Food cravings and food consumption after Roux-en-Y gastric bypass versus cholecystectomy

Reena Sudan\textsuperscript{a}, Ranjan Sudan, M.D.\textsuperscript{b,\ast}, Elizabeth Lyden, M.S.\textsuperscript{c}, Jon S. Thompson, M.D.\textsuperscript{d}

\textsuperscript{a}Duke University, Durham, North Carolina
\textsuperscript{b}Department of Surgery, Duke Medicine, Durham, North Carolina
\textsuperscript{c}Department of Biostatistics, University of Nebraska Medical Center, Nebraska
\textsuperscript{d}Nebraska Medicine, Omaha, Nebraska

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Abstract

Background: Food cravings and consumption of craved foods after Roux-en-Y gastric bypass (RYGB) are poorly understood. Food cravings after bariatric surgery may explain why some patients fail to change eating behaviors after RYGB, and understanding these cravings may provide better information for nutritional counseling to either enhance weight loss or prevent weight regain.

Objectives: To study cravings in RYGB patients and compare them with cholecystectomy (CC) control patients.

Setting: This study took place in a university hospital.

Methods: RYGB patients (n = 50) and CC control patients (n = 38) completed a validated food craving inventory before surgery and at 2 and 6 weeks postoperatively. In addition, RYGB patients completed the food craving inventory at 12, 24, 36, and 52 weeks postoperatively. A linear mixed-effect model with a first-order autoregressive structure for correlations was used to evaluate changes in food consumption and food cravings between visits. Correlations between food cravings and body mass index (BMI) or weight changes before and after RYGB were assessed with Spearman correlation coefficients. \( P < .05 \) was considered statistically significant.

Results: After RYGB, food consumption decreased significantly compared with CC control patients and was lowest at 2 weeks. Consumption progressively increased over time in the first year but remained significantly less than that from presurgery. In addition, a higher preoperative BMI was found to correlate moderately with higher preoperative cravings of the total of all 4 food groups studied (\( r = .3, P = .04 \)); high-fat foods (\( r = .3, P = .04 \)); and sweets (\( r = .3, P = .03 \)). However, with the exception of preoperative cravings for high-fat foods, these scores were not predictive of changes in BMI after surgery. Overall, RYGB did not significantly affect food cravings after surgery compared with CC control patients.

Conclusion: These findings indicate that RYGB may limit food consumption but does not affect the drive to consume certain types of food. Because food cravings are high in patients with obesity before surgery and remain high after surgery, these findings suggest a possible reason for noncompliance with dietary recommendations after RYGB. (Surg Obes Relat Dis 2017;13:220–226.) © 2017 American Society for Metabolic and Bariatric Surgery. All rights reserved.

Keywords: Craving; Roux-en-Y gastric bypass; Food craving inventory; Food consumption; Hunger; Weight loss

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Roux-en-Y gastric bypass (RYGB) has long been established as an effective surgery to help patients with obesity lose weight and resolve co-morbid conditions [1–5]. However, up to 35% of patients who undergo RYGB surgery either fail to lose adequate weight or regain the weight over time, resulting in the recurrence of co-morbid conditions over the long term. Failure after bariatric surgery is defined as achieving <50% of excess weight loss or maintaining a body mass index (BMI) of >35 kg/m² [6–8]. These patients may require additional surgery to improve weight loss and reduce co-morbidities, but revisional surgeries are associated with higher risks compared with primary surgery [9,10]. Ultimately, identifying all the reasons for weight loss recidivism will help reduce failure after bariatric surgery and the associated cost and risk. Previous research has identified several possible explanations for recidivism, including gut adaptation, hormonal imbalances, and poor compliance with dietary and activity recommendations [11,12]. This study investigated a potential cause of non-compliance with dietary recommendations. Studies by Shultes et al. [13], White et al. [14,15], and Burton et al. [16] have shown that a higher BMI is associated with more frequent food cravings, including cravings for high-fat foods, fast food, and carbohydrates. If the findings of these previous studies are correct—that patients with obesity feel an inherent drive to consume more food than do normal-weight people—then it is conceivable that patients’ food cravings could affect weight loss outcomes after bariatric surgery.

To date, only a few studies have investigated the changes in food cravings and consumption of craved foods after bariatric surgery. Moreover, many of those studies did not use empirically validated measures. Consequently, the literature on food cravings and food consumption of craved foods after bariatric surgery is largely inconsistent and inconclusive. For example, studies by Leahey et al. [17], Ullrich et al. [18,19], and Pepino et al. [20,21] have found that bariatric surgery is associated with significant reductions in food cravings and consumption of craved foods in patients who underwent RYGB, laparoscopic adjustable banding (LAGB), or sleeve gastrectomy (SG). Another study by Busetto et al. [22] reported that preoperative food cravings are not associated with postoperative weight loss after an LAGB surgery. However, Burgmer et al. [23] concluded that certain food cravings increase after bariatric surgery. Thus, research is necessary that uses empirically validated instruments to assess different types of food cravings and how they change over time in bariatric surgery patients. The purpose of our study was to examine the frequency of food cravings and frequency of consumption of craved foods in RYGB surgery patients compared with those of the cholecystectomy (CC) control patients using an empirically validated measure, the food craving inventory (FCI).

**Methods**

**Study population**

This study was performed prospectively on 2 groups of patients after obtaining institutional review board approval: 101 volunteers were enrolled initially, but 6 patients withdrew before a planned operation or did not complete the study. The study group included 55 patients who underwent Roux-en-Y gastric bypass with prophylactic cholecystectomy (RYGB); however, 5 of these patients experienced surgical complications and were not able to participate in the postoperative phase. The control group consisted of 40 patients undergoing cholecystectomy alone (CC), but 2 were not available for the postoperative phase of the study. All patients in both groups completed a validated FCI preoperatively and at 2 and 6 weeks postoperatively. In addition, the RYGB patients completed the FCI at 3, 6, 9, and 12 months postoperatively. On completion of the FCI, a second survey, called the “Why Eat” survey, was administered to both groups of patients to assess the situational triggers that lead patients to eat.

**RYGB surgery**

The patients in this study population underwent a standard proximal RYGB surgery, in which a small gastric pouch of about 20 to 30 mL was anastomosed to the proximal jejunum. The Roux limb length was <150 cm and the biliopancreatic limb was 50 cm long. In addition, these patients also underwent a concomitant cholecystectomy as part of our surgical protocol at the time. This was our rationale for using cholecystectomy-only patients as controls. Patients underwent preoperative nutritional and psychological evaluation and postoperative nutritional counseling.

**Food craving inventory**

The initial FCI contained 47 sample items belonging to 7 different food groups (high fat, sweets, carbohydrates, fast food, fruits, vegetables, and dairy), but based on subsequent validation results and modification indices, the fruits, vegetables, and dairy subscores were found to be unreliable and were deleted. Consequently, the initial FCI was revised and designed as a self-report assessment that contains 2 subscales. The first subscale assesses the subjective cravings for 25 different foods, which can be categorized into 4 food groups (high fat, sweets, carbohydrates, and fast food). The high-fat sample included items such as fried chicken, sausage, and butter. The sweets sample consisted of items including chocolate and ice cream. The carbohydrates sample included items such as baked potato and pasta. The final category was fast foods, which contained pizza, hamburgers, French fries, and chips. Although patients may
have consumed other foods not measured with the FCI, the 25 food items assessed were determined to be highly representative of their respective food group. Therefore, the results of the FCI reliably demonstrate overall food craving and consumption trends. Craving was defined as an intense desire to consume a particular food that is difficult to resist. This has sometimes been referred to as a “hedonistic hunger” for certain foods, which suggests it to be emotional in origin [13]. The second subscale was a behavioral assessment that measured how often participants consumed the same 25 foods. Participants rated themselves on how frequently in the past month they experienced a craving for each of the foods and how frequently they ate each of the foods according to a 5-point Likert scale: $1$ = never, $2$ = rarely, $3$ = sometimes, $4$ = often, and $5$ = always/almost every day [14,15].

When the FCI developers compared food scores from the revised FCI with scores from the Three-Factor Eating Questionnaire and the Conceptual Cravings Scale, they found support for the content and concurrent, construct, and discriminant validity of the revised FCI [14,15]. In addition to the initial development and validation study, White et al. [15] conducted another validation study using a sample population of obese patients and revised the inventory to include 25 foods that could be categorized as high fat, sweets, carbohydrates, and fast foods. They found this revised FCI to be a psychometrically sound instrument for measuring general and specific food craving.

“Why Eat” analysis

In addition to the FCI, a “Why Eat” questionnaire was administered to compare the possible reasons why patients in the study group ate compared with those in the control group. The potential reasons why patients eat included the following: boredom, anger, sadness, loneliness, fatigue, stress, hunger, crave flavor, crave texture, commercials, occasion, social, not waste, or to feel full. The possible responses to the “Why Eat?” survey questions were as follows: $1$ = never, $2$ = occasionally (yearly), $3$ = sometimes (monthly), $4$ = frequently (weekly), and $5$ = always (daily).

Statistical analysis

Descriptive statistics (means, standard deviations, counts, and percentages) were used to describe the study populations. A total of 10 scores were observed in this study. The following 5 consumption scores were derived from the behavioral subscale of the inventory: frequency of consumption of fast food, carbohydrates, high fats, sweets, and a total of the 4 (a measure of all 4 food groups). The other following 5 scores were calculated based on the subjective (craving) subscale of the inventory: frequency of cravings of fast food, carbohydrates, high fats, sweets, and a total of the 4 food groups (all 4 food items).

Each of the 10 scores were measured preoperatively and 2 and 6 weeks postoperatively for both groups of patients. In addition, the RYGB patients also were scored at 3, 6, and 9 months and 1 year postoperatively. Means and standard deviations were used to summarize the scores at the different assessment times. The mean food scores at each follow-up visit were compared with the preoperative (Pre-Op) mean score. The difference was reported as the parameter estimate. A linear mixed-effect model with a first-order autoregressive structure for correlations was used to evaluate changes in the frequencies of food cravings and consumption between visits for RYGB patients. In addition, the effect of surgery type on the frequency of food consumption and cravings over the 6-week period was examined using a linear mixed-effects regression model that included visit time, type of surgery, and the interaction of visit time and type of surgery. Spearman correlation coefficients were used to identify whether Pre-Op food cravings were associated with BMI at Pre-Op and also to assess the correlation between changes in food cravings and changes in BMI/weight over the entire study period. Simple linear regression was used to determine whether Pre-Op food craving scores were predictive of the change in BMI over the 12-month period. $P < .05$ was considered statistically significant.

Results

Demographic variables

The demographic characteristics of the RYGB study group and the CC control patients are presented in Table 1. Statistically significant differences were noted in the age and BMI variables of the bariatric patients. The average patient in the RYGB group was nearly 5 years younger ($P < .0003$) and the BMI was 20 points higher than that of the average control group patient ($P < .0001$). The rate of participation declined slightly over the study period; the number of respondents at each follow-up period is reported in Table 2.

Frequency of food consumption after surgery

The mean food consumption scores for RYGB patients at each follow-up visit are reported in Table 2. These mean

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic variables at baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>RYGB n (%)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>46 (92)</td>
</tr>
<tr>
<td>Male</td>
<td>4 (8)</td>
</tr>
<tr>
<td>Smoking history</td>
<td>8 (16%)</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>39.3 (± 7.7)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>50.7 (± 7.9)</td>
</tr>
</tbody>
</table>

CC = cholecystectomy controls; RYGB = Roux-en-Y gastric bypass. Data are expressed as numbers of subjects or mean (± standard deviation).
Table 2
Total frequency of consumption of all 4 food groups after Roux-en-Y gastric bypass compared with preoperative visit

<table>
<thead>
<tr>
<th>Visit</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Parameter estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Op</td>
<td>50</td>
<td>3.24</td>
<td>0.29</td>
<td>0</td>
</tr>
<tr>
<td>Postoperative visits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 wk</td>
<td>42</td>
<td>1.77</td>
<td>0.93</td>
<td>-1.48</td>
</tr>
<tr>
<td>6 wk</td>
<td>46</td>
<td>1.97</td>
<td>0.75</td>
<td>-1.24</td>
</tr>
<tr>
<td>3 mo</td>
<td>46</td>
<td>2.38</td>
<td>0.50</td>
<td>-0.84</td>
</tr>
<tr>
<td>6 mo</td>
<td>46</td>
<td>2.61</td>
<td>0.53</td>
<td>-0.63</td>
</tr>
<tr>
<td>9 mo</td>
<td>44</td>
<td>2.73</td>
<td>0.46</td>
<td>-0.52</td>
</tr>
<tr>
<td>12 mo</td>
<td>47</td>
<td>2.77</td>
<td>0.43</td>
<td>-0.47</td>
</tr>
</tbody>
</table>

Each postoperative frequency of food consumption score was significantly lower compared with preoperative consumption score (P < .0001).

Pre-Op = preoperative; SD = standard deviation.

RYGB food consumption scores were compared with the Pre-Op mean score, and the difference was reported as the parameter estimate. There was a statistically significant change in the average frequency of consumption of the total of all 4 food groups (high fats, sweets, carbohydrates, and fast foods) at every follow-up visit after RYGB (P < .0001). RYGB patients demonstrated the lowest consumption scores at 2 weeks after surgery (week 2 mean: 1.77 ± 0.93). After the second postoperative week, food consumption scores increased slightly over time but remained statistically significantly less than Pre-Op food consumption (see Table 2).

In addition, the mean food consumption scores for RYGB patients were compared with the mean consumption scores for CC patients and demonstrated that the frequency of craved food consumption after RYGB declined significantly more than it did for the CC control patients (Fig. 1).

**Frequency of food cravings and body mass index at Pre-Op**

Table 3 shows the Spearman correlation coefficients for the association of Pre-Op food craving scores with Pre-Op BMI. There was a moderate correlation between greater preoperative BMI and preoperative frequency of craving sweets (r = .31, P = .03), high-fat foods (r = .29, P = .04), and total of all 4 food groups (r = .29, P = .04).

<table>
<thead>
<tr>
<th>Pre-Op food cravings</th>
<th>Correlation coefficient r value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of all 4 food groups</td>
<td>.29</td>
<td>.04</td>
</tr>
<tr>
<td>Fast food</td>
<td>.27</td>
<td>.06</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>-0.13</td>
<td>.35</td>
</tr>
<tr>
<td>High fats</td>
<td>.29</td>
<td>.04</td>
</tr>
<tr>
<td>Sweets</td>
<td>.31</td>
<td>.03</td>
</tr>
</tbody>
</table>

Cravings for the total of all 4 food groups and sweets and carbohydrates correlated with a high preoperative body mass index.

However, with the exception of craving high-fat foods, no Pre-Op food craving scores were predictive of the change in BMI over the 12-month period. Lower preoperative craving scores for high-fat foods were associated with greater overall postoperative change in BMI (P = .05) (Table 4).

**Changes in frequency of food cravings and changes in weight/body mass index**

The mean weight change from Pre-Op to the 12-month visit was 53.5 ± 14.7 kg. The mean BMI change from Pre-Op to the 12-month visit was 18.9 ± 4.9 kg/m². Based on the Spearman correlation coefficients and the associated P values, neither weight change nor BMI change was associated with the change in food cravings over the study period (data not shown).

**Analysis of food cravings frequency after surgery**

The mean food craving scores for RYGB patients at each follow-up visit are reported in Table 5. These mean RYGB food cravings scores were compared with the Pre-Op mean score, and the difference was reported as the parameter estimate. The average cravings score for the total of all 4 food groups of RYGB patients statistically was significantly lower only at 2 weeks (P < .0001) and 6 weeks (P = .0070) compared with Pre-Op scores. Scores for fast foods, high fats, and sweets, but not carbohydrates, also were significantly lower only at 2 weeks (see Table 5).

The mean food cravings scores after RYGB were compared with the mean food craving scores after CC.

Table 4
Association of preoperative food cravings and overall change in body mass index after RYGB

<table>
<thead>
<tr>
<th>Pre-Op food cravings</th>
<th>Parameter estimate</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total of all 4 food groups</td>
<td>-0.48</td>
<td>.80</td>
</tr>
<tr>
<td>Fast food</td>
<td>-0.03</td>
<td>.99</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>1.66</td>
<td>.23</td>
</tr>
<tr>
<td>High fats</td>
<td>-2.45</td>
<td>.05</td>
</tr>
<tr>
<td>Sweets</td>
<td>-1.9</td>
<td>.88</td>
</tr>
</tbody>
</table>

Lower cravings for high fats preoperatively correlated with lower body mass index postoperatively.
and interestingly, the frequency of food cravings decreased after both RYGB and CC in the first 6 weeks (Fig. 2). With the exception of the fast food category, there was no significant difference in the frequency of food cravings between the 2 study groups. These results suggest that RYGB surgery did not significantly affect patients’ food cravings compared with those of the control group.

Relationship between “Why Eat” responses and surgery type

A statistically significant association was found between eating from boredom and surgery type ($P < .0001$). At Pre-Op, 75% of bariatric surgery patients indicated that they ate from boredom at least once or more weekly compared with 36.8% of control patients. Similarly, there was a statistically significant relationship between eating to satisfy flavor cravings among RYGB patients ($P = .0014$). At Pre-Op, 79.5% of bariatric patients indicated that they ate because they craved the flavor at least once or more weekly compared with 44.7% of control patients. There also was a statistically significant relationship between eating for an occasion and surgery type ($P = .0085$). Of the bariatric surgery patients, 40.8% indicated that they ate due to an occasion at least once or more weekly compared with only 15.7% of control patients. In addition, there was a moderate association between eating for a social reason and surgery type ($P = .02$). Of the bariatric patients, 44.8% indicated that they ate for a social reason at least once or more weekly compared with 21% of control patients. Likewise, there was a moderate association between loneliness and surgery type ($P = .045$). At Pre-Op, 34% of bariatric surgery patients indicated that they ate from loneliness at least once or more weekly compared with 13.1% of control patients. Other reasons for eating, such as anger, sadness, fatigue, stress, hunger, texture, and wastefulness, were not associated with type of surgery. In summary, patients who eat from boredom, flavor cravings, loneliness, occasion, or social reasons once or more weekly were more likely to be in the RYGB group.

Discussion

The purpose of this study was to examine the frequency of food cravings and the consumption of craved foods after RYGB plus cholecystectomy compared with CC alone using an empirically validated measure, the FCI. This research uncovered several key findings. The frequency of consumption of craved foods decreased after both CC and RYGB surgery, but the reduction was much more pronounced after RYGB surgery. A moderate correlation was seen between more frequent cravings for sweets, high-fat foods, and the total of all 4 food groups and higher BMI before RYGB. However, changes in food cravings scores were not correlated with changes in weight or BMI after surgery. The first finding in this study was that RYGB significantly reduced the frequency of consumption of craved foods in the first postoperative year. The greatest reduction was recorded at 2 weeks postoperatively. This finding was not surprising because RYGB patients were placed on a liquid diet for 2 weeks after surgery, a common practice among most bariatric programs. After the 2-week period, the type of food and its quantity gradually were liberalized. Thus, an increase in food consumption scores was observed after 2 weeks, although they remained statistically significantly less than Pre-Op scores, indicating craved foods were consumed less frequently after RYGB. Furthermore, RYGB patients reported considerably greater reductions in craved food consumption compared with CC control patients. This finding is consistent with earlier studies in the literature. For example, Søvick et al. (Aivo, Solna, Sweden) [24] conducted a 2-year longitudinal analysis of 31 gastric bypass and 29 duodenal switch patients. The participants recorded their food and drink consumption for 4 consecutive days at Pre-Op, 1 year postoperatively, and 2 years postoperatively. Using DIET32 software to calculate total caloric intake and intake of fat, protein, and carbohydrates, the authors found
that the total caloric intake and the intake of fat, protein, and carbohydrates were significantly reduced after gastric bypass. These results are to be expected because RYGB drastically reduces the capacity of the stomach.

The next finding in the study presented here was that higher preoperative BMI was associated with more frequent cravings for sweets and high-fat foods at Pre-Op. This result supports the findings from previous studies, which have shown that a higher BMI is associated with more frequent and/or intense food cravings, including cravings for high-fat foods, sweets, and the total of all 4 food groups. For example, White et al. [14,15] used the FCI to examine 379 participants and found a statistically significant correlation between the total food cravings score and BMI. Specifically, they found that fat cravers had higher BMIs compared with other specific cravers. Although greater Pre-Op BMI is associated with higher food craving scores, Pre-Op craving scores cannot be used to predict weight loss after surgery with the exception of high-fat scores.

Finally, the study presented here found that the frequency of food cravings were reduced only during the first 6 weeks after surgery and affected both RYGB and CC patients. The observed reductions were not significantly different between the 2 types of surgeries, suggesting that the temporary reduction in cravings during the first 6 weeks cannot be attributed uniquely to RYGB surgery. In addition, the data demonstrated that frequency of cravings was not affected by changes in weight or BMI after surgery, suggesting that even after RYGB surgery and losing weight, patients continue to have frequent or uncontrollable cravings for certain types of food. Together, these findings indicate that RYGB has no effect on food cravings.

These results contradict some findings in the literature. For example, Leahey et al. [17] used the FCI to measure the food cravings and consumption of 20 LAGB and 12 RYGB patients before surgery and 3 and 6 months after surgery. They found that bariatric surgery is associated with significantly less frequent food cravings (with the exception of high-fat foods). Similarly, Pepino et al. [20] used the FCI to measure cravings and consumption of 25 RYGB, 11 LAGB, and 8 SG patients before and after they lost at least 15% of their weight. They found that surgery-induced weight loss decreased cravings for all types of foods. Ullrich et al. [19] used the Power of Food Scale to measure the motivation to consume certain foods of 44 RYGB patients before and after surgery (mean 15.9 ± .9 months). The authors found that patients reported a marked reduction in the desire to consume certain foods after RYGB surgery. There are a few potential explanations for this. Leahey et al. measured food scores only during the first 6 months postoperatively. Pepino et al. also assessed patients at Pre-Op and at 1 follow-up visit sometime within 9 months after surgery, and Ullrich et al. assessed patients only at Pre-Op and at 1 follow-up visit (between 11 and 39 months after surgery). The study presented here examined patients more consistently over a longer period. Another possible explanation for the contradictory results is that Ullrich et al. used a different instrument (the Power of Food Scale), which includes different foods (e.g., fruits, vegetables, and dairy). Scores for fruits, vegetables, and dairy were excluded in our study because these FCI subscales were not reliably validated and patients were encouraged to consume these foods after surgery, meaning inclusion of fruits, vegetables, and dairy would skew the results. In addition, the study population used by Ullrich et al. included patients with either a distal or a proximal RYGB, whereas our study only included patients who underwent a proximal RYGB. Because a distal anastomosis is associated with more pronounced gut hormone changes such as glucagon-like peptide 1 and peptide YY, Ullrich’s study population was not homogenous and the inclusion of patients with a distal bypass may have confounded the results. Similarly, Leahey included LAGB patients and Pepino et al. included LAGB and SG patients.

There are important limitations to this study. Several factors may influence food cravings, and these include race, sex, family history of alcoholism, smoking, and socioeconomic status. Although, 16% of the study group and 20% of the control group in our study were smokers, smoking status was not specifically tracked after surgery. It is possible that bariatric patients stopped smoking after surgery as was recommended to them. Nicotine craving has been associated with greater food craving and may account for higher-than-usual craving scores in our study [25]. Also, we did not track socioeconomic status. However, the population in Nebraska is quite homogenous and is predominantly employed and Caucasian. The amount of calories consumed and the type of food consumed also may affect craving and will be included in future research. Another limitation of this study could be the sample size. This study was performed in conjunction with an olfactory study that was powered for 30 RYGB and 20 CC patients [26]. We used the same patients to study food cravings and a separate power calculation was not performed. Moreover, the surgery patients self-selected to participate in the study and a few participants who completed baseline assessments did not complete the follow-up assessments. Thus, the surgery sample might not represent the larger population of patients undergoing bariatric surgery. Also, we did not measure gut hormones, and the inclusion of these measurements may provide additional insights into cravings. The age and BMI of RYGB patients also were significantly different from those of the CC control patients. It is not known whether these differences may have somehow confounded the results.

Conclusion

Overall, these findings suggest that RYGB limits food consumption and consumption of craved foods after surgery...
but does not affect the patients’ cravings to consume certain food types. These results have far-reaching implications because they suggest that successful bariatric surgery should include some way of controlling patients’ food cravings.

## Disclosure

The authors have no commercial associations that might conflict of interest in relation to this article.

## References


