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Expected benefits and motivation to weight loss in relation to treatment outcomes in group-based cognitive-behavior therapy of obesity

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Abstract

Purpose We aimed to determine cognitive drivers, expected to play a role in target reach and/or attrition in obesity programs.
Methods We recorded the expected benefits of weight loss, weight targets, primary motivation for weight loss, perceived treatment needs, readiness and self-confidence to be successful and a battery of psychopathology questionnaires in 793 subjects with obesity (68% women; mean age 48.7; 46% obesity class III) enrolled into a group-based cognitive-behavioral treatment program. Their relevance on attrition and successful weight loss outcome were tested by logistic regression analysis.
Results The expected benefits of weight loss scored very high in all physical, psychological and social areas, with differences between genders. Attrition rate was 24, 41 and 65% at 6-, 12-, and 24-month follow-up. Average weight loss was 5.8 ± 7.1 kg (-4.8%) at 6 months, with 17% of cases (32% of continuers) maintaining weight loss > 10% at 24 months. After adjustment for confounders, attrition was reduced by concern for present health, motivation/consciousness of the importance of physical activity and need for support; treatment discontinuation was favored by concern for body image, by expectations for drug treatment or bariatric surgery, and by high-challenging weight loss targets. Male gender, higher BMI and concern for present health predicted weight loss > 10%, whereas concern for body appearance was associated with lower probability of attaining the desired weight loss targets.
Conclusion A more precise definition of needs and expectations might help tailor treatment to individual patients, but attrition rates and target reach remain difficult to predict.
Level of evidence Level V, descriptive studies.

Keywords Attrition · Expectations · Psychological distress · Treatment needs · Weight targets

Introduction

Obesity is a heterogeneous and multi-factorial condition; psychological distress, interpersonal relationships, societal stigma, as well as life events, may interfere both with its development and with treatment outcome [1]. Cognitive-behavioral treatment (CBT) is the most accepted intervention for weight loss in clinical practice, but lack of adherence remains a key component of long-term success [2], jeopardizing long-term effectiveness of treatment at various stages of intervention. Psychometric tools and validated questionnaires are frequently used to assess the psychological status of subjects with obesity before, during, and after treatment, to investigate the psychological features predictive of success in weight loss and weight loss maintenance, and to provide an individually tailored treatment [3]. Depression and

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anxiety, binge eating and other eating disorders [1, 4] inter-act with self-motivation, concerns about shape and weight and personality traits in dictating adherence and weight loss outcome [5, 6]. Self-motivation to healthy diet and habitual physical activity, described as "a behavioral tendency to per-severe independently from situational reinforcements" [7], has been considered as a predictor of successful weight loss [8, 9] and weight loss maintenance [10]. All these factors are largely sex- and age-related, and are modifiable according to previous experience during the weight loss program, which explains the difficulties in predicting success and treatment satisfaction.

Very few studies systematically investigated the areas of expected benefits of weight loss, using standardized ques-tionnaires. They range from the area of physical fitness and somatic comorbidities to the area of psychological health, to a social area, reflecting subjects' interaction with rela-tives and friends in social meeting as well as sex life. Foster et al. described a detailed questionnaire very rarely used in clinical practice [11]. However, in different settings and in different language versions, the questionnaire proved useful to identify a remarkable difference between expected weight loss and commonly achievable targets, as well as to identify the expected benefits in various areas of daily living [12, 13]. In general, also subjects with obesity entering bariatric surgery programs have unrealistic expectations regarding their future weight [13], and having more realistic weight expectations are related to healthier psychological and eating behavioral characteristics [12].

Different expectations may partly reflect the primary motivation for weight loss (present and future health *vs*. body image dissatisfaction), reported to drive both attrition and weight loss [14]. Additionally, these variables are dif-ferently distributed according to age and gender [14]. Higher weight-loss expectations and unrealistic weight goals [15], body image dissatisfaction as primary motivation for weight loss, and unsatisfactory results have been associated with treatment discontinuation [16], as well as high levels of stress [17] and emotional disorders, leading to compulsory eating [18]. Attrition rates include both dropouts during the weight loss program and subjects missed at follow-up, because of difficulties to attend outpatient visits for a variety of reasons, independently of treatment results [14].

To define better treatment strategies, we analyzed the drivers for and the expected benefits of weight loss, as well as the psychopathological profile, in a large cohort of sub-jects entering a behavioral weight loss program in an Italian obesity clinic. Data were related to treatment outcome to provide clues for an effective response to individual needs.

Materials and methods

Study population

We report data on 793 outpatients with obesity (543 women) attending the medical center of Clinical Dietet-ics, University of Bologna, and entering a CBT program for weight loss between January 2008 and December 2013. Per protocol, all subjects applying for treatment with obe-sity grade II and III, as well as subjects with obesity grade I with comorbidities, are addressed to a standardized, 3-month, group-based CBT program [19], derived from the classical LEARN program for weight control [20]. The protocol comprises 12 weekly sessions, involving groups of 12–15 patients, who are instructed on principles of calo-rie counting and monitoring daily food intake, with the use of a residential manual. The program also includes motiva-tional interviewing [21], behavioral strategies for stimulus control and to regular eating, without any dietary prescrip-tion. All session begin by reviewing the monitoring daily homework assigned during the preceding week. Exclusion criteria are limited to specialist-treated severe psychiatric disease ($< 5\%$ of cases) and/or logistics or problem at work limiting the access to group sessions (10–15% of cases, eventually requiring individual treatment). The social, anthropometric and clinical characteristics of the study population are shown in Table 1. A first dietary recall is planned after 4–5 months of enrollment, whereas follow-up of weight and clinical parameters are assessed during outpatient visits at 6, 12 and 24 months, or more fre-quently (in the presence of diabetes, severe dyslipidemia, cardiovascular disease). At entry, all patients are invited to complete questionnaires measuring psychological status and eating behavior, an in-house developed questionnaire to score motivation for weight loss [16], and a simplified Goals and Related Weights questionnaire [11], also tested in its Italian version (Supplementary Table 1) [22]. All these questionnaires are rigidly self-administered. Patients are invited to fill in the questionnaires after the initial visit, before planning any additional procedure. During the visit the rationale, the purpose and the different aspects of the questionnaires are presented to facilitate response and completeness, taking care to exclude any influence on the patients.

The procedures of this report are part of our clinical practice, and patients had provided their consent to data collection prior to receiving clinical services, in addition to the standard obligation for privacy. The audit of col-lected data and their statistical evaluation was carried out after complete anonymization and was approved by the senior staff committee of our department.

Table 1 Clinical, anthropometric and psychological characteristics of the population with obesity

	Total ($n = 793$)	Women ($n = 543$)	Men ($n = 250$)	P value
Age (years)	48.7 ± 13.5	47.9 ± 13.5	50.6 ± 13.3	0.012
Weight (kg)	113.6 ± 25.2	106.6 ± 20.7	128.7 ± 27.2	< 0.001
Height (cm)	166.6 ± 9.6	162.2 ± 6.9	176.1 ± 7.4	< 0.001
Body mass index (kg/m^2)	40.8 ± 7.7	40.5 ± 7.4	41.4 ± 8.1	0.107
Obesity class 1/2/3 (%)	27/32/41	28/33/39	26/29/45	0.247
Education (primary, secondary, commercial or vocational, degree) (%)	8/35/44/13	9/34/45/11	4/38/42/16	0.040
Occupation (student, housewife, unoccupied, employee, self-employed, retired) (%)	4/8/7/66/1/14	4/11/7/64/1/12	2/0/7/71/2/18	< 0.001
State-trait anxiety inventory-Y1 (score)	44.4 ± 11.7	46.1 ± 11.4	40.5 ± 11.3	< 0.001
State-trait anxiety inventory-Y2 (score)	45.4 ± 11.6	47.6 ± 11.4	40.6 ± 10.7	< 0.001
Beck depression inventory (score)	14.0 ± 9.0	15.2 ± 9.0	11.3 ± 8.3	< 0.001
Binge eating scale (score)	13.7 ± 9.4	14.6 ± 9.8	11.5 ± 8.1	< 0.001
STAI-Y1 anxiety grade (anxiety: no/mild/moderate/severe)(%)*	7/27/20/46	5/22/21/53	13/36/17/34	< 0.001
STAI-Y2 anxiety grade (anxiety: no/mild/moderate/severe)(%)*	7/24/19/51	3/20/19/59	15/32/19/33	< 0.001
BDI grade (depression: no/mild/moderate/severe)(%)*	36/38/20/6	29/41/23/7	51/31/14/4	< 0.001
BES grade (no BED/suspected BED/highly diagnostic for BED)(%)*	67/22/10	63/26/11	78/15/6	0.003

*For scoring cut-offs, see "Materials and methods"

Questionnaires

The Foster questionnaire on goals and related weights [11] was used to indicate:

1. *Weight loss targets* Only two items of the Foster questionnaire (goals and relative weights questionnaire) were considered: (a) dream weight; (b) maximum acceptable weight [11]. On this basis, we computed the % weight loss needed to reach targets.
2. *Expected benefits of weight loss* The final set of questions investigated the expected benefits of weight loss on specific physical, psychological and social areas of their personal life, scored on a scale from 0 to 10 [11].

The questionnaire investigating drivers for weight loss was derived from the previous experience of the QUO-VADIS study [16]:

1. *Drivers for weight loss* They were chosen between: (a) concern for present health; (b) concern for future health; (c) concern for body shape and desire to improve appearance; (d) recommendation by their general practitioner or significant others;
2. *Perceived treatment needs* The subjects scored on a scale from 0 to 100: (a) need for help by an experienced team; (b) need for support for long-term weight control; (c) need for specific drugs; (d) initial step to bariatric surgery;
3. *Self-assessed readiness to behavioral change* The subjects scored on a scale from 0 to 5 the following personal

beliefs: (a) readiness to change permanently dietary habits; (b) readiness to engage in physical activity;
4. *Self-confidence to be successful* On a line from 0 to 100, the subjects marked their self-confidence to: (a) achieve the desired target of maximum acceptable weight; (b) adhere to dietary restriction; (c) adhere to a physical activity program.

Finally, the psychological distress and binge eating disorder was investigated by the following validated tools:

- *State-trait anxiety inventory (STAI)* It investigates anxiety state and anxiety trait (Form Y1 and Y2, respectively) by means of 20 questions, scored on a scale from 1 to 4 [23]. Values from 0 to 29 indicate no anxiety, mild anxiety scores from 30 to 37, moderate from 38 to 44, severe > 44.
- *Beck depression inventory (BDI)* A highly reliable, multilingual, specific instrument, largely used to detect and score a so-far undetected depressive status, based on 21 multiple-choice questions (maximum score, 63) [24]. Values from 0 to 9 indicate no depression, mild depression scores 10–18, moderate 19–29 (and indicates treatment), severe > 29 (with scores > 21 indicating clinically significant depression) [25–27].
- *Binge eating scale (BES)* [28]. A measure of the severity of binge eating based on 16 items including both behavioral signs and feelings or cognitions during a binge episode. A score ≥ 27 conventionally serves as a cutoff value for severe binge eating [28], whereas scores < 16 may be used to exclude binge eating [29].

All questionnaires were self-administered, and were returned by patients at the end of the initial visit. Physicians made a rapid check to ensure completeness.

Statistical analysis

A descriptive analysis on the whole population was carried out with the use of means ± standard deviation (SD) for continuous parameters, as well as prevalence rates for nominal characteristics. Differences between means and rates in relations to anthropometric and clinical characteristics were tested for significance by means of Student's *t* test and Fisher or Mann–Whitney *U* test, or by repeated measures ANOVA for multiple weight values. Factors associated with attrition rates at 6- (short-term) and 24-month follow-up (long-term) and/or weight loss > 10% (clinically significant weight loss) at the same time points were tested by logistic regression analysis. No attempt was made to test the cluster effect of group. Considering that two treatment outcomes were considered (attrition rates and weight loss ≥ 10%) and most data were split according to gender and obesity class, the statistical significance was adjusted according to Duncan's multiple range to $p\prime = 1 - \sqrt[(n-1)]{(1 - p)}$, where $p = 0.05$ and $n = 4$. The final critical value of significance was therefore set at 0.015.

Results

Baseline data

Our population was characterized by a high grade of obesity (Table 1): 174 individuals were in obesity class I (F/M, 121/53), 255 in class II (F/M, 183/72), 364 in class III (F/M, 239/125). The educational level and occupation were variable and different between genders. In general, women (more than 2/3 of total cases) had higher levels of anxiety and depression, as well as higher BES score, compatible with a severe binge eating (BES > 26) in 11% of cases (vs. 5% in males). Psychopathology scores were progressively higher in relation to obesity class, but significance was only observed for BES (*p* for trend according to obesity class severity, 0.026). Notably, severe anxiety was detected in a large proportion of cases, particularly in females, whereas severe depression and high BES scores were much less common.

Weight loss targets and ratings of the anticipated effect of weight loss (Table 2)

Weight targets were extremely challenging. An average 24% weight loss was needed to reach the maximum acceptable weight, whereas over one-third of body weight loss (and in a few cases over 50%) was indicated to reach the dream weight.

Significant differences in the anticipated effect of weight loss were observed in relation to gender (Table 2). An effect on general health was the most common reported benefit in both genders. Anticipated improvements in sexual life and sexual attention-interest from others were scored higher in men (although not significantly different from women); improvements in social life, physical presence, competence perception by others, comfort in social situations and at family gatherings, and the general attention from others were scored higher in women. Finally, women considered more favorably than men weight loss as a way to systematically improve stress, anxiety, depression, and self-confidence.

Motivation for weight loss and expectations (Table 3)

Concern for present health was the most common driver for entering the weight loss program, irrespective of gender. In females concern for body shape and desire to improve appearance was also indicated by over one-third of cases, whereas in males the second driver was concerned for future health. Only few cases applied for treatment under pressure of external drivers, more commonly in males.

The majority of cases pointed to the search for an experienced team and regular weight control as perceived needs for long-term success. Only a few relied on drugs and the number of cases entering the program as initial step to bariatric surgery was relatively low, in spite of a BMI and complications fulfilling the criteria for surgical intervention in over 50% of cases.

Readiness to change dietary habits was higher in women; in both men and women readiness to engage in physical activity was much lower than readiness to diet (*p* < 0.001 for both).

Self-confidence to be successful was scored as 71% in men and 64% in women (*p* < 0.001), and again the self-confidence to adhere to diet was much higher than the confidence to be able to engage in physical activity (*p* < 0.001 for both men and women).

Attrition and weight loss at follow-up

Ninety-six subjects (12%) stopped their participation in the weight loss program during the intensive treatment phase (first 3 months). Attrition rates continued to increase in the overall sample, with only 76, 59 and 45% available at follow-up at 6, 12 and 24 months. At the 6-month control, attrition was much higher in females (27 vs. 17%; *p* = 0.001), but gender differences were no longer observed after 12 (43 vs. 36%) and 24 months (55 vs. 54%).

Table 2 Weight loss targets and ratings of the anticipated effect of weight loss

Variable	Females ($n = 543$)	Males ($n = 250$)	p value
Weight loss targets			
Maximum acceptable weight (kg)	79.1 ± 13.1	95.3 ± 12.8	< 0.001
Weight loss to maximum acceptable weight (%)	-24.7 ± 9.8	-24.3 ± 10.4	0.613
Dream weight (kg)	64.6 ± 8.8	81.3 ± 9.8	< 0.001
Weight loss to dream weight (%)	-37.9 ± 10.8	-35.0 ± 11.0	< 0.001
Expected benefits of weight loss (0–10)			
Physical area			
Health	9.51 ± 1.13	9.24 ± 1.33	0.006
Ability to physically defend	6.91 ± 2.11	6.47 ± 2.43	0.017
Physical strength	7.57 ± 2.02	6.99 ± 2.17	< 0.001
Fitness	7.78 ± 2.09	7.11 ± 2.06	< 0.001
Social area			
Social life	8.03 ± 1.93	7.75 ± 2.10	< 0.001
Sex life	7.49 ± 2.40	7.70 ± 2.04	0.182
Attractiveness to spouse—significant other	7.52 ± 2.45	7.43 ± 2.03	0.643
Physical presence	8.64 ± 1.72	7.94 ± 2.02	< 0.001
Other's perception of your competence	8.06 ± 1.88	7.53 ± 2.13	0.001
Comfort in social situations with strangers	7.76 ± 1.99	6.95 ± 2.23	< 0.001
Likability	6.97 ± 2.14	6.62 ± 2.26	0.061
Comfort at family gatherings	7.48 ± 2.11	6.73 ± 2.24	< 0.001
Attention from others	7.30 ± 2.03	6.83 ± 2.23	< 0.001
Sexual attention—interest from others	6.43 ± 2.67	6.57 ± 2.59	0.536
Psychological area			
Assertiveness	6.73 ± 2.05	6.60 ± 1.85	0.488
Stress	7.33 ± 2.48	6.52 ± 2.59	< 0.001
Anxiety	7.03 ± 2.56	6.32 ± 2.53	0.001
Depression	6.85 ± 2.82	6.00 ± 2.50	< 0.001
Self-confidence	8.22 ± 2.03	7.35 ± 2.23	< 0.001

Weight loss averaged 5.8 ± 7.1 kg at 6 months (Fig. 1), corresponding to 4.8% of initial body weight (not different between genders: 5.4% in men vs. 4.5% in women; $p = 0.073$), but ranged up to 41.3 kg in a man with an initial body weight of 178 kg. In subjects adherent to follow-up, the mean percent weight loss continued to increase, up to 5.9% in women and 6.4% in men at 12-month ($p = 0.487$) and 7.0 vs. 7.8% at 24-month, respectively ($p = 0.390$). Time x treatment ANOVA confirmed a significant gender-related difference in percent weight loss in subjects on treatment up to 24 months ($p = 0.008$).

Weight loss > 10% was attained in over 16% of cases at 6 months, and this ratio increased to 26 and 32% of cases regularly attending follow-up, corresponding to 17% of enrolled subjects. In nearly 50% of cases weight loss was, however, scarce (< 5%) or null, but also in subjects who did not lose weight, the increase was on average < 3 kg at 12- and 24-month follow-up.

Predictors of attrition and weight loss

After adjustment for sex and age, short-term (6-month) attrition was significantly associated with several clinical and psychological characteristics (Table 4). Notably, it was scarcely associated with the expected beneficial effects of weight loss (in the physical, social and psychological area) (Table 5), and psychopathology traits (anxiety, depression or binge eating) had no effect at all. Attrition was significantly favored by the presence of anxiety and depression in females, not in males, and was significantly reduced by concern for present health (at 6-month, with a non-significant effect in the long term), whereas it was favored by body image dissatisfaction or by considering CBT as a temporary step to bariatric surgery. External drivers and motivation towards dietary change were of no significance, whereas the need for support (by an experienced team and long-term control) and motivation and consciousness of the importance of physical activity reduced

Table 3 Drivers for weight loss, reported treatment needs, readiness to engage in treatment programs, and weight loss targets

Psychological characteristics	Females ($n = 543$)	Males ($n = 250$)	p value*
Weight loss drivers (one or more)^			
Concern for present health (%)	42 (38–46)	52 (46–58)	0.009
Concern for future health (%)	18 (15–21)	23 (18–28)	0.122
Concern for appearance and body shape (%)	37 (33–41)	22 (18–28)	< 0.001
External driver (GPs, relatives, friends) (%)	5 (3–7)	10 (6–14)	0.011
Perceived treatment needs			
Need for help by an experienced team (%)	62 (57–66)	63 (57–69)	0.689
Need for long-term weight control support (%)	29 (25–33)	21 (16–26)	0.012
Need for weight-loss drugs (%)	14 (11–17)	20 (15–25)	0.570
Initial step to bariatric surgery (%)	20 (17–24)	19 (15–23)	0.847
Readiness to weight loss (score 0–5)			
Readiness to change dietary habits	4.05 ± 1.08	3.78 ± 1.15	0.002
Readiness to engage in physical activity	3.26 ± 1.36	3.15 ± 1.31	0.336
Self-confidence to be successful in (score 1–100)			
Reaching the target of maximum acceptable weight	63.6 ± 25.5	69.9 ± 24.1	0.002
Adhering to long-term dietary restriction	60.8 ± 28.2	61.8 ± 28.1	0.657
Adhering to long-term physical activity program	51.7 ± 28.7	52.8 ± 28.0	0.636

Nominal data are given as % (95% confidence interval); numerical data as means ± SD

*Fisher exact test

^Note that percentage does not sum up to 100. In several cases, particularly in males, more than one reason was selected and all choices were considered in the analysis

attrition. Finally, short-term attrition was driven by more challenging targets (higher percent weight loss to maximum acceptable weight), not by dream weight targets.

In a logistic regression analysis, weight loss > 10% of initial body weight was associated with male sex (odds ratio (OR) 2.0; 95% confidence interval (CI), 1.32–3.07 at 6 months), and high BMI (OR, 1.18; 95% CI, 1.04–1.35 at 6 months; OR, 1.24; 95% CI, 1.06–1.45 at 24-month analysis) in subjects compliant to follow-up (Supplementary Table 2). An interaction was also present between sex and psychological distress on target reach: weight loss target at 6 months was predicted by the lower levels of anxiety in females, not in males (STAI-Y1: OR, 0.98; 95% CI, 0.97–0.99; STAI-Y2: OR, 0.99; 95%CI 0.97-1.00). Concern for body appearance was a negative predictor for 6-month success (OR, 1.95; 95% CI, 1.21–3.15), whereas concern for present health was associated with 10% weight loss at 24 months (OR, 1.66; OR, 1.04–2.65). Other variables did not predict weight outcome (Table 5), with the notable exception of benefits in social life in the short-term.

Discussion

The present report, based on a large set of data collected in subjects with obesity, confirms that attrition remains difficult to forecast in subjects enrolled into weight loss programs, as are the short- and long-term results.

Adherence to treatment remains a very complex matter in obesity, driven by several factors differently interacting in individual patients [30], jeopardizing the effectiveness of most treatments. Also in industry-sponsored studies, where adherence is favored by the possibility to receive treatment for free, the rate of attrition may reach 50% [31, 32], and the figure may be even higher in clinical audits of programs where subjects have to pay for treatment [2, 33]. Nonetheless, approximately one-third of cases who keep contact with the center for 2 years (nearly 50% of initial cases) reach the 10% weight loss target, sufficient to produce significant health effects, and only one-fifth of the sample does not lose weight at all.

In general, young age and female sex were significantly associated with attrition in the present setting, in keeping with previous reports [14, 34]. All physical, social and psychological areas tested of Foster's questionnaire [11] were reported to improve remarkably following treatment, but did not predict either attrition or target reach. Areas of sexual life, social stigma and work life have largely been considered in obesity studies [35], and are expected to account for much of the poor health-related quality of life [6]. However, the impact of these benefits is low, both on attrition and target reach. The impairment of these domains is probably dependent on several variables also regulating the expected benefits achievable by weight loss (i.e., gender, age, obesity grade, marital status, psychological status, disability, etc.) [36, 37]. Apparently, their evaluation does not add much to
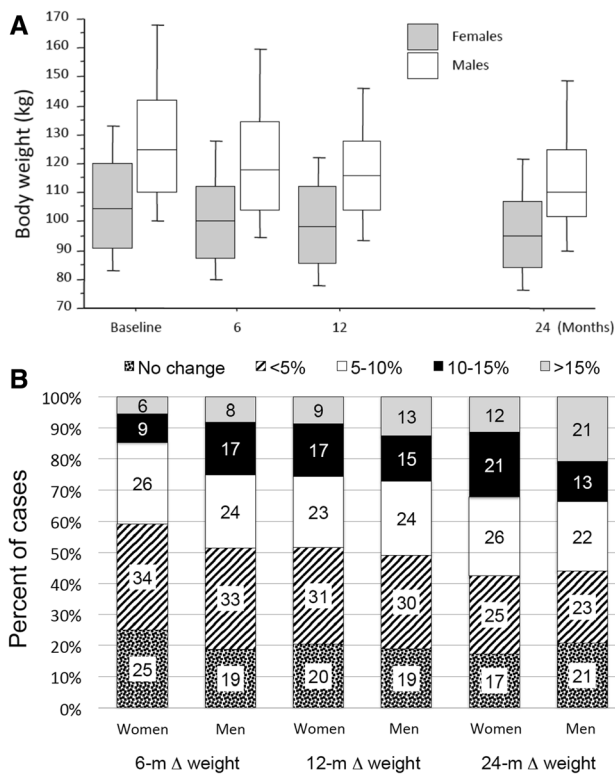
Fig. 1 a Time course of body weight in subjects compliant to follow-up (upper panel). **b** Percent of cases attaining short- and long-term weight loss targets in relation to gender (lower panel). Panel A: the box indicates the area of 25°–75° percentiles (and median); the whiskers stretch to 5° and 95° percentile. Panel B: the numbers inside the columns are the percentage of cases, in relation to weight loss targets

general motivation for weight loss; their value should be put in the context of a multidimensional evaluation of individual subjects, to stimulate adherence to treatment and reinforce motivation.

We also investigated perceived treatment needs. Both need for help by an experienced team and need for long-term weight control were associated with lower attrition rates, whereas need for drug support or option for bariatric surgery were predictors of attrition. The usefulness of drugs in long-term treatment of obesity is limited; pre-treatment confidence in drug support might indicate a poor motivation to lifestyle changes hampering the results of CBT. Similarly, although CBT and surgery may positively add up in weight loss maintenance, it is not defined whether CBT might precede or follow surgery [38]. Long-term control of weight, possibly by an experienced team, is considered mandatory to increase the amount of weight loss (see below); its perceived importance in attrition is less clearly defined and should be tested against the perceived ability to self-manage weight control and weight loss maintenance by a proportion of patients [16].

A set of specific questions investigated readiness to dieting and physical activity, as well as perceived confidence to comply with dietary restrictions and physical activity programs. The stages of change towards diet and physical activity differ in subjects with metabolic diseases [39, 40], as in obesity. Subjects entering weight loss program are aware of the importance of diet, whereas the importance of physical activity, even if moderate considering the limitations due to obesity, is poorly considered. Readiness and self-confidence to adhere to physical activity should be favored by appropriate motivational interviewing to reduce attrition [41].

Motivation for losing weight remained the most significant driver responsible for adherence/attrition after adjusting for age, sex and BMI. In our setting, concern for present health was the most common motivation reported at enrolment. It reduced short-term attrition, and was close to statistical significance in the long-term. It is conceivable that comorbidities and/or their progression remain a source of stress for subjects and help maintain weight control. On contrary, attrition was predicted by concern for body shape and desire to improve appearance at both time-points. A post hoc 6-month analysis shows that this motivation is more strictly associated with attrition in females than in males (OR, 4.50 and 3.53, respectively), and the OR is as high as 6.60 in subjects below 40. The effect of age has been reported in a few [2, 42], but not all [8] epidemiological, community-based surveys, and is also present in randomized controlled trials [43]. Differences might be related to the severity of obesity in the various studies, which is also inconsistently associated with attrition [44].

In previous studies we reported that motivation for losing weight, namely concern for body shape and appearance, may interact with weight loss targets in regulating attrition in large, multicenter populations [14, 34]. This interaction was also confirmed in the present cohort. Challenging weight loss targets—and also weight loss to maximal acceptable weight—were difficult to reach in the short-term; whenever concern for appearance is the primary motivation, the subjects soon realize that their wishes will hardly be accomplished and drop-out might be common, also considering the direct and indirect costs of treatment.

Notably, psychiatric comorbidity was not associated with attrition in the present sample, and a post hoc analysis where psychiatric comorbidity was tested using the nominal cut-offs indicated in the Methods section did not change the results (not reported in details). However, cases with severe psychiatric comorbidities were excluded from CBT, also considering the group-based approach. These data, however, challenge the concept that specific treatment of psychopathology might significantly modify target reach or attrition rates in community subjects.

The study has both strengths and limitations. The use of a large set of data obtained in consecutive patients allowed for

Table 4 Logistic regression analysis of factors associated with attrition

	6-month	24-month
Age (/10)	**0.80 (0.71–0.91)**	**0.75 (0.67–0.84)**
Sex (M)	**0.53 (0.36–0.78)**	0.93 (0.69–1.25)
Body mass index (/5)	0.98 (0.88–1.10)	1.07 (0.97–1.17)
Psychopathological traits^		
State-trait anxiety inventory-Y1 (score)	1.00 (0.98–1.02)	0.99 (0.98–1.01)
State-trait anxiety inventory-Y2 (score)	1.00 (0.99–1.02)	0.99 (0.98–1.01)
Beck depression inventory (score)	1.01 (0.99–1.04)	1.01 (0.99–1.03)
Binge eating scale (score)	1.00 (0.98–1.02)	1.00 (0.98–1.02)
Interactions of psychopathological traits by sex*		
State-trait anxiety inventory-Y1 (score) × sex	**1.01 (1.00–1.02)**	1.00 (0.99–1.00)
State-trait anxiety inventory-Y2 (score) × sex	**1.01 (1.00–1.02)**	1.00 (0.99–1.01)
Beck depression inventory (score) × sex	**1.03 (1.01–1.05)**	1.00 (0.98–1.02)
Binge eating scale (score) × sex	1.02 (0.99–1.04)	1.00 (0.98–1.01)
Weight loss drivers^		
Concern for present health	**0.49 (0.34–0.70)**	0.75 (0.56–1.01)
Concern for future health (%)	1.04 (0.68–1.59)	0.95 (0.66–1.36)
Concern for appearance and body shape (%)	**4.18 (2.93–5.95)**	**2.11 (1.53–2.92)**
External driver (GPs, relatives, others) (%)	1.21 (0.59–2.46)	0.66 (0.36–1.22)
Perceived treatment needs^		
Need for help by an experienced team (%)	**0.49 (0.35–0.70)**	**0.60 (0.44–0.82)**
Need for long-term weight control support (%)	0.74 (0.49–1.10)	**0.67 (0.48–0.94)**
Need for weight-loss drugs (%)	1.12 (0.68–1.84)	1.32 (0.86–2.03)
Possible step to bariatric surgery (%)	**2.63 (1.78–3.90)**	**1.89 (1.29–2.77)**
Readiness to weight loss^		
Readiness to change dietary habits	1.01 (0.86–1.19)	0.97 (0.70–1.34)
Readiness to engage in physical activity	0.91 (0.80–1.04)	**0.89 (0.80-1.00)**
Self-confidence to be successful in^		
Reaching the desired weight target	1.00 (0.99–1.01)	1.00 (0.99–1.01)
Adhering to long-term dietary restriction	0.99 (0.99–1.00)	1.00 (0.99–1.00)
Adhering to long-term physical activity program	0.99 (0.99–1.00)	**0.99 (0.99–1.00)**
Targets^		
Weight loss to maximum acceptable weight (%)	**1.02 (1.00–1.04)**	1.00 (0.98–1.02)
Weight loss to dream weight (%)	1.02 (1.00–1.04)	1.00 (0.98–1.02)

Data are reported as odds ratio (95% confidence interval)

Statistically significant data are indicated by bold character

*Logistic regression adjusted for age and BMI

^Logistic regression adjusted for age, sex and BMI

an extensive evaluation of multiple variables and the analysis of subset cohorts. All data were derived from a single center, acting as second-level in a university hospital, and our patients might not reflect the general characteristics of treatment-requiring subjects with obesity. However, data are in agreement with previous reports of multicenter studies, including subjects treated with variable approaches [16, 34], thus supporting a possible external validity of the results. Limitations also include the large number of statistical tests carried out. Although we adjusted significance according to multiple tests, the possibility of mass significance is not completely ruled out.

In summary, the analysis confirms the difficulties in addressing all needs of subjects with obesity requiring weight loss treatment, because of the large heterogeneity of motivational drivers, targets and expected benefits, as well as the difficulties in weight loss maintenance [45]. Standardized group-based CBT should be personalized by more frequent contacts with therapists and/or specific modules to reduce attrition. Subjects should be encouraged to pursue and being satisfied by achievable targets, associated with better weight loss maintenance [22], and to increase motivation and self-confidence towards physical activity. In conclusion, this work showed that more precise definition of needs

Table 5 Logistic regression analysis of 6- and 24-month attrition and target reach (weight loss > 10%) in subjects with obesity in relation to expected benefits of weight loss

Variable	Attrition rates		Weight loss > 10%	
Expected benefits of weight loss (0–10)	6-month	24-month	6-month	24-month
Physical area				
Health	1.00 (0.86–1.17)	0.99 (0.87–1.13)	0.90 (0.76–1.06)	0.88 (0.73–1.07)
Ability to physically defend	0.95 (0.87–1.03)	**0.92 (0.85–0.99)**	0.99 (0.89–1.10)	0.97 (0.86–1.11)
Physical strength	1.04 (0.95–1.13)	0.99 (0.92–1.07)	0.96 (0.86–1.08)	0.93 (0.81–1.06)
Fitness	0.97 (0.89–1.06)	0.97 (0.90–1.05)	0.97 (0.87–1.10)	0.93 (0.81–1.07)
Social area				
Social life	1.08 (0.98–1.19)	1.02 (0.94–1.11)	**1.17 (1.03–1.33)**	1.10 (0.96–1.25)
Sex life	0.98 (0.90–1.06)	0.98 (0.92–1.06)	1.03 (0.93–1.15)	0.98 (0.88–1.09)
Attractiveness to spouse-significant other	0.98 (0.91–1.07)	0.99 (0.92–1.07)	1.04 (0.93–1.17)	0.94 (0.83–1.05)
Physical presence	0.96 (0.87–1.06)	**0.92 (0.84-1.00)**	1.04 (0.91–1.18)	0.95 (0.82–1.09)
Other's perception of your competence	0.99 (0.91–1.08)	0.98 (0.91–1.05)	1.09 (0.97–1.22)	0.99 (0.87–1.13)
Comfort in social situations with strangers	1.04 (0.95–1.13)	0.99 (0.91–1.06)	1.08 (0.96–1.21)	1.01 (0.89–1.15)
Likability	0.97 (0.89–1.06)	0.98 (0.91–1.07)	1.03 (0.90–1.17)	0.91 (0.80–1.04)
Comfort at family gatherings	1.08 (0.99–1.18)	1.01 (0.93–1.08)	0.99 (0.89–1.10)	0.98 (0.86–1.10)
Attention from others	0.97 (0.87–1.05)	**0.91 (0.84–0.98)**	0.98 (0.88–1.10)	0.90 (0.79–1.03)
Sexual attention—interest from others	0.97 (0.90–1.04)	**0.92 (0.87–0.98)**	1.02 (0.93–1.12)	0.99 (0.90–1.10)
Psychological area				
Assertiveness	0.98 (0.88–1.09)	0.96 (0.88–1.06)	1.09 (0.95–1.26)	1.13 (0.96–1.32)
Stress	1.05 (0.97–1.13)	0.97 (0.91–1.03)	1.10 (0.97–1.21)	1.05 (0.94–1.18)
Anxiety	1.03 (0.96–1.10)	0.95 (0.90–1.01)	1.01 (0.92–1.11)	1.02 (0.92–1.13)
Depression	1.02 (0.96–1.09)	0.97 (0.92–1.03)	1.01 (0.92–1.10)	0.98 (0.89–1.08)
Self-confidence	1.02 (0.93–1.11)	0.95 (0.88–1.03)	1.02 (0.91–1.14)	0.97 (0.85–1.11)

Data are expressed as odds ratio (95% confidence interval) per unit of scored benefits on a 1–10 scale

All data are adjusted for age, gender and BMI. Statistically significant data are indicated by bold character

and expectations might help tailor treatment to individual patients. Future areas of research may include whether more intensive or inpatient treatment settings may help reduce attrition and improve outcome in patients who failed outpatient treatment; implementation of physical activities strategies; the use of ICT (Information and Communications Technology) to reinforce CBT programs; the combination of CBT and obesity drug treatment.

Compliance with ethical standards

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