Psychological predictors of outcome after gastric banding for morbid obesity

Junilla Kirsten Larsen

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Psychological predictors of outcome after gastric banding for morbid obesity

Psychologische predictoren van het effect van een maagbandoperatie voor morbide obesitas

(met een samenvatting in het Nederlands)

Proefschrift

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Over Gewicht

Onlosmakelijk verbonden
Een reflectie als een passe-partout
Door de omgeving haast verslonden
Soms ben ik de wereld zo moe

R.Hofman

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Chapter 1

General Introduction

Obesity has become a major public health problem in Western societies, which has received both national and international attention because of its' detrimental impact on health [1], quality of life [2-4], the economic burden it imposes [5], and its' increasing prevalence [6-9]. Estimates of prevalence suggest that between 7 % and 15 % of subjects in Western societies [7], and between 20 % and 30 % [8, 10] in the United States are obese.

The most commonly used method today for classifying an individual as overweight or obese is based on the body mass index (BMI), a value that is determined by dividing body weight (in kilograms) by the square of height (in meters). The World Health Organization distinguishes several BMI categories based on increasing health risks [11] (Table 1). Obesity has been defined as a BMI of equal to or greater than 30 kg/m^2. It has been categorized as class 1 (BMI 30-34.9), class 2 (BMI35-39.9), and class 3 obesity (BMI ≥40). The prevalence of class 3 obesity, also termed morbid, extreme, or clinically severe obesity, increased almost 3-fold between 1990 and 2000 in US adults from 0.78% to 2.2% [12], and is higher among women than men [8, 12]. In the Netherlands, the prevalence of morbid obesity between 1993 and 1997 was 0.2% for men and 0.6% for women [13]. Obesity is more common among people of higher age [14], and people of whom one or both biological parents are obese [15, 16], and it is inversely associated with educational level and social class [7, 14, 17].

The presence of obesity is associated with increased risk of hypertension, dyslipidaemia, type 2 diabetes, coronary artery disease, stroke, gallbladder disease, osteoarthritis, sleep apnea [18], as well as cancers of the endometrium, breast, prostate, and colon [19]. Due to the increased health risks, mortality is directly related to the amount of overweight, increasing slightly at a BMI greater than 31 and much more rapidly as BMI rises above 35. Persons with morbid obesity have a 2-fold higher risk for all-cause mortality than persons with BMIs of 30 to 31.9 [20].

Table 1 World Health Organization's Body Mass Index (BMI) categories based on increasing health risks

Weight Category	BMI (kg / m^2)
Underweight	< 18.5
Normal weight	18.5-24.9
Overweight	≥ 25.0
Pre-obese	25.0-29.9
Obese	≥ 30.0
Obese class 1	30.0-34.9
Obese class 2	35.0-39.9
Obese class 3	≥ 40.0

Several studies have documented the stigmatization of obese persons in contemporary societies [21, 22]. Obese persons encounter prejudice and discriminations at work, in public, and interpersonally. Both the stigmatization and the functional disabilities obese persons encounter may threat physical, psychological, and social quality of life. Health-related quality of life has gained increasing interest as a multidimensional outcome measure in clinical medicine and public health settings. It is particularly useful in studies on chronic diseases where the realistic goal of care is to make life as comfortable as possible. The deleterious effects of morbid obesity on health-related quality of life have been well described [4, 23, 24]. Severely obese patients even prefer having a major physical disability, such a deafness, blindness, or leg amputation, to being obese [25].

There is good evidence that loss of 5-10% of body weight achieved by way of conservative treatments such as dietary regimen and behavioral modification, when sustained, can produce a significant reduction in cardiovascular and diabetic risk factors and even mortality in obese people [26], and can improve health-related quality of life [27]. However, 5-10% reduction in body weight is not enough for individuals with morbid obesity and conservative treatment has been shown in long-term studies to be ineffective in morbid obesity. Bariatric surgery has been suggested to be the treatment of choice for those individuals [28]. Surgical treatments generally break down into restrictive, malabsorptive and combined restrictive and malabsorptive procedures. Laparoscopic adjustable gastric banding (LAGB) is a purely restrictive form of bariatric surgery designed to induce weight loss by limiting food consumption. In this procedure, a silicone band (Figure 1) is fastened around the upper part of the stomach.

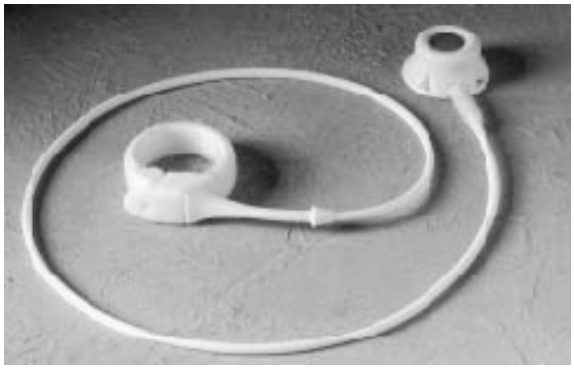

Figure 1 The silicone band used in Laparoscopic Adjustable Gastric Banding

The inner surface of the band is inflatable and connected by a thin silicone tube to an access port. This allows postoperative stoma size adjustment by puncturing the port and injecting or withdrawing a saline solution [29]. Although the amount of weight loss after restrictive types of surgery is somewhat lower than weight loss after malabsorptive types of surgery, such as gastric bypass, LAGB has proved to be a safe procedure, 7 to 10 times safer than gastric bypass in terms of mortality, and it is associated with few perioperative complications [30, 31]. Advantages of laparoscopic adjustable gastric banding are that the operation is minimally invasive to the stomach, totally reversible, and adjustable to the patients' need.

OUTCOME OF BARIATRIC SURGERY

Although weight loss is the most immediate endpoint in the evaluation of surgical treatment of obesity, divergent quality of life dimensions in the obese patient have been widely accepted as important health outcomes after surgical intervention [32]. Apart from being an important goal of intervention, enhanced quality of life may be expected to motivate patients to maintain a surgically established weight loss and to adhere to health behaviors that reduce the chance at comorbidity.

Several studies have reported long-term follow-up results of weight in patients after bariatric surgery for the control of morbid obesity. Studies regarding the quality of life aspects of weight reducing surgery generally report the analysis of short term results, showing major improvements in quality of life within the first two years following surgery [23, 33-37]. Major weight loss occurs in most patients within the first two years following surgery, but about 2 years postoperatively, weight stabilizes or sometimes even increases [38]. This makes a careful evaluation of long-term quality of life from two years after bariatric surgery mandatory. There are few reports of the long-term results that assess patients in terms of both quality of life, weight loss and comorbidity, and information on divergent aspects of social health, a highly significant aspect of quality of life, is lacking. Incidental studies on long-term quality of life show mixed results, with some studies suggesting adequate [39, 40], but others a decrease in quality of life long-term after bariatric surgery [41, 42].

Weight and weight loss are assumed to be associated with quality of life. In previous studies, low correlations between short-term postoperative weight and quality of life outcome were observed [39, 42]. The valid analysis of correlations is only possible in heterogeneous populations. Before surgery, patients are rather homogeneous with respect to their severe obesity and poor quality of life. In the first two years after surgery, changes in weight and quality of life tend to be large for virtually all patients. It is hypothesized that associations between weight and quality-of-life domains will become stronger when the postoperative duration increases, as the group will become more heterogeneous with respect to changes in weight and quality of life.

DETERMINANTS OF OUTCOME

Although surgery is considered the treatment of choice in morbid obesity, the outcome of bariatric surgery is variable and weight regain may occur in the long-term postoperative period [38]. Surgical success is not only dependent upon the technical adequacy of the surgical procedure, but also on the patients' ability to make adequate changes in lifestyle. This may specifically apply for restrictive surgical procedures. Despite the influence of genetics in the regulation of body weight, the rapidity with which obesity has escalated in the Unites States and other industrialized countries suggests that genetic factors cannot play the predominant role in the current obesity epidemic. Instead the increase of obesity is due to the interaction of environmental and behavioral factors with genetic susceptibility [43, 44]. Given how difficult it is for some patients to maintain changes in lifestyle and related weight loss after bariatric surgery, researchers have begun to focus on identifying psychological factors that may predict weight loss maintenance.

GENERAL PSYCHOLOGICAL PREDICTORS

The study of psychological factors and disease outcome in chronic diseases, and of psychological health outcomes in the general population, has often been based on stress-vulnerability models [45, 46]. These models propose that external stressors, such as major (early) life events, and internal vulnerability factors, such as personality characteristics, affect disease outcome.

Personality

Personality characteristics are defined as relatively stable tendencies of individuals to behave habitually across situations and over time. Modern theories in health psychology emphasize the importance of both individual and environmental factors in predicting health behaviors [47]. Personality characteristics are assumed to underlie individual factors, such as personal goals and self-efficacy beliefs, and to affect and be affected by environmental factors, such as social support and reinforcement [48-50]. Whereas some studies observed that personality was not a predictor of weight loss after surgery [51-53], others found that certain personality characteristics such as rigidity [54] and hostility [55] predicted less weight loss following surgery. Most studies on personality variables as predictors of surgical success have relied on a short-term follow-up up to one year after surgery. Just after the operation, nearly all patients lose a great deal of weight. Moreover, they experience improved psychological well-being and are praised and encouraged, which is important to maintain health behaviors. About two years postoperatively, weight stabilizes or even increases and the amount of psychosocial reinforcement decreases, and personality traits may then become more important in the prediction of weight outcome.

Childhood sexual abuse

The one major external stressor that has been shown in this area has been a history of childhood sexual abuse. A history of childhood sexual abuse (CSA) has been related to increased body weight [56] and obesity in adulthood and may also potentially threaten a successful weight outcome after bariatric surgery. Childhood sexual abuse has been associated with increased psychiatric comorbidity [57], and pathological cognitions before bariatric surgery [58], which may influence treatment outcome. Moreover, obesity may play a potentially adaptive function as a defence against sexual proposals for some sexually abused women [59]. Individuals with a history of childhood sexual abuse may become uncomfortable with their body as their appearance becomes more attractive to the opposite sex through weight loss, and weight loss may trigger memories as individuals return to a weight at which they were abused. As yet, there is no information available on the relationship between a history of childhood sexual abuse and weight outcome after bariatric surgery.

SPECIFIC BEHAVIORAL PREDICTORS

In contrast to relatively enduring personality characteristics and irreversible stressors, it is assumed that the mediating factors in the reported stress vulnerability model, i.e., specific behavioral predictors and related cognitions and attitudes, can be affected by psychological treatment. This makes insight into these factors and related determinants specifically relevant for the management of morbidly obese patients after bariatric surgery.

Binge eating

Binge eating behavior characterized by loss of control over eating is very common among the morbidly obese who seek surgical treatment for weight loss, and affects approximately 50% of the patients before bariatric surgery [60-62]. Binge eating is the core feature of binge eating disorder (BED), a defined eating disorder diagnosis in the DSM-IV. The prevalence rates of binge eating disorder in morbidly obese individuals before bariatric surgery vary from 11% to 25% using the DSM-IV criteria of two binges per week [61, 63-65], and from 25% to 39% using a criterion of one binge per week [64, 65]. Binge eating has been associated with a range of characteristics that may affect bariatric surgery treatment outcome, including more psychopathology [66, 67], increased fat intake [68], lower satiety [38], and disturbed eating attitudes [65, 69, 70]. An incidental study found that postoperative binge eating behavior is related to a poor weight outcome after gastric bypass surgery [71]. So far, it is unknown whether postoperative binge eating is related to weight outcome after LAGB. Several studies have examined whether preoperative binge eating predicts weight outcome. Although a pilot study with retrospective assessment and a small sample size suggests that patients with a preoperative binge eating disorder experience a short-term improvement in binge eating after surgery that erodes after 2 years and is associated with weight regain [72], most

studies found that preoperative binge eating [60, 61] and binge eating disorder [61, 63, 73] do not predict postoperative weight outcome. Comorbid psychopathology, specifically depression, may relate to the course of binge eating and outcome after bariatric surgery. The negative mood associated with depression may make an individual with binge eating more susceptible to episodes of binge eating in response to negative mood, inducing a more persistent binge eating pattern after bariatric surgery that prevents weight loss. Evidence exists from the study of bulimia nervosa that the presence of depression predicts poorer treatment outcome [74].

Psychobiological factors of binge eating. Binge eating can be conceptualized as a manifestation of disturbances in dietary restraint and affect regulation, but may also be the clinical manifestation of disturbed physiological mechanisms. According to the boundary model patients set themselves complex and strict dietary rules [75]. Violating these rules often results in a breakdown of control and binge eating. Also people who feel their eating behavior is easily triggered by emotions or by external eating cues, such as the sight or smell of food, are supposed to be at risk of binge eating. A prospective study has shown a clear link between negative emotional states, but not dietary restraint, and subjective binge behavior [76]. Experimental studies showed that participants with high emotional or external eating attitudes consumed large quantities of food during a taste test, while a restrained eating attitude was not associated with the amount of food eaten [77, 78]. This suggests that emotional and external eating attitudes are more crucial determinants of overeating and binge eating than restrained eating.

Physiological factors may also affect binge eating. Binge eating is characterized by the consumption of food that is energy dense in fat and sugar, and food intake, specifically food containing high levels of fat [79, 80] and sugar [81], increases cortisol levels. Moreover, binge eating is characterized by stressful feelings of guilt and disgust about the loss of control over eating and weight and shape appearance, and cortisol is a typical stress hormone, secreted by the adrenal cortex upon activation of the hypothalamus pituitary adrenal (HPA) axis under situations of physiological stress, such as inflammation, and psychological stress, in particular in response to stress situations in which the individual is threatened with loss of control [82]. Thus, there are several reasons to hypothesize that patients with binge eating disorder will have disturbed cortisol functioning.

Physical exercise

In recent decades there has been a general trend towards performing a more sedentary lifestyle (i.e., less physical exercise, sitting down more during leisure time). This reduction in physical activity results in a reduced energy expenditure, which, in relation to increased energy intake, has been a major contribution to obesity. Although studies have shown that lack of physical exercise is associated with obesity in the general population [83, 84], it has not been examined whether exercise behavior is associated with outcome after obesity surgery.

Factors influencing physical exercise. Beliefs on the resulting health benefits as well as the costs or barriers of enacting physical exercise have been found to be cognitive determinants of exercise behavior among older adults [85-87], chronic pain patients [88], and obese patients [89]. Main psychological barriers to physical exercise in the obese are lack of confidence and embarrassment at being observed [89]. In chronic pain patients fear of injury proved to be an important barrier to physical exercise, which leads to a vicious circle characterized by decreased self-efficacy, fear, and a further avoidance of activity [88]. Possibly, in a similar way, fear of injury will be associated with low physical exercise after surgery for severe obesity.

AIM AND OUTLINE OF THE THESIS

The aim of this thesis is to examine psychological predictors of treatment outcome after surgery for morbid obesity. Particular attention is given to the specific behavioral predictors of outcome and related psychological determinants of these behaviors, as these aspects can be influenced by psychological treatment. An ultimate application of findings of this thesis could be the development of a psychological intervention to increase the effectiveness of laparoscopic adjustable gastric banding in patients with morbid obesity. The seven studies (five cross-sectional and two prospective) are described in three parts: psychosocial outcome (chapter 2), general psychological predictors (chapters 3 and 4), and specific behavioral predictors and related determinants (chapters 5, 6, 7, and 8).

The main aim of chapter 2 was to examine the short-term and long-term physical, mental, and particularly social quality of life in patient with severe obesity following LAGB. A second aim was to examine the hypothesized association between weight and quality of life outcome relatively short-term and long-term after LAGB.

Personality characteristics and sexual abuse as general psychological predictors of weight outcome after LAGB are examined in chapters 3 and 4, respectively. The purpose of the prospective study in chapter 3 was to examine whether personality traits predict short-term weight loss, and, specifically, long-term weight loss maintenance after LAGB. Chapter 4 cross-sectionally examined the relationship between reported childhood sexual abuse and weight and health outcome after LAGB.

To examine the short-term and long-term eating behavior after LAGB, binge eating and divergent associated eating characteristics were compared for a preoperative group and two postoperative groups with short-term and long-term postoperative duration in chapter 5. The second aim of this study was to examine the relationship of binge eating with outcome. Preoperative binge eating behavior, depression, and combined binge eating behavior and depression as predictors of postoperative binge eating behavior and weight outcome at 6 and 12 months after LAGB are examined in chapter 6.

Chapter 7 aims to test the appropriateness of a model in which eating attitudes and exercise beliefs influence the behavioral mediators binge eating and physical exercise behavior respectively, that, subsequently, affect the weight and quality of life outcome after LAGB.

Salivary cortisol levels and the awakening cortisol response in persons showing binge eating after LAGB are examined in chapter 8.

The results and conclusions of these studies are integrally summarized and discussed in chapter 9. Implications in the context of improving psychological care for the morbidly obese patient after laparoscopic adjustable gastric banding will be indicated.

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Chapter 2

Psychosocial functioning before and after Laparoscopic Adjustable Gastric Banding: a cross-sectional study

Larsen, J.K., Geenen, R., Van Ramshorst, B., Brand, N., De Wit, P., Stroebe, W., Van Doornen, L.J.P. Psychosocial functioning before and after Laparoscopic Adjustable Gastric Banding for morbid obesity: a cross-sectional study (2003). *Obesity Surgery*, 13, 629-636.

ABSTRACT

Background: The aim of this cross-sectional study was to examine short and long-term physical, mental and, particularly, social quality of life of patients with severe obesity after laparoscopic adjustable gastric banding (LAGB).
Methods: 250 patients (221 female, 29 male, mean age 39.6 years, age range 22-61) filled out questionnaires to evaluate several aspects of quality of life: 93 patients before LAGB, 48 with a follow-up duration of 8 through 24 months and 109 patients 25 through 68 months after LAGB.
Results: Compared to patients before surgery, patients after surgery, in both follow-up groups, had lower weight and comorbidity, felt and functioned better on physical and psychological dimensions of quality of life, and on most aspects of social quality of life. No significant differences emerged between the two postoperative groups. On average, the postoperative quality of life was still lower than the age norm group. Mutual correlations between quality of life and weight outcome were very low up to two years after surgery, but more strongly associated more than two years after surgery.
Conclusion: LAGB could be a long-term solution to morbid obesity with regard to both weight and quality of life outcome. The findings of our study emphasize the importance of including social quality of life variables in outcome research. They further suggest that when the follow-up duration increases, especially in patients who are single, intervention and consultation should be simultaneously directed at weight and psychosocial variables.

INTRODUCTION

Obesity, specifically morbid obesity, is a major public health problem and a stigmatized condition in Western culture, which can have a considerable negative impact on physical, psychological and social aspects of quality of life [1,2]. Surgery is considered the treatment of choice in case of morbid obesity [3]. Divergent quality of life dimensions in the obese patient have been widely accepted as important health outcomes after surgical intervention, next to weight loss and comorbidity. Apart from being an important goal of intervention, enhanced quality of life may be expected to motivate patients to maintain a surgically established weight loss and to adhere to health behaviors that reduce the chance at comorbidity [1].

Social health is a highly significant aspect of quality of life, which is closely intertwined with both psychological and physical health. Increased morbidity and mortality rates have been found among socially isolated persons [4], and higher psychological morbidity among persons lacking social support [5]. Thus, adequate social quality of life can be regarded as an important goal of intervention. There has not been a great deal of research on the social quality of life. Isolated findings suggest improvement in social networks [6], social functioning, including marital and sexual relations [7], and health-related social quality of life [1,8,9] after surgery for morbid obesity. Our study will extend these findings by simultaneously focusing on a range of dimensions of social quality of life before and after bariatric surgery.

Major weight loss occurs in most patients within the first two years following surgery and several studies have shown an improvement of quality of life in this period [8,10-14]. About 2 years postoperatively, weight stabilizes or sometimes even increases [15]. This makes a careful evaluation of long-term quality of life from two years after bariatric surgery mandatory. Incidental studies on long-term quality of life show mixed results, with some studies suggesting adequate long-term quality of life [1,16], but others a decrease in quality of life long-term after bariatric surgery [9,17]. Our study will gain insight into the long term quality of life more than two years after surgery.

Absolute weight and weight loss are assumed to be associated with quality of life. In previous studies, low correlations between short-term postoperative weight and quality of life outcome were observed [1,9]. The valid analysis of correlations is only possible in heterogeneous populations. Before surgery, patients are rather homogeneous with respect to their severe obesity and poor quality of life. In the first two years after surgery, changes in weight and quality of life tend to be large for virtually all patients [15]. It is hypothesized that associations between weight and quality-of-life domains will become stronger when the postoperative duration increases [1], as the group will become more heterogeneous with respect to changes in weight and quality of life.

The main purpose of our study was to examine the short- and long-term physical, mental, and particularly social quality of life in patients with severe obesity following laparoscopic adjustable gastric banding (LAGB). For that aim, the quality of life of three patient groups, one preoperative group and two postoperative groups with short-term and long-term postoperative

duration respectively, were compared. To examine whether the association between weight and quality of life is a function of postoperative duration, correlations between weight outcome and quality of life dimensions were analyzed separately for the preoperative group and the two postoperative groups.

MATERIALS AND METHODS

Subjects and Procedure

The study was designed as a cross-sectional comparison of a group of preoperative patients who are morbidly obese and have signed up, but not yet undergone LAGB, and two postoperative groups of patients after LAGB with distinct postoperative duration. *Preoperative patients.* 123 preoperative patients were on a waiting list for gastric banding between September 2000 and June 2001. All patients were asked to participate in a study on the quality of life before surgery. 104 patients agreed. All these patients received questionnaires of which 93 questionnaires were returned, a total response rate of 75.6% of the population. *Postoperative patients.* During the period November 1995 until August 2000, 199 patients were subjected to gastric banding for morbid obesity. One patient died in the postoperative period and in two patients the band was removed, leaving a postoperative research population of 196 patients. During the year 2001, all these patients were asked to participate in a cross-sectional study on the quality of life after surgery. 179 patients agreed. All these patients received questionnaires of which 160 questionnaires were returned, a total response rate of 81.6% of the population. The questionnaires of three patients were incomplete, leaving 157 evaluable postoperative patients. These patients were divided into a group with a short-term postoperative duration (n=48) and a group with a long-term postoperative duration (n=109). Patient characteristics are shown in Table 1. All patients were accepted for a LAGB procedure using the Lap-Band® system (BioEnterics Corporation) following screening by a team consisting of a bariatric surgeon, an internist, a psychologist, and a dietician. Surgical indications were a BMI ≥ 40 or a BMI between 35 and 40 with serious comorbidity. In the case of obesity-related psychopathology, acceptance of psychological treatment was a condition for acceptance for surgery. The operation was performed according to the techniques described by Belachew and coworkers [18].

Clinical Instruments

Weight assessment. From all patients, objective information of the preoperative weight was available. Objective information of the postoperative weight from three months before or after the completion of the questionnaires was available for 123 of the 157 patients. Self-reported postoperative weight reports were available for 153 of the 157 patients. The correlation between the postoperative objective weight measurement and the self-reported weight data was extremely high ($r=0.98$, $p<0.001$). Therefore, in this study, self-reported weight data was used to assess

postoperative weight. For the 4 patients whose self-reported weight was not available, objective weight assessments were used instead. *Medication use.* To measure current medication use, patients were asked to copy the information from their medication packaging. Answers were classified by a pharmacist according to eight main categories: psychopharmaca, acid reducing medication, cardiovascular medication, anti-inflammatory drugs, anti-diabetic medication, analgesics, thyroid medication, and lung medication.

Table 1 Subject characteristics of morbid obese patients before, short-term after, and long-term after LAGB

	Pre n=93	Post ≤ 2 yrs. n=48	Post > 2 yrs. n=109
Postoperative period (in months)	-	16 (8-24)	42 (25-68)
Women : men	77 : 16	42 : 6	102 : 7
Age	39 (22-59)	40 (24-61)	41 (22-55)
Educational level	3.1 (1-7)	3.3 (1-7)	3.1 (1-7)
Marital status: % single*	32.5	17.9	10.8
Preoperative BMI	46.5 (37-67)	45.5 (37-72)	45.4 (36-63)

Means (and ranges)

BMI: weight / length^2

*Chi^2=12.96; p<0.01); percentage single versus married (widowed, divorced and people living with parents were excluded from the analysis because of small sample sizes)

Quality of Life Instruments

To measure *physical quality of life*, 4 scales of the RAND-36 [19] were used: 'physical functioning', 'vitality', 'pain', and 'general health'. Raw scale scores of the RAND-36 were transformed into scores from 0 (the worst) to 100 (the best).

To measure *psychological quality of life*, the Beck Depression Inventory (BDI) [20], the Rosenberg Self-Esteem Scale (RSE)[21], and the 'mental health' scale of the RAND-36 [19] were used. The BDI has proved to be an internally consistent and valid instrument to measure depressive symptoms (Cronbach α's vary from .73 to .92 across different studies) [22], and the RSE is a reliable and valid measure of global self-esteem (Cronbach α's vary from .72 to .88) [21].

To measure *social quality of life*, the Dutch Inventory for Social Support (ISB),[23] the Dutch Relational Interaction Satisfaction Scale (RISS),[24] the Obesity Psychosocial State Questionnaire (OPSQ: a self-developed questionnaire) [25], and 3 scales of the RAND-36 [19] were used: 'social functioning', 'role limitations due to physical problems', and 'role limitations due to emotional problems'. The ISB consists of 3 subscales: 'potential emotional support', 'actual emotional support', and 'mutual visiting of family and friends'. A higher score on each scale reflects a higher social support level. The scales have a high internal consistency (Cronbach α's vary from .72 to .87) [23].

The RISS is a valid and reliable instrument to measure satisfaction with partner interaction in an intimate relationship (for various samples Cronbach α's vary from .83 to .88) [26]. The OPSQ consists of 7 subscales of which the 3 social subscales were used in this study: 'social discrimination', 'intimate and sexual functioning', and general social network. The psychometric characteristics of the OPSQ, established in a preliminary sample of 287 patients before and after (surgical and dietary) treatment for (severe) obesity, proved to be satisfactory. The three social scales have a moderate to high reliability (Cronbach α's are .54 [general social network], .78 [intimate and sexual functioning], and .87 [social discrimination]).

Statistical analyses

One-way analysis of variance, with post-hoc Bonferroni comparison in case of a significant subgroup effect, was used to compare the different groups. To compare evaluations of health-related quality of life (RAND-36) with the general Dutch population norm group (n=1063) [19], mean scores of the age reference group were subtracted from the patients' scores, after which one sample t-tests were used to test whether these age-adjusted scores deviated from zero. Pearson's product moment correlation coefficients were calculated to analyze the associations between weight outcome and quality of life dimensions in different groups.

RESULTS

Change in Weight and Medication Use

Postoperative patients had a significantly lower weight and BMI than preoperative patients, but the two postoperative groups did not differ in weight (Table 2). Significant differences in medication use were observed between the preoperative group and the two postoperative groups for three types of medication. Before surgery, 23.7% of the patients used psychopharmaca, whereas short- and long-term after surgery 10.4% and 9.2% of the patients used psychopharmaca respectively (χ^2=9.25, p<0.01). Before surgery, 12.9% of the patients used anti-diabetic medication, whereas short- and long-term after surgery 0.0% and 1.8% of the patients used anti-diabetic medication respectively (χ^2=15.15, p<0.001). The use of acid reducing medication was especially prevalent (21.1%) in the group with a long-term follow-up (χ^2=8.40, p<0.05). Band-placement can cause an oesophageal dilation over time with stasis of food causing symptoms of reflux oesophagitis.

Quality of life

There were no significant differences in quality of life between the two postoperative groups (Table 2).

Table 2 Quality of life and weight outcome in the preoperative cohort and the two postoperative cohorts of patients

	Pre			Post ≤ 2 yrs.			Post > 2 yrs.					
Variable	n	Mean	SD	n	Mean	SD	n	Mean	SD		F	p
Weight outcome												
BMI (kg/m^2)	93	46.5	6.6	48	36.4	7.7	109	34.9	6.6		79.95	0.00‡§
Physical quality of life												
Physical functioning (RAND)*	93	-41.8	24.6	48	-11.2	26.3	106	-10.5	24.9		44.45	0.00‡§
Vitality (RAND)*	93	-24.7	21.0	47	-7.9	23.8	108	-14.7	21.7		10.43	0.00‡§
Pain (RAND)*	93	-27.8	28.8	47	-7.3	28.3	106	-13.5	30.8		9.42	0.00‡§
General health (RAND)*	92	-24.7	21.8	47	-10.1	21.9	106	-9.6	21.4		13.74	0.00‡§
Mental quality of life												
Depressive symptoms (BDI)†	93	15.8	9.8	48	9.8	8.0	108	10.0	8.0	Chi^2	27.29	0.00‡§
Self-esteem (RSE)	93	2.7	0.6	47	3.1	0.6	109	2.9	0.6		9.57	0.00‡§
Mental health (RAND)*	93	-14.4	19.6	47	-8.6	21.4	108	-8.6	18.0		2.59	0.08
Social quality of life												
Potential emotional support (ISB)	93	13.6	4.3	48	15.7	3.5	109	14.4	4.6		3.90	0.02‡
Actual emotional support (ISB)	93	8.3	2.3	48	8.4	2.1	109	7.9	2.4		1.58	0.21
Mutual visiting (ISB)	93	5.7	1.5	48	5.7	1.7	109	5.6	1.7		0.11	0.89
Relation-satisfaction (RISS)†	59	4.2	0.6	28	4.4	0.5	86	4.2	0.6	Chi^2	2.31	0.32
Social discrimination (OPSQ)	93	3.4	0.9	46	2.1	1.0	108	2.2	0.9		50.52	0.00‡§
Poor intimate & sexual dysfunctioning (OPSQ)	91	3.2	1.0	45	2.3	1.0	105	2.4	1.0		19.01	0.00‡§
Poor general social network (OPSQ)	93	2.6	0.9	48	2.2	0.8	109	2.1	0.9		6.95	0.00‡§
Social functioning (RAND)*	93	-27.2	28.6	46	-10.0	28.9	106	-13.9	27.0		8.05	0.00‡§
Role limitations physical problems (RAND)*	92	-26.4	43.1	47	-5.6	39.4	106	-10.5	40.0		5.30	0.00‡§
Role limitations emotional problems (RAND)*	92	-15.8	41.7	47	-9.1	41.0	105	-8.7	40.1		0.83	0.44

* Rand-scores are expressed as mean deviations from the general Dutch norm population (the lower scores reflect poorer health as compared to the norm)

† Responses to the RISS and the BDI were not normally distributed, Kruskal-Wallis nonparametric test used

‡ Significant differences between pre- and post ≤ 2 yrs. Groups; § Significant differences between pre- and post > 2 yrs. groups

The two postoperative groups experienced all aspects of *physical quality of life* as significantly better than the preoperative group of patients (Table 2, $p<0.001$). *Psychological quality of life* was also significantly better after surgery. Postoperative patients showed significantly less 'depressive symptoms' ($p<0.001$), more 'self-esteem' ($p<0.001$), and marginally significant better 'health-related mental quality of life' ($p=0.08$) than preoperative patients (Table 2). Before surgery and up to two years after surgery 20.4% and 20.8% of the patients received treatment for mental problems, whereas more than two years after surgery 9.3% of the patients received mental treatment ($\chi^2=5.92$, $p=0.05$).

Several aspects of *social quality of life* were significantly better after surgery. Patients at short- and long-term interval following surgery experienced less 'social discrimination', better 'intimate and sexual functioning', extended 'general social network', and better 'health-related social functioning' and 'role limitations due to physical problems' than before surgery (Table 2, $p<0.001$). Patients short-term after surgery experienced better 'potential emotional support' than the patients before surgery ($p=0.02$); an effect not shown for patients with a long-term follow-up. For 'role limitations due to emotional problems', 'relation-satisfaction', and two aspects of social support ('actual emotional support' and 'mutual visiting of family and friends'), no significant differences between the preoperative group and the two postoperative groups were found. The scores on 'actual emotional support' and 'mutual visiting of family and friends' of the groups were rather similar to the norm (data not shown).

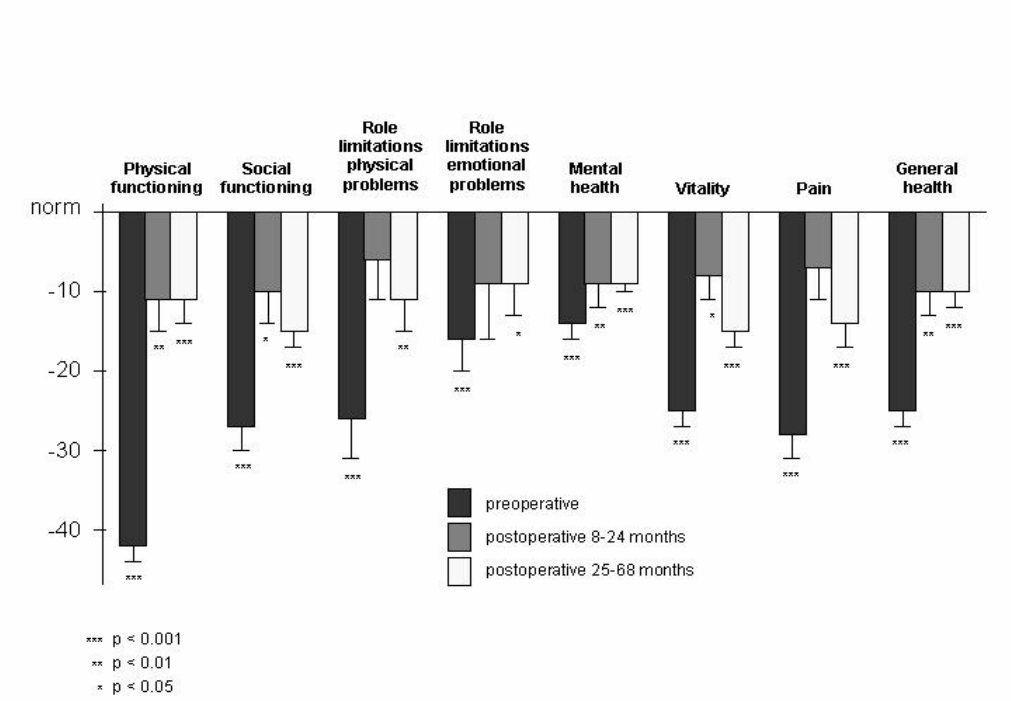

Figure 1 Health-related quality of life as compared to the age norm

Health-related quality of life as compared to the age norm. Figure 1 displays pre- and postoperative evaluations as compared to the general Dutch reference population. Preoperative evaluations of patients on all dimensions of health-related quality of life were *highly* significantly lower than scores of the age norm group ($p<0.001$). Short-term post-surgery patients scored significantly lower than the age norm at 'physical functioning' ($t=-2.93$, $p=0.01$), 'social functioning' ($t=-2.35$, $p=0.02$), 'mental health' ($t=-2.76$, $p=0.01$), 'vitality' ($t=-2.28$, $p=0.03$), and 'general health' ($t=-3.15$, $p=0.00$). Long-term post- surgery patients scored significantly lower than the age norm on all dimensions of quality of life ($p<0.05$).

Correlations between quality of life and weight outcome. More than 24 months after surgery virtually all aspects of quality of life were associated with the absolute weight and many aspects with weight change. Lower BMI and higher BMI-loss were associated with better social, mental, and physical quality of life in patients with a postoperative follow-up of more than 24 months (Table 3). This contrasts with the low correlations between quality of life and weight outcome in the preoperative and the short-term postoperative group.

Table 3 Correlations between quality of life variables and weight outcome in patients in the preoperative cohort and the two postoperative cohorts

	Pre	Post ≤ 2 yrs.		Post > 2 yrs.	
	BMI	BMI	ΔBMI	BMI	ΔBMI
Physical quality of life					
Physical functioning (RAND)	-0.31**	-0.00	-0.09	-0.39***	0.32**
Vitality (RAND)	-0.21	0.03	0.07	-0.26**	0.21*
Pain (RAND)	-0.23*	0.05	-0.21	-0.14	0.10
General health (RAND)	-0.16	-0.08	-0.01	-0.45***	0.35***
Mental quality of life					
Depressive symptoms (BDI)	0.04	0.16	-0.17	0.11	-0.20*
Self-esteem (RSE)	-0.03	-0.15	0.12	-0.32**	0.30**
Mental health (RAND)	-0.03	-0.12	0.17	-0.24*	0.25**
Social quality of life					
Potential emotional support (ISB)	-0.03	-0.15	-0.12	-0.25**	0.16
Actual emotional support (ISB)	-0.19	0.04	-0.10	-0.22*	0.16
Mutual visiting of family and friends (ISB)	-0.18	-0.14	-0.05	-0.24*	0.11
Relation-satisfaction (RISS)	0.24	-0.02	-0.21	-0.09	0.06
Social discrimination (OPSQ)	0.25*	0.45**	-0.19	0.46***	-0.30**
Intimate & sexual dysfunctioning (OPSQ)	0.07	0.18	-0.07	0.38***	-0.34***
Poor general social network (OPSQ)	0.09	0.15	-0.12	0.33***	-0.07
Social functioning (RAND)	-0.14	0.02	-0.07	-0.25*	0.19*
Role limitations physical problems (RAND)	-0.14	0.02	0.12	-0.24*	0.09
Role limitations emotional problems (RAND)	-0.03	0.03	0.03	-0.29**	0.30**

*p<0.05, **p<0.01, ***p<0.001

DISCUSSION

Our study of quality of life in three cohorts of patients before and after surgery for morbid obesity differs from other studies in this field by inclusion of a group of patients with a relatively long follow-up duration and by the investigation of divergent aspects of social quality of life. The main finding of our study is that, in comparison with patients before surgery, patients after surgery felt and functioned better on physical and psychological dimensions of quality of life, and on most aspects of social quality of life. No significant differences emerged between the two postoperative groups.

In agreement with previous studies, our weight and medication data suggest that bariatric surgery improves the clinical condition of patients. The positive clinical condition is also reflected in a better physical quality of life, but on average the postoperative groups still deviate from the norm. Interventions aimed at physical functioning may therefore be considered to support the effects of the operation in patients with physical functioning abilities clearly below the norm. Similar results were found for psychological functioning. Evaluations of patients after surgery reflected less psychological distress, but were on average still somewhat below the norm. Thus, apparently, a limited number of patients require long-term postoperative psychological assistance.

Conform the literature on isolated aspects of social quality of life [6-9], we found that health-related social functioning, social discrimination, general social networks, and intimate and sexual functioning were much better after surgery. However, we found no difference for mutual visiting of family and friends, actual emotional support, and relation satisfaction before and after surgery, and the scores on the social support variables were rather similar to the norm. This suggests that the immediate social support of spouse, family and friends in our patients is relatively independent of obesity.

In our study, fewer patients were single after surgery, and the marital status long term after surgery appeared to be rather similar to the marital status of a general Dutch adult population [27], suggesting an effect of the operation on marital status. The differences in quality of life between the preoperative group and the postoperative groups remained intact after controlling for marital status (data not shown).

A unique aspect of our study was that it included a large sample with long-term follow-up. Incidental studies on the long-term *weight outcome* after bariatric surgery show positive results [28,29], but incidental studies on the long-term *quality of life outcome* show mixed results. While one study observed return of mental health to preoperative levels at 3 years [17], and another study a reduction of physical quality of life with longer postoperative duration (although this probably reflected stabilization at a normal level) [9], other studies observed stable, adequate long-term quality of life outcome [1,16]. Our study supports the positive long-term findings, suggesting that LAGB could be a long-term solution to morbid obesity with regard to both weight and quality of life outcomes.

Mutual correlations between quality of life and weight outcome were very low up to two years after surgery, as was previously shown [1,9]. As hypothesized, quality of life and weight outcome were more strongly associated more than two years after surgery, although, in terms of Standard Deviations, the group was not more heterogeneous with respect to weight and quality of life variables. Mutual correlations between weight and quality of life within a subgroup of single patients more than two years after surgery (n=10; data not shown) were significant and extremely high (between .66 and .94), and scatter plots showed distinct linear relationships. These results were not found for single patients before or short-term after surgery. Future studies are needed to verify whether the same results would be found in a larger patient group of single patients long-term after surgery. When single patients were excluded from the analyses, correlations between quality of life and weight became somewhat lower, but remained significant, for most variables, with the exception of social support. Thus, the association between weight and quality of life more than two years after surgery was partly produced by a specific subgroup of single patients. It is suggested that in patients with less favorable long-term results, specifically single patients, a more integrated approach is advisable, in which the possible reciprocal influences between quality of life aspects and weight outcome should both be the focus of intervention.

This study has some restrictions. First, our design was restricted to a cross-sectional comparison. Future longitudinal studies are needed to determine causal relationships between weight and quality of life, and to make generalizations with regard to interaction effects and mediating variables. For instance, enhanced sexual functioning may be a primary consequence of endocrine changes after surgery [30], but it may also be secondary to enhanced self-esteem, physical functioning, or physical appearance. Second, in our study we used a self-developed questionnaire to assess additional aspects of social quality of life, such as intimate and sexual functioning. Although the initial psychometric results proved to be satisfactory, future research should verify these results. Third, our study population was restricted to patients undergoing LAGB. Future studies should examine whether the same results would be found in patients undergoing other forms of bariatric procedures.

Overall, the findings of our study emphasize the importance of including social quality of life variables in outcome research. They further suggest that when the follow-up duration increases, especially in patients who are single, intervention and consultation should be simultaneously directed at weight and psychosocial variables.

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Chapter 3

Personality as a predictor of weight loss maintenance after surgery for morbid obesity

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ABSTRACT

Objective: Personality characteristics are assumed to underlie health behaviors and, thus, a variety of health outcomes. Our aim was to examine prospectively whether personality traits predict short and long-term weight loss after Laparoscopic Adjustable Gastric Banding (LAGB).
Research Methods and Procedures: 168 patients (143 f, 25 m, age 18-58, mean 37 yrs, preoperative BMI 45 ± 5.6 kg/m^2) undergoing LAGB completed the Dutch Personality Questionnaire on average 1.5 years before the operation. The relationship between preoperative personality and short- and long-term postoperative weight loss was determined using multilevel regression analysis.
Results: The average weight loss of patients progressively increased with 10 BMI kg/m^2 till 18 months after surgery and stabilized hereafter. A lower baseline BMI, being male, and a higher educational level were associated with a lower weight loss. None of the personality variables were associated with weight outcome at short term follow-up. Six out of 7 personality variables did not predict long term weight outcome. Egoism was associated with less weight loss in the long-term postoperative period. The effect sizes of the significant predictions were small.
Discussion: None of the personality variables predicted short-term weight outcome, and only one variable showed a small and unexpected association with long-term weight outcome that needs confirmation. This suggests that personality assessment as intake psychological screening is of little use for the prediction of a poor or successful weight outcome after bariatric surgery.

INTRODUCTION

Obesity is a prevalent health problem in Western societies [1]. Surgery is considered the treatment of choice in morbid obesity [2]. The outcome of bariatric surgery, although usually favorable in the short-term, is variable and weight regain may occur in the long-term postoperative period [3]. Surgical success is not only dependent on the technical adequacy of the surgical procedure, but also on the patients' motivation and ability to make enduring changes in health behaviors, such as eating behavior and physical activity.

Modern theories in health psychology emphasize the importance of both individual and environmental factors in predicting health behaviors [4]. Personality characteristics are assumed to underlie individual factors, such as personal goals and self-efficacy beliefs, and to affect and be affected by environmental factors, such as social support and reinforcement [5-7]. Without explicit consideration of these multiple individual and environmental factors or mediating health behaviors, our study focuses on the possible role of personality as a predictor of weight loss after bariatric surgery.

Whereas some studies observed that personality was not a predictor of weight loss after surgery [8,11,12], others found that a self-defensive attitude, rigidity [13], psychopathic deviancy [14], somatization, hostility [15], and hypochondriasis [16] predicted less weight loss following surgery. We hypothesize that neuroticism, dominance, hostility, and social anxiety predict a poor weight outcome following bariatric surgery. Neuroticism, dominance, and hostility are implicated in ineffective coping strategies [7], poor health habits [6], and a poor outcome in several diseases [9]. Social anxiety and hostility are associated with disturbed social relationships, while social support and reinforcement are important to maintain health behaviors [10].

Most studies on personality variables as predictors for surgical success have relied on a short-term follow-up up to one year after surgery [8,11,13,14]. Just after the operation, nearly all patients lose a great deal of weight, experience improved psychological well-being and are praised and encouraged, which is important to maintain health behaviors [17]. About two years postoperatively, weight stabilizes or even increases [3], and the amount of psychosocial reinforcement decreases [17]. We expect that personality traits are more important in the prediction of weight outcome in this weight stabilization period than in the first period after surgery when favorable weight and psychosocial changes occur.

The purpose of our study was to examine prospectively whether personality traits predict short-term weight loss, and, specifically, long-term weight loss maintenance after Laparoscopic Adjustable Gastric Banding (LAGB).

RESEARCH METHODS AND PROCEDURES

From November 1995 until May 2001, 232 consecutive patients were subjected to a LAGB procedure in the St. Antonius Hospital in Nieuwegein, the Netherlands, using the Lap-Band® system (BioEnterics Corporation). The Dutch Personality Questionnaire, DPQ[18] was completed about one and a half year before the operation as fixed part of the intake psychological screening. Personality questionnaires were tracked down in files of 185 patients. The questionnaires of 4 patients were incomplete and no postoperative weight follow-up was known of 13 patients, leaving 168 evaluable patients (143 female; 25 male): mean age 37.3 ± 8.7 (range 18 – 58) years; ; mean preoperative weight 131.1 ± 17.4 (range 99.0 – 190.0) kg; mean preoperative BMI 45.9 ± 5.6 (range 36.2 – 69.1) kg/m^2; 9.5% of the patients had only primary education, 38.1% had lower secondary education, 42.8% higher secondary education, and 9.6 % tertiary education. Available information from the hospital on age, gender, and preoperative weight showed no differences between the 168 evaluable patients and the remainder of the 232 ($p>.10$). All patients were submitted to surgery following screening by a team consisting of a bariatric surgeon, an internist, a psychologist, and a dietician. Surgical indications were a Body Mass Index (BMI) ≥ 40 or a BMI between 35 and 40 with serious comorbidity. In case of obesity-related psychopathology, acceptance of psychological treatment was a condition for acceptance for surgery. The operation was performed according to the techniques described by Belachew and coworkers [19].

The postoperative development in weight was assessed every three months for the first two postoperative years and every six months from two years after surgery. There were 1337 weight observations of 168 patients. Long-term postoperative weight at 24 or more months after surgery was known of 138 of the 168 patients. Weight observations from four years after surgery were excluded from the analyses, as the sample sizes were too small.

Instruments

The DPQ is a validated personality questionnaire derived from the California Psychological Inventory [20]. It consists of seven scales: ‘neuroticism’, ‘social anxiety’, ‘rigidity’, ‘hostility’, ‘egoism’, ‘dominance’, and ‘self-esteem’. Norm scores of a general Dutch population were used (n=8826); for the scales ‘rigidity’, ‘hostility’, and ‘egoism’ distinct norms are provided for low versus high educational level. For the scales ‘neuroticism’ and ‘dominance’ norms are gender-specific [18].

Statistical analyses

To compare the personality scores of our research group with the general Dutch population norm group (n=8826) [18], mean scores of the appropriate gender or educational level norm group were subtracted from the patients’ scores, after which t-tests were used to test whether these adjusted scores deviated from zero, that is, from the norm.

Multilevel regression modeling, as implemented in the program MLwiN [21] was used to determine the longitudinal relationship between preoperative personality assessments and postoperative weight outcome. Weight outcome was defined as 'BMI change' (preoperative BMI minus postoperative BMI), with a higher score reflecting more weight loss. 'BMI change' was normally distributed (skewness=0.42, min=-4.69, max=26.67). The name multilevel refers to multiple levels of nesting. In our study were two levels of nesting. The repeated postoperative measurements of 'BMI change' (n=1337) at the within subjects level were nested within the 'patients' (n=168) at the between subject-level.

Preceding multilevel regression modeling, the predictor variable year and the demographic and personality variables were centered on their grand mean (i.e., the overall mean was subtracted from the values of a variable). The significance of the effects was determined with the Wald test: $Z = estimate / standard\ error\ of\ estimate$, where Z is referred to the standard normal distribution.[22] An alpha level of .05 was used for all statistical tests.

The adequacy of distinguishing the two levels of analyses (between and within subject-level) was examined in a first step by testing an 'empty model' without any explanatory variables included, referred to as model 1. Assuming two levels of analyses, there has to be enough variance present at both levels (between and within-subject level). In a second step, the trend of weight loss across the postoperative years was examined (model 2), after which the effects of the explanatory demographic and personality variables were tested (model 3). Finally, interaction effects between personality and postoperative time were tested (model 4). These interactions reflect whether the amount of weight loss is different short and long-term after surgery for patients with low and high scores at a specific personality characteristic.

In model 3 and 4, separate multilevel analyses were performed for each personality variable. This was done because covariance between these variables might result in spurious findings. In all tests p-values less than 0.05 were considered significant, but p-values in tests of personality variables were set to the conservative Bonferroni criterion of p=0.007, i.e., the normal alpha of 0.05 divided by the number of personality variables that was analyzed. To examine the magnitude of significant results, effect sizes were computed [23]: the difference between two means divided by the (pooled) standard deviation, thus, the difference between two means in standard deviation units. Effect sizes between 0.2 and 0.5 reflect a small effect, between 0.5 and 0.8 a moderate effect, and above 0.8 a large effect [23].

RESULTS

Preoperative personality scores

Table 1 shows the mean preoperative personality scores of our research group compared with those of the appropriate norm population. The scores on self-esteem (t= -5.1, p<.001) and egoism (t= -2.5, p<.05) were significantly lower, whereas the scores on neuroticism (t = 3.5,

p<.01) and social anxiety (t= 2.6, p<.01) were significantly higher than the norm. No significant differences compared to the Dutch norm scores were observed for rigidity, hostility, and dominance. In terms of effect sizes all deviations were small (effect sizes between 0.2 and 0.5).

Table 1 Personality scores of the study population before surgery (n=168) compared to the norm group (means and SD)

		Patients	Norm	t	p
Neuroticism	Men	12.0 (8.9)	9.7 (7.6)		
	Women	15.8 (9.9)	13.1 (8.3)	3.5	.001
Social anxiety		12.1 (8.6)	10.4 (7.0)	2.6	.009
Rigidity	Low education	29.0 (7.5)	29.1 (7.5)		
	High education	24.6 (7.7)	25.4 (7.8)	-0.8	ns
Hostility	Low education	18.7 (7.0)	19.0 (7.0)		
	High education	17.0 (8.1)	16.1 (6.8)	0.6	ns
Egoism	Low education	12.5 (5.0)	13.9 (5.1)		
	High education	10.2 (4.5)	10.7 (4.9)	-2.5	.014
Dominance	Men	13.2 (6.7)	15.8 (6.1)		
	Women	13.8 (6.3)	12.5 (5.7)	1.4	ns
Self-esteem		25.1 (7.2)	27.9 (5.9)	-5.1	.000

For 'rigidity', 'hostility', and 'egoism' distinct norms are provided for people with low versus high educational level, and for 'inadequacy', and 'dominance' gender-specific norms are available. To arrive at a t-value that is similar to the t-values of the other personality variables, after subtracting the appropriate gender or educational level norm group means from the patients' scores, we examined whether these scores deviated from zero

Weight loss

Table 2 shows the number, mean (sd), and range of weight loss assessments across the four postoperative years. From 18 months onwards weight loss stabilized.

Table 2 Weight loss (BMI change) assessments of 168 patients across 4 postoperative years: number, mean, standard deviation, and range

Postoperative duration	n	Mean	SD	Min	Max
3 months	225	4.2	2.6	-3.6	12.1
6 months	133	6.7	3.3	-0.3	15.7
9 months	94	7.7	3.9	0.2	21.1
12 months	138	9.0	3.9	-0.1	23.6
15 months	112	9.8	4.4	-0.0	22.7
18 months	108	10.3	4.4	0.5	24.0
21 months	97	10.3	4.3	-2.3	22.7
24 months	79	10.1	4.9	-4.7	23.2
27 months	70	9.9	5.2	-3.3	23.1
30 months	61	10.3	5.1	-3.7	22.8
33 months	56	10.1	5.7	-3.8	26.7
36 months	52	10.5	4.6	2.4	21.4
39 months	36	9.9	4.3	0.6	23.4
42 months	40	10.3	5.9	-4.0	26.1
45 months	36	9.8	5.6	2.0	23.6

Some patients had two weight supervisions during a quarter of a year (especially immediately after surgery) or incidentally skipped weight assessments (especially on the long-term after surgery)

Confirmation of the 2-level model (model 1)

To examine the adequacy of distinguishing two levels of analyses, the amount of variance at the between and within subject level was assessed by constructing an intercept only model (model 1, Table 3). The amount of variance at each level was highly significant, justifying the specification of a 2-level model with patients at a between subject level and the repeated weight loss measurements at a within subject level.

Length of postoperative follow-up period (model 2)

To examine weight loss as predicted by the length of the postoperative follow-up period, best fitting linear and curvilinear quadratic curves of BMI change throughout the postoperative time were estimated from the independent variables 'year' (linear trend) and 'year^2' (quadratic trend). The estimated curves did, however, not accurately fit the observed values from two years after surgery. To account for a change of trend about two years postoperatively when weight stabilizes or sometimes even increases, an independent variable named 'period' was added to the model with value '0' for the first two years after surgery and value '1' for the third and fourth years after surgery. Interaction-terms between period on the one hand, and 'year' and 'year^2' on the other hand were calculated, to examine the specific weight loss trends in the short and long-term periods after surgery. The interaction effect of period*year was not significant and was,

therefore, removed from the model. The interaction effect of period*year^2 was significant. This reflected that weight loss more than two years after surgery was characterized by a less steep decrease. The fitting of average weight loss trends had caused a 49.2% reduction of the within subjects variance from 10.503 to 5.339 (Table 3). The accompanying regression equation was the following:

BMI-change' = 10.097 + 1.035 *year* – 2.909 *year*^{2} – 0.377 *period* + 2.212 *period*year*^{2}

Table 3 Fixed and random predictors (standard errors) of weight change

Fixed effects	**Estimate + (S.E.)**			
	Model 1[†]	Model 2[‡]	Model 3[§]	Model 4[‖]
Intercept	8.106 (0.280)*	10.097 (0.284)*	10.368 (0.294)*	10.380
Year		1.035 (0.240)*	1.036 (0.240)*	1.054 (0.239)*
Year²		-2.909 (0.231)*	-2.906 (0.231)*	-2.888 (0.229)*
Period		-0.377 (0.303)	-0.379 (0.303)	-0.410 (0.301)
Period*Year²		2.212 (0.312)*	2.210 (0.312)*	2.185 (0.310)*
Baseline BMI			0.092 (0.046)*	0.087 (0.046)
Gender			-1.728 (0.739)*	-1.698 (0.744)*
Educational level			-0.545 (0.208)*	-0.634 (0.215)*
Egoism				-0.036 (0.057)
Egoism*Period				-0.130 (0.034)*
Random effects	**Variance**			
Between subjects	11.630 (1.431)	11.493 (1.337)	10.399 (1.219)	10.339 (1.212)
Within subjects	10.503 (0.434)	5.339 (0.221)	5.341 (0.221)	5.274 (0.218)
Goodness of fit	7312.242	6509.583	6494.250	6478.404

For all models: 1337 BMI-assessments, 168 subjects; all variables were centered with the exception of the nominal variables period and gender

*p<0.05

[†]Model 1: Estimation of variance at the between and within subject level

[‡]Model 2: Prediction of the time course

[§]Model 3: Demographic and personality variables were added: only the significant variables were included

[‖]Model 4: Personality*period interactions were added to the model to test whether personality was a better predictor of weight change in the period long-term after surgery: only the significant interactions were included

Because the variable 'year' was centered (the mean year value was 1.4609), the value 'year-1.4609' must be filled out for year to fit this regression equation to the data. Both the observed and estimated BMI change values of this equation are plotted in Figure 1. The resulting equation

gives an adequate reflection of the progressive weight loss till about 18 months after surgery and the stabilization thereafter.

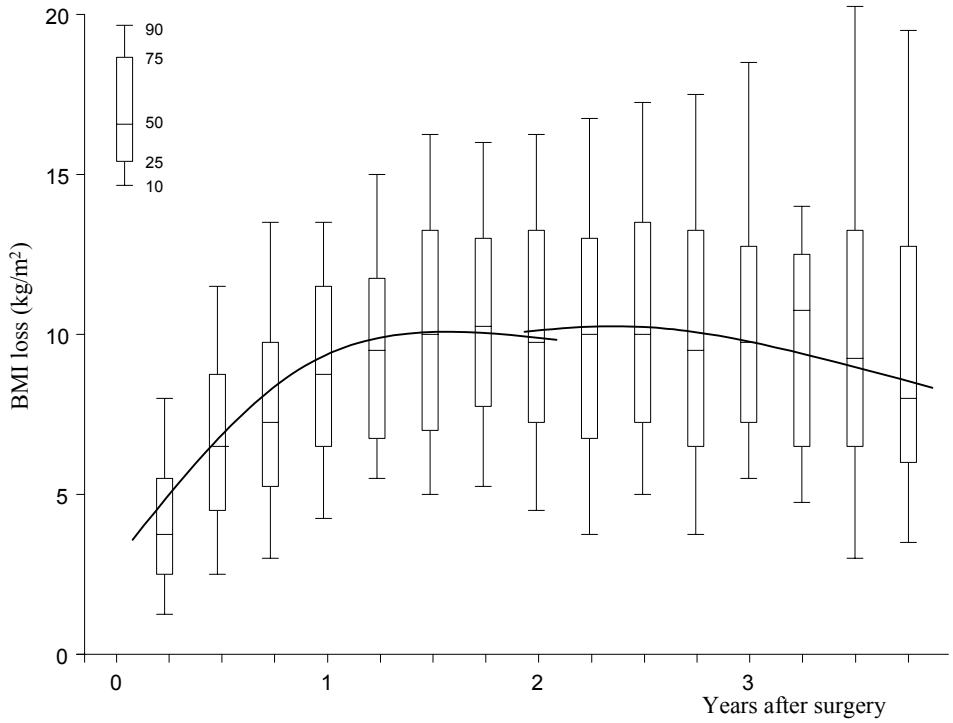

Figure 1 Observed and predicted weight loss (BMI). The boxplots show scores at percentiles 10, 25, 50, 75, and 90, respectively. The curves reflect the estimated weight loss according to model 2

Demographic and personality factors (model 3)

To examine whether demographic or personality factors predict the course of weight loss, the following subject variables were added to the model: 'baseline BMI', 'gender' (0=female; 1=male), 'age', and 'educational level'. Furthermore, in separate analyses the personality variables 'neuroticism', 'social anxiety', 'rigidity', 'hostility', 'egoism', 'dominance', and 'self-esteem' were added to the prediction model with the demographic variables. 'Baseline BMI', 'gender', and 'educational level', but none of the personality variables, were significant predictors of weight loss (Table 3). The reduction in the between subjects variance was from 11.493 to 10.399. This is a reduction of 9.5%. Thus, by addition of 'baseline BMI, 'gender', and

'educational level' the amount of explained variance of individual differences in weight loss was improved with 9.5%. A higher baseline BMI, being female, and a lower educational level were associated with a larger weight loss. Patients with a baseline BMI of about 50 (+1SD) lost on average 1 BMI point more weight than patients with a starting BMI of about 40 (-1SD). Women lost on average 1.7 BMI points more weight than men. Patients with only primary education or lower secondary education lost 1.4 BMI points more weight than patients with higher secondary or tertiary education. In terms of effects sizes, taking the median sd of 4.4 kg/m^2 BMI (Table 1) as a criterion, differences of 1.7, 1.4, and 1 BMI correspond with effect sizes of 0.38, 0.32, and 0.23, respectively. These effects sizes reflect a small difference.

Short-term and long-term prediction by personality (model 4)

To examine our hypothesis that personality becomes a predictor of weight loss when the length of the postoperative follow-up increases and weight stabilizes (after 2 years postoperatively), interactions of personality variables with 'period' (the first and second versus the third and fourth postoperative year) were added to the model. This was done in separate analyses for the personality variables. Five out of seven personality variables did not show a significant interaction with period. Without Bonferroni correction for multiple tests, 'dominance' (estimate = 0.059, s.e. = 0.027) showed a significant interaction with period reflecting that persons with higher preoperative dominance scores tended to lose less weight in the long-term interval. 'Egoism' (estimate = -0.130, s.e.= 0.034) remained significant after Bonferroni correction (Table 3: model 4). In the first period after surgery weight loss was about equal for persons low and high at egoism, but the amount of estimated weight loss in the third and fourth year after surgery differed about 1.6 BMI points for persons low and high at egoism. Less egoism was associated with a larger weight loss in the later period after surgery. The effect size of this difference was 0.36, thus small. The reduction of between subjects variance from 10.399 to 10.339 showed that 'egoism' explained a small amount of 0.6% additional variance of the individual differences in weight loss.

DISCUSSION

Although there is little doubt that bariatric surgery is an effective treatment for severe obesity, there is variability in weight outcome that might have to do with personality characteristics. The main finding of our study is that none of the personality variables predicted short-term weight loss, while six out of seven personality variables did not predict long-term weight outcome. Before discussing the main results of this article, we reflect on the comparison of personality variables of morbidly obese individuals with the norm.

Although no deviant personality profile has been implicated for obese individuals [16,24,25], lack of self-confidence, neuroticism, and depression [13,26-28] have been reported in obese

populations. We found small deviations on the personality variables 'neuroticism', 'social anxiety', 'egoism', and 'self-esteem', which are mainly suggested to be the result of the obese state, as studies have shown that preoperative depression, anxiety, and low self-esteem virtually disappear after surgical treatment for morbid obesity [28-30]. Overall, our data suggest that personality does not meaningfully deviate from the norm.

Our data showed a characteristic pattern of weight loss after surgery. At a group level, patients prospectively lost a significant amount of weight up to 18 months after surgery. Thereafter weight stabilized around an average weight loss of ten BMI points. Thus, in line with previous studies [31,32], our prospective results suggest that LAGB is a long-term solution to morbid obesity with regard to weight outcome.

Being female, a higher baseline weight, and a lower educational level were significantly associated with more weight loss in our study. Our gender result is in accordance with previous studies showing that male sex was a significant failure predictor after bariatric surgery [33,34]. Our finding that a higher baseline weight is associated with more absolute weight loss is in line with a study showing that the level of BMI reduction after LAGB was higher among super-obese patients (BMI>50), although they had a lower success rate in terms of percentage excess weight loss [33]. We found that patients with a lower educational level had more weight loss after LAGB. As far as we know, there are no studies examining the impact of educational level on the outcome after bariatric surgery. Effect analyses showed that the extent to which gender, educational level, and baseline weight predicted weight loss must be considered small.

Our study of personality as a predictor of weight loss differs from other studies in this field by inclusion of a large patient group with both short and long follow-up duration. Studies on personality variables as predictors for short-term surgical success showed mixed results. While two studies with small sample sizes observed that personality variables were significant predictors of short-term weight loss [13,14], two other studies with larger sample sizes [8,11], and previous results from our research group [35] showed no relationship between preoperative personality characteristics and short-term weight outcome. Our current study in a large short-term sample confirms that preoperative personality is definitely not a predictor of weight outcome on the short-term after surgery.

An incidental study on the long-term surgical success found that the preoperative personality variable 'hypochondriasis', in combination with age, was a significant predictor of weight outcome [16]. Preliminary long-term results in a small sample from our research group, examining only the personality traits neuroticism, social anxiety and hostility, suggested that personality may become important in consolidating weight loss [35]. Our hypothesis that especially 'neuroticism', 'social anxiety', 'dominance', and 'hostility' would be important in consolidating weight loss after bariatric surgery, was not confirmed by our current analyses in a relatively large long-term sample. Only 'egoism' showed an association with less weight loss in the long-term postoperative period. However, although the finding was significant after Bonferroni correction, the magnitude of the effect was small and the amount of additional explained variance was low. Moreover, the finding was unexpected and, thus, needs

confirmation in other studies. The observation that six of seven personality variables did not predict weight loss suggests that personality is not an important predictor of long-term weight outcome.

Our study has some restrictions. The population was restricted to patients undergoing LAGB. Because a similar preoperative condition and weight outcome have been reported in studies examining other bariatric surgical procedures [36], we expect similar results in patients undergoing other types of surgery. Our design was restricted to the preoperative measurement of personality characteristics. By definition, personality variables are rather stable characteristics, and even when personality variables interact with life-events, such as surgically induced weight loss, the relative position of individuals to each other at a personality variable will not change to a large extent. However, our study did not answer the question whether possible pre- to postoperative changes in personality predict weight loss and could not confirm a previous finding that an increase in hostility after surgery predicted a poor weight outcome [15]. Finally, our study did not examine the predictive value of psychopathology. Personality disorders, major depression, or substance abuse are examples of pathological individual difference variables that are related to, but not similar to personality. The predictive value of our study does not generalize beyond "normal" individual differences in personality characteristics.

In conclusion, males and persons with a higher education lose on average less weight. Since effects are small, these findings do not have clinical implications. None of the personality variables predicted short-term weight outcome, and only one variable showed a small and unexpected association with long-term weight outcome that needs confirmation. This suggests that personality assessment as intake psychological screening is of little use for the prediction of a poor or successful weight outcome after bariatric surgery.

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Chapter 4

Childhood sexual abuse is not associated with a poor outcome after surgery for morbid obesity

Larsen, J.K., Geenen, R. Childhood sexual abuse is not associated with a poor outcome after surgery for morbid obesity (2004). Manuscript submitted for publication.

ABSTRACT

Objective: To examine whether a reported history of childhood sexual abuse is associated with weight, health, and depression after Laparoscopic Adjustable Gastric Banding for severe obesity.
Research Methods and Procedures: 157 patients (144 female, 13 male) filled out questionnaires on average 34 months after surgery (range 8-68 months).
Results: Twenty-three percent of the participants, all women, reported a history of childhood sexual abuse. There were no differences between patients with and without a history of childhood sexual abuse on weight and physical health, but sexual abuse and depression were associated.
Discussion: Although a reported history of childhood sexual abuse does not appear to impact on weight outcome after bariatric surgery, some patients may need additional psychological treatment for their mental health problems.

INTRODUCTION

Morbid obesity, defined as a body mass index (BMI) of more than 40 kg/m^2, is a life-threatening condition with prevalent co-morbidity such as diabetes mellitus, hyperlipidaemia, hypertension [1], and severely reduced quality of life [2]. Surgery is considered the treatment of choice for morbid obesity [3]. Although surgery is a relatively effective means of weight reduction in patients with morbid obesity, some patients do not achieve a successful weight outcome.

A history of childhood sexual abuse (CSA) has been related to increased body weight and obesity in adulthood [4] and may also threaten a successful weight outcome after bariatric surgery. Childhood sexual abuse has been associated with increased psychiatric comorbidity [5], and pathological cognitions before bariatric surgery [6], which may influence treatment outcome. Moreover, obesity may play an adaptive function as a defence against sexual proposals for some sexually abused women [7]. Individuals with a history of childhood sexual abuse may become uncomfortable with their body as their appearance becomes more attractive to the opposite sex through weight loss, and weight loss may trigger memories as individuals return to a weight at which they were abused.

An incidental study showed that a history of sexual abuse before the age of nineteen was related to less weight loss after a 26-week weight management program that combined behavior therapy and a very-low-calorie diet [8]. The purpose of our study was to examine whether a reported history of childhood sexual abuse is associated with weight, quality of life, and depression after Laparoscopic Adjustable Gastric Banding for severe obesity.

RESEARCH METHODS AND PROCEDURES

Participants and procedure

During the year 2001, 196 consecutive patients after Laparoscopic Adjustable Gastric Banding (LAGB) were asked to participate in a cross-sectional study on the quality of life after surgery: 179 patients agreed and received questionnaires of which 160 were returned. The questionnaires of three patients were incomplete, leaving 157 evaluable postoperative patients (144 female, 13 male): mean age 40.0 ± 7.9 (range 23 – 61) years; mean preoperative BMI 45.5 ± 5.7 (range 36-72). All patients were accepted for a LAGB procedure using the Lap-Band® system (INAMED Health) following screening by a team consisting of a bariatric surgeon, an internist, a psychologist, and a dietician. Surgical indications were a BMI $\geq$ 40 or a BMI between 35 and 40 with comorbidity. The operation was performed according to the techniques described by Belachew and coworkers [9].

Measures

To measure quality of life, two summary components were computed from eight subscales of the RAND-36 [10]: physical health and mental health [11]. To measure depression, the Dutch version of the Beck Depression Inventory (BDI) [12] was used. Self-reported childhood sexual abuse (CSA) was assessed by asking patients whether they had ever been the victim of sexual abuse during childhood (yes/no).

Preoperative weight and height used in this study were assessed in the hospital. We used self-reported weight data to assess postoperative weight. The correlation between the postoperative objective weight measurement, available for 123 out of 157 patients, and the self-reported weight data was extremely high ($r=0.98$, $p<0.001$).

Statistics

Univariate analyses of variance were used to examine the differences in weight, quality of life, and depression between individuals with and without a reported history of CSA, with past psychological treatment as an additional subgroup factor. Because none of the male participants reported a history of CSA, analyses were also performed on female participants only. All analyses were conducted with SPSS 11.5 for Windows.

RESULTS

Thirty-six (22.9%) participants reported a history of CSA, 119 (75.8%) participants reported no history of CSA, and 2 (1.3%) participants (1 male and 1 female) did not answer this question. Characteristics of participants with and without a reported history of childhood sexual abuse are shown in Table 1. The groups did not differ with respect to postoperative period, age, educational level, or preoperative BMI ($p>0.10$), but the sexual abused group encompassed relatively many persons with past psychological treatment (Table 1).

Table 1 Characteristics of participants with and without a reported history of childhood sexual abuse (CSA)

	with CSA (n=36)		without CSA (n=119)	
	M	SD	M	SD
Postoperative period (in months)	32.3	14.2	34.4	15.5
Age	39.1	7.0	40.3	8.2
Educational level*	3.1	1.5	3.2	1.3
Preoperative BMI (kg/m^2)	45.1	5.7	45.7	5.7
Women : men†	36 : 0		107 : 12	
Past psychological treatment (%)‡	75%		42.9%	

*Education was assessed on a 7-point scale: a level of '1' reflects primary education; '2' lower secondary education; '3', '4', and '5' secondary education; and '6' and '7' tertiary education

†χ^2=3.9, p=0.047

‡χ^2=11.4, p=0.001

Table 2 shows the outcome after surgery for the groups. There were no differences between patients with and without a reported history of CSA on weight and quality of life outcome (p>.10), but more depression was observed in individuals with than without a history of childhood sexual abuse (F=5.7, p=0.02). Similarly, weight and perceived health did not differ for the groups with and without past psychological treatment (all p's > 0.10), but individuals with a history of psychological treatment were more depressed (F=4.4, p=0.04), an effect that was strictly due to patients without abuse that received no psychological treatment. There was a marginally significant interaction on mental health between reported CSA and past psychological treatment (F=3.6, p=0.06), reflecting that for individuals without a history of CSA mental health was lower for those who did than for those who did not receive past psychological treatment. Results remained the same in terms of significance when only female participants were examined.

Table 2 Weight, health, and depression outcomes after surgery of participants with and without a reported history of childhood sexual abuse and with or without past psychological treatment (means and SD)

	With CSA						Without CSA					
	Treatment			No treatment			Treatment			No treatment		
	n	M	SD	n	M	SD	n	M	SD	n	M	SD
BMI (kg/m^2)	27	34.9	6.9	9	32.7	6.6	51	35.1	6.9	68	36.0	6.9
BMI loss (kg/m^2)	27	10.11	5.9	9	12.7	7.9	51	9.4	5.4	67	10.8	5.1
Physical health	26	45.8	10.7	8	44.8	15.0	50	45.9	11.5	63	48.2	10.8
Mental health	26	44.2	10.2	8	42.7	13.6	50	41.4	15.1	63	50.1	9.4
Depression	27	13.6	9.8	9	12.8	7.9	50	12.3	8.6	68	6.5	5.0

Larger scores reflect a higher weight, more weight loss, a better physical and mental health, and more depression, respectively

DISCUSSION

The prevalence of a reported history of childhood sexual abuse of approximately 23% in our study of morbidly obese patients after surgery was higher than the reported prevalence of 10% in a normal population [13]. This conforms previous studies [4], suggesting that the experience of childhood sexual abuse is a serious concern in obese populations.

Our hypothesis that a poorer outcome would be associated with sexual abuse was not confirmed for weight loss and physical health. Neither a history of sexual abuse nor psychological problems, as reflected in past psychological treatment, were related to weight outcome. This seems to be inconsistent with the idea that psychological problems as such predict the weight outcome after surgery. Perhaps the uniform pathological weight and eating problems that led to the morbid obese state overruled the impact of psychological factors that have been shown predictive of weight outcome in less severe obesity. However, since most of these individuals received psychological treatment it is also possible that psychological treatment prevented a worse weight outcome.

In agreement with our hypothesis and previous findings in a large-scale community sample [14], childhood sexual abuse and depression were associated. A closer look at our results shows that actually the group without a history of both sexual abuse and psychological treatment showed a better psychological health than the other three groups. This suggests that a history of childhood sexual abuse or past psychological treatment is still associated with reduced mental health after surgery for severe obesity. These existing mental health problems might need additional psychological treatment after bariatric surgery.

Our study design was limited to the retrospective measurement of sexual abuse. Prospective studies are needed to be able to conclude that childhood sexual abuse causes obesity. Although retrospective reports are attenuated by failure to recall abuse and false recall of abuse, the current experience of past abuse is the reality that may influence momentary well-being and functioning. Our study did neither assess the severity and nature of the sexual abuse nor the nature of the relationship between the abuser and the child, which have been shown to be determinants of psychopathology [6].

In conclusion, the prevalence of reported childhood sexual abuse is relatively high in morbidly obese individuals who have undergone LAGB. Although the report of childhood sexual abuse does not appear to impact on the weight and physical health outcome after bariatric surgery, some patients may need additional psychological treatment for their mental health problems.

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Chapter 5

Binge eating and its relationship with outcome after Laparoscopic Adjustable Gastric Banding

Larsen, J.K., Van Ramshorst, R., Geenen, R., Brand, N., Stroebe, W., & Van Doornen, L.J.P (2004). Manuscript accepted for publication.

ABSTRACT

Background: The aim of this cross-sectional study was to examine short and long-term eating behavior after laparoscopic adjustable gastric banding (LAGB) and the relationship of binge eating with weight and quality of life outcome.
Methods: 250 patients (221 female, 29 male, mean age 39.6 years, age range 22-61) filled out questionnaires to evaluate quality of life and eating behavior: 93 patients before LAGB, 48 with a follow-up duration of 8 through 24 months and 109 patients 25 through 68 months after LAGB.
Results: Compared to patients before surgery, patients after surgery, in both follow-up groups, reported less binge eating, fat intake, external eating, and more restrained eating and eating self-efficacy. After surgery, about one-third of the patients showed binge eating problems, which were associated with a worse postoperative outcome.
Conclusion: Our results suggest that eating behavior improves both short and long-term after surgery for severe obesity. Although LAGB could be a long-term solution to part of preoperatively eating disordered patients, the identification and treatment of postoperative binge eating appear critical to promote successful outcome after bariatric surgery.

INTRODUCTION

Although surgery is the most effective means of weight reduction in patients with morbid obesity, a number of patients do not achieve a successful outcome [1]. Restriction of intake of solid foods is the main mechanism for weight loss following Laparoscopic Adjustable Gastric Banding. Binge eating, a breakdown in the control of eating, is an important feature in a subgroup of obese individuals and has been associated with a range of characteristics that may affect bariatric surgery treatment outcome, including more frequent psychopathology [2, 3], increased fat intake [4] and liquid meal consumption,[5] and disturbed eating attitudes [5-7].

Studies evaluated changes in weight, quality of life, and comorbidity after bariatric surgery, but the role of binge eating behavior and related eating characteristics have been relatively neglected. Isolated findings suggest a decrease in binge eating [8], and healthier eating attitudes [8, 9] at *short-term* follow-up. Just after the operation, nearly all patients lose a great deal of weight, experience improved psychological well-being and are praised and encouraged, which is important to maintain health behaviors. About two years postoperatively, weight stabilizes or even increases, and the amount of psychosocial reinforcement decreases, which may complicate the maintenance of healthy eating patterns at the long-term after surgery [10]. An incidental study on *long-term* eating behavior observed a considerable amount of binge eating loss of control behavior at follow-up after Gastric Bypass Surgery [11].

Although binge eating is assumed to affect weight outcome, binge eating and related eating patterns up to one year after surgery were not associated with the amount of weight loss after gastric banding [8]. However, a recent study on *long-term* eating behavior observed that binge eating loss of control behavior more than two years after Gastric Bypass Surgery was associated with a poorer weight outcome [11].

The first aim of our cross-sectional study was to examine the short and long-term eating behavior after LAGB. For that aim, binge eating and associated eating characteristics of three patient groups were compared: one preoperative group and two postoperative groups with short-term and long-term postoperative duration, respectively. The second aim of our study was to examine whether postoperative binge eating was associated with weight and quality of life outcome short and long-term after LAGB.

MATERIALS AND METHODS

Subjects and Procedure

The study-design was a cross-sectional comparison of a group of preoperative morbid obese patients, and two postoperative groups of patients after LAGB with distinct postoperative follow-up. The groups of patients in this study were similar to those of a study of our research group on quality of life [12]. Ninety-three preoperative patients (response rate 75.6%) and 160 postoperative patients (response rate 81.6%) returned questionnaires on quality of life and eating behavior. The questionnaires of three postoperative patients were incomplete, leaving 157 evaluable postoperative patients. To examine short and long-term eating behavior, these patients were divided into a group with a short-term (n=48) duration from 8 months through 2 years after surgery, and a group with a relatively long-term (n=109) postoperative duration more than 2 years after surgery. Patient characteristics are shown in Table 1. All patients were accepted for a LAGB procedure using the Lap-Band® system (INAMED Health, Santa Barbara, CA, USA) following screening by a team consisting of a bariatric surgeon, an internist, a psychologist, and a dietician. Surgical indications were a BMI ≥ 40 or a BMI between 35 and 40 with serious comorbidity. In the case of obesity-related psychopathology, acceptance of psychological treatment was a condition for acceptance for surgery. The operation was performed according to the techniques described by Belachew and coworkers [13].

Table 1 Characteristics of morbid obese patients before, short-term after, and long-term after LAGB

	Pre n=93	Post ≤ 2 yrs. n=48	Post > 2 yrs. n=109
Postoperative period (in months)	-	16 (8-24)	42 (25-68)
Women : men	77 : 16	42 : 6	102 : 7
Age	39 (22-59)	40 (24-61)	41 (22-55)
Educational level*	3.1 (1-7)	3.3 (1-7)	3.1 (1-7)
Preoperative BMI†	46.5 (37-67)	45.5 (37-72)	45.4 (36-63)

Means (and ranges)

*An educational level of '1' reflects primary education; '2' lower secondary education; '3', '4', and '5' secondary education; and '6' and '7' tertiary education

†BMI: weight (kg) / length^2 (m^2)

Weight Assessment

From all patients, objective information of the preoperative weight was available (by means of 'objective' we refer to the weight measured at the doctor's office and recorded in the medical

chart). Objective information of the postoperative weight three months before or after the completion of the questionnaires was available for 123 of the 157 patients. Self-reported postoperative weight reports were available for 153 of the 157 patients. We used self-reported weight data to assess postoperative weight. For the 4 patients whose self-reported weight was not available, objective weight assessments were used instead. The correlation between the postoperative objective weight measurements and self-reported weight was extremely high ($r=0.98$, $p<0.001$).

Instruments

To measure binge eating behavior, the Binge Eating Scale (BES) [14] was translated into Dutch and administered. The BES is a 16-item self-report questionnaire designed to assess the severity of binge eating among individuals with obesity. It examines loss of control over eating and associated binge features, such as eating more rapidly than normal, eating until feeling uncomfortable full, eating large amounts of food when not feeling physically hungry, and eating alone because of being embarrassed by how much one is eating. The reliability of the Dutch BES (D-BES) as assessed in a sample of 250 patients before and after surgery for severe obesity proved to be satisfactory (Cronbach's α was .87; factor loadings of all items > .3). As in previous studies using the BES, patients scoring 18 or higher were included in the binge eating group, whereas patients scoring lower than 18 were included in the non-binge eating group [15, 16]. According to the DSM-IV criteria a binge eating episode is characterized by the loss of control over eating as well as the consumption of a large amount of food within a short amount of time. The D-BES assesses the loss of control aspect of episodes of binge eating, but not the objective consumption of a large amount of food. To determine some information on congruent validity of the D-BES, in a pilot study of postoperative patients of our research group (n=39) we administered the 12th edition of the Dutch Eating Disorder Examination (D-EDE) [17], an interview to assess the presence of episodes of binge eating. According to the DSM-IV criteria, the clinical diagnosis Binge Eating Disorder (BED) is present when the binge eating occurs, on average, at least 2 days a week for 6 months. As suggested by Hsu et al. [5], we included individuals in the binge eating disorder group who had a weekly average of at least one binge within the past 3 months of the D-EDE interview. Comparison between the D-BES (cut-off score of 17) and the diagnosis BED yielded a kappa of .59, reflecting a moderate agreement.

To measure eating attitudes, the Dutch Eating Behavior Questionnaire (DEBQ) was used [18]. The DEBQ has been found to be a valid and reliable instrument for evaluating eating behavior in normal subjects, women with eating disorders, and obese patients [19]. The DEBQ consists of 3 scales: 'emotional, external and restrained eating'. The scales have a high internal consistency (Cronbach α's varied from .82 to .95 within the obese Dutch population).

Dietary fat intake was assessed with the Dutch Fat Consumption Questionnaire (FCQ), which is a valid and reliable instrument to rank individuals according to their dietary fat intake (Cronbach's α is .71) [20]. A higher score reflects a higher level of fat intake.

The perception of satiety after eating was assessed by a self-developed Satiety-Questionnaire (SatQ) consisting of 3 items on a visual analogue scale (how full do you generally feel after eating; how often do you experience hunger after eating; how often do you have the feeling that your stomach is full after eating). The psychometric characteristics of the SatQ proved to be satisfactory. In the present study, Cronbach's α was .77 .

Eating behavior self-efficacy was assessed by a subscale of the Obesity Psychosocial State Questionnaire (OPSQ: Larsen & Geenen, internal report, Utrecht University, Department of Health Psychology 2000). The eating behavior self-efficacy subscale consists of 3 items (to have control over your eating habits; to master your eating behavior; to feel helpless about your eating behavior) with high reliability (Cronbach's α was .81).

To measure quality of life, two summary components were computed, aggregating scores from eight subscales of the RAND-36 [21] into two summary scores: Physical Component Summary (PCS or physical health) and Mental Component Summary (MCS or mental health) [22]. Raw scale scores of the RAND-36 were transformed into Z-scores, using Dutch means and standard deviations, which were multiplied with the US factor score coefficients and summed over all eight subscales (US factor scores were used to facilitate international comparisons). Finally, t-scores were calculated by multiplying the obtained PCS and MCS sums by 10 and adding 50 to the product to obtain transformed summary scores that are normally distributed with a mean of 50 and a standard deviation of 10 [22].

Statistical analyses

The skewness of the distributions of all variables was between –0.59 (physical health) and 0.54 (change of BMI), which was sufficiently normal to allow parametric statistics. It was tested whether we needed to control for the potential covariates age, gender, preoperative BMI, and education in examining the relationship of binge eating with outcome. As no significant differences between patients who did and did not manifest binge eating were found for these variables short and long-term after surgery respectively, adjusting for them was unnecessary.

Chi-square analysis was used to compare the percentage patients with binge eating (BES-score > 17) in preoperative, short-term postoperative, and long-term postoperative subgroups. One-way analysis of variance, with post-hoc Bonferroni comparison in case of a significant group effect, was used to compare eating characteristics of the different groups. To examine differences between patients with and without binge eating in weight and quality of life outcome after bariatric surgery, analyses of variance was used with postoperative duration (short versus long-term) as an additional subgroup factor. To examine the magnitude of significant results, effect sizes were computed: the difference between two means divided by the pooled standard deviations. Effect sizes of 0.2, 0.5, and 0.8 can be considered small, medium, and large, respectively [23]**.** Differences in samples sizes across analyses result from incidental missing values on the included variables. All analyses were conducted with SPSS 11.5 for Windows.

RESULTS

Eating behavior before and after surgery

Based on a BES cutoff-score of 17, 55.9% of the patients before surgery, 31.9% short-term after surgery, and 37.4% long-term after surgery manifested binge eating (χ^2=10.03, p<0.01). Posthoc testing showed that the percentage patients with binge eating differed between the preoperative and the two postoperative groups (p<0.01), but not between the two postoperative groups (p=0.51). Several associated eating characteristics were significantly better after than before surgery. Patients at short and long-term interval following surgery reported less fat intake, external eating, and more restrained eating and eating self-efficacy than patients before surgery (Table 2, p<0.01). At short-term interval patients also experienced less emotional eating (p=0.02) and more satiety (p=0.01) than patients before surgery. There were no significant differences on eating characteristics between the short and long-term postoperative groups.

Binge eating and outcome

Postoperative patients with binge eating showed more fat intake (t=-2.5, p<0.05), external eating (t=-7.8, p<0.001), and emotional eating (t=-8.1, p<0.001), and less eating behavior self-efficacy (t=10.1, p<0.001) than patients without binge eating. Figure 1 shows the mean weight and quality of life outcome of patients with and without binge eating for the short-term and long-term postoperative subgroups. Postoperative patients with binge eating had a lower BMI loss (F=13.32, p<0.001) and a poorer mental health (F=13.02, p<0.001) than patients without binge eating. The magnitude of the difference was medium to large (d=0.77 for BMI loss and d=0.79 for mental health). Physical health showed no significant difference for patients with and without binge eating (F=0.05, p=0.83). The outcomes did not differ for the short-term and long-term groups (all p's > 0.09). There were no significant interactions (all p's > 0.23). This reflects that the magnitude of the difference between the outcomes of the binge-eating and non-binge subgroups was about similar in the groups short-term and long-term after surgery.

Table 2 Eating characteristics in the preoperative cohort and the two postoperative cohorts of patients

	Pre			Post ≤ 2 yrs.			Post > 2 yrs.					
	n	Mean	SD	n	Mean	SD	n	Mean	SD			p
Emotional eating (NVE)	91	3.12	0.92	45	2.69	0.91	102	3.01	0.80	F =	4.22	0.02[†]
External eating (NVE)	93	3.08	0.58	48	2.64	0.55	108	2.73	0.67	F =	10.72	0.00[†‡]
Restrained eating (NVE)	92	2.84	0.71	48	3.35	0.73	108	3.13	0.70	F =	7.20	0.00[†‡]
Fat intake (FCQ) [*]	89	30.07	7.28	46	26.17	5.15	106	26.91	5.54	Chi^2 =	8.65	0.00[†‡]
Eating behavior self-efficacy (OPSQ)	93	2.45	0.83	48	3.51	1.02	109	3.21	1.00	F =	25.53	0.00[†‡]
Satiety (SatQ) [*]	84	6.32	2.19	46	7.70	1.98	108	6.97	2.59	Chi^2 =	5.29	0.01[†]

[*] Responses to the FCQ and SatQ did not show homogeneity of variances between the groups; Kruskal-Wallis nonparametric tests were used.

[†] Significant differences between pre- and post ≤ 2 yrs. groups

[‡] Significant differences between pre- and post > 2 yrs. groups

There were no significant differences between the two postoperative groups

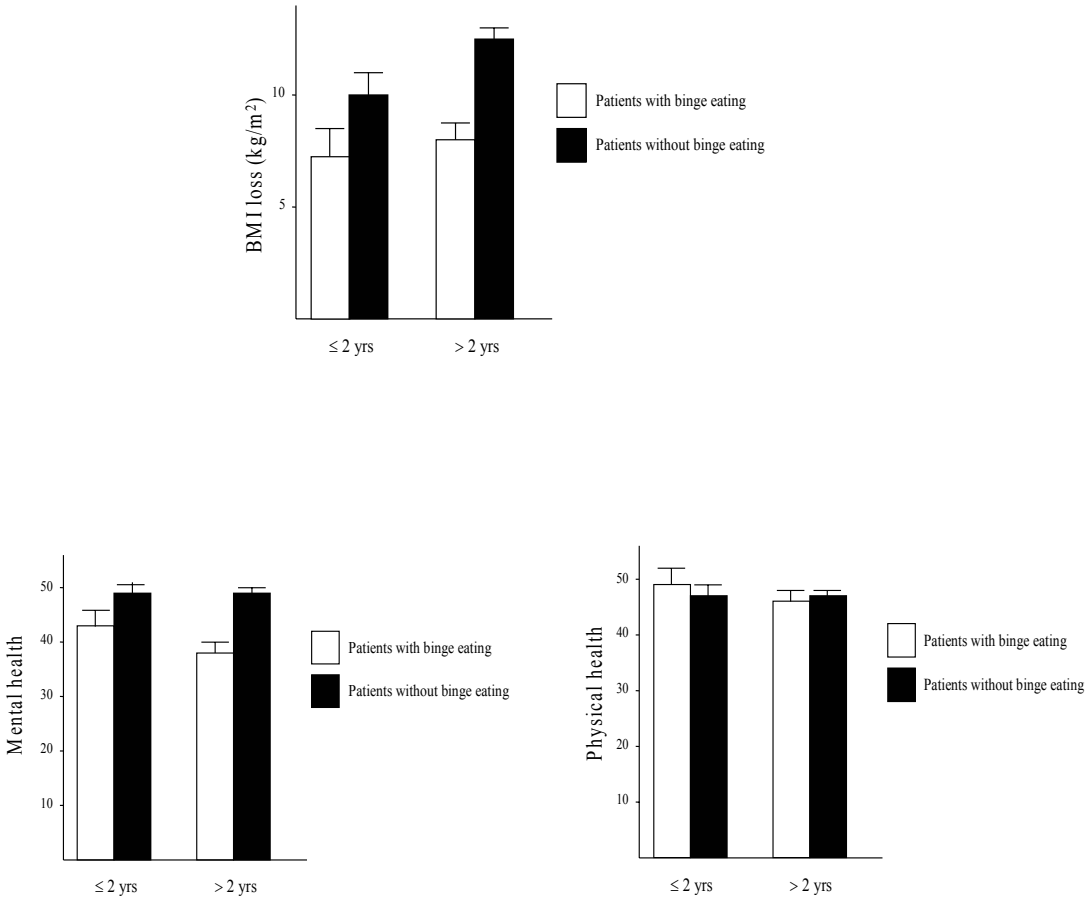

Figure 1 Means ± s.e.m. of weight loss (a), mental health (b), and physical health (c) of patients with binge eating (BES>17) and without binge eating (BES≤17) by postoperative subgroups. The scales at which mental health and physical health are expressed have a mean of 50 and a standard deviation of 10 in the general population

DISCUSSION

Our study analyzed eating behavior of a relatively large patient group with both short and long follow-up duration after LAGB. The main finding is that, although patients short and long-term after surgery show less binge eating and more healthy eating behavior than patients before surgery, binge eating is a common feature in postoperative patients that is associated with reduced mental health and weight outcome short-term and long-term after LAGB.

Our finding of less binge eating and more healthy eating attitudes short-term after surgery than before surgery is in agreement with previous studies on short-term eating behavior [8, 9]. Our study also found a lower prevalence of binge eating and more healthy eating behavior at long-term after than before surgery. No significant differences emerged between the two postoperative groups, suggesting that LAGB could be a long-term solution to a substantial amount of preoperatively eating disordered patients.

In our study, in both short-term and long-term follow-up groups after LAGB, postoperative patients with binge eating problems had a less positive weight outcome than postoperative patients without binge eating problems. This is in agreement with an incidental study reporting an association between postoperative binge eating and weight outcome long-term after Gastric Bypass Surgery [11], but differs from another study finding no significant correlations between binge eating behavior and weight outcome at short-term follow-up after gastric banding [8]. Our short-term group had a mean follow-up duration of 16 months, while the earlier study[8] had a follow-up duration of up to 12 months. The valid analysis of correlations is only possible in heterogeneous populations. It is possible that large changes in eating behavior and weight up to one year after surgery have hidden the relationship between binge eating and weight in the earlier study.

Preoperative binge eating is not associated with preoperative weight[5], as was the case in our preoperative cohort of patients (data not shown), and often fails to predict postoperative weight outcome [19, 24-26]. This suggests that binge eating behavior before surgery cannot be used to preoperatively monitor those patients at risk for a worse outcome after bariatric surgery. However, because postoperative binge eating is associated with weight and mental health outcome, it is advised to monitor binge eating at early stage postoperatively to prevent relapse and, if necessary, to give additional postoperative psychological treatment of binge eating. Although psychological treatment significantly reduces binge eating problems and improves mental health, it has only minimal prolonged effects on weight loss [27]. It, therefore, cannot be used as a substitution to bariatric surgery.

Our study has some restrictions. The population was restricted to patients undergoing LAGB, which limits generalization to patients undergoing other bariatric procedures. Our design was restricted to a cross-sectional comparison, while longitudinal designs are better able to examine causal and reciprocal relationships between binge eating and weight outcome, and to make generalizations with regard to possible mediating variables. For instance, lower weight loss may

be a consequence of binge eating behavior after surgery, but binge eating may also be a consequence of the negative feelings associated with an unsatisfying weight outcome. Finally, we used the BES questionnaire to assess binge eating. This questionnaire assesses the loss of control aspect of binge eating behavior and affects and cognitions during a binge, but not the objective consumption of a large amount of food within a short amount of time. It is suggested that in our sample of patients with morbid obesity the "large amount of food" aspect is present in nearly all the patients reporting binge eating, otherwise they wouldn't have been morbidly obese in the first place. This suggestion is supported by the moderate agreement between the D-BES and the D-EDE found in a pilot study of postoperative patients after LAGB of our research group, as described in the methods.

In conclusion, this cross-sectional study suggests that eating behavior improves both short-term and long-term after surgery for severe obesity. Although LAGB could be a long-term solution to part of preoperatively eating disordered patients, the identification and treatment of postoperative binge eating appear critical to promote successful outcome after bariatric surgery.

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Chapter 6

Binge eating behavior and depression as predictors of postoperative binge eating behavior and weight change after surgery for morbid obesity

Larsen, J.K., Geenen, R., Van Ramshorst, B., Brand, N., Van Strien, T., Stroebe, W., Van Doornen, L.J.P. Binge eating behavior and depression as predictors of postoperative binge eating behavior and weight change after surgery for morbid obesity (2004). Manuscript in preparation.

ABSTRACT

Objective: Negative affect may increase the risk for onset of binge eating, because it provides comfort and distraction from adverse emotions. The aim of this study was to examine whether the combination of preoperative depression and binge eating predict the persistence of postoperative binge eating behavior and change of weight after Laparoscopic Adjustable Gastric Banding (LAGB) for severe obesity.
Methods: Eighty patients were followed in a prospective questionnaire study. Of 68 out of these 80 patients follow-up information from 1 year after surgery was known as yet.
Results: Significant improvements on weight outcome, binge eating behavior, and depression were found after LAGB. Weight outcome and postoperative binge eating behavior were not meaningfully predicted by preoperative binge eating, depression, or the combination of preoperative binge eating and depression. Postoperative binge eating at 6 months was associated with the amount of weight loss at 12 and 24 months after surgery.
Discussion: This study provides no reason to exclude specific subgroups of patients with binge eating behavior from the operation or to give fixed additional preoperative psychosocial care to subgroups of patients. It is advised to monitor binge eating at early stage postoperatively to prevent relapse and, if necessary, to give additional treatment of binge eating.

INTRODUCTION

Morbid obesity, defined as a body mass index (BMI) of more than 40 kg/m^2, is a life-threatening condition with prevalent co-morbidity such as diabetes mellitus, hyperlipidaemia, hypertension [1], and severely reduced quality of life [2]. Surgery is considered the treatment of choice for morbid obesity [3]. Although surgery is a relatively effective means of weight reduction in patients with morbid obesity, some patients do not achieve a successful weight outcome [4].

Restriction of eating is considered crucial to support weight loss after surgery for morbid obesity, specifically among types of surgery that induce weight loss exclusively by means of reduced caloric intake, instead of the malabsorption of food (i.e., bypassing the stomach and upper portions of the small intestine inhibits the absorption of some nutrients). Binge eating behavior, characterized by loss of control over eating, is quite prevalent among individuals before surgical treatment for severe obesity [5-7], and if it persists after surgery it may affect weight outcome [8, 9].

The two main explanatory theories for the etiology and maintenance of binge eating behavior focus on dieting and negative affect. According to the boundary model patients set themselves complex and strict dietary rules [10]. Violating these rules often results in a breakdown of control and binge eating. As people who binge increase their dietary efforts, the risk of binge eating will increase. Although dietary restraint may play a role in the *etiology* of binge eating, a cross-sectional study of our research group suggests that it is not important for the *maintenance* of binge eating behavior in morbidly obese individuals who have undergone bariatric surgery. A second theory posits that negative affect increases the risk for onset of binge eating, because it provides comfort and distraction from adverse emotions [11]. Binge behaviors result in shame, guilt, and other negative feelings which are escaped from through further binge eating, thus maintaining the vicious circle. This theory suggests that the combined influence of preoperative binge eating and depression predicts the persistence of postoperative binge eating behavior and related diminished weight loss.

Most studies on preoperative binge eating as predictor of weight outcome after bariatric surgery found that preoperative binge eating behavior [5, 6] and binge eating disorder [6, 12, 13] do not predict postoperative weight outcome, but two studies suggested less positive weight outcome for binge eaters [14, 15], and one study even found a tendency of a more positive weight outcome in patients with binge eating [16]. The role of depression in predicting weight outcome after bariatric surgery has hardly been explored. An incidental study suggests that patients with more depression before surgery had a better weight outcome [17], perhaps reflecting that patients with more problems before surgery were more motivated to lose weight. The purpose of our prospective study was to examine whether the combination of depression and binge eating predict the persistence of postoperative binge eating behavior and change of weight after Laparoscopic Adjustable Gastric Banding for severe obesity. Beforehand, the effects of LAGB on weight, binge eating, and depression were examined.

METHODS

Participants

From November 2000 until July 2003, 118 consecutive patients were subjected to a LAGB procedure in the St. Antonius Hospital in Nieuwegein, the Netherlands, using the Lap-Band® system (INAMED Health, Santa Barbara, CA, USA), following screening by a team consisting of a bariatric surgeon, an internist, a psychologist, and a dietician. Surgical indications were a BMI ≥ 40 or a BMI between 35 and 40 with serious comorbidity. In the case of obesity-related psychopathology, acceptance of psychological treatment was a condition for inclusion for surgery. The operation was performed according to the techniques as described by Belachew and coworkers. All patients were asked to participate in a prospective study on the quality of life. The 95 patients that agreed received a questionnaire booklet before the operation, of which 90 were returned, a total response rate of 76.3 %. Three patients were excluded because of severe psychopathology, leaving 87 evaluable patients (76 female; 11 male): mean age 39.3 ± 8.9 (range 22 - 59) years; mean preoperative BMI 46.9 ± 5.6 (range 36.2 – 60.1) kg/m^2; 6.9% of the patients had only primary education, 31.0% had lower secondary education, 47.1% higher secondary education, and 13.7 % tertiary education. These patients were re-measured at 6 months and 1 year after surgery. In January 2003, 80 out of 87 patients had returned questionnaire booklets at 6 months after surgery. Of the drop-outs, 4 patients said they were too tied up to fill out the questionnaire; 1 patient had severe complications and a re-operation; and 2 patients had altered telephone numbers and could not be contacted anymore. Of the 80 patients who returned the questionnaires at 6 months after surgery, 71 patients had a postoperative duration of at least 1 year at the time of manuscript preparation, and 68 out of these 71 patients had returned questionnaire booklets at 1 year.

Measures

To measure binge eating, the Binge Eating Scale (BES), a 16-item self-report questionnaire, was translated into Dutch and administered. It examines behavioral, affective, and cognitive aspects of binge eating. Principal component factor analysis with varimax rotations on 110 individuals before bariatric surgery, largely overlapping with the group of patients in this study, showed three factors when the Kaiser criterion was adopted: a behavioral factor (Cronbach's α was .78; explaining 32.6% of the variance), a cognitive factor (Cronbach's α was .65; explaining 8.8% of the variance), and an emotional factor (Cronbach's α was .65; explaining 7.8% of the variance). The items included in the behavioral factor all referred to loss of control over eating behavior. To avoid construct overlap with depression, binge eating was defined by the binge eating behavioral factor of the BES in our study.

To measure depression, the Beck Depression Inventory (BDI) was used [18]. To screen for depression while minimizing the possibility of yielding spuriously high estimates of depression for patients with medical problems, seven cognitive-affective items were drawn from the Beck

Depression Inventory (BDI) afterwards. Six of these seven items (sadness, pessimism, loss of pleasure, self-dislike, self-criticalness, and suicidal thoughts and wishes) were similar to the seven-item Beck Depression Inventory for Primary Care (BDE-PC), a screening instrument for depression for patients with medical problems. One item (punishment) was different compared to the BDI-PC item (failure). In the present study, Cronbach's α of the seven cognitive-affective items of the BDI was .86.

Weight and height were assessed in the St. Antonius Hospital before surgery. Height was measured without shoes and socks, and body weight was determined using a professional balance. Postoperative body weight during the questionnaire study was determined from routine follow-up approximately 6 months and 1 year after surgery. The body mass index (BMI) was calculated as the weight in kilograms divided by the square of height in meters. From 4 patients in this study body weight information at one or more time points was missing.

Statistical analyses

Our data comply with the suggested guidelines for normality, linearity, and homoscedasticity [19].

To examine differences in weight, binge eating, and depression before and after LAGB, t-tests were used. To determine which covariates had to be controlled for, the demographic variables age, gender, and educational level were correlated with postoperative binge eating and the residual BMI change scores (BMI at follow-up adjusted for baseline BMI). A covariate was considered a potential confounder in case of a correlation significant at $p<0.10$. Stepwise regression analyses were performed to examine whether binge eating behavior, depression, and the interaction between binge eating behavior and depression predict postoperative binge eating and change in BMI after surgery. Preceding regression analyses, the binge eating and depression variables were centered on their grand mean (i.e., the overall mean was subtracted from the values of a variable). In the stepwise regression analyses on postoperative BMI at follow-up, the influence of preoperative BMI was first taken into account (step 1) to assess 'change in BMI', after which the potential covariates (step 2), and the variables binge eating behavior, depression, and the interaction between binge eating and depression were entered (step 3). An alpha level of .05 was used for all statistical tests. All analyses were performed with SPSS 11.5.

RESULTS

Preoperative versus postoperative characteristics

At 6 and 12 months follow-up, patients had a significantly lower BMI, and lower depression and binge eating behavior scores than before surgery (all p's <0.001; Table 1). There were no significant differences in binge eating or depression scores at 6 and 12 months after surgery (p's >0.10), but patients had lost significantly more weight at 12 months than at 6 months after surgery ($p<0.001$).

Table 1 Mean values (SD) of preoperative and postoperative weight, binge eating behavior, and depression

	Before surgery		6 months after surgery		12 months after surgery	
	M	SD	M	SD	M	SD
BMI	47.0	5.6	39.1	6.3	37.2	6.4
Binge eating behavior*	8.8	4.5	4.7	3.5	5.2	4.1
Depression	4.5	4.2	2.3	3.3	2.3	3.2

*mean score on the behavioral factor of the Binge Eating Scale (BES)

Prediction of postoperative binge eating

Preoperative binge eating predicted 17% of the variance of postoperative binge eating at 6 months ($F=15.76$, $p<0.001$) and 6% of the variance of postoperative binge eating at 12 months ($F=4.27$, $p=0.04$). Depression and the interaction of binge eating with depression did not significantly predict postoperative binge eating (Table 2).

Table 2 Stepwise regression analyses predicting postoperative Binge Eating (BE) behavior from preoperative predictors

	Postoperative BE at 6 months			Postoperative BE at 12 months		
	r^a	β	R^2 (adj)	r^a	β	R^2 (adj)
Preoperative						
BE behavior	.41†	.41†	.17	.25	.25*	.06
Depression	.25*	.10		.23	.14	
BE behavior*depression	.04	-.08		-.08	-.16	
Total R^2			.17			.06

*p<.05; †p<0.001

[a] correlation with residual change score

Postoperative binge eating at 6 months after surgery predicted 57% of the variance of postoperative binge eating at 12 months after surgery ($\beta=.75$, $F=84.29$, $p<0.001$), while depression and the interaction between binge eating and depression did not significantly predict postoperative binge eating at 12 months ($p>.10$).

Prediction of postoperative change of BMI

Weight change after surgery was not significantly predicted by preoperative binge eating or depression, but the interaction between preoperative binge eating and depression predicted change of weight at 6 months after surgery (F=4.27, p=0.04; Table 3). This interaction reflects that patients with combined binge eating and depression had a better weight outcome at 6 months after surgery than the other patients. The interaction between binge eating and depression was not significant at 12 months (p>0.10) after surgery.

Table 3a Stepwise regression analyses predicting 'change in BMI' from preoperative predictors

	BMI at 6 months			BMI at 12 months		
	r^a	β	R^2 (adj)	r^a	β	R^2 (adj)
Preoperative BMI	.82‡	.82‡	.67	.73‡	.73‡	.54
Preoperative						
BE behavior	-.11	-.07	.17	.01	-.00	
Depression	.03	-.02		-.03	.01	
BE behavior*depression	-.27*	-.15*	.02	-.08	-.06	
Total R^2			.69			.54

*p<.05; p<.001‡

[a] correlation with residual change score

Postoperative binge eating behavior at 6 months after surgery was not significantly associated with the amount of weight loss at 6 months after surgery, but was significantly associated with the amount of weight loss at 12 months after surgery (F=7.1, p=0.01; Table 3).

Table 3b Stepwise regression analyses predicting 'change in BMI' from postoperative predictors at 6 months

	BMI at 6 months			BMI at 12 months		
	r^a	β	R^2 (adj)	r^a	β	R^2 (adj)
Preoperative BMI		.82‡	.67		.73‡	.54
Postoperative (6 months)						
BE behavior	.20	.11		.32†	.22*	.05
Depression	.21	.12		.16	.07	
BE behavior*depression	.11	.07		.07	-.01	
Total R^2			.67			.59

*p<.05; †p<0.01; p<.001‡

[a] correlation with residual change score

As yet, 42 patients in our prospective study have a follow-up duration of 24 months or more after surgery, and postoperative binge eating behavior at 6 months after surgery predicted 10% of the weight loss at 24 months after surgery (data not shown). Figure 1 shows the scatterplots of binge eating at 6 months after surgery with the amount of weight loss at 12 and 24 months after surgery. Neither depression nor the interaction between binge eating and depression at 6 months after surgery were associated with weight loss at 6 months after surgery or predicted weight loss at 12 or 24 months after surgery.

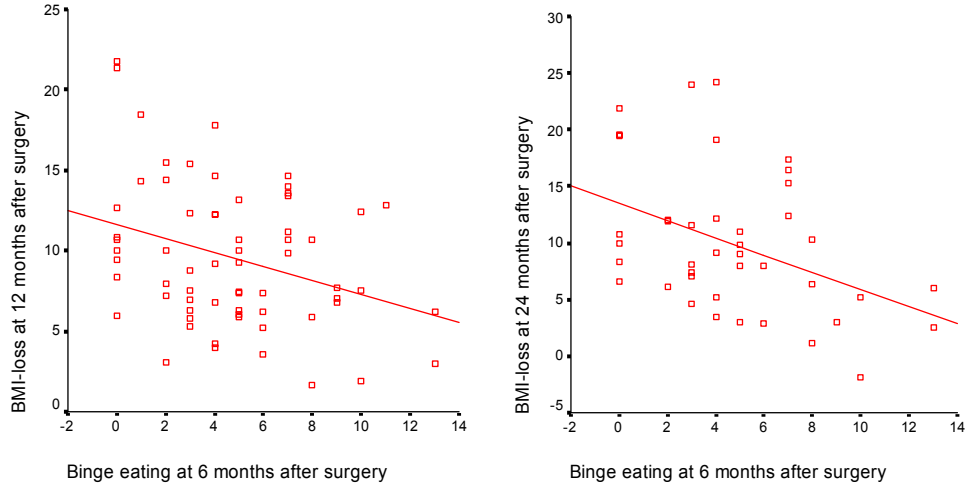

Figure 1 Scatterplots of the relation between binge eating at 6 months after surgery and BMI-loss at 12 months (n=67) and 24 months (n=42) after surgery

DISCUSSION

The present study prospectively examined whether combined binge eating and depression predict the persistence of postoperative binge eating behavior and change of weight after surgery for morbid obesity. Weight outcome and postoperative binge eating behavior were not meaningfully predicted by combined preoperative binge eating and depression. Before discussing the main results of this study, we first reflect on the effects of surgery on weight, binge eating behavior, and depression.

In line with earlier studies [5, 20], we found significant improvements on weight outcome, binge eating behavior, and depression after surgery for morbid obesity. This suggests that

Laparoscopic Adjustable Gastric Banding is a successful treatment for a substantial amount of patients with preoperative binge eating behavioral problems or depressive symptoms.

Preoperative binge eating behavior predicted 17% and 6% of the variance of postoperative binge eating at 6 and 12 months, respectively. This is not much, given that it was the same behavior measured. Postoperative binge eating predicted nearly 60% of postoperative binge eating behavior at follow-up. This suggests that surgery affects the stability of preoperative to postoperative binge eating to a large extent.

In agreement with several other studies on binge eating behavior and binge eating disorder [5, 6, 12, 13] we found that binge eating behavior before surgery was not a predictor of weight outcome after surgery. The hypothesis that combined binge eating behavior and depression lead to a poorer weight outcome after bariatric surgery was not confirmed by our results. Instead, we found that combined preoperative binge eating behavior and depression predicted a better weight outcome at 6 months after surgery. Although this interaction effect was significant at 6 months surgery, it was no longer significant at 12 months after surgery. This probably reflects that patients who experience more psychosocial problems before surgery are more motivated to lose weight as fast as possible. Overall, our results indicate that patients with combined binge eating behavior and depression before surgery do not need additional preoperative treatment compared to other patients.

Cross-sectional studies have shown associations between postoperative binge eating behavior and weight outcome from one year after surgery [8, 9], while binge eating behavior at 6 months after surgery was not associated with the amount of weight loss [5]. In agreement with this, our prospective study found that binge eating behavior at 6 months after surgery was not associated with the amount of weight loss at 6 months after surgery, but it is was associated with the amount of weight loss at 12 and 24 months after surgery. These findings provide some insight into the causality of the earlier cross-sectional associations of binge eating behavior and weight outcome from one year after surgery, and suggest that additional monitoring and treatment of postoperative binge eating at early stage postoperatively may be indicated to prevent a worse weight outcome.

Our study has some limitations. Firstly, we have no information on additional psychological treatment that patients may have received for their eating disorders during the operation. Although this could have influenced the results, our findings still reflect that *fixed* preoperative monitoring and treatment of preoperative binge eating behavior and depression, other than possibly self-initiated by the patients, is not necessary. Secondly, we used questionnaires to assess depression and binge eating behavior. The behavioral binge eating subscale used in this study only assesses the behavioral loss of control aspect of binge eating behavior, but not the objective consumption of a large amount of food within a short amount of time, which is part of the definition of binge eating behavior according to the DSM-IV. It is suggested that in our sample of patients with morbid obesity the “large amount of food” aspect will be present in all the patients reporting behavioral loss of control before surgery, otherwise they wouldn’t have

been morbidly obese. Thirdly, our results only apply to patients undergoing LAGB and not to other maybe superior surgical procedures, such as biliopancreatic diversion.

Overall, our results provide no reason to exclude specific subgroups of patients with binge eating behavior from the operation or to give fixed additional preoperative psychosocial care to subgroups of patients. It is advised to monitor binge eating at early stage postoperatively to prevent relapse and, if necessary, to give additional treatment of binge eating.

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Chapter 7

A structural equation model of binge eating and exercise behavior after surgery for morbid obesity

Larsen, J.K., Geenen, R., Van Ramshorst, B., Brand, N., Hox, J.J., Stroebe, W., Van Doornen, L.J.P. A structural equation model of binge eating and exercise behavior after surgery for morbid obesity (2004). Manuscript submitted for publication.

ABSTRACT

Although surgery is a relatively effective means of weight reduction in patients with morbid obesity, some patients do not achieve a successful outcome. This study aimed to find indications for the appropriateness of a model in which eating attitudes and exercise beliefs influence the behavioral mediators binge eating and physical exercise behavior respectively, that, subsequently, affect the weight and quality of life outcome after Laparoscopic Adjustable Gastric Banding (LAGB). Participants were 157 patients (144 female, 13 male) who filled out questionnaires on average 34 months after LAGB (range 8-68 months). Results showed a well-fitting model in which external and emotional eating attitudes were associated with binge eating and binge eating was negatively related to weight loss and mental health after surgery. Several exercise beliefs were associated with physical exercise, but physical exercise was not associated with weight loss or physical health. The model indicates that, whereas physical exercise was not a crucial mediator between exercise beliefs and outcome, binge eating is a possible mediator between eating attitudes and outcome. This suggests that a binge-eating focused approach aimed at external and emotional eating attitudes may be superior to an exercise-focused approach in the monitoring and management of patients with unsuccessful outcome after obesity surgery. An experimental trial is needed to confirm this suggestion.

INTRODUCTION

Morbid obesity, defined as a body mass index (BMI) of more than 40 kg/m^2, is a life-threatening condition with prevalent co-morbidity such as diabetes mellitus, hyperlipidaemia, hypertension [1], and severely reduced quality of life [2]. Surgery is considered the treatment of choice for morbid obesity [3]. Although surgery is a relatively effective means of weight reduction in patients with morbid obesity, some patients do not achieve a successful weight outcome. The behavioral factors binge eating, characterized by episodic uncontrolled consumption of large amounts of food, and insufficient physical exercise may threat a successful weight and quality of life outcome after obesity surgery. Binge eating and physical exercise are both associated with obesity [4-7], and an incidental study found that binge eating behavior is related to a poor weight outcome after obesity surgery [8]. To the best of our knowledge, there are no studies on the relationship between exercise behavior and outcome after obesity surgery.

Risk factor models and studies of the development and maintenance of binge eating have, in particular, emphasized the potential roles of dietary restraint and affect regulation [9]. According to the boundary model [10] patients set themselves complex and strict dietary rules. Violating these rules often results in a breakdown of control and binge eating. Also people who feel their eating behavior is easily triggered by emotions or by external eating cues, such as the sight or smell of food, are supposed to be at risk of binge eating. A prospective study has shown a clear link between negative emotional states, but not dietary restraint, and subjective binge behavior [11]. Experimental studies showed that participants with high emotional or external eating attitudes consumed large quantities of food during a taste test, while a restrained eating attitude was not associated with the amount of food eaten [12, 13]. This suggests that emotional and external eating attitudes are more crucial determinants of overeating and binge eating than restrained eating.

Physical exercise is another health behavior that is considered important to consolidate weight loss. Beliefs on the resulting health benefits as well as the costs or barriers of enacting physical exercise have been found to be cognitive determinants of exercise behavior among older adults [14-16], chronic pain patients [17], and obese patients [18]. Main psychological barriers to physical exercise in the obese are lack of confidence and embarrassment at being observed [18]. In chronic pain patients fear of injury proved to be an important barrier to physical exercise, which leads to a vicious circle characterized by decreased self-efficacy, fear, and a further avoidance of activity [17]. Possibly, in a similar way, fear of injury will be associated with low physical exercise after surgery for severe obesity.

We propose a unidirectional model in which eating attitudes and exercise beliefs influence the behavioral mediators binge eating and physical exercise behavior respectively, that, on their turn, affect the outcome after Laparoscopic Adjustable Gastric Banding (LAGB) for morbid obesity. The aim of the present study was to find indications for the appropriateness of such a model. Support for the model would be clinically useful, because it suggests which eating attitudes and exercise beliefs could be therapeutically manipulated to try to achieve a change of

eating and exercise behavior and, as a consequence, a favorable weight and quality of life outcome after obesity surgery. In our cross-sectional data-set, the absence of an association rules out the existence of a unidirectional influence, while the existence of an association offers an indication for the rightness of the model without providing evidence for the appropriate direction of the influence.

METHODS

Participants and procedure

Between November 1995 and August 2000, 199 patients were subjected to gastric banding for morbid obesity. All patients were accepted for a LAGB procedure using the Lap-Band® system (INAMED Health) following screening by a team consisting of a bariatric surgeon, an internist, a psychologist, and a dietician. Surgical indications were a BMI ≥ 40 or a BMI between 35 and 40 with serious comorbidity. In the case of obesity-related psychopathology, acceptance of psychological treatment was a condition for acceptance for surgery. The operation was performed according to the techniques described by Belachew and coworkers [19]. One patient died during follow-up and in two patients the band was removed, leaving a postoperative research population of 196 patients. During the year 2001, these patients were asked to participate in a cross-sectional study on the quality of life after surgery. 179 patients agreed to participate. All these patients received questionnaires of which 160 questionnaires were returned, a response rate of 81.6% of the total population. The questionnaires of three patients were incomplete, leaving 157 evaluable postoperative patients (144 female, 13 male). Demographic and weight characteristics of the patients are shown in Table 1.

Table 1 Demographic and weight characteristics

	Mean	SD	Range
Postoperative period (in months)	33.9	15.1	8-68
Age	40.0	7.9	23-61
Educational level [a]	3.1	1.5	1-7
Preoperative BMI (weight / height^2)	45.5	5.7	36-72
Postoperative BMI (weight / height^2)	35.3	6.9	22-64

[a] An educational level of '1' reflects primary education; '2' lower secondary education; '3', '4', and '5' secondary education; and '6' and '7' tertiary education

Measures

Weight assessment. From all patients, objective information of the preoperative weight was available. Objective information of the postoperative weight from three months before or after

the completion of the questionnaires was available for 123 of the 157 patients. Self-reported postoperative weight reports were available for 153 of the 157 patients. The correlation between the postoperative objective weight measurement and the self-reported weight data was extremely high ($r=0.98$, $p<0.001$). We used self-reported weight data to assess postoperative weight. For the 4 patients whose self-reported weight was not available, objective weight assessments were used instead.

Questionnaires. To measure quality of life, two summary components were computed, aggregating scores from eight subscales of the RAND-36 [20] into two summary scores: Physical Component Summary (PCS or physical health) and Mental Component Summary (MCS or mental health) [21]. Raw scale scores of the RAND-36 were transformed into Z-scores, using Dutch means and standard deviations, which were multiplied with the US factor score coefficients and summed over all eight subscales (US factor scores were used to facilitate international comparisons). Finally, t-scores were calculated by multiplying the obtained PCS and MCS sums by 10 and adding 50 to the product to obtain transformed summary scores that are normally distributed with a mean of 50 and a standard deviation of 10 [21]. In the present study, the Cronbach α's were .82 for mental health and .87 for physical health.

To measure binge eating behavior, the Binge Eating Scale (BES) [22] was translated into Dutch and administered. The BES is a 16-item self-report questionnaire designed to assess the severity of binge eating among individuals with obesity. It examines behavioral manifestations as well as affects and cognitions during a binge episode (loss of control, guilt, fear of being unable to stop eating). In the present study, Cronbach's α was .88.

To measure eating attitudes, the Dutch Eating Behavior Questionnaire (DEBQ) was used [23]. The DEBQ consists of 3 scales: 'emotional, external and restrained eating'. A higher score on each scale reflects a higher level of that eating attitude. The scales have a high internal consistency [24]. In the present study, Cronbach's α's varied from .87 to .95.

Physical exercise was assessed with the Sport Index of the Baecke Questionnaire (BAQ) [25]. This validated and reliable index [26-28] is a composite score that takes into account the expected energy expenditure for a given sport, number of hours practiced per week, and number of months per year, as well as an estimation of the level of physical activity compared with that of the subject's contemporaries, and the frequency of sweating during leisure time.

To measure perceived benefits and barriers of physical activity in the obese, the Physical Exercise Belief Questionnaire (PABQ) was used (Larsen & Geenen, internal report, Utrecht University, Department of Health Psychology, 2002). This questionnaire, that is partly derived from the Dutch version of the Tampa Scale for Kinesiophobia [29], consists of 16 items, with a 5-point Likert rating-format, ranging from 1 (strongly disagree) to 5 (strongly agree). It provides scales assessing *exercise benefits* (e.g., sports is healthy for me; by doing sports I lose weight), *confidence* (I have a flair for sports; I am a sporty type of person), and two scales measuring barriers to physical activity: *fear of injury* (e.g., by doing sport I run the risk at being injured;

sport is dangerous because I easily get injured), and *embarrassment* (e.g., I feel embarrassed when other people are looking at me wearing sports clothes; I feel ashamed for my body when doing sports). The psychometric characteristics of the PABQ have been established in a sample of 278 obese or severely obese patients before or after dietary or surgical treatment for their obesity. The four scales explained 67.9% of the variance and the internal consistencies of the scales were high. In the present study, the Cronbach α's varied from .67 for exercise benefits to .88 for fear of injury.

Statistical analysis

The skewness of the distributions of all variables was between –1.12 (physical functioning RAND-36) and 0.48 (binge eating BES), which was considered sufficiently normal to allow parametric statistics [30].

It was tested with SPSS for Windows 11.5 whether relations between psychological determinants, behavioral mediators, and outcome needed control for postoperative duration, BMI before surgery, age, gender, or education. Variables that correlated significantly with at least one predictor and one mediating or outcome variable, or with one mediating variable and one outcome variable were considered potentially confounding covariant variables. Postoperative duration was the only variable that met the criteria for potential confounders.

We used Structural Equation Modeling (SEM) with the AMOS program [31] to investigate a model in which psychological determinants influence behavioral mediators that, on their turn, affect the outcome after surgery for severe obesity. In structural equation modeling the relationships between variables can be tested simultaneously (several regression steps can be taken into one), while controlling for the effects of other variables included in the model and adjusting for measurement errors. The AMOS program does not provide model modification indices when missing data are present. In the present study, 6.4% of the scores on emotional eating, and less than five percent of the scores of the other variables were missing. Missing value analyses showed that the missing scores on emotional eating were at random. Incidental missing values were imputed using Expectation-Maximization estimation. This method is considered the most effective method to impute missing data points, because it uses all the information in the available data [32]. After analyzing the models on the imputed data file, the models were re-analyzed on the original data set with incomplete data using direct likelihood in AMOS, of which the results are presented in this article.

After testing our starting model, in which lines from psychological determinants were only connected with outcome through one of the mediating variables, it was examined whether additional paths directly connecting predictor variables with outcome variables might lead to a better fitting model. Regression weights with modification indexes greater than 4 were simultaneously added to the model, while all non-significant regression weights were removed, after which the model was tested again. This procedure was repeated until a final model was achieved with significant standardized regression weights.

All intercorrelations for psychological determinants and outcome variables were maintained in the final model. Postoperative duration was included in the final model as potential confounder of the relationship between psychological determinants and behavioral mediators. Two general fit indices were examined that counteract problems associated with Chi-square, such as the influence of sample size. We used the Root Mean Square Error of Approximation (RMSEA) and the Tucker-Lewis Index (TLI). If the model fits the data well, the RMSEA is small (common norm suggests smaller than 0.06). For the TLI, a fit index of 0.95 or higher indicates that the model fits well [33].

RESULTS

The final model achieved in testing the relationships between psychological determinants, behavioral mediators, and outcome, while adjusting for postoperative duration, had a Chi-square value of 49.47 with 40 degrees of freedom (Figure 1). The probability level of the model was .15, implying that the model needs not to be rejected. The goodness-of-fit measures (RMSEA = .04; TLI = 1.00) indicated that the model was a good fit to the data.

The model shows that more *binge eating* was reported by individuals high at *external eating* (β = .40) and *emotional eating* (β = .45), but not restrained eating. *Binge eating* was associated with a diminished *BMI reduction* (β = -.29) and a reduced *mental health* (β = -.37). The model did not indicate direct effects from external and emotional eating attitudes to outcome.

More *physical exercise* was reported by individuals high on *restrained eating* (β = .27) and *perceived exercise benefits* (β = .25) and low on *embarrassment* (β = -.21) and *fear of injury* (β = -.19). *Physical exercise* was related to *mental health* (β = .17), but not to physical health or BMI reduction. *Fear of injury* was strongly associated with reduced *physical health* (β = -.62).

A longer *postoperative duration* was associated with less *restrained eating* ($r=-.28$, $p<.001$), *exercise benefits* ($r=-.26$, $p<.001$), and *physical exercise* ($r=-.17$, $p<.05$).

The psychological determinants were able to explain 58% and 26% of the variance of the behavioral mediators binge eating and physical exercise, respectively. Postoperative duration explained an additional 2% of the variance of physical exercise. For the outcome variables, the overall model was able to explain 9% of the variance of BMI reduction, 16% of reported mental health, and 39% of reported physical health.

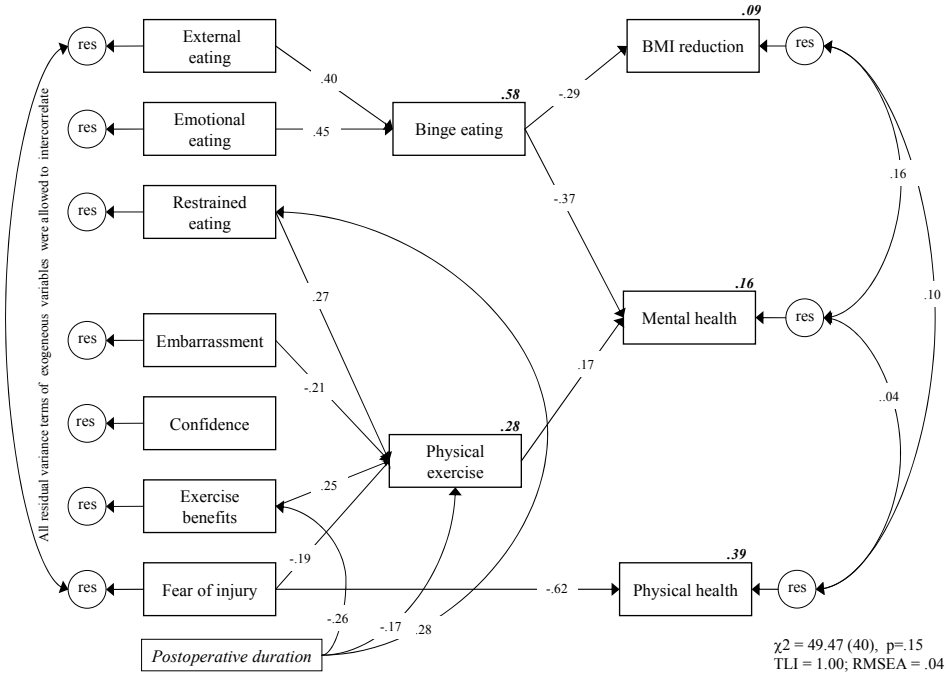

Figure 1 The structural equation model linking psychological factors, behavioral mediators, and multiple outcomes after Laparoscopic Adjustable Gastric Banding for severe obesity. The values of the single-headed arrows reflect significant standardized regression weights. The values above the behavioral mediators and outcome variables reflect the amount of explained variance

DISCUSSION

The perspective of our study was a model examining the influence of psychological variables via behavioral mediators to the outcomes after surgery for morbid obesity. Assets of our study were that it included a large sample, simultaneously examined the relations of binge eating and physical exercise, and applied a statistical technique allowing relationships to be tested while controlling for the effects of other variables. Before discussing the relationships of psychological variables with behavioral mediators, we will discuss the associations of behavioral mediators with outcome.

Our finding that binge eating and, less strongly, physical exercise were related to a poorer mental health is in agreement with previous studies on binge eating [34, 35] and exercise behavior [36, 37]. A recent review concluded that additional research specifically designed to explore the

effects of binge eating on physical health is required [38]. The results of our study suggest that binge eating does not affect physical health in a sample of patients after surgery for severe obesity.

Correlational studies showed inverse associations between physical exercise and the amount of overweight in the normal adult population [5, 6], but this need not apply for the obese population. Our study showed no association between physical exercise and weight or physical health outcome. Moreover, several randomized trials have shown that the combination of diet plus exercise for obesity failed to produce significantly greater long-term weight loss [39-42] and improvement in physical health [42] than treatment by diet alone. Most of our patients after obesity surgery were still obese. Perhaps an increase in the activity level of our obese patients is limited by the ability to perform exercise of higher intensity [43].

While physical exercise was not related to weight outcome, our study and another recent study [8] showed that binge eating was associated with a poorer weight outcome after surgery for severe obesity. Thus, our results suggest that eating-focused programs are superior compared to exercise-focused programs to prevent a worse postoperative weight outcome in morbidly obese patients after obesity surgery.

Emotional and external eating tendencies, but not restrained eating, showed a significant relationship with binge eating. This suggests that, in agreement with experimental studies [12, 13], overeating tendencies are a greater threat to a breakdown in the control of eating than restrained eating. Our model did not indicate direct effects from external and emotional eating attitudes on outcome. This suggests that binge eating is a mediator between eating attitudes and weight and mental health outcome and that a binge-eating-focused intervention aimed at external and emotional eating will affect outcome.

Although restrained eating showed no association with binge eating, it was positively associated with exercise behavior. This may reflect that restrained eating requires similar disciplined and regulated behavior as physical exercise. Beliefs on the resulting *health benefits* as well as low *fear of injury* and low *embarrassment* of enacting physical exercise were associated with physical exercise. Although our study offers many clues to alter physical exercise among this subgroup of patients after obesity surgery by interventions directed at the potentially modifiable cognitions embarrassment, fear of injury, and perceived exercise benefits, our results question whether enhanced physical exercise would be of use in reference to overall weight outcome after obesity surgery.

The variable fear of injury deserves some special attention because it showed a strong relation with experienced physical health. Fear of injury is considered part of a vicious circle characterized by decreased physical exercise, decreased physical health, increased fear and further avoidance of activity [17]. In contrast to this model, the relationship between fear of injury and physical health was not mediated by physical exercise in our study. Perhaps our correlational results predominantly reflect that patients with a poorer physical health experience more fear of injury as a consequence of several functional limitations. If so, longitudinal studies

might show that fear of injury would reduce after successful surgery and accompanying reduction of comorbidity and increased physical health.

Our study has some restrictions. Our study population was restricted to patients undergoing LAGB. Because a similar outcome has been reported in studies examining other bariatric surgical procedures [44], we expect similar results in patients undergoing other types of surgery. Our cross-sectional design prohibits drawing causal inferences. Future longitudinal research assessing psychological variables, mediators, and outcome variables repeatedly over time, will enhance insight into the directionality of the relationships of the model. Finally, we used the Binge Eating Scale (BES) to assess binge eating. Although this questionnaire cannot be used to accurately diagnose binge eating disorder, it has proven to be a useful instrument for measuring the severity of binge eating [45].

In conclusion, binge eating was indicated to be a possible mediator between eating attitudes and weight and mental health outcome, whereas physical exercise was not a crucial mediator between exercise beliefs and outcome. This suggests that a binge-eating focused approach aimed at external and emotional eating attitudes may be superior to an exercise-focused approach in the monitoring and management of patients with unsuccessful outcome after obesity surgery. An experimental trial is needed to confirm this suggestion.

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Chapter 8

Salivary cortisol in binge eating disorder after surgery for morbid obesity

Larsen, J.K., Geenen, R., Van Ramshorst, R., Van Doornen, L.J.P. Salivary cortisol in binge eating disorder after surgery for morbid obesity (2004). Manuscript submitted for publication.

ABSTRACT

Objectives: Episodes of binge eating characterized by loss of control and high fat are hypothesized to be accompanied by changes in the hypothalamus pituitary adrenal system. Cortisol is an end-product of this neuroendocrine stress system. The aim of this study was to examine salivary cortisol levels and the awakening cortisol response in persons showing binge eating after surgery for morbid obesity.
Methods: Thirty-six women participated in the study: 16 women with binge eating disorder (BED) and 20 women without BED. Salivary cortisol was assessed at two consecutive days at 6 time points.
Results: Women with BED showed lower total cortisol output during the day than non-BED women, while the awakening cortisol response did not differ.
Discussion: This study suggests that patients with BED after surgery for severe obesity have lower than normal daytime cortisol values. This finding may be relevant to understand why patients with BED have difficulty to control their eating behavior.

INTRODUCTION

Binge Eating Disorder (BED) is considered a stress-related disorder characterized by feelings of depression, guilt, and disgust about the loss of control over eating and weight and shape appearance [1, 2]. Also typical of BED is the consumption of food that is energy dense in fat and sugar [3].

Cortisol is the central stress hormone. It is secreted by the adrenal cortex upon activation of the hypothalamus pituitary adrenal (HPA) axis in response to physiological stress, such as inflammation, and psychological stress, in particular in response to stress situations in which the individual is threatened with loss of control [4]. Also food intake, specifically food containing high levels of fat [5, 6] and sugar [7], increases cortisol levels. Though there are several reasons for patients with binge eating disorder to have elevated cortisol levels, there is also evidence for relatively low cortisol levels in individuals who suffer from chronic stress [8, 9]. Repeated activation of the adrenal cortex may accomplish alterations on several levels of the HPA axis contribution to the presence of hypocortisolism [8].

Knowledge of the overall daytime cortisol output in individuals with binge eating disorder will be relevant to the understanding of the possible physiological maintenance mechanisms, and adverse health consequences, of this disorder. Both hypersecretion and hyposecretion of cortisol are indicative of dysregulation of the hypothalamus-pituitary-adrenal (HPA) axis. One incidental study suggests that patients with binge eating disorder exhibit normal morning cortisol levels [10]. Apart from the overall daytime cortisol output, the salivary cortisol response to awakening has been described as a test of the propensity of the HPA axis to respond to stress. The aim of our study was to examine salivary cortisol levels and the awakening cortisol response in persons showing binge eating after Laparoscopic Adjustable Gastric Banding for severe obesity.

METHODS

Participants and Procedure

Fifty individuals were selected out of a group of 157 patients who participated in a cross-sectional questionnaire-study on quality of life and eating behavior after laparoscopic adjustable gastric banding for morbid obesity [11]. To enlarge the probability of attaining a sufficient amount of patients with binge eating disorder for this study, patients were not randomly selected out of the 157 patients: 25 women (6.28%) who met the criteria for severe binge eating at the time of the cross-sectional questionnaire study (score ≥ 26 on the binge eating scale; BES) were matched to 25 women without binge eating problems (BES-score ≤ 17) on age, marital status, educational level, and depression scores (depression may be associated with hypersecretion of cortisol and could therefore represent a confounding factor). Male participants were excluded to create a more homogeneous group of patients. Of the 50 selected women, 46 agreed to participate.

The 46 patients were visited at home by one of two research assistants (VC, CdL). During the visit, a clinical interview was administered to assess binge eating disorder (BED) and eating psychopathology. Height, weight, and the waist and hip circumferences were measured at the end of the interview. Moreover, participants were given instructions on cortisol assessments for the next two days using a standardized protocol. Finally, at the end of the second day of cortisol assessments, the Beck Depression Inventory and the Binge Eating Scale were completed. Of 39 participants (response rate 78%) cortisol samples were received. Cortisol assessments of 3 persons were incomplete, leaving 36 evaluable women: 16 women with binge eating disorder and 20 women without binge eating disorder (Table 1).

Table 1 Characteristics of women with and without Binge Eating Disorder (BED)

	BED (n=16)		Non-BED (n=20)	
	Mean	SD	Mean	SD
Postoperative period (months)	42.6	15.1	44.9	12.9
Age (years)	38.4	7.6	41.9	6.8
Educational level*	3.4	1.9	3.7	1.5
Preoperative BMI (kg/m^2)	46.6	6.3	45.5	5.6
Postoperative BMI (kg/m^2)†	40.2	8.2	34.7	6.6
Postoperative WHR	0.85	0.09	0.90	0.09
Depressive symptoms (BDI)	14.9	6.6	12.3	9.4
Marital status : % single	26.7 %	-	35.0 %	-

*An educational level of '1' reflects primary education; '2' lower secondary education; '3', '4', and '5' secondary education; and '6' and '7' tertiary education

† $t=2.2$, $p<0.05$

There were no differences between individuals who did and did not return cortisol samples on demographic variables, but the non-responders had a lower postoperative Body Mass Index ($t=2.5$, $p<.05$). One out of 7 non-responders had a binge eating disorder as assessed by clinical interview. Twelve women were taken oral contraceptives (6 BED and 6 non-BED women), and 3 women were approximately 3 months pregnant (1 BED and 2 non-BED women). Oestrogens increase serum, but not salivary, cortisol concentrations in early pregnancy and in women taken oral contraceptives [12]. Participants were free from corticosteroid medication.

Cortisol assessment

Cortisol was assessed from saliva collected with the use of a small cotton wool swab (Salivette, Sarstedt AG & Co., Numbrecht, Germany). This noninvasive technique was used in the real-life environment at two consecutive days at 6 time points. The first three saliva samples were collected at awakening and at 15 and 30 minutes after awakening, to assess the cortisol awakening response. Thereafter, saliva samples were collected at 12:00 pm, 3:00 pm and 8:00 pm, successively. Awakening was either spontaneous or by alarm clock, as previous studies have shown that the cortisol response is not affected by this variable [13]. Participants were instructed to rinse their mouth with water at each sampling point, to avoid brushing their teeth just before saliva sampling, and to refrain from eating, drinking, or smoking in the 30 minutes before sampling. Salivary cortisol can be stored at ambient temperature for up to 30 days without cortisol values being altered [14]. Nevertheless, participants were asked, if possible, to store the saliva samples in a refrigerator until completion of the sampling. At the end of the two days, samples were sent back to Utrecht University where they were kept frozen at –20C until the time of analysis. Salivary cortisol was analyzed with a time-resolved immunoassay with fluorescence detection (DELFIA), which is described in detail elsewhere [15].

Anthropometric assessment

Height was measured without shoes, and body weight was determined to the nearest 1 kg using two identical weight balances. The body mass index (BMI) was calculated as the weight in kilograms divided by the square of height in meters. The waist and hip circumferences were measured, with the subjects standing, using a 1-cm-wide measuring tape, and the waist to hip ratio (WHR) was calculated. According to the recommendation of the WHO, the waist circumference was measured as the minimum value between the iliac crest and the lateral costal margin, whereas hip circumference was determined as the maximum value over the buttocks.

Psychological assessment

Interview. The Eating Disorder Examination (EDE) interview was administered to assess the presence of binge eating episodes, as well as eating psychopathology such as eating restraint, eating concern, weight concern, and shape concern (Jansen, 2000). The research assistants who administered the interview were blinded to subjects' BES-scores of the earlier cross-sectional

questionnaire-study. These earlier BES-scores were used only as a preliminary selection procedure to enlarge the chance of including patients' with BED, and are therefore not reported in this study. All interviews, except one, were audio taped and reviewed by the first author who was also blinded to subjects' earlier BES-scores. For the purpose of this study, BED was defined by the presence of binge eating episodes within the past 3 months of the EDE examination, as opposed to the 6 months duration recommended in Appendix B of DSM-IV. There was a high correspondence between the students and the first author of this article concerning the presence of binge eating episodes, with only one patient classified differently. As suggested by Hsu et al [16], we included individuals in the binge eating disorder group who had a weekly average of at least one binge over the last 3 months.

Questionnaires. Binge eating severity was assessed with a translated version of the Binge Eating Scale (BES) [17]. The Beck Depression Inventory (BDI) was used to measure depressive symptoms [18].

Statistical analyses

Cortisol data were screened for outliers and deviations from normality separately for the BED and non-BED groups [19]. Multivariate outliers (values above standardized scores of 3.29 on two or more cortisol values within a person) existed for 1 non-BED subjects and 3 BED subjects, resulting into a positive skewness on some cortisol assessments. For two out of these three individuals with BED, persons had written in the questionnaire booklet to have been eating within half an hour before cortisol assessments, perhaps reflecting binge episodes; for the other two cases (1 non-BED and 1 BED individual) no underlying variable was found to be responsible for the outliers. To normalize the distribution of cortisol values without the adverse consequences of transformation of values [19], all 4 cases with multivariate outliers were deleted. After the deletion process, the skewness divided by the standard error of the skewness of all variables was below standardized scores of 3.29 ($p<.001$), which is considered sufficiently normal to allow parametric statistics [19]. It was tested whether we needed to control for potential covariates (Table 1) in examining the relationship of BED with cortisol measures. None of the potential covariates were associated with binge eating, and although women with BED had a significantly higher BMI, BMI was not significantly associated with the total cortisol output and the cortisol awakening response, making adjusting for this factor unnecessary.

Independent t-tests were used to examine differences in eating psychopathology between groups with and without BED.

To examine differences in cortisol levels during the day between women with and without BED, total cortisol release during the day was assessed by taking the Area Under the Curve (AUC) of all time points [20]. The awakening cortisol response (ACR) was calculated by the slope (b-coefficient) and level (AUC) of the first three time points. The slopes and levels of the ACR of women with and without BED were compared using independent t-tests. To examine the

magnitude of significant cortisol results, effect sizes were computed: the difference between two means divided by the pooled standard deviations. Effect sizes of 0.2, 0.5, and 0.8 can be considered small, medium, and large, respectively [21].

Pearson correlations were computed to analyze linear relationships of total cortisol release during the day (total AUC) and the ACR (level and slope) with binge eating severity and eating psychopathology. Cortisol data were averaged across two days. All analyses were conducted with SPSS 11.5 for Windows.

RESULTS

Eating Psychopathology

Individuals with BED differed significantly from individuals without BED on three out of four measures of eating psychopathology of the EDE. The mean scores on eating restraint (1.8 ± 1.1 versus 0.6 ± 0.7; t=-3.9, p<.001), eating concern (2.6 ± 1.6 versus 1.1 ± 1.1; t=-3.5, p<.01), and shape concern (2.8 ± 1.5 versus 1.9 ± 1.1; t=-2.3, p<.05) were significantly higher in individuals with BED than individuals without BED.

Cortisol levels and the awakening cortisol response

Table 2 shows the total cortisol output during the day (total AUC), as well as the slopes and levels of the awakening cortisol response (ACR) for BED and non-BED subgroups.

Table 2 Mean values of the total cortisol output (total AUC) and the awakening cortisol response (ACR: slope and level) in women with and without BED

	BED		Non-BED	
	M	SD	M	SD
Total cortisol output (total AUC)	8.55	1.97	10.83	2.21
ACR slope (b-coefficient)	0.28	0.36	0.22	0.24
ACR level (morning AUC)	18.69	5.62	22.09	6.53

AUC: area under the curve

Women with BED showed lower total cortisol output during the day (total AUC, t=2.98, p<0.01) than non-BED women, while there were no significant differences on the slopes (t=-0.58, p=.57) and levels (t=1.53, p=.14) of the ACR. In terms of effect sizes, the difference in total cortisol levels during the day was large (d=1.09).

Figure 1 shows the mean and standard error of mean (SEM) of the cortisol levels per time point for women with and without BED.

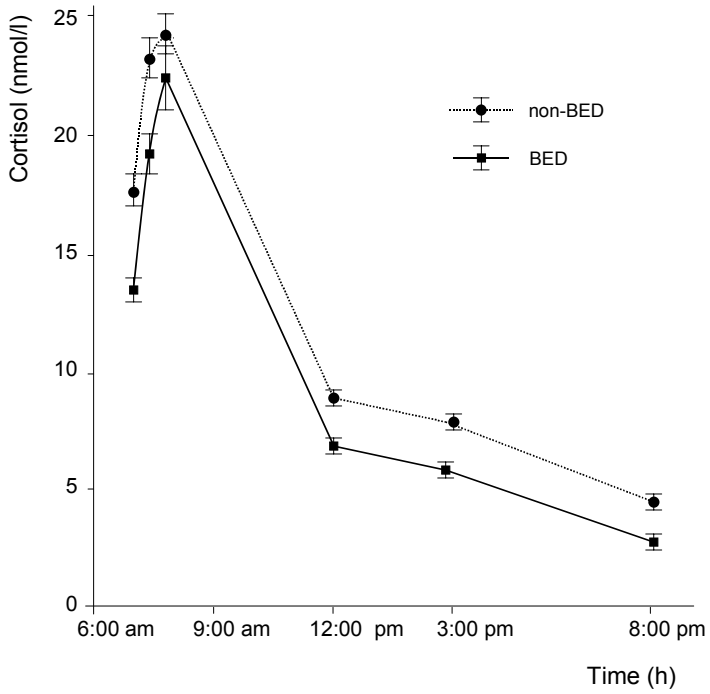

Figure 1 Diurnal course of salivary cortisol in 13 subjects with BED (solid line) and 19 subjects without BED (dashed line). Values are the mean levels from 2 days. Error bars are SEM

Significant negative correlations were found between the total cortisol level during the day (total AUC) and binge eating severity ($r=-.49$, $p<0.01$; Figure 2), eating restraint ($r=-.42$, $p<0.05$), and weight concern ($r=-.37$, $p<0.05$).

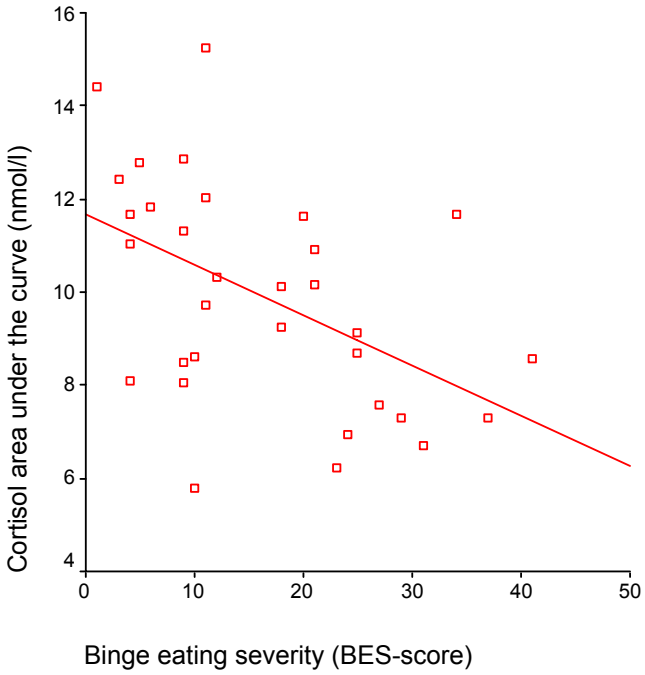

Figure 2 Scattergram of the total score on the Binge Eating Scale (binge eating severity) plotted against the total cortisol output (total AUC). Pearson correlation: r=-0.49, p=0.004, n=32

There were no significant correlations between the ACR (slope and level) and eating psychopathology ($p>0.10$). Depression was not significantly associated with total cortisol output or the awakening cortisol response, and adjusting the correlations of eating psychopathology variables with cortisol for depression did not change the significant effects found.

DISCUSSION

The present study examined the relationship between binge eating and salivary cortisol in women after surgery for severe obesity. Most importantly, women with binge eating disorder showed lower overall cortisol levels than women without binge eating disorder, while the cortisol response to awakening was similar for women with and without binge eating disorder. Before discussing the main results of this article, we reflect on the comparison of eating psychopathology of individuals with and without binge eating disorder.

Patients with binge eating disorder and patients with bulimia nervosa have similar eating disorder psychopathology [22]. We found significant elevated scores in the binge eating group on three out of four measures of eating psychopathology, viz., eating concern, eating restraint, and shape concern; and a marginally significant effect on 'weight concern'. This suggests that individuals with binge eating disorder after surgery for severe obesity are true eating disordered patients fulfilling the whole range of eating disorder psychopathology.

The present study differs from an earlier study on morning cortisol levels in binge eating disorder [10] in that it also included daytime cortisol levels and the dynamic response of cortisol after awakening. In agreement with our results, this earlier study found no significant differences in morning cortisol levels between patients with and without binge eating disorder [10] However, our patients with binge eating disorder showed lower total daytime cortisol levels than patients without binge eating disorder, and the magnitude of this difference was large. Results from two relatively large scale studies of healthy individuals suggest that normal cortisol values at 15:00 pm lie between 7 and 8 nmol/l [23, 24]. In our study, patients with binge eating disorder had a cortisol level of 5.2 nmol/l at 15:00 pm, whereas patients without binge eating disorder had a cortisol level of 7.9 nmol/l at 15:00 pm. This suggests that patients with binge eating disorder have lower than normal daytime cortisol values.

Psychological stressors [25], high fat/sugar intake [5-7], and dietary restraint [26, 27] are features associated with binge eating disorder that are known to increase cortisol levels. However, relatively low cortisol levels in individuals who suffer from chronic stress and somatic complaints have been observed [8, 9, 28]. Similarly, our results suggest lower than normal cortisol values in patients with repeated exposure to binge episodes of uncontrollable stress and high energy intake. Repeated activation of the adrenal cortex may have accomplished alterations on several levels of the HPA axis contribution to hypocortisolism [8].

Low levels of cortisol may explain why patients with binge eating disorder have difficulties to control their eating behavior. Cortisol plays a role in maintaining blood glucose levels and must be present at normal levels for glucagon to antagonize the anabolic effects of insulin, stimulating catabolic pathways, such as the mobilization of stored nutrient [29]. Low cortisol levels may impair the antagonizing effects of glucagon on insulin, resulting into high insulin levels. Generally, when insulin levels are high, hunger is low (because the blood is supplying the cells with glucose). However, if the insulin level remains high, the body continues to move blood

glucose into the cells, and liver cells and fat cells continue to store it as glycogen and fats. Consequently, the blood glucose available for use begins to decline and persons experience increased feelings of hunger [30].

A state of hypocortisolism may have adverse health consequences, related to the role of glucocorticoids in restraining activation of the immune system and other components of the stress response, including the sympathetic nervous system and corticotropin-releasing hormone [9]. A lack of cortisol availability may be hypothesized to promote an increased vulnerability to cytokine involved bodily disorders, such as rheumatic diseases or inflammatory bowel diseases. However, a recent large-scale study showed that binge eating disorder is not associated with the prevalence of these disorders [31], suggesting no comorbidity of low cortisol levels in patients with binge eating disorder.

Some methodological considerations limit the generalizability of the results of our study. The population was restricted to patients undergoing LAGB, which limits generalization to other patients with binge eating disorder. The sample size of our study was rather small. It proved large enough to detect a large group difference in total day cortisol output, while a moderate difference in awakening cortisol output was not significant. As no normal control group had been included, our study does not allow definite conclusions concerning the direction of the group differences in reference to the norm.

In conclusion, our study suggests that patients with binge eating disorder after surgery for severe obesity have lower than normal daytime cortisol values. This finding may be relevant to understand why patients with binge eating disorder have difficulty to control their eating behavior.

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Chapter 9

Summary and General Discussion

The aim of this thesis was to examine psychological predictors of treatment outcome after surgery for morbid obesity. Particular attention was given to the specific behavioral predictors of outcome and related psychological determinants of these behaviors, as these aspects can be changed by psychological treatment. An ultimate application of findings of this thesis could be the development of a psychological intervention to increase the effectiveness of laparoscopic adjustable gastric banding in patients with morbid obesity. This concluding chapter will summarize and discuss the main findings of this thesis for outcome (chapter 2), general psychological predictors (chapters 3 and 4), and specific behavioral predictors and related determinants (chapters 5, 6, 7, and 8). Moreover, methodological considerations will be discussed. The thesis ends with a section about recommendations for future research and clinical implications for patient' care in morbidly obese patients after surgery for severe obesity.

OUTCOME OF BARIATRIC SURGERY

In the first study of this thesis (chapter 2), the quality of life outcome after Laparoscopic Adjustable Gastric Banding (LAGB), with specific emphasis on social health, was cross-sectionally examined in a relatively large patient group with long follow-up duration. It was concluded that, in comparison with patients before surgery, patients after surgery felt and functioned better on physical and psychological dimensions of quality of life, and on most aspects of social quality of life. No significant differences in quality of life emerged between patients short-term and long-term after surgery. This finding is in contrast with an incidental study after gastric bypass that observed return of mental health to preoperative levels at 3 years after surgery [1], and one study after LAGB that observed a reduction in physical quality of life with longer postoperative duration [2], although this reduction probably reflected stabilization at a normal level. Our finding supports other studies that observed stable, adequate long-term quality of life after LAGB [3], gastric bypass [4], and gastroplasty [4], suggesting that LAGB could be a long-term solution to morbid obesity with regard to both weight and quality of life outcomes.

Conform the literature on isolated aspects of social quality of life [5-7], we found that health-related social functioning, social discrimination, general social networks, and intimate and sexual functioning were better after surgery. We found no difference for mutual visiting of family and friends, actual emotional support, and relation satisfaction before and after surgery, and the scores on the social support variables were rather similar to the norm. This suggests that the immediate social support of spouse, family and friends in our patients is relatively independent of obesity, and social support is not an important outcome variable after bariatric surgery, not excluding the possibility that social support may play a mediating role in the relationship between health behaviors and disease outcome, as reported in studies on other chronic diseases [8].

A second aim of the first study was to examine the relationship between weight and quality of life outcome. Conform our hypothesis, quality of life and weight outcome were associated long-term, but not short-term, after surgery. However, in contrast to our hypothesis, the patient group with a long-term follow-up duration was not more heterogeneous with respect to weight and quality of life outcome than the patient group with a short-term follow-up duration. Thus, homogeneity could not account for the absence of the association found between quality of life and weight outcome short-term after surgery. Preoperative quality of life is particularly low among subgroups of patients with eating disorders [9, 10]. When time goes by, the influence of the operation is more definite and postoperative quality of life at long-term after surgery may be less dependent on preoperative quality of life status and more on the definitive weight outcome. Regrettably, so far, we do not have prospective data of patients at long-term after surgery, and cannot confirm this suggestion.

Overall, the findings of our study suggest that LAGB could be a long-term solution to morbid obesity with regard to both weight and multidimensional quality of life outcomes. They further suggest that in patients with less favorable *long-term* results a more integrated approach is advisable, in which the possible reciprocal influences between quality of life aspects and weight outcome should both be the focus of intervention.

DETERMINANTS OF OUTCOME

GENERAL PSYCHOLOGICAL PREDICTORS

Although there is little doubt that bariatric surgery is an effective treatment for severe obesity, there is variability in outcome that might have to do with internal vulnerability factors, such as personality characteristics, and external stressors, such as a history of childhood sexual abuse. The studies described in chapter 3 and 4 focus on the role of personality characteristics and retrospectively reported childhood sexual abuse as predictors of weight outcome after LAGB, respectively.

Personality

Studies on personality variables as predictors of short-term surgical success show mixed results. While two studies with small sample sizes observed that personality variables were significant predictors of short-term weight loss [11, 12], two other studies with larger sample sizes [13, 14], and previous results from our research group [15], showed no relationship between preoperative personality characteristics and short-term weight outcome. The study described in chapter 3 in a large short-term sample confirms that preoperative personality is definitely not a predictor of weight outcome on the short-term after surgery. It was hypothesized that specifically variability in *long-term* weight outcome had to do with personality characteristics. In contrast to this

hypothesis, six out of seven personality variables did not predict long-term weight outcome and only one variable showed a small and unexpected association with long-term weight outcome that needs confirmation. This suggests that personality assessment as intake psychological screening is of little use for the prediction of a poor or successful weight outcome after bariatric surgery. It should be noted, however, that the predictive value of this study does not generalize to psychopathology, such as personality disorders.

Childhood sexual abuse

In line with cross-sectional findings in obese populations [16], we found a higher prevalence of Childhood Sexual Abuse (CSA) in individuals after LAGB for morbid obesity than in normal populations. This raises the possibility that the experience of childhood sexual abuse could be a risk factor for the elevation of obesity. The sexual abused group after LAGB encompassed relatively many persons who had received psychological treatment in the past. Our hypothesis that a poorer outcome after LAGB would be associated with childhood sexual abuse was not confirmed for weight loss and physical health. Also past psychological treatment was not related to weight outcome or physical health after LAGB. Perhaps the uniform pathological weight and eating problems that led to the morbid obese state overruled the impact of psychological factors that have been shown predictive of weight outcome in less severe obesity [17]. However, it is also possible that psychological treatment prevented a worse weight outcome. The group without a history of both sexual abuse and psychological treatment showed a better psychological health than the groups of patients with a history of CSA, past psychological treatment, or combined CSA and psychological treatment. It was concluded that although reported childhood sexual abuse does not appear to impact on the weight outcome and physical health after bariatric surgery, some patients with past psychological treatment or a history of childhood sexual abuse may need additional psychological treatment for their mental health problems.

Concluding remarks on general psychological predictors

Personality characteristics are by definition relatively stable and enduring traits. Similarly, childhood sexual abuse can be regarded as an irreversible psychological stressor, although here social support and psychological treatment could have influenced the relationship between the early stressor and outcome after LAGB. Overall, the results in this thesis show that the general psychological predictors personality characteristics and childhood sexual abuse are not major predictors of weight outcome after bariatric surgery.

SPECIFIC BEHAVIORAL PREDICTORS

Binge eating

Chapter 5 cross-sectionally analyzed binge eating and eating characteristics of a relatively large patient group with both short- and long follow-up duration after LAGB, while chapter 6 prospectively analyzed preoperative binge eating behavior and depression as predictors of weight outcome relatively short-term after LAGB.

In accordance with studies examining eating behavior short-term after bariatric surgery [18, 19], patients in the cross-sectional cohort *short-term* after LAGB showed less binge eating and more healthy eating behavior than the group of patients before surgery. Our prospective data supported these cross-sectional findings, reflecting that binge eating behavior improves relatively short-term after LAGB. Moreover, patients in the cross-sectional cohort *long-term* after LAGB showed less binge eating and more healthy eating behavior than the group of patients before surgery, and there were no significant differences in eating behavior between the two postoperative groups. This suggests that LAGB could be a long-term solution to a substantial amount of preoperatively eating disordered patients. This suggestion needs confirmation in future analysis of long-term prospective data.

Several prospective studies have shown that binge eating often fails to predict postoperative weight outcome [18, 20-22]. In line with these studies, our prospective study showed that binge eating is not a predictor of weight outcome after LAGB. So far, the role of depression in predicting weight outcome after bariatric surgery has hardly been explored. Our hypothesis that the combination of binge eating and depression lead to a poorer weight outcome after bariatric surgery was not confirmed by our results. Neither depression, nor combined binge eating and depression, predicted a worse weight outcome. Thus, it was concluded that *preoperative* binge eating and depression cannot be used to monitor those patients at risk for a worse outcome after LAGB. Our cross-sectional study on binge eating after surgery showed that postoperative binge eating behavior is strongly associated with weight and mental health outcome after LAGB, suggesting that *postoperative* binge eating behavior may affect postoperative weight outcome. This suggestion is supported by our prospective data, showing that binge eating behavior at 6 months after surgery predicted the amount of weight loss at 12 and 24 months after surgery. Therefore, it is advised to monitor binge eating at early stage postoperatively to prevent relapse and, if necessary, to give additional postoperative psychological treatment of binge eating.

Psychobiological factors of binge eating. Insight into aspects influencing binge eating in patients after bariatric surgery is relevant to the adequate treatment of postoperative binge eating. Psychological factors, such as dietary restraint and affect regulation, a general sensitivity to external eating cues, and physiological factors, such as disturbed cortisol levels, may affect binge eating. Chapter 8, focusing on cortisol, and part of the results of chapter 7, focusing on eating styles, will be discussed here as correlates of binge eating behavior.

The eating styles emotional and external eating, but not restrained eating, showed a significant relationship with binge eating. This suggests that, in agreement with experimental studies [23, 24], overeating tendencies are a greater threat to a breakdown in the control of eating than restrained eating. This finding is not so surprising, because emotional and external overeating tendencies comprise by definition the loss of control aspect that is so crucial in binge eating, and, thus, the association between binge eating and overeating attitudes may partly reflect construct overlap. The finding that restrained eating is *not* associated with binge eating is, however, surprising considering the boundary model of overeating [25], and suggests that the boundary model may not apply to the maintenance of binge eating in our sample of patients after surgery for morbid obesity.

Besides psychological factors, physiological factors may affect binge eating. In accordance with findings of an incidental study [26], no differences in morning cortisol levels between patients with and without binge eating disorder were found (chapter 8). However, our patients with binge eating disorder showed lower total daytime cortisol levels than patients without binge eating disorder, and the magnitude of this difference was large. In line with findings in individuals who suffer from chronic stress, lower than normal cortisol values were observed in patients with repeated exposure to binge episodes of uncontrollable stress and high energy intake. Repeated activation of the adrenal cortex may have accomplished alterations on several levels of the HPA axis contribution to the presence of hypocortisolism [27]. Whatever the exact mechanisms, a lower cortisol level in patients with binge eating disorder may be of relevance to the understanding of why patients with binge eating disorder have difficulties to control their eating behavior. This suggestion needs confirmation in future analysis examining binge eating behavior and weight outcome repeatedly over time.

Physical exercise

Correlational studies showed inverse associations between physical exercise and the amount of overweight in the normal adult population [28, 29], but this need not apply for the obese population. In chapter 7 no association between physical exercise and weight or physical health outcome was found. In line with this finding, several randomized trials have shown that the combination of diet plus exercise for obesity failed to produce significantly greater long-term weight loss and improvement in physical health than treatment by diet alone [30-33]. Most of our patients after obesity surgery were still obese. Perhaps an increase in the activity level of our obese patients is limited by the inability to perform exercise of higher intensity, as has been earlier suggested [34].

Factors influencing physical exercise. Beliefs on the resulting health benefits as well as low fear of injury and low embarrassment of enacting physical exercise were associated with physical exercise (chapter 7). Although our study offers many clues to alter physical exercise among this subgroup of patients after obesity surgery by interventions directed at the potentially modifiable cognitions embarrassment, fear of injury, and perceived exercise benefits, our results question

whether enhanced physical exercise would be of use in reference to overall weight outcome after obesity surgery.

LIMITATIONS AND STRENGTHS

The results of this study should be regarded in the light of some limitations as well as strengths to the generalizability of findings, designs of the studies in this thesis, and statistical analyses. Below, we describe methodological considerations with regard to the generalizability of findings, the study design, and the statistical analyses.

Generalizability of findings

When studying the significance of specific risk factors in a population, a prerequisite for the generalizability of the findings is the representativeness of the study samples. Higher levels of distress have been reported in bariatric surgery patients than in morbidly obese patients who undergo non-surgical treatment for their severe obesity [35-37], and, thus, the results in this thesis do not necessarily generalize to morbidly obese patients who undergo non-surgical treatment for their severe obesity. Comparisons of demographic and quality of life variables of our patient groups before surgery with representative samples of other bariatric surgery patients yielded comparable results [4, 21, 38-40], supporting the generalizability of our findings to morbidly obese patients undergoing bariatric surgery. Because a rather similar preoperative condition and weight outcome have been reported in studies examining other bariatric surgical procedures [4], we expect rather similar results in patients undergoing different types of surgery with respect to quality of life outcome and lack of predictive strength of general psychological factors in predicting weight outcome. However, it has been suggested that some surgical procedures, such as biliopancreatic diversion (PBD), may be superior to others, such as restrictive procedures, in severely obese patients with binge eating disorder [41]. Contrary to LAGB, which induces weight loss exclusively by means of reduced calorie intake, malabsorption (bypassing the stomach and upper portions of the small intestine inhibits the absorption of some nutrients), is a primary mechanism of both weight loss and weight maintenance in PBD. Therefore, the findings on binge eating in this thesis are restricted to patients undergoing LAGB as surgical technique.

Study design

Five out of seven studies were characterized by a cross-sectional design. That both binge eating and weight were measured at one moment in time prevents causal inferences of significant associations, which also holds for associations between quality of life and weight, as well as for binge eating and cortisol levels. Strengths of our cross-sectional questionnaire study on quality of life and eating behavior were that it included a large sample with a relatively long follow-up duration. The prospective study on personality as a predictor of weight outcome after LAGB

with a relatively large sample size and long follow-up assessments of weight perhaps better reflects causal relationships, but it should be noted that personality characteristics were assessed at baseline only. Our study did not answer the question whether possible pre- to postoperative changes in personality characteristics predict weight loss. By definition, personality variables are rather stable characteristics, and even when personality variables interact with life-events, such as surgically induced weight loss, the relative position of individuals to each other at a personality variable will not change to a large extent. Our ongoing prospective study assesses cognitive-behavioral predictors, eating behavioral mediators, and quality of life and weight outcome repeatedly over time. However, so far, results of this study are limited by small sample sizes and a relatively short-term follow-up.

Moreover, in this thesis 6 out of 7 studies were restricted to the use of questionnaires to assess psychosocial functioning and eating behavior. Some questionnaires on quality of life and eating behavior used in this thesis have high reliability and validity. However, others were self-developed questionnaires to assess additional aspects of social quality of life, such as intimate and sexual functioning, and perceived benefits and barriers of physical activity in the obese, and a translated version of the binge eating scale. Although the initial psychometric results of these self-developed questionnaires were satisfactory, future research should confirm these results. A preliminary validation of the binge eating scale showed a moderate agreement with the interview diagnosis binge eating disorder in patients after LAGB. Although future research should further examine the validity of the binge eating scale in patients before and after bariatric surgery, results suggest that it potentially has the ability to postoperatively discriminate between patients with and without a successful outcome after bariatric surgery.

Finally, it may be argued that in this thesis the contribution of general psychological predictors to outcome after LAGB was studied independently from possible mediating variables, such as binge eating and related eating attitudes. This was partly due to design technical reasons, as personality characteristics were assessed independently from these mediating variables. However, because the general psychological predictors ‘personality characteristics’ and ‘childhood sexual abuse’ were not associated with outcome after LAGB, the search for mediating variables is considered of less relevance for these variables.

Statistical analyses

In this thesis varying statistical analyses were used. In our personality study, multilevel analysis was used to determine the longitudinal relationship between preoperative personality and postoperative weight loss. Multilevel analysis is not affected by the restrictive data requirements that hamper conventional repeated measurement analyses. Although the number of observations per unit varies, as often applies to repeated weight assessments, all of the available data can be incorporated into the analysis. In our cross-sectional study on binge eating and exercise behavior Structural Equation Modeling (SEM) was used. One main advantage of SEM is that the relationship between several predictors and outcome parameters can be simultaneously

analyzed, while controlling for the effects of other variables. Unfortunately, the relatively small sample sizes in our prospective study did not allow testing of SEM models.

FUTURE RESEARCH

The studies presented in this thesis have shown that both general psychological predictors such as personality characteristics and childhood sexual abuse, binge eating as specific behavioral risk factor, and depression are not important predictors of weight outcome after LAGB. However, a considerable group of patients exhibited binge eating problems after LAGB, which were associated with a worse postoperative outcome. Cognitive behavioral treatment significantly reduces binge eating problems and improves mental health. Therefore, future research should ascertain if the outcome of LAGB could be improved by offering cognitive behavioral guidance to binge eating patients as an adjunct to LAGB. Moreover, future studies should further focus on underlying biopsychosocial mechanisms of binge eating in patients after LAGB, as this information may be relevant to the postoperative treatment of patients with binge eating after LAGB. Both emotional and external eating styles were apparent in individuals with binge eating. To further gain insight into the maintenance process of binge eating, research could focus upon the relationship of specific emotional and external eating styles with current external stressors, such as major life events, and internal stressors, such as inadequate emotion regulation, assessing psychological variables, mediators, and outcome variables repeatedly over time. Finally, the finding that postoperative binge eating is associated with a worse postoperative outcome after LAGB needs replication in patients undergoing different types of bariatric surgery. In conclusion, results in this thesis suggest that future research should be aimed at current postoperative, instead of preoperative, risk factors for a worse weight and quality of life outcome.

CLINICAL IMPLICATIONS

Pointing out clinical implications, the core issue to be addressed is whether our findings can be used to improve outcome of and care for patients after LAGB. The studies assembled in this thesis all provide evidence of a lack of predictive strength of preoperative psychological variables in predicting outcome after LAGB. Neither the general psychosocial predictors personality characteristics and childhood sexual abuse nor the specific behavioral risk factor binge eating behavior, and depression can be used to preoperatively monitor those patients at risk for a worse outcome after LAGB. Thus, in terms of the predictive strength of postoperative outcome from preoperative psychosocial factors, this thesis provides no reason to exclude specific subgroups of morbidly obese patients from the operation or to give additional

preoperative psychosocial care to specific subgroups of patients. Instead, the findings of this thesis suggest that the identification of individual patients requiring extra psychosocial care could better take place *after* the operation, with attention focused upon patients with eating problems.

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Samenvatting (Dutch Summary)

Obesitas wordt door de Wereld Gezondheidsorganisatie gedefinieerd als een chronische ziekte die gepaard gaat met vetstapeling in het lichaam op een zodanige wijze dat er gezondheidsrisico's optreden. De prevalentie van obesitas is de laatste jaren in alarmerende mate toegenomen in geïndustrialiseerde samenlevingen. Geschat wordt dat tussen de zeven en vijftien procent van de mensen in de Westerse wereld en tussen de twintig en dertig procent van de mensen in Amerika aan obesitas lijdt. Men spreekt van obesitas wanneer de Quetelet-index (QI; het gewicht in kilogram gedeeld door het kwadraat van de lengte in meters) groter is dan 30 kg/m^2 en van morbide obesitas als de Quetelet-index groter is dan 40 kg/m^2. De gezondheidsrisico's nemen toe naarmate de Quetelet-index groter is. Naast de gezondheidsrisico's kunnen patiënten met (morbide) obesitas ook worden geconfronteerd met stigmatisering en discriminatie. De gezondheidsrisico's en stigmatisering van obese personen kunnen leiden tot een verminderd fysiek, psychisch en sociaal welbevinden en functioneren. Behandeling van morbide obesitas met dieet en medicatie is veelal teleurstellend vanwege het hoge uitval- en terugvalpercentage. Bariatrische chirurgie, operatieve behandeling met als doel gewichtsreductie, lijkt een gunstig resultaat op langere termijn te bieden. Bariatrische chirurgie is gemiddeld effectief, maar de mate van gewichtsverlies en verbetering van kwaliteit van leven verschillen van persoon tot persoon. De patiënten over wie in dit proefschrift verslag wordt gedaan hebben allen een maagbandoperatie ondergaan. Dit is een vorm van bariatrische chirurgie waarbij een in diameter instelbaar siliconen bandje rond de overgang van slokdarm naar maag wordt geplaatst. Hierdoor kan het voedsel minder gemakkelijk in de maag komen. Patiënten kunnen het effect van een maagbandoperatie teniet doen door inname van grote hoeveelheden *vloeibaar*, calorierijk voedsel, dat de maagband gemakkelijk kan passeren. Onderzoek naar eetgedrag en ander gezondheidsgedrag is belangrijk omdat deze aspecten mogelijk veranderd kunnen worden met behulp van een psychologische interventie. Het doel van dit proefschrift was om te onderzoeken of psychologische factoren de uitkomst na een maagbandoperatie konden voorspellen, waarbij specifiek aandacht is besteed aan gedragsmatige predictoren zoals eetgedrag en bewegingsgedrag. Het proefschrift is onderverdeeld in drie delen die betrekking hebben op de uitkomst (hoofdstuk 2), algemene psychologische predictoren (hoofdstuk 3 & 4), en specifieke gedragsmatige predictoren en determinanten van deze predictoren (hoofdstuk 5 t/m 8).

UITKOMST NA EEN MAAGBANDOPERATIE

In de eerste studie van dit proefschrift (hoodstuk 2) wordt verslag gedaan van de kwaliteit van leven na een maagbandoperatie. Kwaliteit van leven wordt gezien als belangrijke uitkomstmaat in studies naar chronische ziekten. Een goede kwaliteit van leven is in de eerste plaats belangrijk voor de individuele patiënt. Ten tweede heeft een goede kwaliteit van leven een maatschappelijk nut doordat mensen met een betere kwaliteit van leven bijvoorbeeld minder snel een dokter

zullen bezoeken en meer deelnemen aan het arbeidsproces. De kwaliteit van leven van mensen na een maagbandoperatie kan eveneens indirect bijdragen aan de handhaving van het gewichtsverlies via gezondheidsgedrag. Uit de studie beschreven in hoofdstuk 2 bleek dat patiënten na operatie een betere fysieke, psychische en sociale kwaliteit van leven hadden dan patiënten voor operatie. Er waren geen verschillen tussen patiënten op korte en lange termijn na operatie. Dit lijkt te impliceren dat een maagbandoperatie ook op langere termijn gunstige gevolgen heeft voor de kwaliteit van leven. Ondanks dat patiënten in het algemeen een betere sociale kwaliteit van leven hadden, bleek de directe sociale steun van familie of goede vrienden niet te verschillen voor patiënten voor en na operatie. Tevens bleek de directe sociale steun van de onderzoekspopulatie en de Nederlandse normpopulatie niet te verschillen. Hieruit mag geconcludeerd worden dat de sociale steun van dierbaren onafhankelijk is van het gewicht. Sociale steun is geen belangrijke uitkomstmaat na bariatrische chirurgie, maar het wordt niet uitgesloten dat sociale steun een mediërende rol kan vervullen tussen gezondheidsgedragingen en gewichtsverlies.

Uit eerder onderzoek is gebleken dat er weinig samenhang is tussen de uitkomstmaten gewicht en kwaliteit van leven na bariatrische chirurgie. Veel van deze onderzoeken waren gericht op de korte termijn na operatie. Onze hypothese was dat patiënten net na operatie redelijk homogeen zijn qua kwaliteit van leven en gewichtsverlies, hetgeen de valide bepaling van correlaties onmogelijk maakt. Wij verwachtten dat op lángere termijn na operatie patiënten meer zouden verschillen in kwaliteit van leven en gewichtsverlies en kwaliteit van leven en gewichtsverlies wél zouden zijn geassocieerd. Conform onze hypothese bleek dat gewicht en kwaliteit van leven samenhingen op langere maar niet op kortere termijn na operatie. Echter, in tegenstelling tot onze verwachtingen was de groep op langere termijn na operatie niet heterogener in termen van uitkomstmaten dan de kortere termijn groep. Kennelijk was het dus niet zo dat de homogeniteit in uitkomstmaten heeft verhinderd dat bepaalde samenhangen niet werden geobserveerd op korte termijn na operatie.

ALGEMENE PSYCHOLOGISCHE PREDICTOREN

Bariatrische chirurgie is de meest aangewezen methode voor de behandeling van morbide obesitas. Toch bereikt ongeveer 30 procent van de patiënten onvoldoende gewichtsverlies. Persoonlijkheidstrekken van de patiënt zelf en een geschiedenis van seksueel misbruik gedurende de kindertijd werden verondersteld invloed uit te oefenen op de uitkomst na bariatrische chirurgie. Uit de tweede studie van dit proefschrift (hoofdstuk 3) bleek dat geen van de persoonlijkheidsvariabelen het gewichtsverlies op korte termijn voorspelden en slechts één variabele een gering percentage van de verklaarde variantie van het gewichtsverlies op langere termijn voorspelde. Geconcludeerd werd dat persoonlijkheidsvariabelen weinig nut hebben bij de voorspelling van het gewichtsverlies na een maagbandoperatie. De derde studie van dit

proefschrift (hoofdstuk 4) toonde geen samenhang tussen seksueel misbruik in de jeugd en gewichtsverlies na een maagbandoperatie. Wel hing de rapportage van seksueel misbruik in de jeugd samen met depressieve klachten. Dit laatste komt overeen met de bevindingen uit eerder onderzoek onder de Nederlandse bevolking en lijkt los te staan van het effect van de maagbandoperatie.

SPECIFIEKE GEDRAGSMATIGE PREDICTOREN

Vreetbuien

Vreetbuien zijn in dit proefschrift gedefinieerd als controleverlies over eetgedrag. Hoofdstuk 5 van dit proefschrift beschrijft een cross-sectionele studie naar de relatie tussen het hebben van vreetbuien en de uitkomst na bariatrische chirurgie. In hoofdstuk 6 wordt in een prospectieve studie de voorspellende kracht van vreetbuien en depressieve klachten voor het gewichtsverlies na operatie onderzocht. Het eetgedrag van patiënten op korte termijn na een maagbandoperatie bleek te verbeteren. Voorts bleek uit onze cross-sectionele gegevens dat er geen verschillen waren tussen postoperatieve groepen op korte en lange termijn na operatie. Dit suggereert dat een maagbandoperatie tot een stabiele verandering van het eetgedrag leidt. Uit de literatuur blijkt dat vreetbuien en controleverlies over het eetgedrag vóór operatie vaak niet voorspellend zijn voor het gewichtsverlies na operatie. In overeenstemming met deze bevindingen vonden ook wij dat preoperatieve vreetbuien niet voorspellend waren voor het gewichtsverlies na operatie. Postoperatieve vreetbuien bleken daarentegen wel samen te hangen met het gewichtsverlies na operatie en postoperatieve vreetbuien op 6 maanden na operatie bleken voorspellend voor het gewichtsverlies op 12 en 24 maanden na operatie. Op basis van deze resultaten wordt geadviseerd om postoperatieve vreetbuien vroegtijdig op te sporen en zo nodig psychologische behandeling van dit gedrag te geven.

Psychobiologische factoren van vreetbuien. Inzicht in aspecten die vreetbuien beïnvloeden kan nuttig zijn voor de eventuele behandeling hiervan. Vreetbuien zouden onder invloed kunnen staan van psychologische factoren zoals lijnen, emoties en een algemene gevoeligheid voor externe eetprikkels, alsmede fysiologische factoren zoals verstoorde cortisol niveau's. In een postoperatieve groep patiënten (hoofdstuk 7) vonden wij dat een algemene gevoeligheid voor emotionele en externe eetprikkels wél en lijngedrag niet met vreetbuien samenhing. Dit suggereert dat het nuttig kan zijn om de behandeling van vreetbuien bij deze patiëntengroep meer te richten op gevoeligheden voor eetprikkels dan op het lijngedrag van mensen. In hoofdstuk 8 wordt verslag gedaan van cortisol niveau's bij mensen met een vreetbuistoornis. Patiënten met een vreetbuistoornis bleken normale ochtenwaarden van cortisol te hebben, maar de totale cortisol output over de dag was lager dan die van patiënten zonder een vreetbuistoornis.

Lagere cortisol niveau's zouden een mogelijk verklaring kunnen vormen voor het controleverlies dat mensen met vreetbuien over hun eetgedrag vertonen.

Fysieke activiteit

Uit wetenschappelijk onderzoek onder de normale populatie blijkt dat mensen die meer fysieke sportactiviteiten beoefenen minder overgewicht hebben dan mensen die minder aan sport doen en dat bewegingsprogramma's tot gewichtsverlies kunnen leiden. Wij vonden echter geen relatie tussen fysieke activiteit en gewichtsverlies in een postoperatieve groep patiënten na een maagbandoperatie (hoofdstuk 7). Mogelijk is de hoeveelheid fysieke activiteit die patiënten na een maagbandoperatie kunnen vertonen niet voldoende om ook daadwerkelijk een reductie in het gewicht te veroorzaken. Dit komt overeen met de vaak teleurstellende resultaten van obese personen na specifieke bewegingsprogramma's om gewicht te verliezen.

Psychologische factoren van fysieke activiteit. Cognities zoals angst voor letsel en schaamte om te gaan sporten bleken samen te hangen met de mate waarin mensen fysieke sportactiviteiten beoefenen (hoofdstuk 7). Ondanks dat deze cognities over sportgedrag aanknopingspunten zouden kunnen vormen om het sportgedrag van mensen te veranderen, kan afgevraagd worden in hoeverre dat nuttig is in relatie tot de gewichtsuitkomst van mensen.

KLINISCHE IMPLICATIES

De studies die in dit proefschrift zijn beschreven tonen aan dat géén van de algemene psychologische factoren of specifieke gedragsmatige factoren vóór operatie het gewichtsverlies van patiënten na een maagbandoperatie voorspelde. Dit impliceert dat psychologische factoren voor operatie niet kunnen worden gebruikt om mensen preoperatief een operatie te onthouden of om specifieke subgroepen van patiënten voor operatie additionele psychologische behandeling aan te bieden. Daarentegen suggereren de bevindingen in dit proefschrift dat het opsporen van patiënten die mogelijk uiteindelijk een onvoldoende resultaat na een maagbandoperatie behalen beter plaats zou kunnen vinden net ná de operatie. Hierbij lijkt het belangrijk de aandacht vooral te richten op mensen die vreetbuien of ander verstoord eetgedrag vertonen.

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En wat zou de “afdeling bariatrische chirurgie” in het Antonius Ziekenhuis Nieuwegein (AZN) nog zijn zonder verpleegkundig consulente Brigitte Bliemer? Brigitte, uiteraard een persoonlijk woordje voor jou. Jij hebt als spil van de afdeling bariatrische chirurgie niet alleen werktechnisch bezien, maar ook zeker persoonlijk een belangrijke rol voor mij gespeeld, in die zin dat ik me altijd welkom en gesteund heb gevoeld door jou. Pieter de Wit, voormalig psycholoog in het AZN, dank ik voor de gesprekken en groepsbijeenkomsten met patiënten die ik heb mogen bijwonen en zijn hartelijkheid.

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Curriculum Vitae

Junilla Larsen was born in 1976 in Gouda, The Netherlands. After completing secondary eduation (VWO) in 1994, she studied Psychology at Utrecht University. During her study, she worked for three years as a research assistant. She obtained her Masters degree in Health Psychology in 1999. In 2000, she started working as a Ph.D. student on the project 'Determinants of outcome in patients with morbid obesity who undergo laparoscopic adjustable gastric banding (LAGB)', that has resulted in the current thesis. The research was conducted at the Department of Health Psychology at Utrecht University and the Department of Surgery of the Sint Antonius Hospital Nieuwegein. Since May 2004, she works as a post doc researcher on a project 'The Dutch Eating Behavior Questionnaire Revisited' at the Department of Clinical Psychology and the Centre for Women's Studies at Nijmegen University.

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