Les troubles psychologiques et la perte de poids après bypass gastrique

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LES TROUBLES PSYCHOLOGIQUES ET LA PERTE DE POIDS APRES BYPASS GASTRIQUE

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INTRODUCTION

L'obésité est devenue, dans les pays développés, un problème de santé publique. Son incidence augmente chaque année en corrélation étroite avec le changement de mode de vie, notamment avec la sédentarité et le changement des habitudes alimentaires : régime riche en graisses et glucides.

L'obésité est accompagnée d'une multitude de pathologies associées : hypertension artérielle, maladies coronariennes, diabète, dyslipidémies, syndrome des apnées du sommeil, cancers (sein, endomètre, côlon), gonarthrose etc. ; d'où l'importance du traitement et de la prévention.

Malheureusement, parmi les traitements de l'obésité, l'efficacité n'est pas la règle. Il est connu actuellement que le traitement le plus efficace de l'obésité morbide (Index corporel > 40kg/m2) est le bypass gastrique. Son efficacité a été démontrée sur une perte de poids supérieure à 50% de l'excès de poids pour une durée de 5 ans. Il est également connu que le profil psychologique de base des patients obèses morbides joue un rôle important dans l'évolution de la perte de poids.

La dépression, l'anxiété ainsi que les troubles du comportement alimentaire font partie intégrante du tableau psychologique complexe du patient obèse. Les cliniciens avaient l'impression qu'une corrélation existe entre les paramètres psychologiques et le succès de l'intervention thérapeutique dans le cas de l'obésité, mais il n'y avait pas d'étude pour le confirmer ou l'infirmer. C'est la raison pour laquelle nous avons dessiné une étude prospective ayant comme objectif de répondre à la question suivante :

Question :

Y a-t-il une corrélation entre le profil psychologique de base des patients obèses morbides et leur évolution après bypass ? En d'autres termes : pouvons nous prédire qui est le meilleur candidat pour le bypass gastrique en déterminant son profil psychologique ?

SUJETS ET METHODES

80 patients (68 femmes et 12 hommes) ayant une obésité morbide (BMI > 40kg/m2 ou BMI > 35kg/m2 associé à des complications connues de l'obésité) ont bénéficié d'un bypass gastrique dans le cadre d'un programme multidisciplinaire de prise en charge de l'obésité morbide, au sein de l'Hôpital Universitaire de Genève.

Le protocole de notre étude a reçu l'approbation de la Commission d'Ethique du Département de Chirurgie de l'Hôpital Universitaire de Genève.

Nos patients ont été sélectionnés par une équipe multidisciplinaire composée de : médecin spécialiste en médecine interne, chirurgien, psychiatre, psychologue et diététicienne. Tout patient ayant une pathologie psychiatrique grave a été exclu.

Avant l'opération, nos patients ont rempli plusieurs tests psychologiques afin de déterminer leur profil psychologique : *Beck Depression Inventory* BDI pour la dépression (6,7), *Hospital Anxiety and Depression Scale* HAD pour l'anxiété et la dépression (96), *Rathus test* pour l'estime de soi (20), *Nottingham Health Profile* NHP pour la qualité de vie (50) et *Eating Disorder Inventory II* EDI pour les troubles du comportement alimentaire (37).

A 3 mois, 6 mois et 1 année après l'opération, nous avons étudié les paramètres suivants : poids, BMI, leptine, acides gras plasmatiques (FFA), insuline, glycémie, métabolisme basal, oxydation des protéines, des glucides et des lipides ainsi que l'apport calorique et la composition corporelle.

Pour l'analyse de nos données nous avons divisé nos patients en sous-groups utilisant les critères d'âge et de poids. Malgré le fait que ces deux variables soient des variables continues nous avons, tout de même choisi de séparer notre groupe en sous-groupes en utilisant comme point de séparation une valeur fixe correspondant à la médiane calculée pour le groupe entier: 35 ans pour l'âge et 44kg/m2 (75% excès de poids) pour le poids. Le choix de la limite de séparation à été fait en concordance avec les travaux antérieurs effectués par notre groupe de recherche (12).

Les résultats ensuite ont été analysés par régression simple et/ou multiple pour évaluer tous les paramètres psychologiques. Les résultats ont été exprimés en moyenne +/- erreur standard en utilisant le programme de statistique StatView 4.5, Abacus Concepts Inc. Berkeley, CA. Nous avons considéré comme statistiquement significatif une valeur de $P < 0.05$. Une analyse par ANOVA a été utilisé pour comparer les quatre groups selon l'âge et le pourcentage d'excès de poids.

RESULTATS

Le profil psychologique de nos patients avec obésité sévère a présenté les caractéristiques suivantes : une anxiété modérée, une dépression moyenne, une mauvaise qualité de vie et, paradoxalement, peu de troubles du comportement alimentaire (sous-estimation due a une tendance de la part de nos patients de ne pas rapporter de tels troubles du comportement).

La perte de poids après un an est de 76.5% de correction de l'excès de BMI.

Parmi tous les autres paramètres étudiés, nous avons trouvé une corrélation étroite, dans le groupe entier, entre les scores de dépression avant l'opération et la perte de poids après

l'intervention : plus les patients étaient déprimés avant l'opération plus ils corrigeaient leur poids grâce au bypass.

Dans le sous-groupe des patients avec moins de 75% excès de poids la corrélation trouvée entre la perte de poids et les paramètres psychologiques a été encore plus étroite. Plus ces patients étaient anxieux, dépressifs et avec une mauvaise qualité de vie, plus ils perdaient du poids. Cette perte de poids a été corrélée étroitement avec la diminution de l'apport calorique (ingestion alimentaire).

La tendance à été contraire dans le groupe avec > 75% excès de poids : plus ces patients étaient anxieux, avec une mauvaise qualité de vie et une mauvaise estime de soi, moins ils perdaient du poids. Cette évolution a été également corrélée étroitement avec l'apport calorique.

Chez les patients < 35 ans nous avons trouvé 37% plus de troubles du comportement alimentaire que dans le groupe plus âgé de > 35ans.

Nous n'avons trouvé aucune corrélation entre les paramètres métaboliques, biophysiques, biochimiques et le profil psychologique préopératoire.

Une corrélation, rassurante d'ailleurs, à été retrouvé entre la quantité de calories ingérées et la perte de poids : moins les patients mangent plus ils perdent du poids !

Nous avons aussi vérifié qu'il existe une bonne corrélation entre les différents tests psychologiques ($P < 0.001$).

DISCUSSION

Le profil psychologique retrouvé dans notre groupe de patients obèses morbides est concordant avec les données disponibles dans la littérature (9, 39, 43, 49, 80, 31,15 etc.).

L'impact du profil psychologique sur la perte de poids à un an après bypass n'est pas influencé par l'âge, mais par l'excès de poids avec une inversion de tendance autour de 44 kg/m2 de BMI (75% excès de poids) ! Cette modification est due au fait que l'influence des troubles psychologiques (dépression, anxiété etc.) sur l'apport alimentaire post-opératoire change selon l'excès de poids préopératoire. Nous pouvons spéculer qu'en dessous de 44 kg/m2 de BMI les troubles psychologiques (dépression, etc.) ont un effet anorexigène après bypass et que pour les patients avec une obésité sévèrissime (BMI > 44) ceci n'est plus le cas. Cette influence est due à un mécanisme qui est très probablement lié aux changements neuro-métaboliques complexes qui surviennent avec l'âge dans l'obésité extrême, mécanisme qui nous échappe pour le moment.

La perte de poids, une année après bypass est, dans notre étude, supérieure à celle rapportée dans la littérature. Nous expliquons cette différence par le fait que nos données

sur le poids sont relevées à un an seulement et qu'il est connu après un an, que les patients ont une tendance à reprendre du poids (7-8kg).

Les troubles du comportement alimentaire prédominent chez les jeunes de moins de 35 ans. Notre impression, basée sur les autres paramètres des questionnaires est que dans le groupe plus âgé (de > 35 ans) il peut y avoir une sous-estimation des troubles du comportement alimentaire: les patients ont suivi de multiples diètes amaigrissantes drastiques qui favorisent les troubles du comportement alimentaire et la peur d'être jugé augmentent peut-être avec l'âge.

Nos résultats sont à interpréter en tenant compte de quelques limitations. L'échantillon de patients que nous avons étudié est de seulement 80 patients et la répartition par sexe favorise essentiellement les femmes (85%). Pour pouvoir étudier les différentes corrélations entre le profil psychologique et l'évolution après bypass, nous avons dû séparer notre groupe en sous groupes en utilisant comme critère deux variables continues (âge et poids).

CONCLUSION

Le profil psychologique préopératoire influence la perte de poids après bypass. Cette influence est dépendante de l'excès de poids préopératoire, surtout chez les patients avec un BMI > 44 kg/m2. Pour ces patients, une amélioration du profil psychologique préopératoire par une prise en charge spécialisée pourrait améliorer la perte de poids après bypass.

INTRODUCTION

Definition

Obesity is defined as an unhealthy amount of body fat *(45)* or, in other words, an excess of fat (triglycerides) storage in the adipose tissue *(19)*.

The most appropriate tool to quantify the degree of obesity is the Body Mass Index (BMI) or Quetelet Index. This index is calculated by dividing one's weight (in kg) by the square of one's height.

$$BMI = \text{mass (kg)} / \text{height}^2 \text{ (square m)}$$

The reference values of BMI are identical for both sexes (table 1):

Normal range	**18.5 – 24.9 kg/m2**
Overweight	**25 - 29.9 kg/m2**
Obesity class I	**30 - 34.9 kg/m2**
Obesity class II (severe)	**35 - 39.9 kg/m2**
Obesity class III, (morbid)	**> 40 kg/m2**

Table 1: Obesity classification using BMI values in adults.

Prevalence and incidence

Obesity increased dramatically its prevalence the last 20 yeas *(91, 72, 36)*. Obesity became a big health problem for the modern, developed countries. Great Britain obesity's prevalence doubled between 1980 and 1991 to reach nearly 20% of the population. Some other country averages are: USA – which detains the record – 25%; France, Sweden and Holland 7-10%.

Morbidity

Morbidity is an important feature when we talk about obesity. If there is some debate if there is a health benefit of being thinner among the individuals whose BMI is less than 25, there is no doubt that a BMI over 25 confers increased health risk. Overweight and obesity have been associated with an increasing risk of a large number of disorders including, but not limited to the following:

- Dyslipidemias *(25,26)* characterised by:
    - *high total cholesterol* (> 2.40g/l) - more than 25% prevalence for BMI bigger than 30
    - *high LDL* (low density lipoproteins cholesterol) >1.6 g/l which is a risk factor for cardiovascular disease (CVD)
    - *low HDL* (high density lipoproteins cholesterol) <0.450mg/l, which is a protection factor against the CVD
    - *high triglycerides* (>2.5g/l)
- Non-Insulin Dependent Diabetes Mellitus (NIDDM). It has been shown that excessive adipose tissue is associated with increased insulin resistance.
- Hypertension
- Coronary heart disease
- Osteoarthritis in the weight bearing joints
- Cancers:
    - *breast cancers* in postmenopausal women which might be due to the estrogenic secretion of the adipose tissue
    - *colon cancer*
    - *endometrial cancer*
- Sleep apnoea and respiratory disorders are present in up to 24% of overweighted man and 9% of overweighted women (Allison DB '00)

Factors influencing the weight gain

Both increasing prevalence and morbidity of obesity have multiple causes. Among the most important factors in the development and persistence of obesity we remind the following:

- age – maximal prevalence is found between age 60 and 70 years old.
- sex – female > male *(91)*
- heredity –genetic predisposition that determines a bigger susceptibility of a person to gain weight into a given environmental context *(86)*. The impact of heredity is estimated at 25-40% for obesity in general and 50% for abdominal obesity *(13)*
- geographic region –the Eastern and the Northern part of Europe are prone to an increase prevalence of obesity *(72,91)*
- social level – the maximal prevalence is in the poor communities of developed countries *(82,83)*
- life style – **a)** industrialisation and urbanisation have reduced considerably the energy expenditure of the *individuals (34, 45)* and physical exercise became optional (*46*). There is a direct, positive correlation between obesity and the lack of physical activity. The time spend per day watching TV is proportional with the degree of obesity *(2, 27, 41, 92)*.

  b) the evolution in food intake is characterised by the decrease in complex sugars intake - as fibbers from fresh fruits and vegetables – and by the increase in lipid intake, mostly of animal origin. The vast majority of the industrially prepared food has a high caloric density, much higher than the traditional meals.

Physical exercise limits the decrease in energy expenditure (EE) at rest, that appear with ageing and explain the weight gain in elder persons *(46, 90)*.

Psychological factors

The role of psychological factors in inducing obesity is controversial. Historically, prevailing opinions on the relationship between obesity and the psychological profile have varied greatly. In the 1960s and prior, the belief was hat obesity was, in part, *caused* by certain psychological abnormalities. At that point, most of the studies were based on limited samples of obese people seeking treatment *(32)*. A study published by Stunkart and Mendelson (1967), caused the pendulum to swing in the other direction. By examining a less specific, wider sample of obese persons, it was concluded that the previous opinion might have been incorrect. The authors found that in a large, non-clinical community-based sample, there was no meaningful association between obesity and gross pathology. From the influence of Stunkard and those who followed in the 1970s and 1980s, it was generally thought that either there was no real correlation between obesity and psychological adjustment, the attendant social stigma caused psychological maladjustment and not the reverse. In the 1990s, a greater complexity is being acknowledged *(36)*. There is accepted that there may be a complex interrelationship between psychological profile and obesity, but causal direction is unclear.

Binge eating disorder (BED) - eating very fast a huge amount of food in response to psychological stimuli instead of hunger, followed by a feeling of culpability and poor self esteem – is viewed as the major psychological disorder of obese persons. It occurs in about 40% of the obese persons *(80)*. Among those subjects BED is associated with increased adiposity and frequent, significant weight fluctuations *(81, 29, 15)*. This explains the difficulty of maintaining the low weight levels achieved after treatment especially in BED patients.

Compared with non-BED obese subjects, BED obese patients have lower self-esteem, poorer sense of personal effectiveness, more disturbed self-attitudes and higher levels of depression, anxiety and personality disturbances *(89, 94)*.

Even if we don't know the sense of the causal relationship between obesity and psychological disorders, we can notice that morbidly obese persons have a real psychological and somatic sufferance, which lowers considerably their quality of life.
The psychological aspect is marked by different degrees of anxiety and depression. Both of them are significantly improved by the stable weight loss.

Treatment

It have been demonstrated that even a small decrease in body weight, (i.e. of 5-10%), is associated with clinically important improvements in cholesterol levels, blood pressure, glycaemia and other health indices *(40)*. These benefits persist if the weight loss is maintained *(95)*. Those findings as well as the huge increasing in prevalence of obesity and its complications have justified substantial efforts in finding effective methods for loosing weight and maintaining stable low weight.

a) Food restriction diets

The food restriction was, historically, the first approach in treating obesity but, unfortunately, with poor long-term results. Diet, as unique treatment, induces or aggravates the eating disorders. The complications of dieting are: gaining more weight (by the means of reducing the metabolism at rest), increasing morbidity of obesity, inducing weight cycling and diminishing the psychological status of the patient. As an example, all the studies that followed patients for 5 years or more after a successful food restriction diet – which means loosing at least 10% of their initial body weight - showed that almost all the patients have reached or exceeded their initial body weight after 5 years (*54, 96, 19 etc.*). This is why, at present, the food restriction alone it is no longer recommended as treatment of obesity.

b) Cognitive- behavioural approach

Association of cognitive-behavioural approach to the food restriction or to a regular, healthy, diet was thought to be the solution in treating obesity. Unfortunately this was not the case. Excepting the improvement in the eating behaviour and anxio-depressive disorders, the weight loss was disappointing *(69)*.

c) Drug treatment

Drugs alone or in association with previous types or therapies gave place to big expectations. There are a few classes of drugs used in the treatment of obesity:

- *anorexic agents* divided in two commonly used families: noradrenergics and serotoninergics. A third family, the fenfluramins, induce dependence, have a poor efficiency and severe adverse reactions. Their use is limited at max 3 months.
- *drugs that diminish the energetic intake* – as Orlistat that is a selective and powerful inhibitor of gastric and pancreatic lipase inducing steatorrhoea . At the moment orlistat is the most reliable drug in the treatment of obesity.
- *drugs that increase the energy expenditure* – thermogenetic agents are not effective in humans. Ephedrine and xantines have a significant effect on loosing weight, but the benefit and risk balance is not sufficiently evaluated.

Unfortunately none of those substances can give a solution to the big problem that is obesity either because of the induced risks, or of their inefficacy.

d) Surgical treatment of obesity, so-called - bariatric surgery

Because current treatments, as we have seen, are usually ineffective in patients with morbid obesity, *surgical methods* (especially Roux-en-Y gastric by-pass) have been assessed. The success rate in achieving and maintaining long term weight loss is 80% or greater, significantly higher than with any other treatment *(16)*.

Results of bariatric surgery

What do we expect from surgical methods of loosing weight – called bariatric surgery – in terms of results? Patients lose after the gastric bypass, around 50-60% of their excess body weight in the first year and they can generally maintain the weight loss at 5 years with only a modest regain of 5-7 kg *(18, 64, 8)*. These long term results makes the

bariatric surgery the only way of loosing weight and maintaining weight lost for the morbidly obese persons.

Classification of the bariatric procedures:

1. Gastric Bypass (GBP), the most used is the Roux en Y GBP technique (see description below)
2. Horizontal Gastroplasty
3. Vertical Gastroplasty
4. Gastric Banding
5. Biliopancreatic Diversion
6. Jejunoileal Bypass

1.Gastric Bypass (GBP)

The gastric bypass (GBP) is considered by many to be the gold standard of the bariatric surgery.

Historical data on GBP

The GBP has been practised on humans since 1967 and has undergone many modifications ever since. The prototype was Billroth II gastric operation but without removal of the distal stomach.

GBP description

The GBP consists in creating a small pouch of 30cc from the upper stomach by stapling and therefore, separating the stomach in two separate compartments. The 30cc stomach pouch is drained into an intestinal loop (Roux en Y loop, most frequently) made by the small bowel (figure 1). To bring the bile and the pancreatic secretion for the normal digestion, another surgical anastomosis is practiced between two loops of the small bowel at various distances from the ileo-caecal valvulae, for ex: 50-60cm for distal Roux en Y GBP.

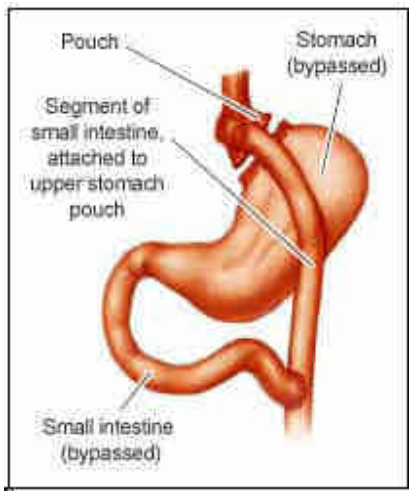


Figure 1: Horizontal Roux en Y Gastric Bypass

The mechanism of GBP functioning
GBP causes weight loss – by diminishing caloric intake - through multiple mechanisms :

- decreased capacity of the stomach that produces rapid sensation of satiety with even minimal food intake
- restricted rate of emptying the pouch
- prohibiting, by the apparition of the dumping syndrome, the ingestion of certain hyper osmolar foods (generally the sweet food containing sugar, glucose, etc., which are generally calories-dense foods)

2,3,4. Horizontal Gastroplasty, Vertical Gastroplasty and Gastric Banding
Those are techniques by which the stomach is divided in two pouches that communicate one to another (figure 2 and 3). The only mechanism of loosing weight, in this case, is the mechanical restriction of the quantity of food intake. That's why the long-term results are poorer than with the GBP.

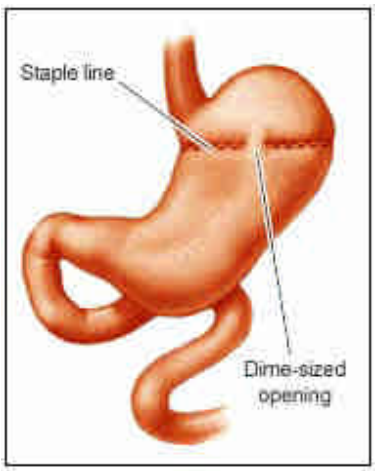


Figure 2: Gastric stapeling.

Inconvenients of the gastroplasties (gastric stapeling)

- the enlargement of the gastro-gastric stoma (figure 2)

Inconvenients of the gastric binding (figure 3)

- the slip of the band
- the difficulty of establishing the limit between the tightness (with vomiting) and the loseness (with weight gain)

Figure 3: adjustable gastric banding



5. Biliopancreatic diversion (BPD)

Developed by Scopinaro in Genoa, has some similarities to the distal Roux en Y distal GBP (figure 6), but a subtotal gastrectomy is performed and a gastric pouch of 200cc to 400cc is left. There is a wide stoma between the gastric poach and the gut to permit adequate meals and avoid the major sequelae, hypoalbuminemia, which occurred in about 10% of patients (*Scopinaro N, Probl. Gen. Surg. 9:298*) .

Figure 4: Scopinaro's BPD,

Inconvenients of BPD

- fatty, soft stools - 2 or 3 per day
- calcium and fat-soluble vitamin malabsorbtion that require adequate supplementation
- it is a procedure of a certain magnitude

6. Jejunoileal Bypass (JI)

Performed at large scale in the '60s-'70s JI (figure 5) has been abandoned because of the high incidence of the complications.

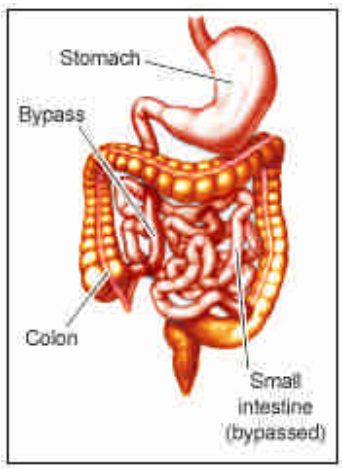


Figure 5*:* Jejunoileal Bypass

Complications of JI

- anaerobic proliferation on the blind loop with secondary abdominal distension
- absorption of bacterial products led to circulating immune complexes with polyarthralgies that usually responded to antibiotics *(24)*
- calcium oxalate nephropathy caused by the absorption of calcium oxalate and favourised by dehydration caused by diarrhoea
- diarrhoea
- hepatic insufficiency

Considering all previous data and the complex profile of the morbidly obese individual, those patients should be selected and clinically followed by a multidisciplinary team. This team consists in: physicians with special interest in obesity, dieteticians, psychologists or psychiatrists interested in behaviour modification and eating disorders and a surgeon with experience in bariatric procedures.

Hypothesis

We clinically observed that the most obese of our patients have more difficulties to correct their BMI after the GBP. Our hypothesis is that those patients might be psychologically different from the less obese individuals of our group (BMI < 44 kg/m2) and this difference might play a role in loosing weight after the GBP.

The purpose of our study is to determine the relationships or even the correlations, between the pre-surgery psychological profile of morbidly obese subjects and the post-surgery outcome, in terms of loosing weight.

Question

What it would be interesting to know, but there is no available coherent data, is:

1) Who will be the best subject for the bariatric surgery? In other words: is it possible, using the pre-surgery data only, to predict who will lose a satisfactory amount of weight without any psychological complications (suicide, alcoholism, worsen BED etc.)?
2) Is there a method to improve the weight loss after the GBP? If yes, which subgroup of patients would benefit the most?

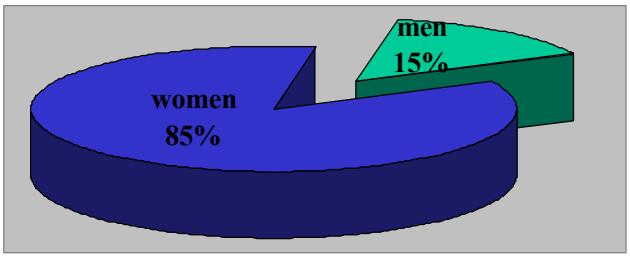
SUBJECTS AND METHODS

STUDY SUBJECTS

Our subjects were 80 morbidly obese patients. They underwent bariatric surgery (Roux en Y gastric by-pass) at the Geneva University Hospital, as treatment for obesity. The protocol of this study received the approval of the Ethical Committee of the Department of Surgery of the Geneva University Hospital.

A multidisciplinary medical team involving internists, surgeons, psychiatrists, dieteticians and psychologists, examined the candidates for the bariatric surgery. No one of the candidates was rejected.

The group was composed of 68 women (85%) and 12 men (15%):



The average preoperative BMI was 45.3, range 33.2 – 88.3; the average age was 37.6 years, range 21 – 64 years; the average weight was 122.8 kg, range 90 – 226 kg; the average height was 1.64m, range 1.46 – 1.91 m (Table 2).

Pre-surgery parameter	Mean +/- sem	Range
BMI (kg/m2)	45.3 +/- 0.85	33.2 - 88.3
Age (years)	37.6 +/- 1.01	21 - 64
Weight (kg)	122.8 +/- 2.51	90 - 226
Height (m)	1.64 +/- 0.01	1.46 – 1.91

Table 2: physical characteristics of our 80 patients group of obese patients before the bypass.

Inclusion Criteria

All entrants into the study were required to meet certain criteria before surgery:

- BMI > 40 if no co-existing morbidity,

- BMI >35 if either one of the following morbidities is present: HTA, diabetes mellitus, arthrosis, sleep apnoea etc.
- acceptable surgical risks,
- capability of understanding the surgery, its consequences and to give an informed consent.

Exclusion Criteria

As part of the pre-surgery protocol, a psychiatrist evaluated all patients. Psychiatric pathology, history of substance abuse or suicidal ideation was exclusion criteria in our study. At that moment there was no person excluded from the GBP therapy because one of those criteria in our study.

METHODS

Study Design

In order to establish weather the pre-surgery psychological profile influences the outcome of the gastric bypass in our 80 obese patients, they were asked to fill in a battery of psychological tests prior to surgery:

- Beck Depression Inventory
- Hospital Anxiety and Depression Scale
- Rathus test
- Nottingham Health Profile
- Eating Disorder Inventory.

The non-psychological parameters used in our study are:

- body weight (BW), height, body mass index (BMI)
- the BW was determined before surgery and at one year after surgery.

The aim of the study was to establish the correlation, if any, between the pre-surgery psychological profile and the post-surgery evolution of the BW.

Intervention

All our patients underwent the Roux en Y gastric bypass - as described in the Introduction - as a treatment of morbid obesity. The surgical technique of the GBP is highly standardised in our hospital, so all our patients underwent exactly the same surgery. The day of the surgery was considered the time zero of our study.

Methods of measurement

a) The psychological profile was determined by means of the following 5 tests:

1. Eating Disorder Inventory II *(37).* This test was designed to quantify a certain number of psychological and behavioural traits common to eating disorders as anorexia nervosa and bulimia. It is composed of 64 questions grouped into 8 subgroups.

- Drive for thinness - indicates the excessive concern with dieting, preoccupation with weight and extreme pursuit of thinness

- Bulimia - indicates the tendency toward episodes of uncontrollable overeating (bingeing) and may be followed by self-induced vomiting.
- Body dissatisfaction - reflects the belief that specific parts of the body are too large.
- Ineffectiveness - assesses feeling of general inadequacy, insecurity, worthlessness and the feeling of not controlling their lives.
- Perfectionism - indicates excessive personal expectations.
- Interpersonal distrust - reflects a sense of alienation and general reluctance to form close relationships.
- Interoceptive awareness - reflects one's lack of confidence in recognising and accurately identifying emotions or visceral sensations of hunger or satiety.
- Maturity fears - measures one's wish to retreat to the security of the pre-adolescent years because of the overwhelming demands of adulthood.
- Ascetism - reflects the avoidance of sexual relationships.
- Impulse regulation - shows the difficulty in regulating impulses, especially the binge behaviour.
- Social insecurity - estimates social fears and insecurity.

Category	Normal range	Eating disorder range
Drive for thinness	3 - 7	12 - 16
Bulimia	1 - 2	9 - 13
Body dissatisfaction	9 - 15	13 - 19
Ineffectiveness	1 - 4	9 - 14
Perfectionism	4 - 9	7 - 11
Interpersonal distrust	1 - 3	4 - 8
Interoceptive awareness	1 - 5	8 - 14
Maturity fears	2 - 4	4 - 6
Asceticism	2 - 5	5 - 11
Impulse regulation	1 - 4	4 – 8
Social insecurity	2 - 5	6 - 9

Table 3: Eating Disorder Inventory ranges.

2. Hospital Anxiety and Depression Scale *(96),* which gives a score of anxiety and depression (Table 4).

Range	Meaning
< 7	No anxiety or depression
8 to 10	Border line anxiety or depression
> 11	Marked anxiety or depression

Table 4: meaning of Hospital Anxiety and Depression scores.

3. Beck Depression Inventory *(6,7),* measures the intensity of the depression.

Range	Meaning
< 8	No depression
8 to 18	Mild depression
18 to 29	Moderate depression
> 30	Marked depression

Table 5: meaning of Beck Depression Inventory scores.

For both HAD and BDI we choose as cut off value in our study the superior limit of the normal range. Our choice is justified by the difficulty to compare degrees of anxiety or depression that have not been standardised.

4. Nottingham Health Profile *(50),* which is a standardised tool for the survey of general health problems. The more affected the patient is, the higher score he/she gets.

5. Rathus test *(20),* gives a score that that represents the quantification of patient's self esteem.

Range	Meaning
< 90	Tendency to aggressiveness
90 - 100	Normal
> 125	Low self esteem

Table 6: meaning of Rathus test scores.

b) The BW measurements were performed after an overnight fast .

Analysis of data

The parameters were summarised as average +/- standard error of the mean (sem).

Statistical analysis was simple or multiple regression analysis (StatView 4.5; Abacus Concepts Inc. Berkeley, CA). We considered a P value significant when $P < 0.05$.
Analysis of variance (ANOVA) was used to compare the means of different psychological parameters among the groups (either two groups or four groups).

Bonferroni's correction was originally designed in the field of analysis of variance to take into account multiple sub group comparison, only when the overall model has been shown to be statistically significant. The correction imply to divide the usual p threshold set at 0.05 by the number of groups to compare. Thus, when one perform multiple comparison with 4 subgroups, the new p threshold becomes, here either 0.05/2=0.025 or 0.05/4=.0125. The need for this correction is controversial and disputed in the literature. (see 97: Thomas V Perneger What's wrong with Bonferroni adjustments BMJ 1998;316:1236-1238) "This paper advances the view, widely held by epidemiologists, that Bonferroni adjustments are, at best, unnecessary and, at worst, deleterious to sound statistical inference."

By providing exact p value, we let the reader choose whether he want to apply the Bonferroni's adjustment or not.

Regression models were performed to analysethe association between different psychological parameters assessed as continuous scores (independent variables, X_i) and the percentage of BMI variation after one year of follow-up (dependent variable, Y). The strength of this association was quantified by r-squared, which express the amount of variability of Y explained by X.

We divided our group in subgroups by two criteria:

- Age – cut off point 35 years
- BW – cut off point BMI 44 = 75% excess body weight (BW).

Even if age and BW are continuous variables, we choose to split our group in subgroups because, according to our study hypothesis, different subgroups might react differently after the GBP.

The choice of the cut off points was made according to previous publications of our group *(20)*. The original explanation of the cut off points was that, for all the patients that underwent GBP in our hospital, the median for age was 35 years and the median for weight was BMI 44 which means 75% excess BW or 120kg in the above mentioned article.

RESULTS

We found the following psychological profile in our patients comparing to *normal* subjects *(Table 1) :*

- A small elevation of anxiety scores of Hospital Anxiety and Depression Scale (HAD),
- A mild depression scores (Beck Depression Inventory = BDI),
- A very small elevation of the Eating Disorder Inventory total score ($sEDI_2$),
- A poor quality of life at Nottingham Health Profile (NHP).

TABLE 1: *Pre-surgery psychological profile in BW and age groups*

		Mean +/- sem (pre-surgery values)				
Psychological test	**Normal range**	**<75% exc. BW**	**>75% exc. BW**	**Age <35 years**	**Age >35 years**	**All patients**
HAD anxiety score	**<7**	**7.8** ±0.6	**8.4** ±0.6	**8.3** ±0.6	**8** ±0.6	**8.1** ±0.4
HAD depression score	**<7**	**5.7** ±0.6	**5.4** ±0.5	**5.5** ±0.6	**5.6** ±0.5	**5.6** ±0.4
BDI	**<8**	**13.7** ±1.7	**14.6** ±1.3	**15.5** ±1.7	**13** ±1.3	**14.2** ±1
RATH	**90 - 100**	**96.1** ±3	**99** ±3	**95.6** ±3.8	**99.3** ±2.2	**97.6** ±2.1
NHP	**0**	**10.7** ±1.2	**12.6** ±1	**11.5** ±1.1	**11.8** ±1.1	**11.7** ±0.7
$sEDI_2$	**27 - 63**	**66.4** ±5.2	**65.3** ±3.6	**70.3** ±5.3	**62** ±3.6	**65.9** ±3.1
Number of patients		**39**	**41**	**37**	**43**	**80**

No significant difference between those groups

There were no significant differences in the pre-surgery psychological profile between the following groups:

- Age: more than 35 years
  less than 35 years.
- BW excess: more than 75% excess BW (> 44 BMI)
  less than 75% excess BW (< 44 BMI), *(Table 1).*

The % BMI correction = (actual BMI – normal BMI)*100 / (pre-surgery BMI – normal BMI)

The normal BMI in the above formula was considered the BMI = 25kg/square meter which is the superior value of the normal range.

The % of BMI correction at 1 year after GBP had the following characteristics *(Table 2):*

- The <75% exc. BW (<44 BMI) group lost 28% more in terms of BMI correction after 1 year than the >75% exc. BW (>44 BMI) group. This difference was statistically significant *(p<0.001)* even if, in absolute terms, the most obese lost more kilograms.
- The younger lost 28% more in terms of absolute weight and 11% more in terms of BMI correction than the older, but this difference is not statistically significant.

TABLE 2: *Weight loss at 1 year after GBP*

	Mean +/- sem (values 1 year after surgery)				
Weight loss at 1 year	**<75% exc. BW**	**>75% exc. BW**	**Age <35 years**	**Age >35 years**	**All patients**
In kg	**36.3** ±1.53	**40.4** ±2.1	**43.4** ±4.9	**34** ±1.2	**38.1** ±1.3
BMI correction	**84.7%**● ±3.4	**65.9%** ±4.2	**81.2%** ±4.5	**72.8%** ±3.9	**76.5%** ±3
Number of patients	**23**	**18**	**18**	**23**	**41**

● *p<0.001 between <75% and >75% excess BW groups*

High scores of depression in the HAD-D test were significantly correlated with a higher body weight correction after one year in our entire group (p<0.04) (Table 3).

The degree of anxiety influenced the BW correction after 1 year. The influence was depending on the BW excess at pre-surgery time point. We found a positive correlation in < 75% excess BW group (< 44 BMI) and a negative correlation in the >75% excess BW group (> 44 BMI).

TABLE 3: *Prediction of BMI correction at 1 year with pre-surgery psychological tests, in BW and age groups*

	P values for regression analysis of: % of BMI correction at 1y vs. psychological tests				
Psychological test	**<75% exc. BW**	**>75% exc. BW**	**Age <35 years**	**Age >35 years**	**All patients**
HAD-A	***0.0147***	***0.0152****	0.109	0.450	0.490
HAD-D	***0.0026***	0.550	0.322	***0.023***	***0.032***
BDI	***0.0044***	0.071	0.795	0.134	0.161
RATH	0.439	***0.024****	0.200	0.658	0.293
NHP	***0.0003***	***0.015****	0.410	0.159	0.521
$sEDI_2$	0.0623	0.383	0.542	0.329	0.190
Number of patients	**23**	**18**	**18**	**23**	**41**

* negative correlation

Globally, the impact of pre-surgery psychological profile on BMI correction after 1 year was as follows *(Table 3)*:

- In the < 75% BW excess group (<44 BMI) we found significant *positive correlations* with: anxiety (HAD-A), depression (HAD-D and BDI) and the quality of life (NHP)

- In the >75% BW excess group (>44 BMI) the correlations were negative with significant values for: anxiety (HAD-A), self esteem (RATH) and the quality of life (NHP).

The age had no influence on the relationship between psychological tests and the BMI correction at 1 year *(Table 3)*.

TABLE 4A: *Pre-surgery EDI_2 categories in BW and age groups*

EDI_2	Normal range	Mean +/- sem (pre-surgery values) <75% exc. BW	>75% exc. BW	Age < 35 years	Age > 35 years	All patients
Drive for thinness	**3 - 7**	**7.9** ±0.7	**7.7** ±0.7	**7.32** ±0.62	**8.2** ±0.7	**7.8** ±0.5
Bulimia	**1 - 2**	**3.4** ±0.7	**3.1** ±0.6	**3.9** ±0.8	**2.7** ±0.4	**3.2** ±0.4
Body dissatisfaction	**9 - 15**	**21.9** ±0.9	**22.9** ±0.8	**22.5** ±1	**22.4** ±0.8	**22.4** ±0.6
Ineffectiveness	**1 - 4**	**5.2** ±1	**4** ±0.6	**5.8** ±1.1	**3.6** ±0.6	**4.6** ±0.6
Perfectionism	**4 - 9**	**3.8** ±0.6	**4.7** ±0.6	**3.9** ±0.7	**4.6** ±0.5	**4.3** ±0.4
Interpersonal distrust	**1 - 3**	**3** ±0.5	**3.4** ±0.6	**3.9** ±0.6	**2.7** ±0.5	**3.2** ±0.4
Interoceptive awareness	**1 - 5**	**5.2** ±0.8	**4.7** ±0.7	**5.4** ±0.9	**4.5** ±0.7	**4.9** ±0.5
Maturity fears	**2 - 4**	**3.7** ±0.6	**3.4** ±0.5	**3.8** ±0.7	**3.3** ±0.4	**3.5** ±0.4
Asceticism	**2 - 5**	**5.6** ±0.6	**4.9** ±0.5	**5.7** ±0.7	**4.8** ±0.4	**5.2** ±0.4
Impulse regulation	**1 - 4**	**3** ±0.6	**2.8** ±0.45	**3.8**● ±0.6	**2.1** ±0.4	**2.9** ±0.4
Social insecurity	**2 - 5**	**3.7** ±0.6	**3.8** ±0.5	**4.2** ±0.7	**3.4** ±0.5	**3.8** ±0.4
Number of patients		**39**	**41**	**37**	**43**	**80**

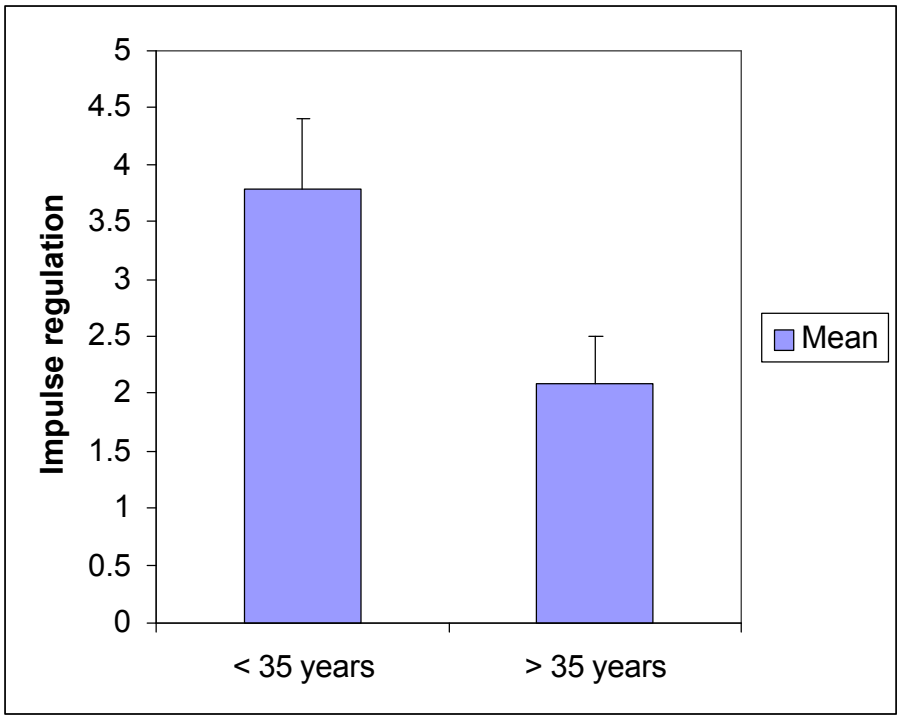
● *p< 0.03 between <35years and >35years group*

The Impulse regulation scores were significantly influenced by age. For the younger group the score is 80% higher than in the older group *(Figure 1 and Table 4A).* Even if both values are in the normal range, there is a statistically significant *(p<0.03)* trend in the younger group to have higher scores; meaning that the <35 years patients had more difficulty to regulate their binge eating behaviour than the >35 years patients. .

Concerning all the other categories of the EDI_2 test, there was no difference by age, or by BW excess *(Table 4A)*.

Note: The above statements disregard an eventually misreport correlated with the same age groups

Figure 1: Impulse regulation and age



There was no significant correlation between EDI_2 categories and BMI correction at 1 y in our subgroups *(Table 4B)*, excepting in >75% excess BW group (less than 44 BMI). In this group we found a negative correlation *($p<0.03$)* between Impulse regulation score and BW correction at 1y.

TABLE 4B: *Prediction of BMI correction at 1 year with pre-surgery EDI_2 categories*

EDI_2		P and R^2 values for regression analysis: % of BMI correction at 1y vs. EDI test			
		<75% excess BW	**>75% excess BW**	**Age <35 years**	**Age >35 years**
Drive for thinness	**P**	0.140	0.301	0.146	0.747
	R^2	0.099	0.067	0.128	0.005
Bulimia	**P**	0.273	0.524	0.586	0.697
	R^2	0.056	0.026	0.018	0.007
Body dissatisfaction	**P**	0.069	0.123	0.219	0.198
	R^2	0.149	0.143	0.092	0.078
Ineffectiveness	**P**	0.102	0.364	0.282	0.881
	R^2	0.125	0.051	0.073	0.001
Perfectionism	**P**	0.983	0.806	0.924	0.583
	R^2	0.0001	0.004	0.001	0.015
Interpersonal distrust	**P**	0.639	0.197	0.451	0.519
	R^2	0.010	0.102	0.036	0.019
Interoceptive awareness	**P**	0.340	0.981	0.280	0.722
	R^2	0.043	0.000	0.072	0.006
Maturity fears	**P**	0.484	0.279	0.422	0.662
	R^2	0.023	0.073	0.041	0.009
Asceticism	**P**	0.321	0.412	0.337	0.622
	R^2	0.048	0.042	0.058	0.012
Impulse regulation	**P**	0.190	***0.025****	0.479	0.746
	R^2	0.080	0.277	0.032	0.005
Social insecurity	**P**	0.223	0.875	0.622	0.177
	R^2	0.070	0.002	00.016	0.085
Number of patients		**23**	**18**	**18**	**23**

* negative correlation

We also divided our group in combined subgroups, by age and % of excess BW as follows:

- <35 years and <75% excess BW (BMI < 44),
- <35 years and >75% excess BW(BMI > 44),
- >35 years and <75% excess BW (BMI < 44),
- >35 years and >75% excess BW(BMI > 44),

in order to detect further implication of the age and BW on the weight loss at one year.

The pre-surgery psychological profile of those groups we found the following significant differences *(Table 5A):*

TABLE 5A: *Pre-surgery psychological profile in combined BW and age groups*

		Mean +/- sem (pre-surgery values)			
		Age <35 years		**Age >35 years**	
Psychological test	**Normal range**	**<75% excess BW**	**>75% excess BW**	**<75% excess BW**	**>75% excess BW**
HAD-A	**<7**	**8.5** ± 0.837	**8.1** ± 0.836	**7.3** ± 0.775	**8.7** ± 0.773
HAD-D	**<7**	**6.1** ± 0.903	**4.8** ± 0.896	**5.4** ± 0.850	**5.8** ± 0.63
BDI	**<8**	**17.3**● ± 2.683	**13.7** ± 2.069	**10.6** ± 1.992	**15.4** ± 1.549
RATH	**90 - 100**	**96.2** ± 5.514	**94.9** ± 5.427	**96** ± 3.163	**102.5** ± 2.891
NHP	**0**	**12.6** ± 1.617	**10.5** ± 1.413	**9.1**▲ ± 1.746	**14.3** ±1.239
$sEDI_2$	**27 - 63**	**77.7**●● ± 9.256	**63.2** ± 5.092	**56.8** ± 4.912	**67.1** ± 5.073
Number of patients		**18**	**19**	**21**	**22**

● *p< 0.03 between <35 years and > 35 years, in the <75% excess BW*

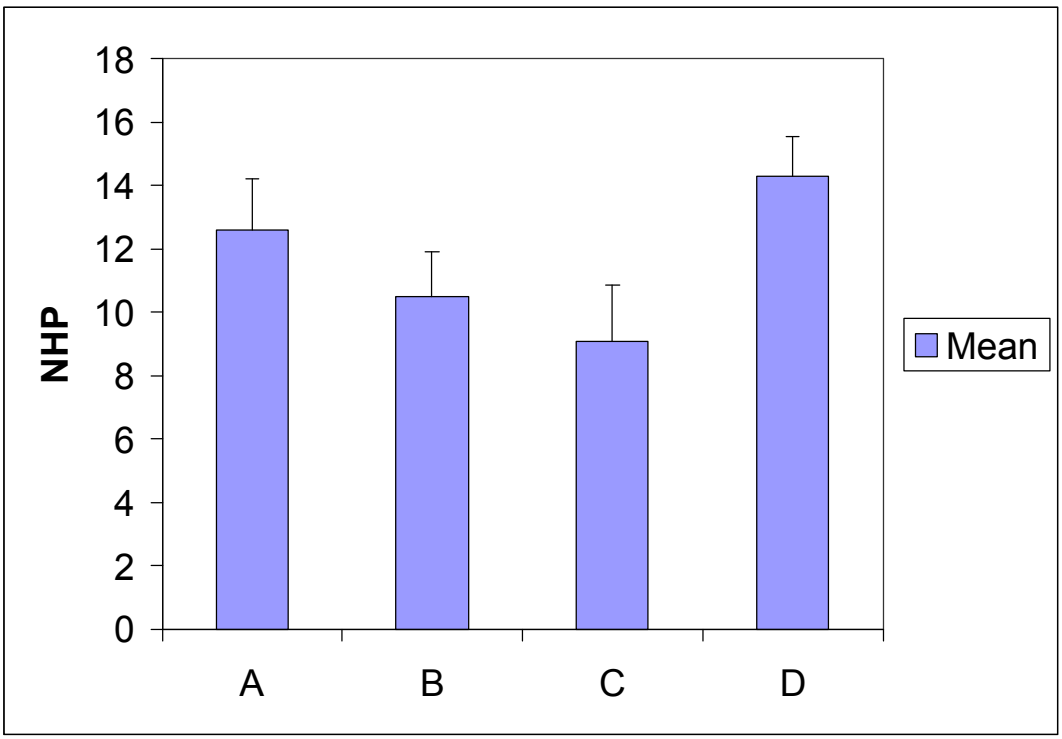
●● *p< 0.02 between <35 years and > 35 years, in the <75% excess BW*

▲ p< 0.02 between <75% and >75% excess BW, in the >35 years group

1. **depression** score (BDI) was 63% higher in <35 years than in >35 years in the <75% excess BW group (BMI < 44), *(p<0.03)*. So younger subjects had a significantly higher score of depression than older subjects.

2. **quality of life** score (NHP) was 57% higher – showing a poorer quality of life – in >75% excess BW (BMI > 44),than in <75% excess BW (BMI < 44), in the >35 years group *(p<0.02)*. So the older the patient is, the poorer the quality of life he/she had *(Figure 2)*.

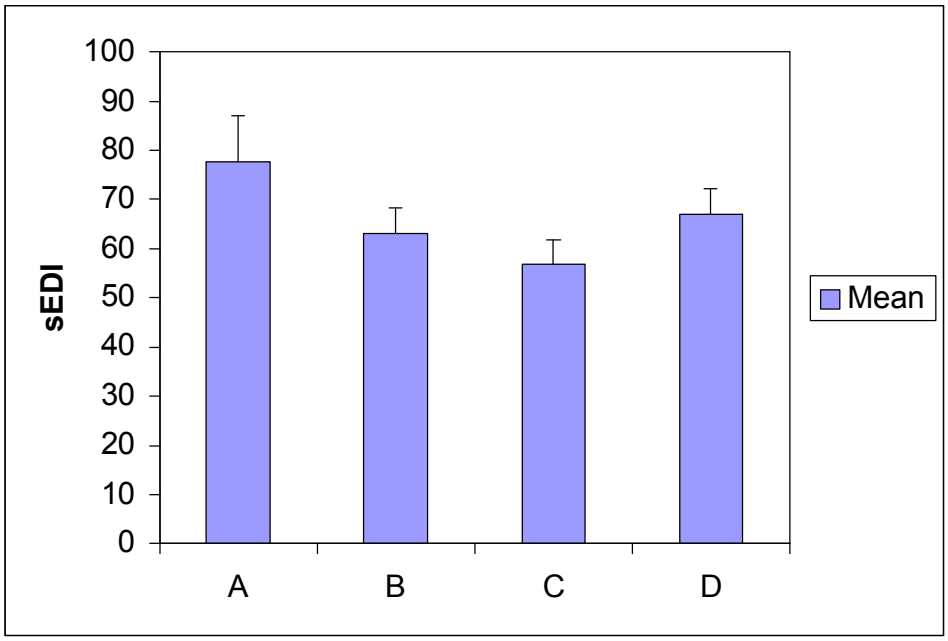
Figure 2: *Quality of life (NHP)*



A = <35 years < 75% exc.BW group, **B** = <35 years > 75% exc.BW group, **C** = >35 years < 75% exc.BW group, **D** = >35 years > 75% exc.BW group.

3. **eating disorder** summary score ($sEDI_2$) was 37% higher in <35 years than in >35 years in the <75% excess BW group (BMI < 44), *(p<0.02)*. So younger subjects had a significantly higher eating disorder summary score than older subjects, meaning that eating disorders are more important in young people *(Figure 3)*

Figure 3: *Eating disorders ($sEDI_2$) in combined groups*



A = <35 years < 75% exc.BW group, **B** = <35 years > 75% exc.BW group, **C** = >35 years < 75% exc.BW group, **D** = >35 years > 75% exc.BW group.

In the mixed (age and BW excess) groups the pre-surgery psychological profile had a significant correlation with the BMI correction after 1 year as follows:

- in <35 years >75% excess BW (BMI > 44) group we found significant *negative correlations* with: anxiety (HAD-A) *($p<0.02$),* self esteem (Rathus Test) *($p<0.05$),* and quality of life (NHP), *($p<0.03$), (Table 5B)*. We can speculate that in this group the less the psychological profile is altered the more weight they loose after 1year.
- in >35 years <75% excess BW (BMI < 44) group we found a significant *positive correlation* with: depression (HAD-D) *($p<0.03$),* and quality of life (NHP), *($p<0.005$), (Table 5B)*. So in the less obese older patients the more depressed they are and the poorer quality of life they have, the more weight they loose.

TABLE 5B: *Prediction of BW correction at 1 year with pre-surgery psychological tests in combined BW and age groups*

	P values for regression analysis of: % of BMI correction at 1y vs. psychological tests			
	Age <35 years		**Age >35 years**	
Psychological test	**<75% excess BW**	**>75% excess BW**	**<75% excess BW**	**>75% excess BW**
HAD-A	0.311	***0.014****	0.061	0.508
HAD-D	0.065	0.805	***0.024***	0.753
BDI	0.070	0.169	0.059	0.990
RATH	0.366	***0.041****	0.519	0.961
NHP	0.151	***0.022****	***0.005***	0.895
$sEDI_2$	0.245	0.218	0.210	0.492
Number of patients	**11**	**7**	**12**	**10**

* negative correlation

When we analysed the EDI_2 categories in mixed (age and excess BW) groups *(Table 6A)*, we found some interesting facts:

- the **drive for thinness** scores were not significantly different in those 4 groups disregarding the important difference in pre-surgery BW.

TABLE 6A: *Pre-surgery EDI_2 categories in combined BW and age groups*

		Mean +/- sem (pre-surgery values)			
		Age <35 years		Age >35 years	
EDI_2	**Normal range**	**<75% excess BW**	**>75% excess BW**	**<75% excess BW**	**>75% excess BW**
Drive for thinness	3 - 7	**7.7** ±0.9	**7** ±0.9	**8** ±1.1	**8.3** ±1
Bulimia	1 - 2	**4.8**● ±1.2	**3** ±1	**2.1** ±0.6	**3.2** ±0.7
Body dissatisfaction	9 - 15	**22.3** ±1.4	**22.7** ±1.5	**21.7** ±1.3	**23** ±0.9
Ineffectiveness	1 - 4	**8.2**●● ±2	**3.5**■ ±0.8	**2.6** ±0.6	**4.5**▲▲ ±1
Perfectionism	4 - 9	**3.2** ±1.1	**4.6** ±1	**4.4** ±0.7	**4.7** ±0.7
Interpersonal distrust	1 - 3	**3.7** ±0.8	**4** ±0.9	**2.4** ±0.6	**3** ±0.7
Interoceptive awareness	1 - 5	**6.8** ±1.5	**4.2** ±1	**3.8** ±0.8	**5.2** ±1.1
Maturity fears	2 - 4	**4.9** ±1.1	**2.8** ±0.7	**2.7** ±0.5	**3.8** ±0.8
Asceticism	2 - 5	**6.8**● ±1.1	**4.7** ±0.8	**4.5** ±0.6	**5** ±0.7
Impulse regulation	1 - 4	**4.8**●● ±1.1	**2.8** ±0.6	**1.4** ±0.4	**2.7**▲ ±0.7
Social insecurity	2 - 5	**4.6** ±1.1	**3.8** ±0.8	**3** ±0.7	**3.7** ±0.6
No of patients		**18**	**19**	**21**	**22**

● *p< 0.05 between <35 years and > 35 years, in the <75% excess BW group*

●● *p< 0.002 between <35 years and > 35 years, in the <75% excess BW group*

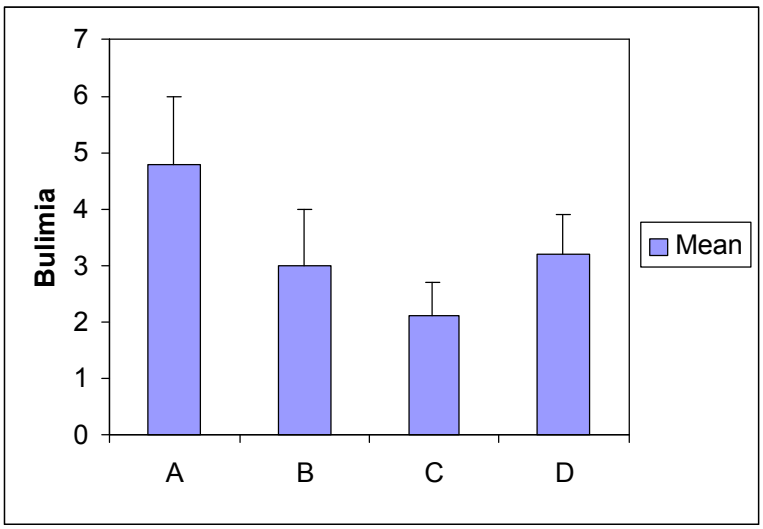
■ *p< 0.008 between <75% and >75% excess BW, in the <35 years group*

▲▲ *p< 0.03 between <35years <75% excess BW group and >35years >75% excess BW group*

▲ *p< 0.05 between <35years <75% excess BW group and >35years >75% excess BW group*

- the **bulimia** scores were 121% more elevated in <35years than >35 years in <75% excess BW (BMI < 44) group which is statistically significant *(p< 0.05), (Figure 4)*

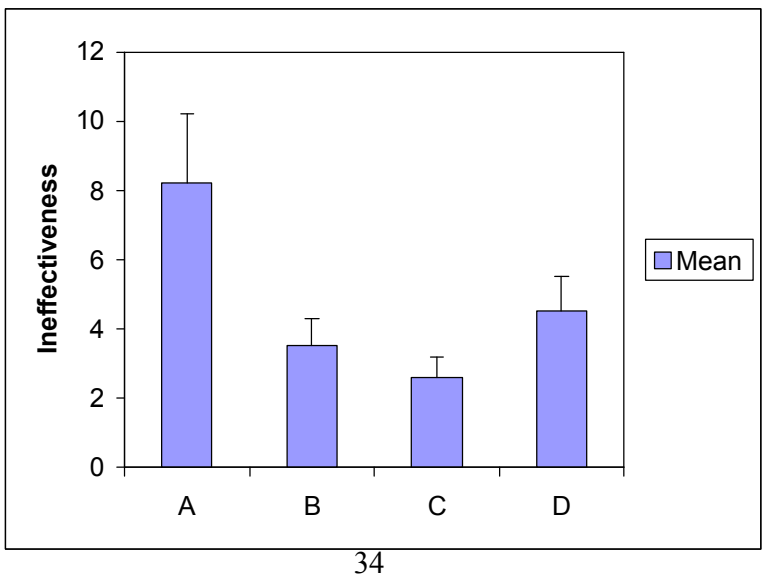
Figure 4: *Bulimia in combined groups*



A = <35 years < 75% exc.BW group, **B** = <35 years > 75% exc.BW group, **C** = >35 years < 75% exc.BW group, **D** = >35 years > 75% exc.BW group

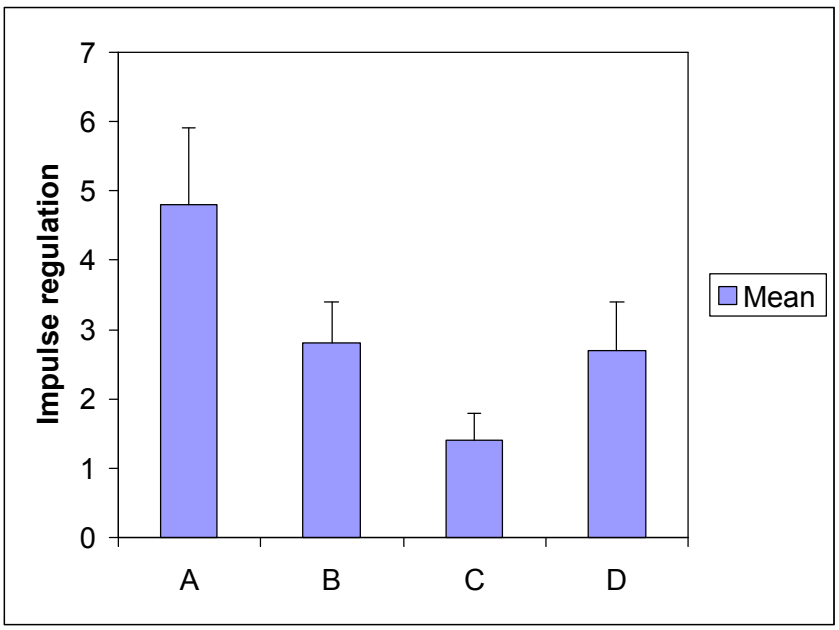
- **ineffectiveness** scores were significantly more elevated in <35years <75% excess BW (BMI < 44) group then in all the other three groups *(Table 6A and Figure 5)*

Figure 5: *Ineffectiveness in combined groups*



- the **interoceptive awareness** and the **maturity fears** scores were elevated - but without statistically significance - in <35years <75% excess BW (BMI < 44) group then in all the other three groups *(Table 6A),*
- the **ascetism** scores were 51% more elevated in <35years than >35years in the <75% excess BW (BMI < 44) group, which is statistically significant *(p< 0.05), (Table 6A),*
- the **impulse regulation** scores are significantly more elevated in <35years <75% excess BW (BMI < 44) group then in all patients of >35 years *(p< 0.002), (Table 6A and Figure 6).*

Figure 6: *Impulse regulation in combined groups*



A = <35 years < 75% exc.BW group, **B** = <35 years > 75% exc.BW group, **C** = >35 years < 75% exc.BW group, **D** = >35 years > 75% exc.BW group

TABLE 6B: *Prediction of BW correction at 1 year with pre-surgery EDI categories in combined BW and age groups*

		P and R^2 values for regression analysis of: % of BMI correction at 1y vs. EDI test			
		Age <35 years		Age >35 years	
EDI_2		<75% excess BW	>75% excess BW	<75% excess BW	>75% excess BW
Drive for thinness	**P**	0.086	0.501	0.493	0.641
	R^2	0.280	0.095	0.047	0.026
Bulimia	**P**	0.751	0.703	0.2965	0.716
	R^2	0.011	0.032	0.106	0.015
Body dissatisfaction	**P**	0.854	***0.044****	0.073	0.819
	R^2	0.004	0.589	0.287	0.006
Ineffectiveness	**P**	0.219	***0.039****	0.240	0.989
	R^2	0.165	0.606	0.134	0.000
Perfectionism	**P**	0.583	0.691	0.725	***0.033***
	R^2	0.036	0.035	0.012	0.412
Interpersonal distrust	**P**	0.293	0.781	0.807	0.093
	R^2	0.121	0.017	0.006	0.282
Interoceptive awareness	**P**	0.490	0.823	0.678	0.507
	R^2	0.053	0.011	0.017	0.051
Maturity fears	**P**	0.232	0.330	0.137	0.938
	R^2	0.156	0.188	0.206	0.001
Asceticism	**P**	0.510	0.746	0.625	0.394
	R^2	0.051	0.022	0.025	0.080
Impulse regulation	**P**	0.499	***0.011****	0.307	0.892
	R^2	0.052	***0.759***	0.101	0.002
Social insecurity	**P**	0.283	0.531	0.458	0.270
	R^2	0.127	0.088	0.055	0.135
Number of patients		**11**	**7**	**12**	**11**

* negative correlation

The EDI_2 categories were significantly correlated with the BMI correction after 1 year as follows *(Table 6B):*

- in <35 years and >75% excess BW group we found significantly *negative correlations* with: **body dissatisfaction** *(p<0.05),* **ineffectiveness** *(p<0.04)*, and **impulse regulation** *(p<0.02)*. So, in this group, the more elevated the psychological scores the less the BW correction after 1 year.
- In >35 years and >75% excess BW group there is a significantly *positive correlation* with **perfectionism** *(p<0.04)*.

In combined age and excess BW groups the analysis of the BW loss after one year showed that *(Table 7):*

- In the >75% excess BW (BMI > 44) group, the <35 year lost 40% more than the >35 years, in terms of absolute weight *(p< 0.002)*. Age was an important factor in determining the weight loss after one year in very obese subjects.
- The very obese young subjects lost the most in terms of absolute weight.
- In the >35 years group, the <75% excess BW (BMI < 44) lost 31% more in terms of BMI correction that the >75% excess BW *(p<0.009)*. So the degree of obesity is an important factor in limiting the BMI correction in older patients.

TABLE 7: *Weight loss after 1 year in combined BW and age groups*

	Mean +/- sem (values 1 year after surgery)			
	Age <35 years		**Age >35 years**	
Weight lost	**<75% excess BW**	**>75% excess BW**	**<75% excess BW**	**>75% excess BW**
In kg	**39.9** ±2.3	**48.9**► ± 1.9	**33.1** ± 1.6	**34.9** ± 1.9
% of BMI correction	**87.5** ±3.5	**71.3** ±9.4	**82.2**● ±5.6	**62.4** ±3.5
Nnumber of patients	**11**	**7**	**12**	**10**

► *p< 0.002 between <35years >75% excess BW group and >35years >75% excess BW group*

● *p<0.009 between <75% and >75% excess BW, in the >35 years group*

We verified the correlations between $sEDI_2$ and all the other psychological tests we used. We found a very strong correlation *($p<0.0001$)* for all of them.

DISCUSSION

In our group the ***BW loss after one year*** was slightly higher than the one reported in the literature: 76.5% BMI correction one year after the bypass (i.e.76.5% loss of the excess BMI) compared to 50-60% correction in the literature *(4, 8, 18, 64).* We speculate that the difference arises from the different follow-up periods considered: one year in our study, between one and two years in the literature. More specifically, we know that after the first year there can be a weight regain of 7-9kg *(4)* that corresponds to the difference between our results and the literature.

The pre-surgery psychological profile of our patients was sensibly equivalent with the same population sample in the literature in terms of:

- **Eating disorders:** 51% of our patients had an abnormal eating behaviour. In the literature have been reported figures between 30% and a maximum of 81.5% *(49).* The lower figure is based on a multicentric study on the obese seeking for treatment *(80, 81, 29, 15, 85)* while the higher figure was determined into a restricted group (i.e.22 patients) with an average of BMI 48.8kg/m2. The average for the eating disorders incidence, especially the binge eating, has been placed between 40-50% in the literature *(50% precisely 47,49),* when adapted for a population over BMI 40 - which correspond to our results.
- **Anxiety and depression:** The separation of our group of patients in subgroups was made using as cut point the superior limit of the normal. The main group was divided into a group of normal patients and a pool of different degrees of anxiety or depression (very mild, mild, moderate and severe). In the main group abnormal scores for depression were found as follows: 29% of the subjects when using HAD-d test and 69% of the subjects when using the BDI test. We speculate that this difference comes from the different sensitivity of those two tests. In the literature a *prevalence of major depression* was found in 29% to 51% of a similar population *(9, 39, 43)*. However, no control groups were used in these studies, neither in ours, and therefore the findings cannot, be clearly interpreted.

Concerning the anxiety, our results showed that 58% of our group have abnormal scores. There was no coherent data in the literature to compare our results.

We speculate that it is possible that there may be an increase incidence of depression among the severely obese subjects, but a comparison of clinical and epidemiological data may not be valid and obviously further investigations are needed.

- **Quality of life and Self-esteem:** 80% of our patients had abnormal scores for those two parameters. Unfortunately, even there is a large consensus in the literature that morbidly obese persons have a poor quality of life and a low self-esteem, there is no available coherent data to compare our results. The reasons of this situation consist in: the use of different tests to assess those two parameters, the absence of control groups, the variability of selection criteria for the testing groups.

Correlation between pre-surgery depression and BW correction at one year

Our finding that pre-surgery depression is positively correlated with the weight loss after the GBP – is a new element. Anyhow previous studies *(43, 87)* showed that depression, even in the severe stage, did not diminish the weight loss after GBP.

Our hypothesis that some subgroups of our main group might loose weight differently after the GBP, in relation to their pre-surgery psychological profile – was confirmed. Weight was determining in this relationship. Age did not play a role.

For the most obese of our patients, anxiety, depression and the poor quality of life influenced negatively the weight loss after the GBP. This was not the case for the less obese of our group (BMI < 44). The choice of our cut off in separating the groups – as described in the Methods – can be criticize, but the results we found on the psychological field correspond with the biological differences found when studying the same subgroups

(12), meaning that those groups are different and the pre-surgery BMI induce the difference.

The patients included in our study with a BMI between 35 and 40kg/square meter, by definition had additional pathology related/induced by obesity. The patients over BMI 40kg/square meter have almost all the time obesity related pathology which means that our group was quite homogeny. So we had a selection bias in our study imposed by the bypass selection criteria that made difficult to assign the pre-surgery differences in the psychological profile we found - comparing to the normal range – to obesity itself or to the polypathology related to it. Further studies are needed examining subgroups with and without associated pathology in order to answer the above question.

We stress upon the fact that there is no difference in the pre-surgery psychological profile between our two weight groups (35 to 44 kg/square m and more than 44), the only difference is their way to react – in terms of loosing weight - to psychopathology.

We can speculate that pre-surgical BW changes the impact of the pre-surgical psychological profile on the BW correction after the GBP. We do not now the mechanism. Further studies would be needed.

Strengths of our study

- All our patients underwent exactly the same surgery. The GBP technique used in our clinic is a standardised technique.
- Using our exclusion criteria no patient seeking for obesity treatment was excluded. We might speculate that our group is representative for Geneva's morbid obese persons seeking for treatment.
- The battery of the five tests used, largely investigate the psychological profile of our patients.

Weakness of our study

- Our group of patients was limited to 80 subjects meaning that we are at the inferior limit of the statistic significance.
- The recruitment of our patients was limited to Geneva region given that our research was done at the Geneva University Hospital.
- The group was not representative for Geneva population, in general, given that most of our patients have Hispanic origins.
- The psychological estimations concerning the entire group do not take into account different degrees of one pathology, given that we choose to express results in normal versus not normal.
- The patients between 35 and 40kg/square m had one or more obesity related pathology by definition - due to the selection criteria for the gastric bypass.
- We used cut off points to determine subgroups even if the variable (age or weight) was linear, and this because of our clinical hypothesis that subgroups might react differently in term o loosing weight after GBP.
- The choice of the above mentioned cut off points was made using the median of our group for age and for weight so it depended on our sample. Similar investigations – using the same cut off points – made by other groups, are needed to confirm or infirm our findings.

Recommendations

Taking into account the above results we can speculate that very obese patients (BMI>44) would beneficiate from a psychological therapy BEFORE surgery, in order to diminish the degree of anxiety and depression, and to improve the self-esteem. This intervention might improve their BW correction at one year after the GBP.

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