

# Risk factors for weight gain: a longitudinal study in non-weight loss treatment-seeking overweight adults

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## Abstract

**Purpose** To study some psycho-social variables in a sample of non-weight loss treatment-seeking overweight adults and to evaluate the weight outcome and the possible risk factors for weight gain over a 1-year period.

**Methods** 167 Overweight (BMI range 25–29.9) subjects (66 % females, age  $50 \pm 10$  years, BMI  $28 \pm 1.49$ ) were recruited randomly in the surgeries of primary care physicians (PCPs). Data were collected through an ad hoc questionnaire with personal details and medical history. The following tests were administered: Binge Eating Scale (BES), Beck's Depression Inventory (BDI) and Body Uneasiness Test (BUT). Weight and height were measured using a mechanical balance with a stadiometer in standard conditions. At follow-up, 1 year after, updated data were collected for 125 subjects (75 %).

**Results** At follow-up, there was remarkable weight instability: only 16 % of the subjects maintained their baseline weight, 40.8 % showed a decrease, and 43.2 % gained weight. In 14.4 % of cases, weight gain led to obesity (BMI  $\geq 30$ ). 18 individuals (14.4 %) reported

having followed weight loss treatments in the last year, 11 among people with stable/decreased weight and 7 among those with weight gain. Lifetime comorbidity for anxiety and intense body uneasiness at baseline were the most important factors significantly associated with weight gain. Living with someone and habitually practicing sport resulted to play a protective role against weight increase. **Conclusions** Our study highlights the importance of a multidimensional assessment (medical and psycho-social) of overweight patients, aimed to identify individuals at greater risk of weight gain. They should receive targeted interventions.

**Keywords** Overweight · Obesity · Binge eating · Weight gain · Risk factors

## Introduction

The prevalence of overweight and obesity is increasing at an alarming rate in both developed and developing countries throughout the world [1]. It represents a serious public health burden and national programs aimed to obesity prevention are becoming a major priority [2]. Therefore, it is crucial to identify factors associated with the onset and maintenance of a state of obesity.

Important factors for weight gain in overweight subjects are unhealthy diet and insufficient physical activity [3–6]. Some eating disorders, such as Night Eating Syndrome (NES) and Binge Eating Disorder (BED) [7, 8], at the least maintain, and at worst promote, overweight and obesity [9–12]. BED in overweight patients can be a serious risk factor for the progression to obesity and primary care physicians should screen for BED when overweight and obese patients present with rapid weight

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gain [13]. Patients with BED obesity have greater psychiatric comorbidity than patients with non-BED-obesity, particularly in the area of mood, body image and personality disorders [14–17].

Intense body dissatisfaction is a robust and shared risk factor for eating disorders and obesity. Dieting is often associated with body dissatisfaction and can increase the risk for binge eating and weight gain over time; furthermore, body dissatisfaction may lead to the development of obesity due to its correlation with lower levels of physical activity [18–21].

Anxiety and depression often go together with obesity [22]. Data obtained in a cross-sectional survey from 3,361 general practice patients demonstrated a U-shaped relationship between weight and depression, with higher prevalence of depressive symptoms observed among underweight (24 %) and obese individuals (23 %) in comparison with normal weight (11 %) and overweight (12 %) subjects [23]. A number of studies suggest a bidirectional relation between obesity and depression [24, 25].

Studies regarding the weight control have been mainly performed on seeking treatment obese patients or on pregnant women; the research is mostly directed to assess the short-term and long-term course of weight after treatments, or to investigate on pretreatment predictors of weight control as well [26–29]. Identifying significant predictors of weight loss/gain outcomes is central to improving treatments for obesity. A study on psychosocial and behavioral pretreatment predictors of weight loss outcomes found that among overweight, non-obese individuals participating in a six-month calorie restriction trial, poor psychological adjustment, somatic symptoms, and negative mood states resulted to form a psychosocial profile that was predictive of less weight and fat loss [29]. However, research efforts have resulted in weak predictive models with limited practical usefulness [30, 31].

Little is known about overweight subjects who are not seeking weight loss treatment. Studies on this topic regard above all children/adolescents [32, 33] and show a higher frequency of abnormal attitudes and behavior toward food in overweight subjects compared to normal-weight individuals of same age: unregulated food consumption, overeating and unhealthy eating habits to control weight that threaten the physical and psycho-social well-being of overweight teenagers and are risk factors for further weight gain and major eating disorders [33].

The aims of the present study were: (1) to investigate the characteristics of a sample of non-treatment-seeking overweight adults; (2) to assess weight outcome and possible associations between weight gain and psycho-social factors at a 1-year follow-up.

## Materials and methods

### Sample

The study involved a group of 14 Primary Care Practitioners (PCP) working in Ferrara, a little town of Northern Italy. A sample of overweight individuals (BMI range 25–29.9) was recruited randomly among the patients addressing the PCP for different reasons from weight management and who were not currently following a weight loss treatment. 167 Individuals agreed to participate in the baseline phase. At follow-up, 1 year after, it was possible to collect updated data for 125 subjects (75 %).

All participants signed an informed consent, and data were treated according to the Italian privacy law (L 575/1996, Art. 10–13).

### General characteristics

Information on age, gender, educational and residential status, current/past medical and psychiatric comorbidity, familiarity for obesity or eating disorders, and physical activity was collected through an ad hoc specific questionnaire, filled out by both the PCP and the subjects.

Weight and height were measured in the PCP's surgery using a mechanical balance with a stadiometer at standard conditions (without shoes and with light clothing). At follow-up, the weight was measured in the PCP's surgery following the same modality of baseline for 97 subjects (78 %); for the remaining 28, the weight was reported by the subjects. The subjects with self-reported weight did not differ from the others at follow-up neither for weight change (gain, stability, decrease) nor for the other variables considered in this study. Therefore, reported weights were retained for analyses. The weight was considered as increased or decreased when change was  $\geq 1$  kg; otherwise, it was evaluated as stable. Body Mass Index (BMI) was computed as the ratio between the weight (Kg) and the square of the height (m). At follow-up, data on weight loss treatments performed in the last year were also collected.

### Psychometric instruments

The following questionnaires were administered at baseline:

1. Binge Eating Scale (BES), a 16-item questionnaire aimed to investigate the presence of binge eating episodes. The score ranges from 0 to 46 (cutoffs, for two severity levels, 16/17 and 26/27) [34, 35].
2. Beck's Depression Inventory (BDI-II), a 21-item questionnaire intended to assess the existence and severity of symptoms of depression. The score ranges

from 0 to 63 (cutoffs, for three severity levels, 9/10, 18/19 and 29/30) [36].

3. Body Uneasiness Test (BUT), a 71-item questionnaire which explores different areas of body image psychopathology and consists of two parts: BUT-A which measures weight phobia, body image concerns, avoidance, compulsive self-monitoring, detachment and estrangement feelings towards one's own body (depersonalization); BUT-B which looks at specific worries about particular body parts or functions. In the present study, we considered only the Global Severity Index (GSI) of the BUT-A (BUT-GSI) with a cutoff 1.2/1.3 [37, 38].

### Statistical analyses

Analyses were performed with the Statistical Package for the Social Sciences (SPSS-PC), release 13. The following routines were used: frequency distribution; contingency tables with Chi square test to evaluate statistical differences between categorical variables; non-parametric test of Kolmogorov–Smirnov (K–S) to evaluate whether the age was normally distributed; analysis of variance (ANOVA) to test the age difference between weight outcomes at follow-up; a multiple logistic regression model with weight gain ( $\geq 1$  kg) as a binary-dependent variable (0 = no, 1 = yes) to identify possible risk factors related to the weight increase at follow-up. At follow-up, 1 year after, we did not expect, in general, very large weight increments. We used a logistic regression model to provide an indicative possible 'quantification' of the risk (i.e., odds ratios). A multiple regression with BMI as a continuous variable provides another type of information. We tried to run also a multiple regression with continuous BMI, but we found no relevant results. The following independent factors were considered: gender, age, residential status (living with someone = 0, living alone = 1), educational status (high = 0, low-medium = 1), physical activity (yes = 0, no = 1), lifetime self-reported specific comorbidity (no = 0, yes = 1), familiarity for obesity (no = 0, yes = 1), depressive symptoms ( $BDI \leq 18 = 0$ ,  $>18 = 1$ ), body dissatisfaction (BUT-GSI as a continuous variable) and binge eating (BES as continuous variable). Statistical significance referred to a  $p < 0.05$ .

### Results

Baseline general characteristics of the studied sample are described in Table 1. Females and working subjects were predominant. About half of the sample (53 %) reported medium–high educational level (high school or university

**Table 1** Baseline data ( $N = 167$ )

Gender	
Men	57 (34.1 %)
Women	110 (65.9 %)
Age (years)	49.7 $\pm$ 10.8 (21–65)
BMI	28 $\pm$ 1.49 (25–29.9)
Educational status:	
None/primary	23 (13.8 %)
Lower high school	54 (32.3 %)
High school	68 (40.7 %)
University degree	20 (12.0 %)
Missing	2 (1.2 %)
Working status	
Yes	102 (61.1 %)
No	65 (38.9 %)
Residential status	
Not alone	143 (85.6 %)
Alone	24 (14.4 %)
Physical activity	
Yes	44 (26.3 %)
No	123 (73.7 %)
Lifetime comorbidity	
Depression	28 (16.8 %)
Anxiety	39 (23.3 %)
Anorexia nervosa	1 (0.6 %)
Bulimia nervosa	1 (0.6 %)
Binge eating disorder	3 (1.8 %)
Substance abuse	3 (1.8 %)
Hypertension	42 (25.1 %)
Diabetes	7 (4.2 %)
Thyroid disorders	16 (9.6 %)
Heart diseases	7 (4.2 %)
Familiarity	
Obesity	30 (18.0 %)
Eating disorders <sup>a</sup>	13 (7.8 %)

<sup>a</sup> Anorexia nervosa or Bulimia nervosa or Binge eating disorder

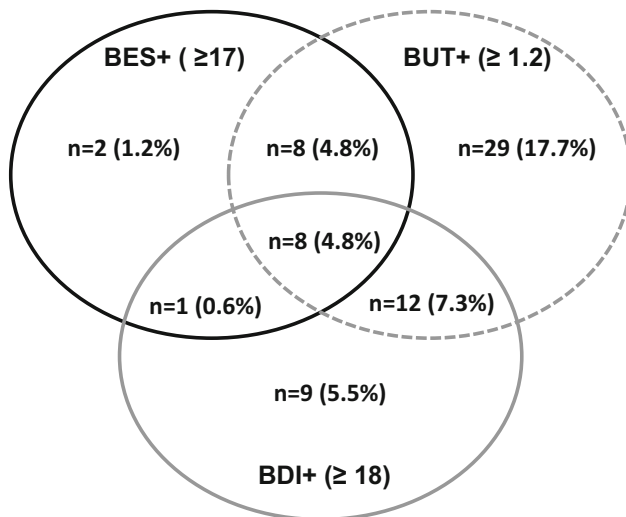
degree). The majority of subjects lived with someone (86 %). With regard to lifetime medical comorbidity, hypertension and thyroid disorders were the most frequent. Among the psychiatric disorders, depression and anxiety were the most frequently reported disorders. Familiarity for obesity and eating disorders (anorexia nervosa, bulimia nervosa, binge eating disorder) was reported by 18 and 7.8 % of the sample respectively.

Table 2 shows the BES, BDI and BUT scores at baseline. 40 % of subjects reported at least one test score above the cutoff. In particular, there was a substantial presence of possible body dissatisfaction (BUT-GSI  $>1.2$  in 34 % of cases). There was an evident overlapping in the positivity

**Table 2** Test scores at baseline

BES, M ± SD (range)	8.20 ± 7.25 (0–35)
Moderate-severe (>17), N (%)	19 (11.4 %)
BUT, M ± SD (range)	0.97 ± 0.76 (0.02–3.97)
Possible significant uneasiness (>1.2), N (%)	57 (34.3 %)
BDI, M ± SD (range)	10.13 ± 8.29 (0–37)
Moderate-severe (>18), N (%)	30 (18.0 %)

BES Binge Eating Scale, BUT Body Uneasiness Test, BDI Beck's Depression Inventory

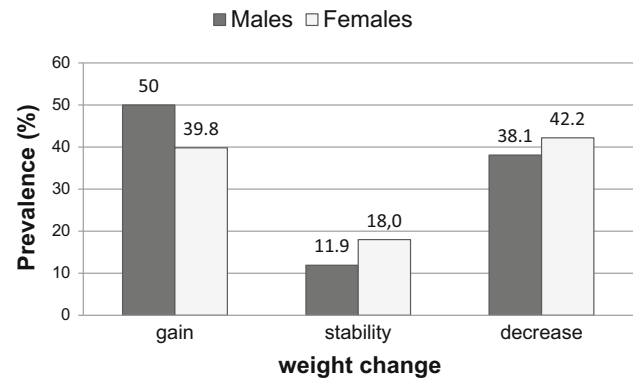
**Fig. 1** Test high scorers. Non-proportional Venn diagram

of the three tests, as shown by the non-proportional Venn diagram in Fig. 1.

At 1-year follow-up, a weight change occurred in 84 % of subjects, with similar frequencies of gain (43.2 %) and decrease (40.8 %). Weight gain led to obesity (BMI  $\geq$  30) in 14.4 % of cases. There was no significant difference in the prevalence of weight outcome between males and females, although the increment was more prevalent in males (50 vs. 40 %) (see Fig. 2). The subjects who reported having followed weight loss treatments in the last year were 18 (14.4 %), 11 among people with stable/decreased weight and 7 among those with weight gain.

A multiple logistic regression model with weight change as the dependent variable (stability/decrease vs. increase) indicated that residential status, sport activity, lifetime diagnosis of anxiety, and body dissatisfaction were significantly associated with weight gain 1 year after (Table 3).

The subjects who lived alone, when compared to those who lived with someone, had a nearly sixfold increased risk of weight gain. The same result was found for the subjects who did not practice sport, compared to those who practiced it. The presence of lifetime anxiety, as well as

**Fig. 2** Prevalence of weight change at 1-year follow-up by gender

each unitary increment in the BUT score, increased almost five times the risk of weight gain. We found also evident positive associations, although not statistically significant, between the weight increase at follow-up and moderate/severe BDI score ( $\geq$ 18), thyroid disease (lifetime comorbidity), diabetes ((lifetime comorbidity). On the contrary, gender, age, familiarity for obesity, and BES score did not result to influence significantly the weight trend.

## Discussion

The research was performed to study a group of non-weight loss treatment-seeking overweight adults and to assess possible relationships between some baseline psycho-social characteristics and weight gain, over a 1-year period.

We found substantial weight instability in our sample: 1 year after the weight remained unchanged only in 16 % of overweight subjects. This result is noteworthy if we consider the relatively short time of follow-up. On the other hand, weight gain ( $\geq$ 1 kg) occurred in 43.2 % of subjects and it led to obesity in 14.4 %. The prevalence of weight gain was lower, but not significantly, in the subjects who reported to have followed diets during the follow-up than in those who did not (39 vs 44 %). Therefore, weight loss treatments did not produce significant differences: the prevalence of weight loss treatments was similar both in the subjects with stable-decreased weight and in those who gained weight.

The very poor number of specific studies on weight change in non-weight loss treatment-seeking overweight adults makes it difficult to compare our results with those reported by other surveys.

The Isfahan Cohort Study, an ongoing longitudinal study of 6,504 Iranian adults started in 2001, recently found that in males weight gain was more frequent from normal to overweight (11.7 %), while in females weight

**Table 3** Multiple logistic regression model

Factors	Adjusted OR (95 % CI)	<i>p</i>
Living alone	5.7 (1.0–33.2)	0.05
No sport activity	5.7 (1.3–24.2)	0.02
Anxiety (lifetime comorbidity)	4.7 (1.2–18.3)	0.03
Thyroid disease (lifetime comorbidity)	2.1 (0.3–16.0)	0.46
Diabetes (lifetime comorbidity)	1.8 (0.2–19.0)	0.62
BUT score (increment 1)	4.8 (1.2–18.7)	0.02
BDI score $\geq 18$	1.6 (0.3–7.6)	0.56

Odds ratios (OR) and 95 % Confidence Intervals (CI) for having weight gain at 1-year follow-up. In the model also age, gender, familiarity for obesity and BES score were contemplated

gain was observed more from overweight to obesity (11.4 %). Younger individuals gained weight more than older individuals. Education was negatively associated with weight gain while smoking was positively related to weight loss in females and weight gain in males [5].

In our study, gender and age did not result to influence significantly the weight trend. However, it is to point out that our sample and study design were too different to allow a correct comparison. Furthermore, considering the age of the females in our sample (55 % over 50 years), as well as their prevalence (66 %), it might be reasonable to assume that hormonal changes associated with menopause played a role in weight gain. Indeed, although men showed higher prevalence of increased weight than women, the latter became obese at follow-up with higher prevalence than men, although not significantly (16 vs. 12 %).

In our survey, almost half of the subjects presented test scores consistent with loss of control over eating (binge eating), body dissatisfaction, and depression. It is common knowledge that these symptoms may play an important role in weight gain of both adolescents and adults [39, 40].

Binge eating is one of the most studied variables in the context of obesity treatment and prevention [15, 41, 42]. Ivezaj and colleagues surveyed weight change trajectories among 97 overweight and obese patients with binge eating disorder (BED) versus without, during the year prior to seeking treatment [13]. They found that BED patients gained considerably more weight. Ivezaj's study was a retrospective inquiry. On the contrary, in our prospective study, we found that BES score at baseline did not result to affect significantly the weight trend 1 year after. Similarly, in a review of psychosocial pre-treatment predictors of weight control, Teixeira and colleagues found little or no association between baseline binge eating, most frequently assessed by the BES, and weight changes at follow-up [31]. However, in our study the lack of association between baseline BES and weight gain might be also partially

explained by the low number of subjects with severe binge eating behavior.

In our sample, lifetime history of anxiety disorders was among the baseline characteristics significantly associated with weight gain. We found also a positive association, but not statistically significant, between moderate/severe BDI score ( $\geq 18$ ) at baseline and weight increase at follow-up. According to a number of surveys and reviews, the relationship between overweight/obesity and depression may be considered bidirectional, both in adolescence and in adulthood [24, 25, 43, 44]. A prospective cohort study performed in Norway, including 25,180 men and women (19–55 years of age), recently found that symptoms of anxiety and depression were associated with larger weight gain and an increased cumulative incidence of obesity after 11 years, in both men and women [22].

It is well known that overweight/obese individuals, above all women, suffer from negative body image that is usually associated with depressive symptoms and low self-esteem [38, 45–48]. At the same time, some researchers found that overweight and obese men [49] and women [50] are likely to underestimate their body size. In our survey, intense body uneasiness (BUT high scoring) was a baseline attribute significantly associated with weight gain. Intense body dissatisfaction seems to be a crucial risk factor for weight gain not only in adults but also in children. Sushma Shama and colleagues recently studied the influence of body dissatisfaction on 1-year change in nutrient intake of 88 overweight and obese African American children [51]. They found that baseline body dissatisfaction was associated with 1-year increase in intake of energy, and all macronutrients in girls, but not in boys.

In our sample, living with someone was inversely related to weight increase. An interaction between the living status and symptoms of depression could be assumed. Indeed, in our study, we found higher prevalence of depression symptoms in subjects living alone than in those living with someone (27 vs 17 %). In a large study on a nationally representative sample of Finnish adults (1,695 men and 1,776 women, mean age 45 years), living alone resulted associated with psychological disadvantages, an increased risk of mental-health problems, and higher rates of consumption of psychotropic drugs; the study found that those who lived alone had an about twofold higher risk of initiating antidepressant use during the follow-up period than those who did not live alone [52]. Regrettably, the Finnish research did not explore body weight outcome. With regard to weight, the U.S. National Health and Nutrition Epidemiological Follow-up Survey (NHEFS), a longitudinal study that interviewed and measured 9,043 adults in a baseline assessment and reassessed them again 10 years later, found conflicting results. Unmarried women who entered marriage at follow-up gained more weight

than women married at both baseline and follow-up. Conversely, men who remained divorced/separated or became widowed lost more weight than men married at both baseline and follow-up [53]. More recently, Lori A. Klos and Jeffery Sobal analyzed the relationship between marital status and weight-related variables in more than 8,000 U.S. adults, men and women [54]. They found that married women more often perceived themselves as overweight than unmarried women, while men's marital status was unrelated to their perceived weight status.

Finally, our results indicate that practicing regular physical activity plays a protective role against weight increase. These data are not surprising. Ji Won Choi and colleagues evaluated changes in weight and waist circumference from enrollment to 2 years later in 232 women aged between 40 and 50 [55]. They found that weight increased significantly for the entire sample. However, those who increased their physical activity from enrollment to 2 years later had the smallest increase in weight and had a slight decrease in waist circumference. A study performed on 689 women with normal or overweight BMI over a 2-year period found that among women of normal weight at baseline, 18 % became overweight or obese by follow-up and 25 % of women overweight at baseline became obese [56]. Low physical activity at baseline was significantly associated with a twofold elevation in the odds of transitioning from normal BMI to overweight/obesity. In a 3-year longitudinal study of a large population-based cohort of middle-aged and older Australians, there was a 10 % reduction in the odds of weight gain for participants who reported 300 min/week or more of moderate to vigorous physical activity (MVPA) compared to less than 150 min/week of MVPA [6]. A recent review explored and confirmed the role of physical activity and exercise training in the prevention of weight gain, initial weight loss, weight maintenance, and the obesity paradox [57].

Obviously physical activity is influenced by psychiatric comorbidity and, in particular, by anxious-depressive symptoms and severe body uneasiness. Anxiety sensitivity, or the fear of somatic arousal, has been linked to both maladaptive eating behavior and exercise avoidance. It may represent a double-edged risk factor for obesity contributing to both exercise avoidance and calorie consumption [58].

Our study has several strengths. It was focused on a population that has been poorly studied (overweight adults non-seeking a weight loss treatment). The implementation of a longitudinal design allowed the assessment of weight change over time and the evaluation of possible risk factors for weight increase. For most of the subjects, data on body weight have been objectively measured with the same modality both at baseline and 1 year after. Finally, the compliance at follow-up was relatively high (75 %).

The most important limitation is the lack of control samples for comparison (i.e., a sample of treatment-seeking overweight adults or a negative control sample of healthy weight adults). Other limitations are the small sample size, the higher prevalence of females, and the relatively short time of follow-up.

## Conclusion

According to a great number of studies, weight gain is associated with significant increase in risk of type 2 diabetes, cardiovascular disease (CVD) and other obesity-related diseases and disabilities. For example, a prospective study of 7,176 British adult men with no diagnosis of CVD or diabetes, followed up for 20 years, found that long-term risk of CVD and diabetes increased significantly with increasing overweight and obesity [59]. Our study highlights the need to provide a comprehensive multidisciplinary approach to overweight subjects, aimed to identify individuals with increased risk of weight gain so as to implement targeted interventions for obesity prevention.

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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