Changes in body mass during weight loss treatment – a two-year prospective study

Zmiany masy ciała w trakcie terapii odchudzającej – dwuletnie badanie prospektowe

Katarzyna Krekora-Wollny, Edyta Suliga

Department of Prevention of Alimentary Tract Diseases, Faculty of Medicine and Health Science, Jan Kochanowski University, Kielce, Poland

Head of the Department: Prof. Grażyna Rydzewska MD, PhD

Abstract

Introduction: A reduction of 5% to 10% of body mass is related to a significantly lower risk of the occurrence of conditions whose underlying cause is obesity.

Aim of the research: The analysis of body mass and body composition changes in overweight and obese patients undergoing weight loss treatment.

Material and methods: A total of 129 overweight and obese individuals qualified for the study. All patients were instructed to follow a healthy, balanced diet based on the nutritional standards. The patients were subjected to anthropometric measurements and body composition tests by means of bioimpedance analysis. The analysis included measurements performed 3, 6, 12, and 24 months after the first appointment. One-factor analysis of variance was applied to test the changes of body mass and composition in the following months.

Results: The average body mass index of the patients decreased on consequent follow-up appointments from 33.8 ±5.1 kg/m² to 31.8 kg/m² after 3 months, 30.5 kg/m² after 6, and 29.6 kg/m² after 12 months, and remained at this level for another 12 months. The average amount of adipose tissue decreased from 40.98 ±7.1% to 38.34% after 3 months, 36.26% after 6, 34.69% after 12, and 34.43% after 24 months.

Conclusions: Due to lifestyle adjustments, about 70% of the subjects achieved satisfactory results in the weight-loss process. The majority of these individuals were able to maintain satisfactory body mass loss in the longer term. After 24 months of observation, in about 1/3 of the individuals, a tendency to an increase in body weight and adipose tissue was observed, and in some cases a total regain of pre-treatment body mass. In order to improve the effectiveness and stability of the weight-loss process, it is necessary to conduct further studies aimed at identifying the causes for this phenomenon.
Introduction

The number of obese people in the world, despite ongoing prevention and treatment, is rapidly increasing [1]. This is accompanied by an increasing number of patients with obesity complications. It is widely known that a reduction of 5% to 10% of body mass is related to a significantly lower risk of the occurrence of conditions whose underlying cause is obesity [2–4]. The majority of patients subjected to weight loss treatment are able to achieve such an effect. It is obvious that the pace of weight loss and the value of the achieved weight loss is an individual issue for each patient and is dependent on such factors as: initial body mass, number and type of poor dietary habits, family occurrence of obesity, coexisting diseases, medication, etc. However, we expect that during treatment patients will achieve the desired results, i.e. weight loss from 0.5 to 1 kg per week, which corresponds to 2 to 4 kg per month. Assuming such values, we are able to approximately determine the time a patient needs to obtain normal body mass. It is known that not all patients are able to achieve such results, especially if they start weight loss treatment from the level of super obesity. However, even for those individuals who obtain satisfactory effects, maintaining a normal body mass after the weight loss process is still challenging. A significant number of patients trying to lose weight, sooner or later, experience the yo-yo effect [5]. Several authors indicate that maintaining a reduced body mass after the weight loss phase is a much more serious problem than weight loss itself [6–9].

Aim of the research

The aim of this study was the examination of body mass and composition changes in overweight and obese patients subjected to weight-loss treatment.

Material and methods

The study was conducted from 11.2007 to 02.2013 and involved 129 patients (105 women and 24 men) with overweight, and simple obesity (body mass index (BMI) 33.8 ±5.17 kg/m²), who came to the clinic in order to treat their overweight or obesity. The project was given approval by the Bioethics Committee of the Faculty of Medicine and Health Sciences of the Jan Kochanowski University in Kielce. The study was based on the analysis of medical documentation. Patients consciously agreed to the use of their data for scientific purposes. The average age of the subjects was 36.6 (from 18 to 69) years. After calculating each participant’s individual calorie intake needs, a calorie intake lowered by 600 calories per day was calculated. All patients were instructed to follow a healthy diet, given a balanced diet: total fat content below 30% and animal fats below 10% of energy value of a daily calorie intake, protein content of 20–22%, carbohydrate content of more than 55%, with a reduction of simple sugars and products with a high glycaemic index. The diet composition was calculated using the DIETA 4 program. The diet involved five meals a day, consumed about every 3.5 h. The elimination of sweets from the diet and an increase of liquid intake up to 2.5 l/day (including 1.5 l of table water or other non-sweetened beverages) were recommended. During the study, the intake of calories based on the current energy needs of the patients was modified, but the composition of the diet did not change significantly. Those patients who were physically active (fitness classes, cycling, swimming, aquaerobics) were instructed to maintain this activity at the same level at least. The patients who were not active had physical activities selected depending on their level of obesity, earlier experiences, and possible contraindications against some types of exercise. They were encouraged to exercise at least three times a week for about 30–40 min, with the intensity of the training not exceeding 70% maximal heart rate (HRmax).

The patients underwent anthropometric measurements and body composition tests by means of bioimpedance analysis, with the use of a Bodystat 1500 device. The abovementioned measurements and analyses were performed every 6–8 weeks for the whole treatment period. The analysis included measurements performed 3, 6, 12, and 24 months after the first appointment. The patients who resigned from the treatment before a lapse of 6 months from the first appointment were excluded from the study. The pace of the total body mass reduction and changes related to body composition were examined (the amount of adipose tissue, body water content, and fat-free mass).

Statistical analysis

Statistical analysis involved the calculation of average values and standard deviations, medians, minimum and maximum, the range of 25–75 centiles, and the normality of the distribution of characteristics. One-factor analysis of variance was applied to test the changeability of body mass and body composition in the following months. Levene’s test of variance of homogeneity was performed, followed by the Student-Newman-Keuls Test for the comparison of pairs. The significance level was adopted at the level of \( p < 0.05 \).

Results

The characteristic of the subject group in the first test is presented in Table 1. The average body mass decreased from 94.4 ±17.3 kg to 88.9 kg after 3 months, which resulted in a loss of 5.5 kg (on average 1.83 kg per month) (Figure 1). During subsequent follow-up appointments, a systematic loss of body weight was observed to 85.1 kg after 6 months (3.8 kg loss in 3 subsequent months) and 82.9 kg after 12 months (2.2 kg loss in 6 subsequent months). Twelve months after the last appointment, which is 24 months after
Table 1. The characteristics of the study participants – results of first examination

| Parameter | Mean ± SD | Median (min.–max.) | 25th–75th percentiles | Normal distribution |
|-----------|-----------|--------------------|------------------------|---------------------|
| Age       | 36.6 ±12.2| 35.0 (18.0–69.0)   | 28.0–45.0              | 0.072               |
| Height    | 166.9 ±7.1| 166.0 (153.0–190.0)| 162.0–170.3            | 0.008               |
| Weight    | 94.4 ±17.3| 91.1 (66.0–155.0)  | 81.2–108.0             | 0.001               |
| BMI       | 33.8 ±5.2 | 33.2 (24.3–49.9)   | 29.4–37.5              | 0.083               |
| %BF       | 41.0 ±7.1 | 40.7 (23.3–59.6)   | 36.6–45.3              | 0.480               |
| TBW       | 45.4 ±3.3 | 45.2 (29.2–52.4)   | 43.8–47.5              | < 0.001             |
| FFM       | 32.7 ±2.8 | 32.9 (24.5–39.1)   | 31.2–34.3              | 0.252               |

%BF – percentage of body fat, TBW – total body water, FFM – fat-free body mass.

Figure 1. Patient body mass at the beginning and during the weight loss treatment; (F[4, 645] = 12.44, p < 0.001). Statistically significant differences between average scores in the following months of the study, calculated by means of a post hoc test: 0–3, 0–6, 0–12, 0–24, 3–12, 3–24

Figure 2. Body mass index at the beginning and during the weight loss treatment; (F[4, 645] = 17.89, p < 0.001). Statistically significant differences between average scores in the following months of the study, calculated by means of a post hoc test: 0–3, 0–6, 0–12, 0–24, 3–6, 3–12, 3–24

Figure 3. Fat mass of the patients at the beginning and during weight loss treatment; (F[4, 645] = 19.16, p < 0.001). Statistically significant differences between average scores in the following months of the study, calculated by means of a post hoc test: 0–3, 0–6, 0–12, 0–24, 3–6, 3–12, 3–24

According to the definition by Wing and Hill, individuals who have intentionally lost at least 10% of their body weight and kept it off for at least 1 year should be considered to be people who have effectively decreased their body mass [10].

Discussion
The results of the conducted study revealed that after 12 and 24 months of observation, body mass reduced by at least 10% compared to the weight recorded during the first examination. This was present in 92 individuals after 12 months (71.3%) and 88 individuals after 24 months (68.2%), respectively. These results should be considered satisfactory in comparison with the results achieved by other authors [11–13]. The meta-analysis of the scores related to following various programs modifying lifestyle has shown that about 30% of participants had weight loss ≥ 10%, 25% between 5% and 9.9%, and 40% ≤ 4.9% [11]. The lowest effectiveness of losing weight defined as weight loss maintained for at least 1 year was described in the group of 14,306 adult Americans (the 1999–2006 National Health and Nutrition Examination Survey) [12]. The study showed that among the participants who had ever been overweight or obese, only 17.3% reduced their body weight by the recommended 10% and kept it off for at least a year. In the weight-loss program presented by Carney et al. [14], in which meal substitutes were used in order to reduce the intake of calories in combination with behavioural therapy, weight loss equaled 16.2 kg (14.4%) for 61% of the participants who completed a 16-month treatment. Only Thomas et al. [15] concluded that as many as 87% of participants were still maintaining at least a 10% weight loss after 5 and 10 years.

In the period between 12 and 24 months from the beginning of the treatment, in 41 of the subjects (31.8%), another gain in body mass was observed, and in 36.4% an increase of adipose tissue was noted. In consequence, after 24 months it was higher than or equal to the weight from the first examination in 6 individuals (4.7%), while the percentage of the amount of adipose tissue after 24 months from the commencement of the treatment was higher compared with the amount in the first examination in 10 (7.8%) subjects. Several authors emphasise that maintaining a reduced body mass after the completion of weight loss poses a much greater problem than the weight loss process itself [5–9]. Coughlin et al. [16] showed that after 30 months from the intervention, a continuation of the weight loss program for another 30 months turned out not to have any additional benefits. Carney et al. [14] concluded that among individuals whose weight loss after 16 months of treatment was 16.2 kg (14.4%), more than 2 years later the loss was maintained at a level of 14.3 kg (12.9%) compared with the initial body weight.

**Conclusions**

The scores of the conducted study show that due to lifestyle changes, about 70% of the subjects achieved satisfactory results in the weight-loss process and that the majority of those individuals were able to maintain the desired body mass loss in the longer term. These promising findings should stimulate researchers to take further action related to the treatment of obesity, involving lifestyle adjustments. After 24 months of observation, in about 1/3 of the individuals a worrying tendency towards a new increase of body and fat mass was noted, and in some cases total pre-treatment body weight regain occurred. In order to improve the effectiveness and durability of the weight loss process, it is necessary to conduct further studies aimed at finding the reasons for this phenomenon.

**Conflict of interest**

The authors declare no conflict of interest.
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Address for correspondence:
Prof. JKU Edyta Suliga PhD
Department of Prevention of Alimentary Tract Diseases
Jan Kochanowski University
al. IX Wieków Kielc 19, 25-317 Kielce, Poland
Phone: +48 41 349 69 74
E-mail: edyta.suliga@ujk.edu.pl