Quality of life after Roux-en-Y gastric bypass and changes in body mass index and obesity-related comorbidities

C. Julia a,b,c, C. Ciangura a, L. Capuron d, J.-L. Bouillot e, A. Basdevant a,f,g, C. Poitou a,f,g, J.-M. Oppert a,* b

Abstract

Aim. – Dynamics of improvement in health-related quality of life (QoL) after bariatric surgery have never been fully assessed, and neither has the potential influence of body mass index (BMI) and comorbidity modification. The objective of this study was to investigate early and medium-term changes in QoL following Roux-en-Y gastric bypass (RYGB), and their relationship to BMI and comorbidity variations.

Methods. – A total of 71 obese subjects (80% women, mean age 42.1 ± 11.2 years, mean baseline BMI 47.6 ± 6.2 kg/m²) undergoing RYGB filled in QoL questionnaires (SF-36) before and 3, 6 and 12 months after surgery. QoL was assessed using repeated-measures Anova, with associations between its changes and changes in BMI and comorbidities (diabetes, hypertension, dyslipidaemia, sleep apnoea, knee pain) assessed by mixed-effects models.

Results. – Physical QoL scales (physical component summary, PCS) significantly increased over time (from 38.9 ± 9.3 to 52.6 ± 7.9; P < 0.001) as did other physical SF-36 scales (all P < 0.001), whereas mental QoL summary scale did not vary significantly (from 45.7 ± 9.5 to 48.6 ± 11.5; P = 0.072). Major changes in QoL occurred at 3 months after surgical intervention to reach values comparable to those in the general population. PCS was mostly associated with changes in either BMI or comorbidity status except for diabetes, dyslipidaemia and sleep apnoea.

Conclusion. – Results show that improvements in physical QoL after RYGB are observed as early as 3 months after intervention, and are independently associated with weight loss and improvements in comorbidities.

Keywords: Quality of life; Roux-en-Y gastric bypass; Morbid obesity; Post-surgery follow-up

Résumé

Cinétique des changements de la qualité de vie après bypass gastrique : relations avec les modifications du poids et des comorbidités.

Objectifs. – La cinétique de l’amélioration de la qualité de vie liée à la santé (QdV) après chirurgie bariatrique n’a pas été bien étudiée, de même que l’influence potentielle des modifications de l’indice de masse corporelle (IMC) ou des comorbidités associées à l’obésité. L’objectif de cette étude était d’analyser la cinétique à court et moyen terme de la QdV et ses relations avec les modifications de l’IMC et des comorbidités dans un échantillon de patients qui avaient bénéficié d’un bypass gastrique de type Roux-en-Y (BPGRY).

Méthodes. – Soixante et onze patients obèses (80% de femmes, âge moyen 42,1 ± 11,2 ans, IMC moyen préopératoire 47,6 ± 6,2 kg/m²) qui avaient bénéficié d’un BPGRY ont rempli un questionnaire de QdV (SF-36) en préopératoire et à trois, six et 12 mois postopératoires.
Les modifications de QdV ont été analysées par Anova pour mesures répétées et les associations entre les modifications de la QdV et les modifications de l’IMC ou des comorbidités (diabète, hypertension artérielle, dyslipidémie, syndrome d’apnées du sommeil, gonalgies) ont été analysées par des modèles mixtes.

Résultats. – La composante physique résumée de la QdV (PCS) augmentait significativement avec le temps (de 38,9 ± 9,3 à 52,6 ± 7,9, P < 0,001), de même que les autres échelles de QdV physique (tous les P < 0,001) alors que la composante mentale résumée (MCS) n’augmentait pas significativement (de 45,7 ± 9,5 à 48,6 ± 11,5, P = 0,072). Les modifications les plus importantes de la QdV avaient lieu dès trois mois postopératoires, et rejoignaient des valeurs comparables à celles de la population générale. La PCS était associée aux modifications de l’IMC et des comorbidités, excepté pour le diabète, la dyslipidémie ou le syndrome d’apnées du sommeil.

Conclusions. – Nos résultats montrent que l’amélioration de la QdV physique après BPGRY est observée dès le troisième mois après l’intervention, et est associée de manière indépendante à la perte de poids et à l’amélioration des comorbidités.

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Mots clés : Qualité de vie ; Obésité morbide ; Bypass gastrique de type Roux-en-Y ; Surveillance postopératoire

1. Introduction

Morbidly obese subjects are at risk of numerous physical and psychological comorbidities that severely impair their health-related quality of life (QoL) [1–3]. Compared with subjects of normal body weight, obese subjects tend to have low QoL [4,5], and morbidly obese subjects seeking bariatric surgery as a treatment have even poorer QoL than their non-seeking-treatment counterparts [6,7]. Comorbidities also impair QoL, and studies have reported that their effect on QoL is cumulative and independent of body mass index (BMI) [4]. Ul-Haq et al. [8] were able to show not only that QoL was significantly lower for subjects with obesity, with a gradient following BMI category, but also that, for every BMI category, subjects with metabolic comorbidities had lower QoL.

Bariatric surgery not only allows sustained drastic weight loss, but also reduces comorbidities and improves QoL [9,10]. Evidence indicates that improvement in QoL is maximum during the first year following bariatric surgery and stable thereafter [11]. Several studies have suggested that this improvement in QoL occurs very early after intervention [12,13], but evidence for the dynamics of the improvement in the first year is scarce.

Some studies have shown that QoL improvement is associated with weight loss and comorbidity improvement. Chang et al. [12] found that weight loss and comorbidity status were independently associated with improvement in QoL in a multivariate analysis. However, comorbidity was not further defined, and the relative importance of metabolic or mechanical comorbidities was not investigated. Moreover, to our knowledge, no study has investigated these associations while discriminating between baseline effects and the effect of changes in status.

QoL is a crucial patient-reported outcome likely to be strongly affected during the immediate post-surgery period, when drastic weight loss and lifestyle modifications take place. For this reason, our objectives were to investigate the dynamics of QoL changes in the first year after bariatric surgery and to determine their relationship to weight loss and comorbidities, while discriminating between cross-sectional and longitudinal effects. It was hypothesized that beyond the effects of weight loss, the presence of comorbidities would be related to QoL and that changes in BMI and comorbidity status would be more closely related to QoL than baseline differences between subjects.

2. Materials and methods

2.1. Study population

All patients consecutively admitted to the nutrition department of Pitié-Salpêtrière University Hospital (Paris, France) for Roux-en-Y gastric bypass (RYGB) because of morbid obesity between March 2007 and October 2009 were eligible for inclusion in the study. The decision to operate was made by a multidisciplinary team according to French, European and North American guidelines for the management of obese patients [14–16]. In all cases, non-surgical weight-loss methods had failed. Participants were informed of the potential risks of the surgical procedure, received general advice and support on diet and physical activity, and gave their informed written consent to participate [17]. The follow-up study protocol had the approval of the ethics committee of Hôtel-Dieu Hospital (Paris, France). Patients for whom it would have been a second bariatric intervention after failure of a first procedure were excluded. As part of the systematic evaluation, each patient was asked to fill out a QoL questionnaire, and to undergo clinical examinations measuring body weight and height, and assessing comorbidities, at baseline (preoperative) and at 3, 6 and 12 months postoperative.

All participants with complete information on QoL and comorbidity status for each examination were included in the present analyses.

2.2. Data collection

The French version of the 36-item short-form (SF-36) questionnaire [18] was self-completed by the patients at every examination. The SF-36 is a generic QoL questionnaire widely used in health research and describes two dimensions of QoL: physical health and mental health. The individual items are used to construct scales that, in turn, are summarized in a physical component summary (PCS) and mental component summary (MCS). Scales include physical functioning, role limitations due to physical problems (termed ‘role physical’), bodily pain, general health, vitality, social functioning, role limitations due to emotional problems (termed ‘role emotional’), and mental health. Standardized scores range from 0 (poor health) to 100 (good health) [19]. A population difference of 5 points in any scale is considered clinically significant. The French version
of the SF-36 QoL questionnaire has been tested and shown to have adequate psychometric characteristics, such as good reproducibility and validity [18].

Clinical examination by a physician at every study time point monitored the comorbidities found before the surgical procedure. The comorbidities taken into account in the present study were diabetes, dyslipidaemia, hypertension, sleep apnoea and knee pain.

Baseline comorbidity status was defined as follows: diabetes was defined as a fasting blood glucose ≥ 7.0 mmol/L or use of antidiabetic medication; hypertension was defined as a mean blood pressure ≥ 140/90 mmHg or use of antihypertensive medications; dyslipidaemia was defined as the presence of hypercholesterolaemia (total cholesterol > 5.7 mmol/L or use of statin medication) or hypertriglyceridaemia (triglycerides > 1.7 mmol/L or use of fibrate medication); sleep apnoea was defined as an apnoea/hypopnoea index (AHI) ≥ 5/h on a sleep study or the use of a continuous positive airway pressure (CPAP) device; and knee pain was defined by a simple yes/no question.

Comorbidities at any examination were considered cured if medication (or CPAP) was discontinued, and if biological measurements were within the normal range, using validated cut-offs whenever possible. For diabetes, recommendations from the American Diabetes Association (ADA) were followed (fasting glucose < 5.6 mmol/L without antidiabetic medication) [20].

Body weight was measured to the nearest 0.1 kg, and height to the nearest 0.5 cm with a wall-mounted stadiometer with subjects wearing indoor clothing and no shoes. BMI was calculated by dividing weight (in kg) by the square of height (m²). Analyses (see below) focused on changes in BMI over time; this parameter was selected instead of excess weight loss or percent weight loss to have a height-independent variable that was not a relative proportion.

2.3. Statistical analysis

SF-36 QoL scales were calculated according to standard procedures and yielded scores between 0 and 100 points [21]. Weighted standardized PCS and MCS were computed to allow comparison of results with data available for the general French population [21].

Differences between mean QoL variables at each time point during follow-up were compared using repeated-measures analysis of variance (Anova). Two-by-two mean comparisons were performed using pairwise t tests, with adjusted P values for repeated measures. Comparisons with the general French population scores for SF-36 QoL scales and summary measures were computed using t tests. Changes in comorbidity status between baseline and 12 months after intervention were compared with McNemar’s tests.

Associations between PCS and BMI and comorbidities were assessed with mixed-effects models using fixed effects and random intercepts. To discriminate between baseline (cross-sectional differences between subjects at baseline) and longitudinal (effect of changes) effects of BMI and comorbidity status, the following variables were included in the model: baseline comorbidity status (reflecting baseline differences in PCS between subjects according to comorbidity status); interaction between baseline comorbidity status and time (reflecting effect of baseline status on changes in PCS); change in comorbidity status from baseline status (reflecting effect of changes in comorbidity status on PCS, or longitudinal effect); baseline BMI (reflecting baseline differences in PCS between subjects according to baseline BMI); interaction between baseline BMI and time (reflecting effect of baseline BMI on changes in PCS); changes in BMI from baseline (reflecting effect of changes in BMI on PCS, or longitudinal effect); gender; and time (in months).

Comorbidities were tested as independent variables changing with time as follows: each comorbidity alone; metabolic comorbidities (diabetes, dyslipidaemia or hypertension); mechanical comorbidities (sleep apnoea or knee pain); presence of comorbidities (any/none); and number of comorbidities (from 0 to 5). Comorbidities were modeled from absence to presence, so that associations read as an effect of the presence of the comorbidity (or effect of change from absence to presence). To read the effect of the absence (or change from presence to absence), the opposite of β must be used, with no modification of the variable test. As for continuous variables (BMI in this case), β reads as the effect on PCS of a 1-point change in the variable. Analyses were performed using R (version 2.11.1) and SAS (version 9.1; SAS Institute, Cary, NC, USA) software.

3. Results

Between March 2007 and October 2009, 124 patients with complete baseline data for anthropometrics and QoL measurements underwent RYGB. Of these patients, 53 were excluded because of incomplete data at any of the follow-up examinations, leaving 71 with complete data for analysis. Of these, 57 (80.3%) were women with a mean age of 42.1 ± 11.2 years. Mean baseline BMI was 47.6 ± 6.2 kg/m²; baseline PCS was 38.9 ± 9.3 and baseline MCS was 45.7 ± 9.5 (Table 1).

After RYGB, mean BMI decreased to 32.4 ± 6.1 kg/m² at 1 year after the surgical procedure, corresponding to a mean percentage weight loss of 32.0 ± 7.1%.

QoL measures increased at 12 months to 52.6 ± 7.9 (+35.2% from baseline) for PCS and to 48.6 ± 11.5 (+6.3% from baseline) for MCS. The latter increase was of borderline significance (P = 0.072; Table 1 and Fig. 1). During the 12 months following bariatric surgery, every scale included in the SF-36 QoL increased significantly (P < 0.001) except for the role emotional scale (P = 0.167; Table 1). As for PCS, physical functioning and general health scales, the improvement in QoL was significant as early as 3 months postoperative and continued to consistently increase up to 12 months. For all other scales, the observed increase from baseline to the 3-month postoperative time point was significant (Table 1).

All baseline QoL scales and summary measures were significantly lower compared with those available for the general French population (Table 1) [21]. Differences between our sample and the general population were, however, less important for mental than for physical health scales. After undergoing gastric bypass, the QoL in our sample reached values...
Table 1
Changes in mean SF-36 quality of life scores and body composition variables between baseline and at 3, 6 and 12 months after bariatric surgery.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>12</th>
<th>( P_{\text{trend}} )</th>
<th>Mean GP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS</td>
<td>38.9*</td>
<td>47.2*a,b</td>
<td>49.9*a,b</td>
<td>52.6*a,b,c</td>
<td>&lt;0.001</td>
<td>50</td>
</tr>
<tr>
<td>MCS</td>
<td>45.7*</td>
<td>48.9</td>
<td>49.7*a</td>
<td>48.6</td>
<td>0.072</td>
<td>50</td>
</tr>
<tr>
<td>Physical functioning</td>
<td>56.7*</td>
<td>76.9*a,a</td>
<td>85.9*a,b,c</td>
<td>90.9*a,b,c</td>
<td>&lt;0.001</td>
<td>84.5</td>
</tr>
<tr>
<td>Role physical</td>
<td>60.6*</td>
<td>74.3*a</td>
<td>81.5*a,b,c</td>
<td>87.1*a,b</td>
<td>&lt;0.001</td>
<td>81.2</td>
</tr>
<tr>
<td>Body pain</td>
<td>50.7*</td>
<td>70.0*a</td>
<td>72.3*a,b,c</td>
<td>75.7*a</td>
<td>&lt;0.001</td>
<td>73.4</td>
</tr>
<tr>
<td>General health</td>
<td>48.1*</td>
<td>67.8*a</td>
<td>72.1*a,b</td>
<td>75.9*a,b,c</td>
<td>&lt;0.001</td>
<td>69.1</td>
</tr>
<tr>
<td>Vitality</td>
<td>43.0*</td>
<td>55.8*a</td>
<td>60.9*a,b,c</td>
<td>61.9*a,b,c</td>
<td>&lt;0.001</td>
<td>60.0</td>
</tr>
<tr>
<td>Social functioning</td>
<td>63.7*</td>
<td>78.3*a</td>
<td>81.2*a,b,c</td>
<td>84.0*a</td>
<td>&lt;0.001</td>
<td>81.5</td>
</tr>
<tr>
<td>Role emotional</td>
<td>72.3*</td>
<td>79.3</td>
<td>84.0</td>
<td>80.3</td>
<td>0.167</td>
<td>82.1</td>
</tr>
<tr>
<td>Mental health (individual)</td>
<td>62.1*</td>
<td>71.6*a</td>
<td>73.5*a,b</td>
<td>72.2*a,b,c</td>
<td>&lt;0.001</td>
<td>68.5</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>47.6</td>
<td>39.6*</td>
<td>35.7*a,b,c</td>
<td>32.4*a,b,c</td>
<td>&lt;0.001</td>
<td></td>
</tr>
</tbody>
</table>

\( P_{\text{trend}} \) value by repeated measures ANOVA; GP: general French population; PCS: physical component summary; MCS: mental component summary; BMI: body mass index.

* \( P < 0.05 \) vs. French GP
a \( P < 0.05 \) vs. baseline.
b \( P < 0.05 \) vs. 3 months.
c \( P < 0.05 \) vs. 6 months.

similar to those available for the general French population [21]: MCS, role physical, body pain, general health, vitality, social functioning, role emotional and mental health differences between our sample and the general population were no longer significant at the 3-month postoperative time point. For PCS and physical functioning, differences were no longer significant at 6 months after surgery (Table 1). QoL variables therefore increased rapidly to reach values comparable to those of the general population and were maintained at such levels thereafter.

Between baseline and 12 months post-surgery, the prevalence of comorbidities also significantly decreased (all \( P < 0.001 \) except for diabetes, which was \( P=0.002 \)). Diabetes was considered cured in ten participants (41.7%), dyslipidaemia in 24 (85.7%), hypertension in 18 (52.9%) and sleep apnoea in 36 (78.3%; Table 2).

Table 2
Evolution of comorbidities between baseline and 12 months after surgery.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>12 months postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>24</td>
<td>37.5</td>
</tr>
<tr>
<td>Dyslipidaemia</td>
<td>28</td>
<td>43.8</td>
</tr>
<tr>
<td>Hypertension</td>
<td>34</td>
<td>53.1</td>
</tr>
<tr>
<td>Sleep apnoea</td>
<td>46</td>
<td>71.9</td>
</tr>
<tr>
<td>Knee pain</td>
<td>43</td>
<td>67.2</td>
</tr>
</tbody>
</table>

\( a \) McNemar’s test for dependent samples.

Mixed-effects models showed that PCS was significantly associated with comorbidity status as was BMI, and allowed discrimination between cross-sectional and longitudinal effects (Table 3). Baseline PCS differed between those presenting with knee pain and those who did not (\( \beta = -4.372, P=0.012 \)), and the more comorbidities present, the lower the baseline PCS (\( \beta = -2.183, P < 0.001 \)). Moreover, baseline presence of hypertension was significantly associated with smaller changes in PCS (\( \beta = -0.428, P=0.025 \)). Change in comorbidity status was significantly related to change in PCS and was independent of the effect of change in BMI, except for diabetes, dyslipidaemia and sleep apnoea, with a cumulative effect: improvement in one comorbidity was associated with improvement in PCS by 1.59 points (\( P=0.007 \)). In all models, baseline BMI was not significantly associated with PCS and changes in PCS. However, change in BMI was significantly related to change in PCS (in all models, \( P \leq 0.001 \)). Gender was not significantly associated with PCS except in the model adjusted for knee pain, which showed that women had a statistically significantly higher PCS over time compared with men (\( \beta = 4.36, P=0.022 \)).

4. Discussion

Our present results suggest that improvement in QoL after bariatric surgery takes place in the first months after surgical intervention and achieves values comparable to those in the
Table 3
Results for mixed models with fixed effects and random intercepts.

<table>
<thead>
<tr>
<th>Comorbidity (yes/no)</th>
<th>Effect of baseline comorbidity on baseline PCS (cross-sectional)</th>
<th>Effect of change in comorbidity status on change in PCS (longitudinal)</th>
<th>Effect of baseline BMI on baseline PCS (cross-sectional)</th>
<th>Effect of baseline BMI on change in PCS (longitudinal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$</td>
<td>$P$</td>
<td>$\beta$</td>
<td>$P$</td>
</tr>
<tr>
<td>Comorbidity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes (yes/no)</td>
<td>$-5.590$</td>
<td>$0.098$</td>
<td>$0.341$</td>
<td>$0.258$</td>
</tr>
<tr>
<td>Hypertension (yes/no)</td>
<td>$-3.234$</td>
<td>$0.092$</td>
<td>$-0.034$</td>
<td>$0.864$</td>
</tr>
<tr>
<td>Dyslipidaemia (yes/no)</td>
<td>$-2.961$</td>
<td>$0.096$</td>
<td>$-0.195$</td>
<td>$0.323$</td>
</tr>
<tr>
<td>Metabolic comorbidity</td>
<td>$-1.585$</td>
<td>$0.416$</td>
<td>$-0.183$</td>
<td>$0.345$</td>
</tr>
<tr>
<td>Sleep apnoea (yes/no)</td>
<td>$-2.108$</td>
<td>$0.275$</td>
<td>$-0.046$</td>
<td>$0.820$</td>
</tr>
<tr>
<td>Knee pain (yes/no)</td>
<td>$-4.372$</td>
<td>$0.012$</td>
<td>$0.081$</td>
<td>$0.639$</td>
</tr>
<tr>
<td>Mechanical comorbidity</td>
<td>$-2.255$</td>
<td>$0.340$</td>
<td>$0.064$</td>
<td>$0.777$</td>
</tr>
<tr>
<td>Sum of comorbidities (0–5)</td>
<td>$-2.183$</td>
<td>$&lt;0.001$</td>
<td>$-0.014$</td>
<td>$0.807$</td>
</tr>
</tbody>
</table>

PCS: physical component summary; BMI: body mass index. Co-variables included in the models: gender; baseline BMI (kg/m²); interaction between baseline BMI and time; change in BMI (from baseline level); baseline comorbidity status; interaction between baseline comorbidity status and time; and change in comorbidity status (from baseline status) and time (months).

general population. The improvement in QoL was mainly related to changes in comorbidity status and BMI (longitudinal effect), whereas differences in PCS between subjects were of lesser importance.

Several studies have reported that changes in QoL after bariatric surgery essentially occur within the first year and level off thereafter [11,22,23]. However, most of these studies focused on medium- and long-term outcomes. Sarwer et al. [23] observed that improvement in SF-36 was significant 20 weeks after gastric bypass, then leveled off, and was related to percent weight loss. Some studies have investigated the early outcomes of bariatric surgery. Torquati et al. [13] determined that QoL significantly improved 3 months after surgery in subjects undergoing gastric bypass. Consistent with our present results, Chang et al. [12] suggested that QoL improved as early as 1 month after bariatric surgery and stabilized after 3 months, and that improvement in QoL was significantly associated with BMI changes. In another report comparing laparoscopic and open gastric bypass, Nguyen et al. [24] found that improvement in QoL was sizeable as early as a month after intervention, although improvement in all scales of the SF-36 questionnaire was only substantial 3 months after surgery in both study groups. As a complement to our main study, an analysis of the SF-36 data was also performed with patients who had also completed a questionnaire 1 month after surgery ($n=61$ of our initial sample). The results showed that QoL slightly decreased in the first month (mean PCS: 37.22 ± 8.4; mean MCS: 41.61 ± 11.6), but subsequently increased as described above at 3 months. This might be explained by the fact that, at that time point after surgery, patients may experience postoperative complications. Our data support the contention that actual improvement in QoL appears to occur 3 months after intervention rather than earlier.

Improvement in mental health domains was not significant in our present study. However, baseline measures were less impaired than were physical measures, which might partly explain these results, as the range of variation in MCS may therefore not have been sufficient to identify any significant improvement in our limited number of subjects. Mental health variables have also been found to be less impaired in morbidly obese subjects undergoing bariatric surgery and have even been found to be comparable to mean values of the general population, with less significant improvement following surgery [22,24].

Compared with other obese subjects undergoing bariatric surgery, the baseline SF-36 QoL scores were higher in our sample. In 110 morbidly obese subjects, de Zwaan et al. [25] found lower values in every SF-36 scale before surgery (41.6 in physical functioning vs. 56.7 in our sample), while Sarwer et al. [23] found values for preoperative SF-36 similar to ours except for physical functioning (34.2 vs. 56.7 in our sample). Other baseline characteristics (particularly BMI) were comparable across studies. Improvements in the different SF-36 scales at 1 year after surgery were also comparable. Baseline differences might be explained by the different settings of the studies.

Important findings were that PCS was mainly associated with longitudinal modification of comorbidity status and BMI, whereas differences between subjects were either not significant (for BMI and most comorbidities) or of lesser magnitude. However, improvements in diabetes, dyslipidaemia and sleep apnoea taken separately were not significantly related to change in PCS. In additional analyses, mixed-effects models assessing only the effect of baseline comorbidity status (and not changes in status after surgery) on PCS yielded results similar to those of complete models except for baseline diabetes status: those with diabetes at baseline had significantly lower PCS at baseline that were maintained over time ($P<0.05$). Introducing the variable corresponding to change in diabetes status modified the effect of baseline diabetes status to non-significant. These results suggest that the effect of diabetes status on PCS is mediated by both baseline status and change in status. The lack of significant effects in the complete model may be explained by the lack of power due to our limited number of subjects.
More importantly, using synthetic variables of mechanical or metabolic comorbidities, or the sum of comorbidities, and taking into account multiple pathologies showed that change in status was significantly related to change in PCS, whereas baseline BMI was associated with neither baseline differences in PCS between subjects nor change in PCS. Absence of a cross-sectional effect of baseline BMI may be due in part to the homogeneity of our sample, with all subjects being morbidly obese and seeking bariatric surgery. In contrast, BMI change was significantly associated with PCS in all models and showed a predominantly longitudinal effect. Chang et al. [12] also found that QoL after bariatric surgery was associated with BMI and comorbidity status, but they were not able to discriminate between cross-sectional and longitudinal effects of these variables in their analyses.

A generic QoL questionnaire was used in our study and some have argued that a specific obesity-related questionnaire would have been more appropriate for investigating changes following bariatric surgery [26]. The SF-36 is less weight-dependent than other obesity-specific tools and therefore less sensitive to weight loss as it tapers off over time [7,27]. Despite such limitations, however, the SF-36 is a widely used standardized questionnaire [28] that allows direct comparisons across medical conditions. Furthermore, the French version of the SF-36 questionnaire was validated, and mean values for the general population were available for comparison [18].

Strengths of our present study include the repeated assessment of QoL using validated tools. Mixed-effects models were also able to take into account potential confounders in the analyses. To our knowledge, the associations between QoL and comorbidities and BMI have never been previously examined to this extent. Nevertheless, some limitations need to be addressed. Of all subjects invited to participate in the study, only half completed all of the QoL questionnaires. Our limited sample size could also have led to a lack of power in our analyses. Although subjects included in the study were comparable to those excluded due to incomplete data at baseline, this does not preclude the possibility that some may have discontinued the study because of poor QoL, leading to a selection bias in our sample. Moreover, psychological comorbidities, such as depression, were not taken into account in our analyses. However, as mixed-effects models were used for PCS, psychological comorbidities are thought to have little impact.

5. Conclusion

The physical component of health-related QoL was predominantly related to changes in BMI and comorbidity status: the variable most consistently associated with PCS was change in BMI, although changes in comorbidity status (mechanical, metabolic, all comorbidities taken together) also demonstrated an independent effect. More important, improvement in QoL after gastric bypass was seen as early as 3 months post-surgery and reached values comparable to those of the general population that were maintained over time, although weight continued to gradually decrease.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Acknowledgements

Our thanks go to the staff of the Department of Nutrition, Pitié-Salpêtrière Hospital (formerly the Hôtel-Dieu Hospital) in Paris, France, for their expert management of patients and to Christine Beaudoin for administration of the questionnaires.

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