance at treatment meetings and chat sessions, as well as frequency of self-monitoring, were positively correlated with weight loss from baseline to 18 months ($r = 0.26$, $p < 0.01$ for attendance; $r = 0.33$, $p < 0.01$ for self-monitoring).

Changes in reported physical activity were examined using repeated measures ANOVA. There was a significant time effect ($p < 0.001$) but no group × time effect ($p = 0.77$). All groups significantly increased reported physical activity during treatment (2735 ± 5397 kJ/wk; $p < 0.01$). Repeated measures ANOVA showed a significant time effect ($p < 0.001$) but no group × time interaction ($p = 0.67$) for changes in energy intake. All groups significantly decreased reported energy intake during the first 6 months of treatment (−2223 ± 2497 kJ/d).

Social Influence Components

Changes in perceived social support (24) and the working alliance inventory (25) were examined for all three conditions at the 6- and 12-month assessments. Only the F-IPS and IS conditions reported on perceived social support and the working alliance at 18 months (data not shown). There were no significant differences in perceived group support or therapeutic alliance by condition for any of the times examined.

Discussion

Conventional wisdom posits that longer obesity treatment programs enhance weight loss and the maintenance of weight loss (3). Unfortunately, sustaining contact with patients over a long period of time has been problematic. The results of this study showed that the internet was an effective vehicle for promoting long-term clinically significant levels of weight loss. Weight losses as little as 5% of baseline body weight have been shown to substantially reduce morbidity associated with obesity-related conditions (27). One year after participating in a behavioral weight loss program, 62% of internet group participants had sustained a weight loss of at least 5%. These results are in direct contrast to our previous study on the use of the internet for promoting weight maintenance (17). Individuals in that study who were randomized to internet support had significantly poorer long-term weight loss than those treated in person. However, a closer examination of the data suggests that the difference is attributable primarily to the poorer performance of the in-person groups in this study compared with a better performance of the internet group. In our previous trial, subjects in the in-person groups maintained an average weight loss of 10.4 kg over 18 months, with 81% sustaining a weight loss of at least 5% (17). Subjects in the in-person conditions of this study did half as well, with a sustained average weight loss of 5.1 kg and only ~47% achieving a weight loss of at least 5%. Initial treatment, in the current trial, was conducted over ITV—an approximation of face-to-face contact. Previous research from our group found that ITV was a viable alternative to face-to-face treatment (19), with subjects losing equivalent amounts of weight compared with those treated in person (7.6 vs. 7.9 kg over 12 weeks). In the present study, subjects lost an average of 7.8 kg over 24 weeks, an amount substantially below that achieved by subjects in our previous ITV study. More importantly, subjects in this study lost less weight over ITV (7.8 kg) than those treated in person in our first internet trial (9.5 kg) (17). Therefore, although ITV allows for broader intervention dissemination, the effectiveness may not be as potent as once thought. It is, however, important to point out that ITV and other similar forms of communication technology still have great potential as public health tools. A population-based weight loss of 7.8 kg (or ~6.2% of baseline body weight) would have a tremendous public health impact. Despite the diminished initial weight loss in this study, subjects in the internet condition ultimately fared as well as those who attended maintenance group meetings with a televised therapist but live group members. It is reasonable to assume that larger initial weight losses would have resulted in even better maintenance results given the pattern of long-term weight change that emerged in this study.

It is interesting to note that there were no weight loss differences between the F-IPS and M-IPS conditions. These results are in agreement with our previous internet study but remain contrary to the majority of those in the

literature. For example, Perri et al. (28) found that those with bi-weekly post-treatment contact over 12 months sustained a significantly greater weight loss than those with no further post-treatment contact. However, at least one other study found no advantage to an ongoing 12-month maintenance program (29). While subjects in the M-IPS condition were not a true "no treatment control," we hypothesized, based on previous research (30), that subjects in both the intensive support conditions (IS and F-IPS) would do better than those in the M-IPS condition. Instead of observing weight loss based on intensity and method of contact, we were perhaps observing weight changes that were attributable only to the medium of contact. Future research may need to re-evaluate the relative merits of frequent vs. infrequent post-treatment contact for weight maintenance.

Admittedly, this study was powered to detect a difference in weight loss among groups. It is, therefore, more difficult to interpret a nonsignificant finding and is certainly more problematic to assert with confidence that there were, in fact, no differences. However, given the weight loss differences obtained in each condition at 6, 12, and 18 months, an ad-hoc power analysis was calculated to determine the sample size that would have been necessary to detect differences. Using an α level of 0.05 and a power of 83%, a sample size of 1500 individuals per group would be necessary to detect group differences, with 2000 per group needed to observe any interaction effects with reasonable power. Therefore, the necessity of such a large sample size calls into question the clinical relevance of such a small difference in weight loss. Additionally, another important issue to consider when interpreting the weight loss data is the attrition rate in this study. The overall attrition rate for the study was 31%, with 25% attrition during maintenance (33%, 21%, and 20% for the IS, F-IPS, and M-IPS, respectively). Generally, attrition rates in behavioral weight loss programs of this duration tend to range between 20% and 25% (26). Therefore, our rate was higher than expected and higher than we have observed in previous studies conducted by our research group (17,19,31). Whereas there were no statistically significant differences in attrition by condition, it is very clear that the high level of attrition was driven by the IS group. Both of the in-person groups experienced predictable levels of attrition. However, only 67% of the subjects in the IS group completed the study. Therefore, whereas the IS group sustained the same, and even somewhat better, levels of weight maintenance, fewer individuals elected to continue with this mode of intervention delivery. What this may imply is that internet-based interventions are not universally appealing to everyone with an internet connection. Our attempts to identify differences between those who left the internet condition and those who remained generally failed. Aside from losing less weight during treatment, the only difference was one of educational attainment, with those who had less education being more likely to drop out. Interestingly, it is not clear how having less education might be related to dissatisfaction with the internet intervention, because there were no differences by attrition in rated computer comfort, computer ability, or job attainment. Further research will need to examine carefully who is best served by internet programming and under what circumstances. Type of intervention (32) (e.g., behavior change vs. knowledge gain), schedule of contact (33), type or severity of disease or illness (34), and degree of isolation of the participant (35) have all been shown to be relevant with regard to the success of internet program outcomes.

A number of process measures were examined in an effort to identify the mediators of change in weight. Whereas the attendance rate was better for the in-person compared with the internet condition, the internet group was more likely to continue to self-monitor their eating and exercise behavior and initiate peer support contacts. Attendance and self-monitoring are associated with weight loss both in this study and in the literature overall (36,37). Because there were no significant weight loss differences among groups, it seems that any advantage obtained by better attendance was canceled out by less self-monitoring, and vice versa. Whereas electronic self-monitoring, through the use of hand-held devices, has been studied previously (38), the relative advantage compared with paper and pencil is not clear. The results of this study suggest that there is value in initiating a further investigation of electronic modes of self-monitoring. The attendance rate at group chat sessions in the internet group was similar to that observed in our previous internet study (17), where it was also significantly lower than in the in-person group. It is not clear what was responsible for the lower attendance rates, particularly in light of the similarity observed between conditions in ratings of perceived group support and bonding with the group therapist. In fact, numerous investigations have found that a therapeutic alliance can be successfully fostered over telecommunications technology (39–41).

In summary, the results of this study showed that an internet weight maintenance program could sustain comparable long-term weight loss compared with a similar program conducted in person and over the phone. Unfortunately, who is best suited to this method of intervention delivery is not completely clear. However, given the growth in obesity rates and the tremendous potential of the internet to deliver public health interventions, further research in this area is warranted.

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