

# Internet-Based Weight Control: The Relationship Between Web Features and Weight Loss

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## Abstract

*Internet-based weight control programs have been showing promising results; however, as of yet, it is unclear which website components are critical for producing and maintaining weight loss. The aim of this study is to examine the utilization patterns of a weight control website and the relationship of the Web features to weight loss and maintenance. One hundred and twenty three (N = 123) participants took part in a 12-month behavioral weight control program over the Internet and their website utilization patterns were monitored. When examining the clustering of Web feature utilization and weight loss, the “feedback” factor (progress charts, physiological calculators, and past journals) was the best predictor of weight loss during the treatment period (baseline to 6 months), while the “social support” factor (Web chats and biographical information/e-mail addresses of participants) was the best predictor during maintenance. Weight loss in an online weight control program was related to dynamic Web features that provided feedback, support, and motivation to participants.*

**Key words:** *Internet-based weight control programs; Web features; VTrim; focus groups*

## Introduction

Structured, facilitated behavioral therapy is the standard treatment for mildly or moderately overweight individuals. Weight losses equivalent to 10% of baseline weight, or about 9–10 kg, over 20–26 weeks are typical.<sup>1,2</sup> The health benefits associated with this degree of weight loss are compelling.<sup>3</sup> Potentially due to the cost or inconvenience of current treatment options, relatively few individuals who could benefit from weight-loss programs are participating in them.<sup>4</sup> Weight control programs conducted by mail, telephone, and television have shown promise as alternatives to in-person treatment,<sup>5–7</sup> and the Internet has recently emerged as a promising way to reach greater numbers of individuals, particularly those in remote areas. A majority of Americans have access to the Internet (63%–75%) and between 35% and 44% report using the Internet as a source for health, nutrition, or exercise information.<sup>8,9</sup>

The literature on Web-based weight loss therapy suggests that the Internet is a promising weight-loss treatment modality.<sup>10–13</sup> Incorporating behavioral therapy principles<sup>12</sup> and including therapist contact via e-mail<sup>13</sup> appear to improve the success of an online weight-loss program. Internet behavioral weight-loss programs may also promote peer-to-peer support<sup>10,11</sup> through chat rooms and bulletin boards, and facilitate self-monitoring<sup>11</sup> more than in-person programs do. To encourage participants to access the lessons and resources, it has been suggested that future public health Internet interventions utilize high-quality, dynamic websites with entertaining, frequently updated features and a high volume of therapist-initiated and automatic feedback.<sup>14,15</sup>

Given the wide reach of the Internet and the potential cost-effectiveness of this approach, it is important to continue to explore

the role of online weight management. There has been a proliferation of online weight-control programs in recent years and generally, an "everything but the kitchen sink" approach has been used. This study was part of a larger study examining the efficacy of Web-based weight-loss techniques. The purpose of the current analysis was to explore the utilization of various weight-control website components and their impact on weight loss.

## Methods

### PARTICIPANTS

One hundred and twenty-three ( $n = 123$ ) overweight and obese adults were recruited from 2003 to 2005 through newspaper advertisements. Interested participants were directed to a secure website, which screened out individuals who did not meet study eligibility criteria. Eligibility criteria included: 18 years or older, body mass index (BMI)  $>25$  and  $\leq 39.9$  kg/m<sup>2</sup>, and access to a computer with at least 64 MB RAM, a sound card, 350 MHz processor, and a 33 kilobits per second (Kbps) connection speed and an adequate Internet connection. Potentially eligible participants were interviewed over the telephone. Participants were ineligible if they had a history of major medical or psychiatric problems that would affect their weight or inhibit compliance with diet and/or physical activity prescriptions. Additional exclusion criteria included planning to move from the area within the next year, smoking, taking medications associated with weight change, planning a pregnancy in the next year, and conflicts with scheduled meeting times. All participants agreed that they would not participate in other weight-loss treatment programs during the course of the study.

### PROCEDURE AND TREATMENT

Participants attended an orientation that described the study protocol in detail, and informed consent was obtained. Individuals attended a second orientation to learn how to use the study's website ("VTrim"), including the food and exercise self-monitoring journals, the chat room, and the bulletin board.

Participants received standard behavioral weight-loss treatment over 12 months, which focused on changing dietary and physical activity patterns through behavior modification strategies. Lesson topics included stimulus control, problem solving, goal setting, social support, and relapse prevention. Weekly group Web chat sessions were offered during the treatment period from months 0–6 with monthly maintenance meetings held from months 7–12. The maintenance period targets maintaining skills learned during treatment with less program structure to allow the participants more independence in managing their lifestyle behaviors. A registered dietitian or

a master's level graduate student, both trained in behavior therapy principles and the VTrim curriculum, facilitated Web chats and in-person meetings.

Participants reviewed each week's lesson and submitted, electronically, the corresponding homework assignment to their facilitator before the meeting. The facilitators provided weekly, personalized feedback on self-monitoring journals and homework assignments. Participants also received automated feedback from the website itself (e.g., upon lesson completion or submission of a food/exercise diary). Postings to online bulletin boards and e-mail interactions with the group therapist and other members were encouraged.

Participants were prescribed calorie goals of between 1,200 to 2,100 calories, based on baseline body weights. Calorie goals were determined by multiplying body weight by 12 to estimate current daily intake needs, and then subtracting 1,000 calories to produce a loss of 1 to 2 pounds per week.<sup>10,11,16</sup> Participants were instructed to gradually increase their exercise energy expenditure up to 1,000 calories per week, and they were instructed to record their energy intake and exercise in an online diary.

### WEBSITE DESIGN

The website was developed based on the results of three sets of focus groups: (1) previous participants in an Internet weight control intervention of one of the authors (JHB) ( $N = 17$ ), (2) previous participants in an in-person weight-control intervention of the same author ( $N = 12$ ), and (3) individuals who had lost weight but did not participate in any of the author's research ( $N = 9$ ). During the focus groups, participants analyzed three other weight control websites and suggested potential website features. After the website was developed, the same 38 individuals were asked to beta-test the site; specifically, participants submitted comments on the functionality, aesthetics and content of each website feature. Based on this input and knowledge of the behavioral principles necessary to promote weight loss, the website design was finalized, and included 24 different components (Table 1).

### MEASURES

Weight was measured on a beam-balance scale (Health-o-meter ProSeries, Pelstar LLC, Bridgeview, IL) at baseline, 6 months, and 12 months, with participants in street clothes without shoes. Self-reported height was collected at baseline. Website usage (i.e., number of log-ins and utilization of various Web features) was automatically tracked throughout the study. Dietary intake, physical activity levels, computer ability and attitudes, and measures of social influence were also assessed and have been reported elsewhere.<sup>17</sup>

**Table 1. Theoretical Conceptualization of Website Components**

|  | EDUCATION/<br>SKILL<br>BUILDING | PROMOTE<br>TREATMENT<br>COMPLIANCE | PROMOTE<br>SELF-<br>MONITORING | PROMOTE<br>CALORIE GOAL<br>COMPLIANCE | PROMOTE<br>EXERCISE<br>GOAL<br>COMPLIANCE | FEEDBACK | SOCIAL<br>SUPPORT |
|--|---------------------------------|------------------------------------|--------------------------------|---------------------------------------|---|----------|-------------------|
| Lessons/homework   | x                               |                                    |                                |                                       |   |          |                   |
| Web chats  | x                               |                                    |                                |                                       |   |          | X                 |
| Portion size guide   | x                               |                                    | x                              |                                       |   |          |                   |
| "Carmen's story" (motivational mascot)                     |                                 | X                                  |                                |                                       |   |          |                   |
| "Need a boost" (motivational tips)                         |                                 | X                                  |                                |                                       |   |          |                   |
| "Challenges"   |                                 | x                                  |                                | x                                     | x   |          |                   |
| News flashes   |                                 | x                                  |                                |                                       |   |          |                   |
| Local events guide   |                                 | x                                  |                                |                                       |   |          |                   |
| "Pantry" (calories in frequently eaten foods)              |                                 |                                    | x                              |                                       |   |          |                   |
| Printable journal  |                                 |                                    | x                              |                                       |   |          |                   |
| USDA calorie database                                      |                                 |                                    | x                              | x                                     |   |          |                   |
| Recipes  |                                 |                                    |                                | x                                     |   |          |                   |
| "Pantry list" (shopping list of healthy foods)             |                                 |                                    |                                | x                                     |   |          |                   |
| CalorieKing website  |                                 |                                    | x                              | x                                     |   |          |                   |
| Menu planner   |                                 |                                    |                                | x                                     |   |          |                   |
| Dining-out guides  |                                 |                                    |                                | x                                     |   |          |                   |
| Exercise expenditure counter                               |                                 |                                    | x                              |                                       | x   |          |                   |
| Past journal feedback                                      |                                 |                                    |                                |                                       |   | x        |                   |
| BMI, waist-to-hip ratio, and target heart rate calculators |                                 |                                    |                                |                                       |   | x        |                   |
| Progress graphs  |                                 |                                    |                                |                                       |   | x        |                   |
| Bulletin board   |                                 |                                    |                                |                                       |   |          | x                 |
| Biographical information/e-mail addresses                  |                                 |                                    |                                |                                       |   |          | x                 |

USDA, U.S. Department of Agriculture; BMI, body mass index.

**STATISTICAL ANALYSES**

The analyses focused on Web use during treatment (0–6 months) and maintenance (7–12 months) for subjects with complete weight data at baseline, 6, and 12 months. Outliers were examined, and one participant was removed from the analyses as an outlier. Given the large number of Web features, exploratory factor analysis with a vari-

max rotation was used to examine the clustering of the feature use with Scree plots, and factor loadings were examined to determine the number of factors for the treatment and maintenance periods. Factor loadings above 0.40 were used as a minimum for inclusion in a factor. Additive factor scales were constructed and Cronbach's  $\alpha$  values, which reflect the average correlation between items and are indica-

tive of a single factor when the value is closer to 1, were obtained to assess internal consistency reliability. Cronbach's  $\alpha$  values greater than 0.70 indicate good internal reliability. Linear regression models were used to examine the relationship between the additive factor

scales and weight loss at each time point, with and without adjusting for weight at baseline or weight at the beginning of maintenance. Data were analyzed using SAS Version 9.1 (SAS Institute, Cary, NC) using a 5% significance level for formal testing. All procedures were

**Table 2. Factor Loadings of Web Feature Utilization During Treatment (0–6 months)**

|   | FACTOR 1:<br>MOTIVATION/<br>SUPPORT | FACTOR 2:<br>FEEDBACK | FACTOR 3:<br>EDUCATION | FEATURE<br>UTILIZATION<br>(MEAN $\pm$ SD) |
|---|-------------------------------------|-----------------------|------------------------|---|
| Bulletin board  | 0.75                                | 0.42                  | 0.14                   | 82.9 $\pm$ 82.6                           |
| CalorieKing website   | 0.53                                | 0.50                  | -0.10                  | 61.3 $\pm$ 71.4                           |
| Biographical information/e-mail addresses                     | 0.50                                | 0.10                  | 0.41                   | 12.4 $\pm$ 12.5                           |
| "Carmen's story" (motivational Mascot)                        | 0.62                                | 0.44                  | 0.06                   | 7.1 $\pm$ 10.8                            |
| Local events guide  | 0.56                                | 0.23                  | 0.27                   | 3.0 $\pm$ 4.2                             |
| "Pantry list" (shopping list of healthy foods)                | 0.60                                | -0.09                 | -0.08                  | 1.4 $\pm$ 2.5                             |
| "Need a boost" (motivational tips)                            | 0.51                                | 0.04                  | 0.18                   | 0.8 $\pm$ 1.1                             |
| Past journals (with facilitator feedback)                     | 0.45                                | 0.71                  | 0.14                   | 36.8 $\pm$ 37.6                           |
| Progress graphs   | 0.27                                | 0.80                  | 0.07                   | 35.9 $\pm$ 54.0                           |
| Body mass index calculator                                    | 0.19                                | 0.65                  | 0.12                   | 1.6 $\pm$ 2.4                             |
| Waist-to-hip ratio calculator                                 | 0.03                                | 0.50                  | -0.01                  | 0.3 $\pm$ 0.6                             |
| Target heart rate calculator                                  | -0.03                               | 0.44                  | 0.17                   | 0.8 $\pm$ 1.0                             |
| "Pantry" (calories in frequently eaten foods)                 | 0.17                                | -0.003                | 0.61                   | 73.4 $\pm$ 109.5                          |
| USDA calorie database   | -0.09                               | -0.13                 | 0.63                   | 37.3 $\pm$ 41.6                           |
| Web Chats   | 0.20                                | 0.32                  | 0.42                   | 22.7 $\pm$ 12.7                           |
| Lessons   | 0.41                                | 0.19                  | 0.55                   | 33.2 $\pm$ 14.8                           |
| Exercise expenditure counter                                  | -0.19                               | 0.44                  | 0.47                   | 23.8 $\pm$ 38.1                           |
| "Challenges"  | 0.48                                | 0.18                  | 0.57                   | 5.4 $\pm$ 5.6                             |
| Portion size chart  | 0.12                                | 0.34                  | 0.54                   | 1.5 $\pm$ 1.4                             |
| Dining out guides   | 0.41                                | 0.25                  | 0.46                   | 2.6 $\pm$ 2.4                             |
| News flashes  | 0.22                                | 0.20                  | 0.53                   | 5.4 $\pm$ 6.0                             |
| Menu planner <sup>a</sup>                                     | 0.38                                | 0.004                 | 0.35                   | 1.7 $\pm$ 2.1                             |
| Recipes <sup>a</sup>  | 0.36                                | -0.20                 | 0.39                   | 1.8 $\pm$ 3.8                             |
| Printed hard-copy of weekly journal <sup>a</sup>              | -0.12                               | 0.28                  | 0.34                   | 1.6 $\pm$ 2.1                             |
| Percent variance explained                                    | 28.6                                | 8.6                   | 6.8                    |   |
| Cronbach's $\alpha$   | 0.78                                | 0.74                  | 0.80                   |   |
| Additive scale of factor features utilization (mean $\pm$ SD) | 169 $\pm$ 152                       | 75 $\pm$ 89           | 205 $\pm$ 166          |   |

<sup>a</sup>These Web features did not load on any of the factors.  
USDA, U.S. Department of Agriculture; SD, standard deviation.

**Table 3. Regression Model Predicting Weight Change (0–6 months) (Model  $R^2 = 0.14$ ,  $p = 0.008$ )**

| VARIABLE                          | COEFFICIENT | STANDARD ERROR | p-VALUE |
|-----------------------------------|-------------|----------------|---------|
| Intercept                         | 13.33       | 9.66           | 0.17    |
| Weight at baseline (lb)           | -0.136      | 0.05           | 0.0065  |
| Factor 2: "feedback" <sup>a</sup> | -0.03       | 0.01           | 0.0038  |

<sup>a</sup>Feedback factor: Past journals, progress graphs, and body mass index, waist-to-hip, and target heart rate calculators.

reviewed and approved by the University of Vermont Institutional Review Board for the Social Sciences.

## Results

Participants (102 women, 21 men) were a mean age of 46.8 years and had an average BMI of 31.7 kg/m<sup>2</sup>. They were predominantly white (99%), female (83%), and well educated (74% had college degrees). Treatment attrition was 21%; 63% of participants provided data at all assessment points (baseline, 6, and 12 months). Participants lost an average of 7.5 ± 6.4 kg (16.5 ± 14.1 lb) or 8.5% of baseline weight at 6 months and 6.6 ± 6.6 kg (14.6 ± 14.6 lb) or 7.5% of baseline weight at 12 months. The only significant baseline difference between non-completers and completers was weight, such that non-completers were significantly heavier than completers at baseline (93.8 ± 21.9 kg [206.8 ± 48.3 lb] versus 89.7 ± 12.3 kg [197.8 ± 27.1 lb]);  $p = 0.003$ .

### THE RELATIONSHIP OF TREATMENT COMPONENTS WITH WEIGHT LOSS

Participants logged on to the website on average 190.9 ± 138.5 times during treatment and 94.6 ± 96.1 times during maintenance. Over the treatment period, three additive factors, reflecting the sum of the Web feature usage, emerged (Table 2). Table 2 lists the item-specific usage during the 6-month treatment phase along with their factor loadings and the corresponding percent of variance explained. Additively, 44% of the factor variance was explained by these three factors, which appeared to reflect motivation/support, feedback, and education. All of the factors had Cronbach's  $\alpha$  levels greater than 0.70 (Table 2).

Simple linear regression modeling indicated that utilization of the features under Factor 1 ("motivation/support") ( $R^2 = 0.05$ ,  $p < 0.05$ ) and Factor 2 ("feedback") ( $R^2 = 0.07$ ,  $p < 0.01$ ) were modest predictors of weight loss. Factor 3 ("education") did not predict weight loss ( $R^2 = 0.003$ ,  $p = 0.61$ ). Multiple linear regression modeling further indicated that Motivation/Support and Feedback factors appeared to have shared

variance, given that the statistical significance level for both of the factors was reduced to nonsignificance ( $p = 0.64$  and  $p = 0.13$ , respectively) when included in a joint model. When including baseline weight as a covariate, the "feedback" factor alone was the best predictor of weight loss from 0 to 6 months ( $R^2 = 0.14$ ,  $p < 0.01$ ; Table 3).

Different website usage patterns were apparent over the maintenance period with seven factors being identified, which explained additively 73% of the factor variance (Table 4). The factors appeared to have reasonable Cronbach's  $\alpha$  levels (Table 4). Simple linear regression modeling of additional weight loss over the maintenance period indicated that utilization of the features in Factor F ("social support") ( $R^2 = 0.08$ ,  $p = 0.01$ ) was the most highly related to weight change, while none of the other subscales achieved statistical significance. The addition of weight at 6 months as a covariate ( $p = 0.96$ ) did not change the contribution of this subscale to the multiple regression model ( $R^2 = 0.08$ ,  $p = 0.02$ ; Table 5).

## Discussion

Consistent with previous research,<sup>12,13</sup> overall website usage was strongly correlated with weight-loss success. Higher log-in rates were likely a factor in the higher weight losses seen in this study as compared to previous research.<sup>12,13</sup>

Based on website utilization patterns, three factors emerged for the treatment period and seven factors emerged for the maintenance period. During the treatment period, the "feedback" Factor 2 (which included progress charts, physiological calculators, and past journals) was the best predictor of weight loss. Previous research has also found visual representations of goal progress<sup>18</sup> promoted better weight-loss outcomes. In addition, as past journals included feedback from the facilitator, this finding is consistent with previous research indicating the importance of facilitator feedback.<sup>13</sup> Features, roughly approximating a "motivation/support" factor during the treatment time period, which included the bulletin board, biographical information/e-mail addresses, the motivational mascot's story, local events guide, and motivational tips, were also related to weight loss; however, this factor had shared variance with Factor 2 and was not included as a significant predictor of weight loss in the final model.

During maintenance, a different pattern of factors emerged. Factor F (a "social support" factor, including Web chats and accessing biographical information and e-mail addresses of participants) was the best predictor of weight loss. The Web chats were a novel element of this Internet-based treatment program. The weekly chats provided participant/therapist contact and opportunities for participants to interact in a way similar to traditional in-person meetings. Perception of peer support has been shown to be related to higher log-in fre-

quency in a study of diabetes management.<sup>19</sup> Thus, the website utilization patterns appear to differ between treatment and maintenance periods, and may reflect a differential importance of Web features

during different points of a weight control program (e.g., skill/information acquisition during treatment versus social support during maintenance).

**Table 4. Factor Loadings of the Web Feature Utilization During Maintenance (7–12 months)**

|   | FACTOR A:<br>CORE<br>FEATURES | FACTOR B:<br>DIETARY<br>PLANNING<br>TOOLS | FACTOR C:<br>SKILL<br>BUILDING | FACTOR D:<br>PHYSIO-<br>LOGICAL<br>TOOLS | FACTOR E:<br>NEWS | FACTOR F:<br>SOCIAL<br>SUPPORT | FACTOR G:<br>CALORIE<br>INFORMATION |
|---|-------------------------------|---|--------------------------------|--|-------------------|--------------------------------|-------------------------------------|
| CalorieKing website   | 0.80                          | 0.26                                      | 0.05                           | -0.05                                    | 0.31              | -0.04                          | -0.05                               |
| Past journal feedback                                       | 0.90                          | 0.20                                      | 0.03                           | 0.03                                     | 0.14              | -0.01                          | 0.15                                |
| Progress graphs   | 0.85                          | -0.02                                     | -0.02                          | -0.05                                    | -0.15             | 0.13                           | 0.25                                |
| Exercise expenditure counter                                | 0.57                          | 0.25                                      | 0.09                           | -0.09                                    | 0.17              | -0.36                          | -0.14                               |
| "Carmen's story"  | 0.59                          | 0.03                                      | 0.06                           | 0.48                                     | 0.35              | 0.12                           | -0.03                               |
| Bulletin board  | 0.77                          | -0.06                                     | 0.05                           | 0.07                                     | 0.10              | 0.50                           | 0.03                                |
| Menu planner  | 0.27                          | 0.61                                      | 0.31                           | -0.01                                    | 0.31              | -0.23                          | 0.02                                |
| Portion size guide  | 0.21                          | 0.81                                      | 0.03                           | 0.22                                     | 0.13              | -0.04                          | 0.03                                |
| Dining-out guides   | 0.24                          | 0.63                                      | 0.23                           | 0.00                                     | 0.28              | 0.10                           | -0.21                               |
| Printed hard-copy of weekly journal                         | -0.09                         | 0.83                                      | -0.13                          | -0.01                                    | -0.08             | 0.28                           | 0.15                                |
| Lessons   | 0.19                          | 0.21                                      | 0.70                           | -0.03                                    | 0.24              | 0.32                           | 0.15                                |
| Recipes   | -0.04                         | -0.04                                     | 0.89                           | 0.03                                     | -0.06             | 0.00                           | 0.01                                |
| "Pantry list"   | -0.12                         | 0.08                                      | 0.43                           | 0.36                                     | 0.34              | 0.24                           | 0.00                                |
| "Need a boost" (motivational tips)                          | 0.10                          | 0.07                                      | 0.79                           | 0.19                                     | 0.10              | 0.08                           | 0.03                                |
| Body mass index calculator                                  | 0.09                          | 0.08                                      | 0.11                           | 0.83                                     | 0.13              | 0.05                           | -0.09                               |
| Waist-to-hip ratio calculator                               | 0.01                          | -0.01                                     | -0.11                          | 0.77                                     | -0.21             | 0.09                           | 0.05                                |
| Target heart rate calculator                                | -0.08                         | 0.09                                      | 0.27                           | 0.79                                     | 0.02              | -0.06                          | 0.05                                |
| "Challenges"  | 0.40                          | 0.37                                      | 0.10                           | 0.16                                     | 0.61              | 0.20                           | -0.13                               |
| News flashes  | 0.40                          | 0.19                                      | 0.21                           | 0.20                                     | 0.57              | 0.07                           | 0.20                                |
| Local events guide  | 0.04                          | 0.06                                      | 0.05                           | -0.09                                    | 0.75              | 0.08                           | 0.18                                |
| Web chats   | 0.21                          | 0.23                                      | 0.18                           | 0.17                                     | -0.09             | 0.65                           | 0.05                                |
| Biographical information/email addresses                    | -0.01                         | 0.00                                      | 0.16                           | -0.05                                    | 0.32              | 0.79                           | -0.10                               |
| "Pantry"  | 0.31                          | 0.14                                      | 0.06                           | -0.08                                    | 0.56              | -0.10                          | 0.54                                |
| USDA calorie database                                       | 0.10                          | -0.02                                     | 0.10                           | 0.03                                     | 0.18              | 0.00                           | 0.90                                |
| Percent variance explained                                  | 28.0                          | 11.9                                      | 8.5                            | 7.8                                      | 6.5               | 5.7                            | 4.5                                 |
| Cronbach's $\alpha$   | 0.85                          | 0.77                                      | 0.77                           | 0.75                                     | 0.72              | 0.66                           | 0.70                                |
| Additive scale: factor features utilization (mean $\pm$ SD) | 115 $\pm$ 170                 | 1.2 $\pm$ 2.1                             | 18 $\pm$ 15                    | 0.6 $\pm$ 1.2                            | 6 $\pm$ 6         | 13 $\pm$ 10                    | 36 $\pm$ 90                         |

USDA, U.S. Department of Agriculture; SD, standard deviation.

**Table 5. Regression Model Predicting Weight Change (7–12 months) (Model  $R^2 = 0.08$ ,  $p = 0.015$ )**

| VARIABLE                               | COEFFICIENT | STANDARD ERROR | p-VALUE |
|--|-------------|----------------|---------|
| Intercept                              | 5.574       | 1.479          | <0.001  |
| Factor F "social support" <sup>a</sup> | -0.235      | 0.084          | 0.01    |

<sup>a</sup>Social support factor: Web chats and biographical information/e-mail addresses.

These results provide direction for developing better, more effective weight-loss websites—dynamic, entertaining, and interactive features. In general, the features related to weight loss were dynamic: they were updated frequently or they offered feedback to the individual. In contrast, website features not related to weight-loss were static: they were available online at the start of the study and did not change over the course of the 12-month program. This finding supports the idea that enhancing websites with dynamic, entertaining content may increase log-in frequency and, consequently, improve weight loss outcomes.<sup>14,15</sup>

However, as some Web features (including many of those that did not correlate with weight loss) were scarcely used, it is difficult to assess whether they might have predicted weight loss if participants had taken greater advantage of them. For example, while our optional menu planner did not correlate with greater weight losses, previous research has shown that providing structured menus significantly increased weight losses.<sup>20</sup> If the menu planner and recipe sections were more strongly encouraged or featured more prominently, they may have been also associated with improved outcomes.

These results are tempered by the fact that our measure of website utilization was based on our automatic tracking of the number of times each feature was clicked on by the participant; however, clicking on the feature did not necessarily indicate that the participant *used* the feature. As another limitation, the capacity to see relationships between the Web features and weight loss may have been restricted during the maintenance phase as a result of low weight-loss variance during this time period.

Future research should continue to study the impact of various online weight-control program features on weight loss and maintenance. Examining the time participants actually spend on a Web feature would help further our understanding of actual “use” of a Web component, which is one aspect of this current analysis that is difficult to discern. Examining website feature utilization in diverse populations could also prove important. In addition, the cost-effectiveness of providing Web features should also be investigated, in

order to guide the development of future online programs, including larger-scale (state or national) Internet weight-loss programs. Finally, a series of trials that “dismantle” various Web features to proactively test the benefit of their inclusion/exclusion for weight loss promotion would help to establish a minimum level of Web interaction that is necessary to promote clinically significant weight loss.

## Conclusion

Analysis of various components of the website indicated that, consistent with previous research, Web features that provided participants with visual representations of goal progress, self-monitoring feedback, and social support were predictive of weight loss and maintenance. Features appear to be differentially important during treatment and maintenance, such that the factor including progress charts, physiological calculators, and past journals was the best predictor of weight loss during the treatment period, while the factor including Web chats and e-mail addresses/biographical information of fellow participants was the best predictor during the maintenance period. Overall, this study illustrated the importance of dynamic and interactive website features, and may provide direction to future online weight-control programs.

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## Disclosure Statement

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