PSYCHOBEHAVIORAL RESPONSE AND WEIGHT LOSS PREDICTION IN A HOSPITAL-BASED WEIGHT REDUCTION PROGRAM

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Interest in obesity and its comorbidities have increased in conjunction with the Westernization of the Taiwanese lifestyle. An increasing number of hospital-based weight loss programs have recently emerged to help obese people reduce weight. Integration of recent findings in the fields of genetics, physiology, biochemistry, psychology and nutrition has led to the view that obesity is a chronic disorder resulting from complex interactions between biologic, psychologic and social factors [1]. Psychologic assessment and intervention have an important role in the etiology and management of obesity.
Two common adverse responses associated with weight loss in overweight and obese adults are depression and binge eating. Depressive disorders are frequently associated with changes in weight and weight-related variables (activity, appetite). It is generally agreed that depression affects the outcome of weight control programs through its effects on compliance with the treatment regimen. Researchers have argued that weight loss in obese patients may lead to increases in both depression and anxiety [2]. Binge eating was identified by Stunkard as one of the three pathologic eating patterns among obese people [3], and has been related to dietary restraint [4]. Binge eating is defined as the rapid ingestion of a large amount of food in a short period of time, during which patients have the sense of losing control of their behavior. Normal-weight individuals with bulimia nervosa nearly always report that dieting preceded the onset of binge eating [5]. Therefore, dieting has been implicated as a risk factor in the development of binge eating in obese people [6].

There is substantial evidence to show that obese people have tremendous difficulty in reaching and maintaining an ideal body weight [7]. However, it is possible for obese people to achieve health improvement with moderate weight reduction. A new approach for weight reduction recommended by the Institute of Medicine (IOM) of the National Academy of Science in the USA is to refocus the traditional definition of successful weight reduction from weight loss alone to weight management. Successful weight management is defined as “at least 5% of body weight loss maintained for at least 1 year” [8]. This definition is based on evidence that weight losses of 5 to 10% are frequently sufficient to improve many of the physical conditions associated with being overweight, including hypertension, type II diabetes and dyslipidemia [8–10]. However, there are only limited data on the effects of weight loss on psychologic functioning and eating pathology based on these weight reduction criteria [11]. The aims of this study were to: 1) assess the beneficial effects of different degrees of weight loss on psychologic functioning and the relationship between mood change and weight reduction; and 2) identify the biologic, psychologic or behavioral predictors of short-term weight loss.

**Methods**

**Subjects**

Subjects were selected from participants in a weight reduction program held once a year at National Taiwan University Hospital. Only individuals older than 18 years who weighed a minimum of 20% in excess of standard body weight [12] and were willing to participate were enrolled in the study program. Those who had physical conditions that contraindicated participation, e.g. severe liver function abnormality, severe musculoskeletal disorders, or abnormalities on exercise electrocardiogram (ECG), were excluded. A total of 189 participants were accepted into this obesity treatment program in the years 1995 to 2000. Because there were no significant differences in the basic data of subjects in each year, they were treated as one group.

Participants ranged in age from 18 to 67 years (mean, 40.5 ± 12.3 yr) with female predominance (87.8%). Mean body weight was 79.3 ± 13.9 kg (range, 59.6–143.5 kg) and mean body mass index (BMI) was 31.1 ± 3.8 kg/m² (range, 25.3–47.4 kg/m²). Body composition test showed 36.3 ± 4.5% body fat. One-third of the sample (34.9%) had an onset of obesity before adulthood (defined as 20 years of age).

**Procedures**

Subjects were required to undergo a complete physical examination, exercise and resting ECG, body composition analysis using the bioimpedance method (Biodynamics Model 310, Biodynamics Corp., Seattle, WA, USA), blood chemistry examination, and psychiatric evaluation before being accepted into the program.

This was a two-stage program. During Stage 1, all participants met twice weekly for 4 weeks. The behavioral weight loss program, conducted in four groups composed of eight to 10 members each, followed a standard format: lectures in nutrition, exercise and psychology for people with obesity; meal preparation participation (calorie restriction, 1,200–1,500 kcal/day); and review of the participants’ food diaries with the leader (a dietitian). Stage 2 included 1-hour aerobic exercise sessions twice weekly. Participants were required to do an additional 30 minutes of exercise at home every week. The exercise sessions lasted for 8 weeks of the 12-week program.

**Attendance rate**

Attendance rate was determined as the percentage of group meetings attended during the program. The percentage of meetings attended, rather than the total number, was used because the total number of meetings varied (range, 23–25) in different years. Participants whose attendance rate was higher than 70% were considered to have completed the program.

**Weight measurement and body composition test**

Participants were weighed in the clinic at baseline, at each attendance during Stage 1, and at the end of
treatment. Participants were classified into three groups according to the percentage of their weight loss, with cutoffs of 5% and 10%, at the end of treatment. Body composition analysis was performed at baseline and at the end of treatment.

Rating scales for general psychopathology and eating pathology

Subjects received two self-administered questionnaires, the Brief Symptom Rating Scale (BSRS) and the Bulimic Investigatory Test, Edinburgh (BITE), pre- and post-treatment.

The BSRS is a satisfactory global measure and case-finding screening instrument for psychopathology in both psychiatric and nonpsychiatric medical settings. The BSRS used was the Chinese language version of a shorter form of the Derogatis’ Symptom Check List-90 (SCL-90-R) [13]. It is comprised of 50 items, including 10 symptom dimensions (somatization, obsession, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism, additional). The BSRS score was calculated as a T score based on the mean scores of nonpsychiatric medical inpatients throughout the study. Severe depression was defined as a depression score of above 70. Only the scores of three relevant subscales (anxiety, phobia and depression) and the General Severity Index (GSI; mean of the 50 items of the BSRS) are reported.

BITE is a 33-item self-report questionnaire designed to identify subjects with symptoms of binge eating and to measure severity and response to treatment [14, 15]. It consists of two subscales: the Symptom Scale, which measures the degree of a symptom that is present, and the Severity Scale, which provides an index of the severity of binging and purging behavior as defined by their frequency. The Chinese version of BITE used in outpatients with eating disorders and obese subjects has satisfactory reliability and validity [16] and was used here. The criteria that a symptom score of 20 or more indicates a highly disordered eating pattern and the presence of binge eating [15] were applied in this study.

Statistical methods

Statistical analyses were conducted using SPSS 9.0 for Windows (SPSS Inc., Chicago, IL, USA). Categoric data were analyzed using the nonparametric test (Chi-square test). ANOVA or Student’s t-test was used for continuous data analyses. Weight losses were calculated using two methods: last observation carried forward (LOCF) and completers. The paired t-test was used for pre- and post-treatment comparisons of psychologic assessment data. The correlation of pre-treatment measurements with attendance rate or weight change was calculated using Pearson’s correlation coefficient. Stepwise multiple regression analysis was applied to determine predictors of greater weight loss. A value of p less than 0.05 was considered statistically significant.

Results

Clinical characteristics of obese subjects

Nonparticipants did not differ significantly from the participants in age, BMI, sex ratio, and other assessment scores (data not shown). Severe depressive symptoms were found in 13.2% (n = 25) of participants, and 15.9% (n = 30) were classified as binge eaters.

Of the 189 participants, 177 (93.7%) completed Stage 1 only, while 115 (60.8%) completed the entire 12-week program. The attrition rate was 39.2% (n = 74). Subjects who did not complete the program were younger (p = 0.06), and had significantly higher BITE scores (p < 0.05) and phobia scores (p < 0.01) than those who completed the program. There was no difference between those who completed or did not complete the program in terms of sex ratio, education years, initial body weight or BMI, body composition, and onset of obesity (Table 1).

The average attendance rate for all participants was 77 ± 27%. No relationship was found between attendance

| Table 1. Clinical characteristics of subjects who completed the program and dropouts |
|---------------------------------------------|-----------------|-----------------|
|                                             | Completers      | Dropouts        |
|                                             | (n = 115)        | (n = 74)        |
| Age† (yr)                                   | 41.9 ± 11.6     | 38.4 ± 13.1     |
| Female (%)                                  | 89.6            | 85.1            |
| Weight (kg)                                 | 78.5 ± 12.7     | 80.4 ± 15.6     |
| BMI (kg/m²)                                 | 31.0 ± 3.2      | 31.3 ± 4.5      |
| Body fat component (%)                      | 36.6 ± 4.3      | 35.9 ± 4.9      |
| Onset of obesity before 20 years of age (%)| 33.3            | 39.0            |
| BITE*                                       | 13.8 ± 8.4      | 16.6 ± 9.6      |
| Symptom†                                    | 10.9 ± 6.2      | 12.8 ± 7.0      |
| Severity*                                   | 2.8 ± 3.0       | 3.8 ± 3.6       |
| BSRS                                        |                |                 |
| Depression                                  | 54.4 ± 17.3     | 56.6 ± 14.7     |
| Anxiety                                     | 49.3 ± 9.0      | 51.7 ± 10.6     |
| Phobia†                                     | 54.8 ± 13.8     | 61.2 ± 16.4     |
| GSI                                         | 56.6 ± 15.2     | 60.1 ± 16.2     |

Data expressed as mean ± standard deviation. BMI = body mass index; BITE = Bulimic Investigatory Test, Edinburgh; BSRS = Brief Symptom Rating Scale; GSI = General Severity Index. †p < 0.05; ‡p < 0.01; *p = 0.05 by Student’s t-test.
rate and age, binge eating severity, or any subscale scores of BSRS at baseline by correlation analyses. In addition, no relationship was found between attendance rate and mood change (depression, anxiety and phobia) among those who completed the program.

Short-term response
The response of subjects was evaluated at baseline, week 4 (end of Stage 1), and week 12 (end of Stage 2). The Figure shows the mean absolute weights at these three times. The average weight loss was $5.6 \pm 3.7$ kg ($7.1 \pm 4.6\%$) for all participants using LOCF analysis and $6.6 \pm 3.6$ kg ($8.5 \pm 4.5\%$) for subjects who completed the program. Fat components dropped from a baseline value of $36.6 \pm 4.3\%$ to $32.7 \pm 5.4\%$ at the end of the program.

Post-treatment outcome measures were available for $91.3\%$ ($n = 105$) of subjects who completed the program. Significant positive changes in general psychopathology and eating pathology were found over the 12-week treatment period. Subjects who completed the program had significantly reduced BITE and all BSRS subscale scores at the end of the program.

Among subjects who completed the program, the percentage with severe depression decreased from $10.4\%$ ($n = 12$) to $4.3\%$ ($n = 5$), and the percentage of binge eaters decreased from $12.2\%$ ($n = 14$) to $0\%$, at the end of the program. However, these changes did not reach statistical significance. Among those with depression at baseline, symptoms of depression resolved after treatment in 10 subjects (83.3%), one dropped out, and one had unchanged symptoms. Among the five subjects who were depressed at the end of treatment, four (80%) originally had no symptoms of depression, although clinical psychiatric evaluation at baseline revealed that two were binge eaters with dysphoric mood and one had schizophrenia. All subjects who were binge eaters at baseline had lost this classification at the end of treatment. No subject who was not a binge eater at baseline became a binge eater after participating in the program.

Relationship between mood and weight loss
Correlation analysis revealed no evidence that mood change (depression or anxiety) was related to weight loss among subjects who completed the program. Among subjects who completed the program, $23.5\%$ ($n = 27$) had limited successful weight loss (weight reduction $< 5\%$), $41.7\%$ ($n = 48$) had moderately successful weight loss (weight reduction $\geq 5\%$ and $< 10\%$), and $34.8\%$ ($n = 40$) had highly successful weight loss (weight reduction $\geq 10\%$). There were no significant differences between these three groups in initial weight, pre-treatment mood or binge eating assessments, and mood or binge eating change after treatment. Pre- and post-treatment comparison showed significant improvement of BSRS subscale scores and BITE score among the most successful weight loss group. It also showed improvement in almost all dimensions of psychopathology except for the phobia subscale among the moderately successful weight loss group (Table 2). Patients with the least success in weight loss showed no improvement in general psychopathology, but did have improvement in binge eating severity.

Predictors of body weight loss
A stepwise multiple regression analysis was conducted that included age, initial BMI, body weight, family history of obesity, fat component, attendance rate, initial weight loss, depression, anxiety, phobia, GSI and BITE scores as independent variables, and post-treatment weight loss using LOCF as the dependent variable among the 189 participants. As shown in Table 3, factors contributing significantly to short-term weight loss were initial weight loss ($p < 0.001$), attendance rate ($p < 0.001$), and initial body weight ($p = 0.001$). The adjusted $R^2$ is 0.50, indicating that these three factors accounted for 50% of the variance.

Discussion

One of the reasons for the high attrition rate (40%) in this study was that the “deposit refund” behavior modification method was not applied, which has been
reported to be an important predictor of attendance [8]. We adopted this method at the beginning of the first year of the program, but were not successful in convincing all of the participants to deposit money. Another reason for the high attrition rate was the definition of program completion as a 70% attendance rate. Most previous studies of weight reduction programs did not apply a strict definition of program completion [17, 18]. Although the 70% attendance rate defined in this study was arbitrary, it provided a strict criterion to assess the relationship of compliance and treatment response.

The average initial weight loss of 7.1% (5.6 kg) overall or 8.5% (6.6 kg) among those who completed the 12-week program was comparable to the results of other behavioral approaches using group treatment. These data indicate that participants treated as a comprehensive group using a behavioral approach lose approximately 8.5 kg (9% of initial weight) in 20 weeks of treatment — a loss of 0.5 kg/week [19]. Although our weight loss program included components of diet, behavior and exercise, evidence shows that the addition of regular exercise to a balanced deficit diet increases weight loss only slightly (i.e., 2 kg) over 16 to 20 weeks [20, 21].

Among subjects who completed the program, no linear relationship was found between attendance rate and mood change. There was also no evidence to suggest that weight loss made mood or eating pathology worse. On the contrary, participants who completed the program had significantly improved general psychologic functioning and significantly decreased binge-eating severity with a minimum 5% weight loss. Participants with higher degrees of weight loss showed improvement in more dimensions of psychologic functioning. These results are in contrast to findings reported before the 1980s [22, 23], but are more consistent with recent publications [24, 25], which show positive changes (at least no increase) in depression or anxiety associated with behavioral weight loss programs. Several factors related to the discrepancy between early and later findings have been reviewed in previous studies [7, 11].

With regard to the relationship between mood change, weight reduction and compliance, initial mood or binge-eating status predicted neither compliance nor weight reduction. This finding challenges the concept that initial depression makes obese patients poorly compliant with weight loss treatment regimens. However, our study was limited by its use of infrequent assessments of mood status during the weight management period, which made it difficult to determine whether increased mood severity or failure to show improvement in mood was responsible for the high attrition rate during the weight loss program. Three previous studies assessed mood at each treatment meeting and examined the self-reported mood at the meeting prior to termination [22, 26]. They found no evidence that dropping out was a response to increasing levels of depression or anxiety. By further analyzing the cases who received follow-up 6 months after the program ended (n = 59; 51%), we found that a lower

Table 2. Comparison of pre- and post-treatment psychometric scores of subjects (n = 105) with different degrees of weight loss (< 5% to ≥ 10% of initial weight)

<table>
<thead>
<tr>
<th></th>
<th>&lt; 5% (n = 23)</th>
<th>≥ 5%, &lt; 10% (n = 42)</th>
<th>≥ 10% (n = 37)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>End</td>
<td>Baseline</td>
</tr>
<tr>
<td>BITE</td>
<td>11.4 ± 8.1*</td>
<td>7.7 ± 0.62</td>
<td>15.0 ± 9.2‡</td>
</tr>
<tr>
<td>Symptom</td>
<td>9.5 ± 6.7*</td>
<td>6.9 ± 4.7</td>
<td>11.5 ± 6.4‡</td>
</tr>
<tr>
<td>Severity</td>
<td>1.9 ± 2.1†</td>
<td>0.8 ± 2.2</td>
<td>3.4 ± 3.7†</td>
</tr>
<tr>
<td>BSRS Depression</td>
<td>54.2 ± 16.1</td>
<td>50.1 ± 10.8</td>
<td>55.6 ± 14.0‡</td>
</tr>
<tr>
<td>Anxiety</td>
<td>48.4 ± 7.8</td>
<td>47.5 ± 8.6</td>
<td>50.8 ± 9.9‡</td>
</tr>
<tr>
<td>Phobia</td>
<td>54.1 ± 11.8</td>
<td>53.1 ± 14.1</td>
<td>57.0 ± 15.0</td>
</tr>
<tr>
<td>GSI</td>
<td>55.4 ± 14.3</td>
<td>51.6 ± 14.4</td>
<td>59.1 ± 16.4‡</td>
</tr>
</tbody>
</table>

BITE = Bulimic Investigatory Test, Edinburgh; BSRS = Brief Symptom Rating Scale; GSI = general severity index. *p < 0.05; †p < 0.01; ‡p < 0.001; baseline data compared with the data on completion of the program.

Table 3. Multiple linear regression with post-treatment weight loss as a dependent variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-4.95</td>
<td>1.29</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Initial weight loss</td>
<td>1.16</td>
<td>0.11</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Attendance rate</td>
<td>4.29</td>
<td>0.74</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Initial body weight</td>
<td>0.05</td>
<td>0.01</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Adjusted R² = 0.50.
percentage of subjects in the least successful weight loss group returned for follow-up, and subjects in this least successful weight loss group who received follow-up had more positive depression changes at the end of treatment than those who were lost to follow-up. Subjects in the least successful weight loss group who had less reduction of dysphoria might have been more likely to drop out of the weight reduction program than others with more prominent mood change. Thus, the psychologic effects of weight reduction on subjects’ attendance are complex and need to be assessed throughout the weight management period.

Possible predictors of successful weight loss mentioned in other studies include high initial body weight (or BMI), high resting metabolic rate, high perceived self-efficacy, repeated attempts at weight loss (negative predictor), experiencing perceived stress (negative predictor), attendance, and initial weight loss [8]. Greater weight loss in the first few weeks of treatment is more consistently associated with greater weight loss at the end of therapy [27]. In contrast, few psychologic and behavioral variables (e.g., dietary restraint, locus of control, personality test, binge eating) [28] and other biologic predictors (e.g., body composition, fat cell number) [8] consistently predicted weight loss. Our study identified two biologic factors (initial weight loss, initial body weight) and one behavioral factor (attendance rate) that predicted short-term weight loss. These factors are easy for clinicians to assess.

Our study design was limited by its lack of assessment of whether the mechanism of mood change was due to the weight loss itself, exercise effect, or group effects such as universality, altruism or support. Neither could these results be generalized to other obese subjects who lost weight by alternative methods (e.g., self-help, individual counseling, commercial programs) to our weight loss program.

The weight loss program used in this study yielded favorable results as judged by the criteria for success (5–10% reduction in initial weight) proposed by the World Health Organization and the IOM. It also showed beneficial effects on general psychologic functioning and eating pathology in subjects with a minimal weight loss of 5% of initial weight. Furthermore, subjects with higher degrees of weight loss had improvement in more dimensions of psychologic functioning. On the other hand, there was no evidence that pre-treatment psychologic characteristics could predict weight loss. It remains an open question whether the psychologic response to weight reduction over the treatment period prevented dropout subjects from completing the program.

ACKNOWLEDGMENTS: Preparation of this report was supported by Grant 88F004 from the National Taiwan University Hospital. The authors would like to thank the Deputy Chief of the Department of Nutrition, Cheng Chin-Pao, for assistance in administering the weight reduction program and Ching-Ju Hsiao for data preparation.

References

Psychologic Response and Predictors of Weight Reduction


