

# Analysis of the Factors Affecting the Success of Weight Reduction Programs

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Obesity is a risk factor for numerous health problems. Behavior therapy is important for obesity treatment. The aim of the present study was to identify the parameters that are associated with successful weight reduction. A database of 123 subjects who underwent weight reduction programs at the Center for Health Promotion, Samsung Medical Center from June 2001 through November 2004 was retrospectively analyzed. The goal of the program was to reduce the body weight by more than 5% during the follow-up period. The study population was divided into 2 categories (the success group and the failure group) based on the outcome of weight reduction. We analyzed the demographic, laboratory and clinical parameters to determine the predictors of successful weight reduction. The prevalence of success group was 36.6% (45/123). Significant correlations for successful weight reduction were found for the follow up period and the frequency of medical visits. Our results suggest that strong motivation was the most important factor for successful weight reduction.

Key Words: Obesity, weight loss, behavior therapy

## INTRODUCTION

The prevalence of obesity is increasing in the Korea as well as around the world.<sup>1</sup> Obesity is a risk factor for numerous health problems such as

coronary heart disease, hypertension, diabetes, stroke, osteoarthritis and cancer.<sup>2-4</sup> Behavior modification is the foundation of obesity treatment.<sup>5-7</sup> Behavior modification refers to changes in eating behavior and the level of physical activity.<sup>5-7</sup> The weight reduction program in our study was directed by a doctor, a dietitian, a nurse and an exercise programmer. The weight reduction program included an interview on the patients' diet, physical activity and medical condition. Sibutramine or orlistat were also prescribed to complement the behavioral therapy.<sup>8,9</sup> It is clinically important that we can predict which factors are related to reduction of body weight after weight loss intervention. The aim of the present study was to identify the parameters associated with successful weight reduction.

## MATERIALS AND METHODS

### Study subjects and data collection

The Center for Health Promotion, Samsung Medical Center opened the obesity clinic for undergoing the weight reduction programs for obese patients since June 2001. The obese patients who were recommended to participate in weight reduction programs keep within the limits of subjects who have health screening in the Center for Health Promotion and then was diagnosed as obesity. Only a small proportion of patients (about 0.1%, 131/112572) of total patients consented to participate in weight reduction programs because

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subjects who are to participate in this program have to pay medical expenses and especially times. That program recommended that the patients visit the clinic at least 12 times (minimal requirement) and the goal of the program was to reduce their body weight more than 5% after minimal requirement period. All obese patients visited to the center were registered to the patient-database (DB) and the information for the risk factors of obesity was collected by the detailed standardized questionnaires and a series of blood test at the first visit time. As of November, 2004, 78 unsuccessful subjects and 45 successful subjects were identified among 123 cohort members registered in the weight control program DB, based on the outcome of weight reduction. All subjects provided written informed consents.

The collected information was as follows; smoking, alcohol consumption (frequency and amount of alcohol), a medical history of diabetes mellitus and fatty liver, a family history of obesity, obesity in childhood, the composition of the diet (calories, protein, fat and carbohydrate) and dietary habits (regular eating, over-eating, eating-out and hasty eating). The status of smoking was divided into two groups (none: 0 and past or current: 1). Alcohol consumption was divided into two groups by the amount of daily alcohol that was consumed. 80 grams or more of alcohol consumption a day was classified as the heavy alcohol consumption group. Below 80 grams of alcohol consumption a day was classified as not-heavy alcohol consumption group.

The fasting glucose, lipid profiles, including total cholesterol, low density lipoprotein-cholesterol (LDL-C), high density lipoprotein-cholesterol (HDL-C) and triglyceride and C-reactive protein (CRP), were obtained from the electronic medical record.

To measure the resting metabolic rate (RMR), the subjects rested supine for 30 minutes in a moderately dark and quiet room and then they underwent measurements under a ventilated hood.<sup>10</sup> Ventilation and the expired oxygen and carbon dioxide were measured by using a metabolic cart. Energy expenditure was calculated from the abbreviated equation of Weir. To measure the peak oxygen uptake value ( $\text{VO}_2\text{max}$ ), the subjects performed symptom-limited graded

exercise tests on a treadmill with using the Bruce protocol.  $\text{VO}_2\text{max}$  (mL/kg/min) was defined as the highest value recorded during the test. The waist circumference was measured at the high point of the iliac crest at the end of exhalation.

### Weight reduction programs (behavior therapy)

Most obese patients who visited the obesity clinic were enrolled the weight reduction program including the advice and intervention on their diet and physical exercise and the routine medical interview for continuous education. Sibutramine or orlistat were also used to complement the behavioral therapy. The dietary intervention focused on reducing the caloric intake by decreasing consumption of excess fat and alcohol, keeping daily food diaries that emphasized monitoring, in order to assess the patients' progress. As the patients gained experience, they were able to determine the caloric intake that produced moderate weight loss for them. Men were recommended to consume less than 1500 kcal/day and women less than 1200 kcal/day. The physical activity goal was to gradually increase activity to 30 to 45 minutes per day, four to five days/week. The exercise intensity recommendation was moderate, approximately 40% to 55% of the heart rate reserve, and this primarily consisted of brisk walking. A weight loss between 0.5 and 1 kg per week was recommended.

### Statistical analysis

The study population was divided into 2 categories (success or failure group) based on the outcome of weight reduction. Success group was defined by those who attained more than 5% weight reduction during the follow-up period. The dependent variable was binomial (success or failure group), based on the outcome of weight reduction. The independent variables included as follows: cigarette smoking, alcohol consumption, a medical history of diabetes mellitus and fatty liver, a family history of obesity, obesity in childhood, the diet composition (calorie, protein, fat and carbohydrate), diet habits (regular eating, over-eating, eating-out and hasty eating), fasting glucose, the lipid profile including total chole-

terol, LDL-C, HDL-C and triglyceride, CRP, RMR, VO<sub>2</sub>max, weight and the waist circumference. Each of the independent variables was tested against the outcome variables using the logistic regression model, adjusted for age, sex and education. The statistical significance was assumed at  $p$ -values < 0.05. All analyses were performed with SAS version 9.1 (SAS Institute Inc, Cary, NC, USA).

## RESULTS

The percentage of people who lost weight on the weight reduction program was 36.6% (45/123) and percentage of people who failed to loose weight was 63.4% (78/123). One hundred twenty three persons (94%) among the total number surveyed (131 persons) were included into the final multiple logistic regression analysis. All persons had been given medication (sibutramine or orlistat) in the early period of the weight reduction program. The baseline characteristics of the success group and failure group, according to outcome of weight reduction are shown in the Table 1. The subjects were divided into the success group ( $n = 45$ ) and the failure group ( $n = 78$ ). There were no significant differences in age, gender and education between the 2 groups (Table 1). The follow up period and the frequency of medical visits between the 2 groups were

significantly different ( $p = 0.0004$  and  $p = 0.0005$ , respectively). However, the mean follow-up interval was not different between failure and success group ( $p = 0.3$ ) (Table 1).

Table 2 illustrates the association of the selected risk factors with the outcome of weight reduction. All of them were not significant.

## DISCUSSION

The prevalence of obesity is increasing around the world.<sup>1</sup> The clinical significance of obesity is that obesity is a risk factor for numerous health problems such as cardiovascular disease and diabetes mellitus.<sup>2,4</sup> Because of the public health burden of obesity, it is not surprising that enormous sums of money are spent annually on diet aids and treatment approaches. Any short-term weight losses are generally temporary with relapse.<sup>11</sup> Only long-term behavior-modification strategies can substantially enhance and maintain weight lost, so obesity treatment can have a good outcome.<sup>12</sup> A modest reduction in calories and a small increase in activity may be the optimal way to achieve weight reduction.<sup>12-15</sup> Although the mechanisms of pharmacotherapy and behavior modification are different, they complement each other and enhance the treatment outcome.<sup>8,9</sup> The combination of medication plus behavior modification was superior to either approach when they

**Table 1.** The Baseline Characteristics of the Success Group and the Failure Group According to the Weight Reduction Outcome

	Failure group (n = 78)	Success group (n = 45)	<i>p</i> value
Age (mean ± SD)	45.8 ± 10.8	46.4 ± 8.3	0.7
Gender (%)			
Male	41 (52.6)	28 (62.2)	0.3
Female	28 (47.4)	17 (37.8)	
Education (%)			
< university	19 (27.9)	9 (22.0)	0.5
≥ university	49 (72.1)	32 (78.0)	
Total Follow up (days)	104.7 ± 81.1	165.0 ± 99.7	0.0004*
Frequency of medical visits	5.7 ± 2.5	8.6 ± 4.4	0.0005*
Mean interval of follow-up (days)	17.0 ± 9.4	18.8 ± 7.9	0.3*

\*adjusted for age, sex, and education.

**Table 2.** Association with the Selected Risk Factors between the Success Group and the Failure Group According to the Outcome of Weight Reduction

	Failure group (mean $\pm$ SD)	Success group (mean $\pm$ SD)	<i>p</i> value
Initial weight (Kg)	80.0 $\pm$ 14.2	82.1 $\pm$ 13.2	0.7
Waist circumference (cm)	97.6 $\pm$ 8.5	98.6 $\pm$ 8.7	0.6
Calorie (cal/day)	2168.9 $\pm$ 616.7	2226.2 $\pm$ 512.8	1.0
Fat (g/day)	60.0 $\pm$ 26.9	60.3 $\pm$ 22.3	0.9
Protein (g/day)	98.0 $\pm$ 32.8	99.1 $\pm$ 27.5	1.0
Carbohydrate (g/day)	279.5 $\pm$ 65.1	278.2 $\pm$ 61.3	0.9
CRP (mg/dL)	0.17 $\pm$ 0.50	0.08 $\pm$ 0.36	0.5
VO <sub>2</sub> max (ML/kg/min)	28.8 $\pm$ 4.9	30.5 $\pm$ 4.9	0.1
RMR percent (%)	96.8 $\pm$ 18.6	95.8 $\pm$ 27.5	0.8

CRP, C-reactive protein; RMR, resting metabolic rate.

	Failure group No. (%)	Success group No. (%)	<i>p</i> value
Serum total cholesterol (> 240 mg/dL)	26 (33.8%)	16 (38.1%)	0.5
Serum triglyceride (> 160 mg/dL)	29 (38.2%)	18 (42.9%)	0.5
Serum LDL-C (> 150 mg/dL)	46 (61.3%)	21 (50.0%)	0.3
Serum HDL-C (< 35 mg/dL)	20 (26.78%)	4 (9.5%)	0.4
Fasting glucose (> 110 mg/dL)	22 (29.0)	11 (26.2)	0.4
Irregular eating (yes)	19 (24.7)	13 (29.6)	0.7
Hasty eating habit (yes)	8 (13.3)	2 (4.9)	0.1
Overeating (yes)	28 (36.8)	17 (38.6)	0.7
Eating-out (yes)	18 (23.4)	12 (27.3)	0.3
Smoking	55 (73.3)	34 (75.6)	0.8
Heavy alcoholics	34 (46.0)	13 (28.9)	0.1
Obesity in childhood (yes)	77 (98.7)	45 (100.0)	1.0
Family history of obesity (yes)	53 (68.0)	29 (64.4)	0.9
Fatty liver history (yes)	33 (47.1)	20 (45.5)	0.6
Medical history of diabetes (yes)	57 (79.2)	38 (90.5)	0.1

LDL-C, low density lipoprotein-cholesterol; HDL-C, high density lipoprotein-cholesterol.

were used separately.<sup>8,9</sup> All subjects in this study population had medication in the early period or they took medicine intermittently.

In this study, the total follow up period and high frequency of medical visits were powerful predictor of successful weight reduction. Our result suggested that strong motivation is the

most important factor for successful weight reduction. Many obese patients enrolled on the first visit time were prompt to drop out from the weight reduction program since they had suffered hardships to modify their behavior, for example, to exercise and reduce their caloric intake.

A high initial body weight by itself has a pos-

sibility to provide strong motivation to participate in the program. While males subjects had a busier social schedule as a consequence of their occupations, female subjects showed better behavior modification of their life style, for example, less frequent eating-out and taking sufficient time for exercise. Obesity is positively associated with insulin resistance and increased serum concentrations of vascular inflammatory markers.<sup>16,17</sup> It is well known that CRP is elevated in obese adults.<sup>17</sup> In this study, we didn't observe any relationship with initial body weight and CRP level. In previous studies, the current smokers are known to have higher metabolic rates than none-smoker.<sup>18</sup> Current smokers have a tendency to also have other inappropriate life style factors, for example, inappropriate stress coping strategies.<sup>18</sup> Fatty liver and diabetes are obesity related illness.<sup>2,3</sup> Diagnosed obesity related illnesses were significant sources of motivation for the participants.<sup>2</sup> The subjects who have a family history of obesity and obesity in childhood seemed to have more difficulty for weight reduction.<sup>19</sup> The subjects who have a high RMR and high  $\text{VO}_2\text{max}$  seemed to loose weight more easily.<sup>10</sup> This study failed to demonstrate a significant association between the outcome of weight reduction and any risk factors.

This study has some limitations. The number of subjects who participated in weight reduction programs and registered in the weight control program DB, based on the outcome of weight reduction was only 123. Due to the small number of study subjects, there was limited statistical power to evaluate certain main effects of most risk factors. Second, this study was not a clinical trial with random allocation and blinding method. Thus, the interpretation was limited by the lack of qualified measures. We need the further research using clinical trial design. Third, the success group is defined by people who attained more than 5% weight reduction during the follow-up period. By defining the success group as those people who attained more than 5% weight reduction, that is, considering just a change to a lower weight category only, we couldn't exactly analyze which parameter was really associated with the extent of successful weight reduction, that is, changes that might occur within the same category. This definition could underestimate the real

weight reduction, especially in the severe obese patients. In present study, the dietary components, including carbohydrates, proteins, fats and calories, were not associated with weight reduction. The additional limitation of our study is that a validated dietary survey was not used.

The present study identified the predictors for successful weight reduction. Total follow up period and high frequency of medical visits were the significant predictors of successful weight reduction. Our result suggested that strong motivation is the most important factor for successful weight reduction.

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