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Original article

The short- to mid-term symptom prevalence of dumping syndrome after primary gastric-bypass surgery and its impact on health-related quality of life

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Abstract

Background: Early and late dumping are complications of gastric bypass surgery. Early dumping occurs within an hour after eating, when the emptying of food into the small intestine triggers rapid fluid shifts into the intestinal lumen and the release of gastrointestinal hormones, resulting in gastrointestinal and vasomotor symptoms. Late dumping occurs between 1 and 3 hours after carbohydrate ingestion and is caused by an exaggerated insulin release, resulting in hypoglycemia. Almost no data are currently available on the prevalence of early and late dumping or their impact on health-related quality of life (QoL).

Objectives: To study the prevalence of early and late dumping in a large population of patients having undergone a primary Roux-en-Y gastric bypass (RYGB) and its effect on QoL.

Setting: Cross-sectional study at a single bariatric department in the Medical Center Leeuwarden, The Netherlands between 2008 and 2011.

Methods: In 2013, this descriptive cohort study approached by email or post all patients who underwent a primary RYGB in the setting between 2008 and 2011 in one hospital. These patients were asked to fill in standardized questionnaires measuring their QoL (RAND-36), anxiety and depression (HADS), fatigue (MFI-20) and any disease specific indicators of early and late dumping syndrome.

Results: The questionnaire was completed and returned by 351 of 613 patients (57.1%) and 121 nonobese volunteers. Participants were mostly female (80%), aged 42 (40–54 years), with an excess weight loss of 76.8% [IQR 61–95] after RYGB surgery 2.3 [IQR 1.6–3.4] years earlier. Self-reported complaints of moderate to severe intensity suggestive of early and late dumping were present in 18.8% and 11.7% of patients, respectively. Patients with early and late dumping demonstrated significantly lower scores on the RAND-36 and HADS compared with patients without dumping. No differences were seen in the MFI-20 scores between patients with or without early and late dumping.

Conclusion: In this descriptive cohort, self-reported complaints suggestive of early and late dumping of moderate-to-severe intensity were, respectively, 18.8% and 11.7% in a cohort after primary gastric bypass surgery. These complaints were associated with markedly reduced health-related QoL. (Surg Obes Relat Dis 2017;13:1489–1500.)

Keywords: Early dumping; Late dumping; Gastric bypass; Bariatric surgery; Post-gastric bypass hypoglycemia; Quality of life

Morbid obesity is a growing healthcare problem in the world. Its prevalence is increasing and, consequently, weight loss strategies are needed. Weight loss surgery is

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the most effective way to achieve sustained weight loss, resolve co-morbidity, and improve rates of survival [1]. One of the most frequently performed weight loss operations is the laparoscopic Roux-en-Y gastric bypass (RYGB). This is an effective procedure but it is known to result in several long-term side effects, with some beneficial effects (rapid transit time, stimulation of L-cells, and secretion of GLP-1 and therefore remission of diabetes) as well as adverse effects such as dumping syndrome [2,3].

Two variants of dumping syndrome have been differentiated—namely, early and late dumping—and distinct pathogenic mechanisms have been proposed for both variants. Early (hypovolemic) dumping is probably caused by the entry of undigested food in the small bowel. Relative intravascular volume contraction and hemoconcentration occur as a consequence of an osmotic shift of fluids from the intravascular compartment into gut lumen. A drop in plasma volume, elevation of the hematocrit, and an acceleration of the heart rate have been observed in patients with early dumping in response to an oral hyperosmolar glucose load. Symptoms start between a few minutes to an hour after a meal and include autonomic symptoms as sweating, palpitations, drowsiness, and the need to lie down. Late dumping (also known as post-gastric bypass hypoglycemia) is in general ascribed either to a reset of incretins after bypassing the duodenum (foregut theory) or to the entry of undigested food in the jejunum (hindgut theory) [4,5]. Consequently, increased levels stimulate beta cells in the pancreas, which in turn induce an increase in the postprandial production of insulin. This phenomenon starts soon after a meal and results between 1 and 3 hours later in typical symptoms related to hypoglycemia such as sweating, drowsiness, trembling, or even coma. Usually, these symptoms of late dumping start 1–3 years after gastric bypass operation [4].

The incidence of early dumping after gastric bypass—measured by questionnaire or hematocrit change—is estimated to be between 12% and 42% [6–9]. Svennevig et al. reported on self-reported symptom prevalence for patients after gastrectomy for gastric ulcer [8]. They reported a prevalence for early dumping of 14% for daily symptoms and 19% of the patients had symptoms occasionally. Laurennius et al. reported a prevalence of early dumping of 12%, measured with a self-developed questionnaire [6]. The prevalence of late dumping as assessed by oral glucose tolerance test or mixed meal tolerance test is estimated between 17% and 68% [7,10–12]. No data are available in literature with regard to self-perceived complaints of late dumping after RYGB.

The treatment for dumping begins with modifications to the diet, mainly to eliminate or reduce the intake of carbohydrates. The second step is medication (ranging from Acarbose to Liraglutide), followed by revisional procedures such as undoing the gastric bypass or performing a (partial) pancreatectomy [13].

Quality of life (QoL) after weight loss surgery is improved in comparison with that of obese volunteers not undergoing weight loss surgery [1,14–16]. In addition, the improved QoL is reported to be relatively stable for years after surgery [15]. However, it is unknown to what extent early and late dumping influence health-related QoL in patients after gastric-bypass surgery.

Therefore, our aim is to investigate both the symptom prevalence of dumping after primary gastric bypass surgery by the dumping severity score and its associated impact on health-related QoL. The prevalence of self-reported complaints was compared with healthy controls with no history of gastric surgery, to test whether the same complaints are prevalent in a group of healthy, nonobese volunteers.

Methods

Study population, patient group

For this descriptive cohort study, we created a database of all patients who underwent a primary Roux-en-Y gastric bypass at single bariatric center between 2008 and 2011. Preoperative assessment of patients eligible for surgery included counselling by dietician and psychologist to exclude people with non-adjusted eating patterns or eating disorders. If detected, these issues were addressed before any surgery was considered. All patients were screened before operation according to the criteria outlined by the International Federation for Surgery of Obesity and metabolic disorders (IFSO) [17].

In 2013, all patients were invited to participate in a questionnaire survey. Four rounds of invitations were sent (3 by post and one by email). For the purposes of this study, all patients who underwent primary gastric bypass were selected, but patients with a history of earlier stomach operation were excluded. Other operations were not a reason for exclusion. Records for individual patients were completed by data review. The study protocol was approved by the Regional Ethical Review Board of the Medical Centre, Leeuwarden.

Weight loss

The ideal weight of every patient was estimated based on a target BMI of 25. The percentage of excess weight loss (%EWL) was calculated as ((operative weight – follow-up weight)/operative excess weight) x 100. The Total Weight Loss (TWL) was calculated as ((operative weight – follow-up weight)/operative weight) x 100. We used the weight and height of patients of patients at their last outpatients visit and we calculated from this EWL and TWL. We compared the weight measured at outpatient clinic with self-reported weight of the patients.

Operation details

All 3 surgeons performing the RYGB operations complied with a standardized operation technique on all

patients. Routine antibiotic prophylaxis was administered. The pouch was created by linear stapling (Ethicon Endo-Surgery, Inc, Cincinnati, USA). We started the creation of the pouch approximately 4–5 cm below the gastroesophageal junction at the lesser curvature. The estimated volume of the pouch was 30–60 cc. The biliopancreatic limb was measured at 80 cm from the angle of Treitz. With this loop, the gastroenterostomy was made by linear stapling and the anterior defect was closed with sutures. An alimentary limb of 150 cm was measured and the enteroenterostomy was fashioned with the endoscopic linear stapler and interrupted sutures. Confirmation of integrity of both anastomoses was performed by methylene and air-leak testing after introduction of a gastric tube by the anesthesiologist. In the event of leakage, additional sutures were placed. After testing for both anastomoses, the Roux-en-Y construction was completed by dividing the loop with linear stapling between the 2 anastomoses. Mesenteric defects were not closed.

Group of volunteers

To evaluate whether our study was identifying abnormal symptoms or the normal gastrointestinal complaints associated with oral intake (i.e., the "after-dinner dip"), we also presented the dumping severity score to a group of healthy, nonobese volunteers.

For this we asked more than hundred healthcare workers working on the operation room or the outpatient department of the medical center to complete our questionnaire. Volunteers with diabetes mellitus or a history of a gastric operation were excluded. The volunteers completed the same questionnaire regarding on their complaints of early and late dumping as well as questions about use of medication. A power analysis to calculate the minimum number of volunteers for adequate study power was 98 (alpha 0.05 and power 90%, assuming the prevalence for early and late dumping was zero in the volunteer group and in the gastric bypass group 10%).

Questionnaires

Dumping severity score (Table 1a and 1b). The prevalence of early and late dumping can be estimated by several questionnaires assessing subjective complaints; however, none of these is adequately validated. The Dumping Severity Score (DSS) was ultimately chosen because it is the only questionnaire available that differentiates between early and late dumping. In addition, it uses a simple scale to estimate severity of the complaints. The dumping severity score, based on symptom pattern descriptions in the literature, is using a 4-point Likert scale [18]. The patient was asked to grade the intensity (0 = absent; 1 = mild; 2 = moderate; and 3 = severe, interfering with daily activities) of 8 early dumping symptoms (within 1 hour after food ingestion) and 6 hypoglycemia symptoms (more than 1 hour after food ingestion) [18].

Table 1a
Questionnaire for early dumping symptoms.
Do you experience any of the following complaints within one hour after eating a meal?

	No complaints	Mild	Moderate	Severe, interfering with daily activities
Sweating	0	0	0	0
Flushes	0	0	0	0
Dizziness	0	0	0	0
Palpitations	0	0	0	0
Abdominal pain	0	0	0	0
Diarrhoea	0	0	0	0
Bloating	0	0	0	0
Nausea	0	0	0	0
I feel scared, anxious or troubled by these complaints	0	0	0	0

To assess the psychological impact of these complaints, we also asked if this provoked anxiety or insecurity. Patients were asked if they had complaints as mentioned in the dumping severity score in the last month.

We defined a high suspicion of early dumping as someone having 3 or more symptoms (including at least one autonomic symptom) with an intensity of 2 or 3 (i.e., moderate or severe, interfering with daily activities) on the early dumping severity score. A high suspicion of late dumping (post-gastric bypass hypoglycemia) was defined as having 3 or more symptoms (including at least one neuroglycopenic symptom) with an intensity of 2 or 3 (i.e., moderate or severe, interfering with daily activities) on the late dumping severity score. Mild symptoms were not included.

Additional questions (on self-measured blood glucose levels, the occurrence of neuroglycopenia and the potential

Table 1b
Questionnaire for late dumping symptoms.
Do you experience any of the following complaints within one to 3 hours after eating a meal?

	No complaints	Mild complaints	Moderate complaints	Severe, interfering with daily activities
Sweating	0	0	0	0
Palpitations	0	0	0	0
Hunger	0	0	0	0
Drowsiness/ unconsciousness	0	0	0	0
Tremor	0	0	0	0
Irritability	0	0	0	0
I feel scared, anxious or troubled by these complaints	0	0	0	0

Table 2
Prevalence and intensity of early and late dumping symptoms

Early dumping	Absent	Mild	Moderate	Severe, interfering with daily activities	Missing
Abdominal symptoms					
Abdominal pain (%)	50.0	29.5	14.8	5.1	0.6
Diarrhoea (%)	60.2	24.4	10.5	4.3	0.6
Bloating (%)	38.4	39.5	16.8	4.8	0.6
Autonomic symptoms					
Nausea (%)	50.0	30.7	15.3	3.7	0.3
Sweating (%)	70.5	17.0	9.7	2.6	0.3
Flushing (%)	67.0	18.2	10.5	3.7	0.6
Dizziness (%)	61.9	22.4	11.4	3.1	1.1
Palpitations (%)	64.5	20.7	11.6	3.1	0.0
I feel scared, anxious or troubled by these complaints (%)	69.3	21.3	8.8	0.6	0.0
Late dumping	**Absent**	**Mild**	**Moderate**	**Severe, interfering with daily activities**	**Missing**
Autonomic symptoms					
Sweating (%)	79.3	13.4	5.1	1.7	0.6
Palpitations (%)	77.6	15.6	5.7	0.9	0.3
Hunger (%)	56.5	23.6	17.3	2.0	0.6
Tremor (%)	66.8	19.9	10.2	2.6	0.6
Neuroglycemic symptoms					
Drowsiness/unconsciousness (%)	59.1	20.7	15.6	4.3	0.3
Irritability (%)	65.6	17.0	13.1	4.0	0.3
I feel scared, anxious or troubled by these complaints (%)	72.7	18.2	6.8	1.7	0.6

Data are numbers and frequencies (percentages).

related use of healthcare and treatment) were asked with regard to dumping, weight development, co-morbidities, and use of medication. These responses were checked against the data collected at the patients' last outpatient visits.

Quality of life questionnaires

RAND-36. HR-QoL was measured with the RAND-36 questionnaire, which contains 36 questions on various aspects of general wellbeing over the preceding 4 weeks. The items are formulated as statements or questions with Likert scale response options. These are organized into 8 sections (physical functioning, physical problems, bodily pain, general health, vitality, social functioning, emotional problems, and mental health) linearly converted to a scale of 0 to 100. The first 3 sections measure physical health, the last 3 measure mental health, and the general health and vitality scales are sensitive to both physical and mental health outcomes. Higher scores represent better QoL [19]. Normative data by age are available for the Dutch population [20]. The RAND-36 is almost identical to the 36-item Short Form Health Survey (SF-36).

Multidimensional Fatigue Inventory-20. The Multidimensional Fatigue Inventory-20 (MFI-20) records fatigue. It contains 20 statements organized into 5 sections (general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue). Each section has a maximum score of 20 [21]. Higher scores indicate a higher level of fatigue or impairment. Dutch normative data were derived from Smets et al. [22].

Hospital Anxiety and Depression Scale. The Hospital Anxiety and Depression Scale (HADS) consists of 14 statements divided into 2 sections related to anxiety and depression [23].

Each item is scored on a scale of 1–3, with higher scores per section indicating more severe anxiety or depression. Clinical depression or anxiety are indicated by a score of 6 or higher on the depression scale or 7 or higher on the anxiety scale out of 21. Dutch normative data were derived from Spinhoven et al. [24].

Hypoglycemia Fear Scale-II. The Hypoglycemia Fear Scale II (HFS-II) is a 33-item questionnaire with 2 subscales that measure behaviors to avoid hypoglycemia and its negative consequences and worries about hypoglycemia [25,26]. Responses are made on a 5-point Likert scale where 0 = Never and 3 = Always. We used the 12-item Worry subscale which has a score range of 0–72 with higher scores indicating increased fear of hypoglycemia. The HFS-II is a widely used measure in clinical trials, has been translated into more than 20 languages, and has demonstrated reliability and validity in type 1 diabetic patients [27].

Statistics

Data are presented as mean (± standard deviation), median [interquartile ranges, IQR], frequencies, or percentages where appropriate. Differences were assessed with unpaired t tests (for continuous variables) or χ^2 tests (for categorical variables). An alpha level of .05 was used for determining statistical significance. For graphical

Table 3a
Clinical characteristics of the study population at high suspicion for early dumping compared with patients at low suspicion

	High suspicion group for early dumping	Low suspicion group for early dumping	*P* value
Number	68	283	
Age (y)	46 [39;53]	47 [40;54]	.824
Female (%)	62 (91.2)	220 (77.7)	.011
Time between surgery and study (months)	31 [24;37]	26 [19;33]	.106
Time between surgery and last visit (months)	19 [14;24]	20 [14;26]	.81
Weight and weight loss			
Weight at surgery (kg)	122 [111;139]	131 [117;147]	.08
Lowest weight after surgery, self-reported (kg)	75 [66;90]	83 [71;99]	.76
Current weight, self-reported (kg)	83 [73;94]	87 [75;103]	.156
Weight at last outpatient visit (kg)	84 [74;98]	91 [78;107]	.155
EWL at last outpatient visit (%)	76 [55;90]	71 [54;90]	.759
TWL at outpatient visit (%)	29 [23; 37]	31 [23; 38]	.545
Co-morbidities preoperative			
Type 2 diabetes	20 (29.4)	84 (29.7)	1.000
Hypertension	29 (42.6)	128 (45.4)	.786
Dyslipidemia	16 (23.9)	54 (19.6)	.499
Sleep apnea	7 (10.3)	31 (11.0)	1.000
Co-morbidities postoperative			
Type 2 diabetes, self-reported	11 (16.2)	26 (9.2)	.121
Hypertension, self-reported	7 (10.3)	55 (19.4)	.079
Dyslipidemia, self-reported	13 (19.1)	28 (9.9)	.056
Sleep apnea, self-reported	0	13 (4.6)	.081
Postoperative support and lifestyle			
Support of dietician	9 (13.2)	8 (2.8)	.002
Support of psychologist	7 (10.3)	26 (9.2)	.817
Sport (more than 30 minutes per week)	37 (53.4)	164 (58)	.313
Smoking	12 (17.6)	48 (17.0)	.859
Treatment satisfaction			
Satisfaction with result of operation?	60 (88.2)	260 (91.9)	.344
Would you do the operation again?	62 (91.2)	278 (98.2)	.009

TWL = total weight loss
Data are median and interquartile ranges [IQR], or numbers and frequencies (percentages).

representation, study population mean with 95% confidence intervals are shown. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS, Inc., Armonk, NY, USA), version 22.

Results

Response

In the period between 2008 and 2011, a total of 615 patients at the Center underwent a primary laparoscopic RYGB for morbid obesity. Of this group, 2 patients died during follow-up (both of malignancies). Thus, 613 patients were contacted and asked to participate in this study. The invitation was declined by 42 patients (6.8%). Despite repeated invitations, 211 patients did not respond. The questionnaire was completed and sent back by 360 patients. Nine of the returned questionnaires were not usable because they could not be linked to the correct patients. Thus, the number of questionnaires for the patient group analyzed for this study was 351 (57.3%).

The questionnaire was also completed by 121 healthcare workers.

Demographic characteristics

In the patient group participants were mostly female (80%), and the group of volunteers contained 74 females (61.2%). The mean age for the patient and volunteer group was 46 ± 10 years and 42 ± 12 years, respectively ($P < .001$). No significant differences were seen between the self-reported weight and the weight at the outpatient clinic (Table 3a and 3b).

The weight and body mass index (BMI) during the study was significantly different between patients and volunteers: weight 86 ± 19 kg and BMI 29 ± 5.6 kg/m2 versus weight 74 ± 12 kg and BMI 23 ± 2.9 (both $P < .001$). In the volunteer group, the maximum BMI was 33, and 30% of the volunteers had a BMI above 25.

The median follow up for the patient group after surgery was 27 [IQR 20–34] months. The patient group had an excess weight loss of 76.8% [IQR 61%–95%]

Table 3b
Clinical characteristics of the study population at high suspicion for late dumping compared with patients at low suspicion

	High suspicion group for late dumping	Low suspicion group for late dumping	*P* value
Number	40	311	
Age (y)	41 [37;49]	47 [40;54]	.034
Female (%)	35 (87;5)	247 (79;4)	.226
Time between surgery and study (months)	31 [20–41]	27 [19–33]	.176
Time between surgery and last visit (months)	20 [14;29]	20 [14;26]	.989
Weight and weight loss			
Weight at surgery (kg)	125 [116;140]	130 [116;146]	.233
Lowest weight after surgery, self-reported (kg)	79 [68;98]	81 [70;98]	.617
Current weight, self-reported (kg)	86 [74;104]	86 [75;102]	.762
Weight at last outpatient visit (kg)	86 [73;105]	90 [78;107]	.270
EWL at last outpatient visit (%)	77 [56;104]	72 [54;90]	.226
TWL at last outpatient visit (%)	32 [25;39]	30 [25;37]	.505
Co-morbidities preoperative			
Type 2 diabetes	11 (27.5)	93 (29.9)	.754
Hypertension	15 (37.5)	141 (45.3)	.339
Dyslipidemia	6 (15.0)	63 (20.3)	.434
Sleep apnea	7 (17.5)	31 (10.0)	.339
Co-morbidities postoperative			
Type 2 diabetes, self-reported	4 (10,0)	33 (10.6)	.906
Hypertension, self-reported	6 (15.0)	56 (18.0)	.639
Dyslipidemia, self-reported	7 (17.5)	34 (10.9)	.223
Sleep apnea, self-reported	7 (17.5)	31 (10.0)	.504
Postoperative support and lifestyle			
Support of dietician	8 (20.0)	9 (2.9)	< .001
Support of psychologist	6 (15.0)	27 (8.7)	.197
Sport (more than 30 minutes per week)	24 (60.0)	177 (46.9)	.563
Smoking	5 (12.5)	56 (18.0)	.387
Treatment satisfaction			
Satisfaction with result of operation?	31 (77.5)	289 (92.9)	.001
Would you do the operation again?	34 (85.0)	306 (98.4)	< .001

EWL = excess weight loss
Data are median and interquartile ranges [IQR], or numbers and frequencies (percentages).

and underwent RYGB surgery 2.3 [IQR 1.6–3.4] years earlier.

In the patient group, the participants were highly comparable in all aspects to those who had declined participation or who had not responded, with the exception of age; responders were slightly older (median [IQR]: 47 [39–53] versus 43 [36–51] years; $P = .02$). No other differences were present.

Symptoms of early and late dumping

In the patient group, the prevalence and severity of the individual symptoms of early and late dumping is shown in Table 2. Bloating, abdominal pain, and nausea were the most frequent complaints in early dumping. For late dumping, the most frequent complaints were hunger, drowsiness, and irritability.

In the volunteer group moderate-to-severe postprandial complaints were rare. Only 2 patients had some symptoms of early dumping (sweating, dizziness, palpitations, abdominal pain, and diarrhea), and no differences were observed between volunteers whose BMI was below or above 25.

For the symptoms of late dumping, 4 volunteers were moderately hungry and 1 had complaints of drowsiness; this was the similar for volunteers whose BMI below of above 25. Complaints of moderate or severe tremor, sweating and/or irritability were only seen in the group of volunteers with BMI of more than 25; this differed significantly from volunteers with BMI of less than 25, where 5 volunteers had complaints of tremor ($P = .028$), one had sweating ($P = .029$), and 2 suffered from irritability ($P = .004$). All the differences between patients and volunteers in the prevalence of symptoms were statistically significant ($P < .001$).

Identification of a population with high suspicion of early and late dumping

A high suspicion for early and late dumping based on self-reported complaints of moderate and severe intensity was present in 68 (18.8%) and 40 (11.7%) of the patients, respectively. Twenty-five patients (7% of the group) had a high suspicion for both early and late dumping.

In the volunteer group, only 2 volunteers suffered from early and late dumping. One (0.8%) had self-reported

Table 4
Prevalence of self-measured hypoglycemia, neuroglycopenia, and use of related healthcare

	All patients 351	High suspicion group for late dumping 40	Low suspicion group for late dumping 311	*P* value*
Low self-measured blood glucose after a meal	70 (20.1)	16 (40.0)	54 (17.5)	.003
Concentration of low self-measured blood glucose				
>4 mmol/L	9 (2.6)	0 (0)	9 (16.7)	
3–4 mmol/L	16 (4.5)	5 (12.5)	11 (3.6)	
2–3 mmol/L	24 (6.8)	6 (15.0)	18 (5.8)	
1–2 mmol/L	9 (2.6)	3 (7.5)	6 (1.9)	
Unknown	12 (3.4)	2 (5.0)	10 (3.2)	
Symptoms of neuroglycopenia†	26 (7.4)	8 (20.0)	18 (5.8)	.001
Hypoglycemia for which help of others was necessary	19 (5.4)	5 (12.5)	14 (4.5)	.003
Hypoglycemia for which help of healthcare workers or admission to hospital was necessary	9 (2.6)	4 (10.0)	5 (1.6)	.07
Medical treatment for early or late dumping	8 (2.3)	2 (5.0)	6 (1.9)	.223

Data are numbers and frequencies (percentages).
*P value of high suspicion versus low suspicion group for late dumping.
†Symptoms of neuroglycopenia include feelings of loss of control (e.g.) disorientation, impaired speech, loss of consciousness).

complaints of moderate-to-severe complaints of early dumping (0.8%) and 1 of late dumping (0.8%). No statistically significant differences were seen between the volunteers with BMI of above or below 25.

Differences between the patient and volunteer group were statistically significant ($P < .001$).

Characteristics of the patients with a high suspicion for dumping

The characteristics of patients with a high suspicion for early and late dumping are shown in Table 3a and 3b, respectively. Compared with those with a low suspicion, patients with early dumping were more often female. In contrast, patients with a high suspicion of late dumping were slightly younger than patients with a low suspicion but no gender difference was observed. More patients with a high suspicion of early and late dumping had support of a dietician. The patients with high suspicion of late dumping were less satisfied with the operation results, and fewer patients in both groups with high suspicion for dumping said they would not perform the operation again if they had the choice.

High suspicion of late dumping by other estimates in the patient group (Table 4)

Nearly 20% of patients reported a low self-measured blood glucose after a meal. Significantly more patients with a high suspicion of late dumping (27.5% versus 12.3%) reported a low self-measured blood-glucose level after a meal ($P = .015$) Loss of self-control (e.g., by disorientation, impaired speech, loss of consciousness) was reported by 7% of all patients. However, this was 20% in patients with a high suspicion of late dumping versus 5.6% in patients with a low suspicion ($P = .001$). Hypoglycemia for which the help of others was necessary (severe hypoglycemia) occurred in 5.4% of patients. Contact with healthcare workers or institutions for hypoglycemia was 2.6%.

Self-treatment of dumping in the patient group (Table 5a and 5b)

Patients with early and late dumping changed their eating pattern significantly more than patients without dumping symptoms; they changed the composition of their meals but no difference was seen in the intake of sugars, carbohydrates, or meat. Patients with symptoms of late dumping did

Table 5a
Change of food intake of study population at high suspicion for early dumping compared with patients at low suspicion

	High suspicion group for early dumping	Low suspicion group for early dumping	*P* value
Total	68	282	
Change of amount of food per meal	55 (80.9)	190 (67.4)	.029
Change of frequency of meals	41 (60.3)	140 (49.6)	.115
Change of content of meal	60 (88.2)	196 (69.5)	.002
Fewer concentrated sweets	40 (66.7)	142 (72.4)	.387
Less carbohydrates	39 (65.0)	111 (56.6)	.250
Less vegetables	8 (13.3)	35 (17.9)	.412
Less meat	34 (56.7)	109 (55.6)	.886

Data are numbers and frequencies (percentages).

Table 5b
Change of food intake of study population at high suspicion for late dumping compared with patients at low suspicion

	High suspicion group for late dumping	Low suspicion group for late dumping	*P* value
Total	40	309	
Change the amount of food per meal	33 (82.5)	211 (68.3)	.065
Change of frequency of meals	21 (52.5)	159 (51.5)	.901
Change of content of meal	37 (92.5)	218 (70.6)	.003
Fewer concentrated sweets	26 (70.3)	155 (71.1)	.918
Less carbohydrates	25 (67.6)	124 (56.9)	.223
Less vegetables	2 (5.4)	41 (18.8)	.044
Less meat	18 (48.6)	124 (56.9)	.351

Data are numbers and frequencies (percentages).

not reduce their intake of vegetables (in contrast with patients without symptoms of late dumping). No difference was seen in vegetable intake for the patients with symptoms of early dumping. Patients with early dumping also changed the amount of food per meal.

Medical treatment of dumping in the patient groups (Table 4)

Three patients were treated for late dumping with medication (1 with long-acting Octreotide, 2 with Acarbose) at the time of the survey.

Health related quality of life in the patient group

RAND-36, HADS, MFI-20 and HFS-II. Patients with early and late dumping had significantly lower scores on the RAND-36 and HADS questionnaires compared with patients without dumping (Fig. 1a and 1b). No differences were seen in the MFI-20 scores (Fig. 1a and 1b). The negative effects observed for health-related QoL, anxiety and depression were of similar magnitude in early and late dumping. In the Hypoglycemia Fear Scale (HFS-II) all 12 subscales were significantly different between patients with or low suspicion of late dumping (all $P < .001$). It is noteworthy that similar results were found in patients with early dumping (data not shown).

Weight loss and regain after primary RYGB (Table 2) in the patient groups

Self-reported percentage of excess weight loss (%EWL) or weight regain were not different between patients with high or low suspicion of early or late dumping.

High suspicion of early and late dumping in patients without diabetes, with cured diabetes and with persistent diabetes postoperatively

The prevalence of medical treatment for diabetes postoperatively was approximately 10% (Tables 3a and 3b). No differences were seen in the prevalence of a high suspicion of early and late dumping in the patients without diabetes preoperatively, in patients with cured diabetes postoperatively or in patients with persistent diabetes (Table 6). Subgroup analysis according to type of medication was not possible due to very low numbers. But in the group at high suspicion for early dumping, 7.4% of the patients used insulin against 4.2% in the low-suspicion for early dumping ($P = .241$). In the group at high suspicion for late dumping group 5.5% of the patients used insulin against 4.8% in the low suspicion group ($P = .978$).

Discussion

This study shows that complaints of moderate to severe intensity of both early and late dumping have a symptom prevalence of approximately 19% and 12%, respectively, at 2 to 3 years after primary gastric bypass surgery, and that they are associated with a markedly reduced health-related QoL as well as anxiety and depression.

Since the initial reports on late dumping (post-gastric bypass hypoglycemia) by Service et al. [28] and Patti et al. [29], increasing numbers of cases have been described and reviewed in the literature [30]. However, only 2 studies report on its prevalence. First, Lee et al. performed a study in which the Edinburgh hypoglycemia questionnaire was used in patients with gastric bypass or sleeve gastrectomy [31]. Although of interest, it must be noted that this questionnaire is used and validated for hypoglycemia in the treatment of diabetes and not for late dumping [32]. Lee found that the prevalence of complaints leading to high suspicion for hypoglycemia was 34%, which is much higher than the prevalence in our study. This discrepancy can be explained by the definition they adopted for suspected late dumping, which was based on the presence of 3 or more of 11 symptoms related to hypoglycemia. Their operational definition lacks specificity, for instance due to the potential absence of symptoms of neuroglycopenia. Furthermore, their results may be an overestimation of the true prevalence of late dumping due to enrichment with patients with early dumping because they did not distinguish between early and late postprandial complaints. In our study, we divided early and late dumping by autonomic and neuroglycemic

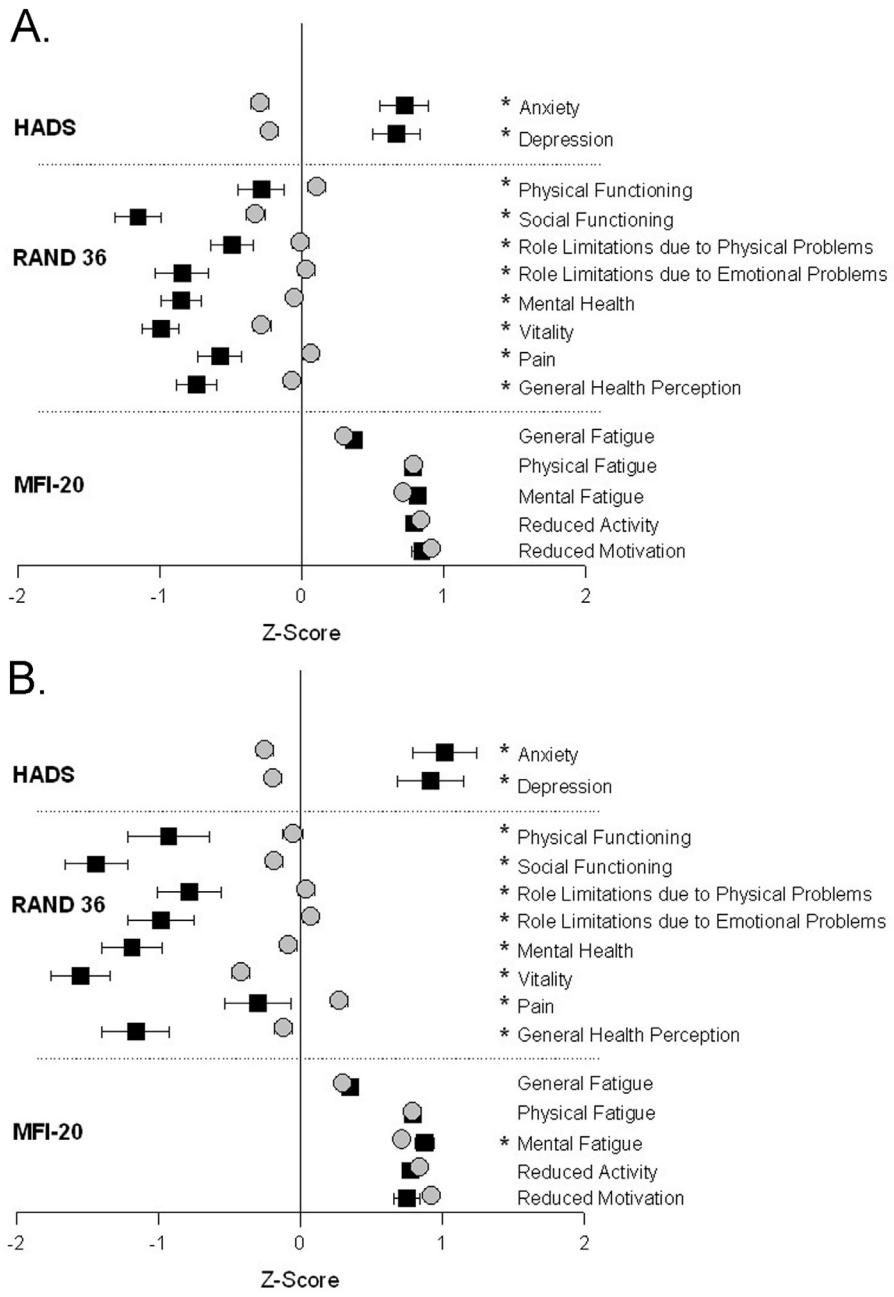

Fig. 1. (A) Z-scores for RAND36, HADS, and MFI in patients with a high and low suspicion of early dumping.
○ Patients with a low suspicion of early dumping.
■ Patients with a high suspicion of early dumping.
(B) Z-scores for RAND36, HADS, and MFI in patients with a high and low suspicion for late dumping.
○ Patients with a low suspicion of late dumping.
■ Patients with high suspicion of late dumping.

symptoms and therefore we think our prevalence is more accurate, although lower.

A second study on the prevalence of late dumping was published by Marsk et al., using several nation-wide registries in Sweden. They reported that obese persons who have undergone a gastric bypass have an increased risk of hospitalization for diagnoses associated with late dumping, although only few patients (< 1%) were affected [33]. Interestingly, their results are consistent with self-reported prevalence of severe neuroglycopenia in our population (i.e., contact with healthcare workers in 2.6% of the patients). Only one study describes the prevalence of early dumping based on a self-administered questionnaire. Svennevig et al. studied a group of more than 200 patients who had gastric resection for ulcer disease [8]. Although investigated in a different patient population, their results are in

Table 6
Prevalence of a high suspicion for early and late dumping in patients without diabetes, with cured diabetes and with persistent diabetes postoperatively

	Total number of patients 351	Early dumping 68	Late dumping 40
No type 2 diabetes,	255	37 (54.4)	30 (75)
Cured type 2 diabetes,	70	13 (19.1)	7 (17.5)
Persistent type 2 diabetes,	26	18 (26.5)	3 (7.5)
P value		.212	.721

Data are numbers and frequencies (percentages).
P value for high versus low suspicion groups of early and late dumping, respectively.

agreement with our findings, with daily symptoms of early dumping reported in 14% of patients and occasional symptoms in 19.5%.

Several investigators studied dumping by means of a provocation test to elucidate its pathophysiology. The prevalence of late dumping in these studies is estimated between 17% and 68% [7,10–12]. In the study by Kim et al., asymptomatic hypoglycemia was also found. This raises the possibility of hypoglycemia unawareness in patients with a gastric bypass, a finding which may affect the symptom prevalence.

In the literature, it is suggested that late dumping is associated with the presence of diabetes before or after gastric bypass [11]. In the present study, no differences were seen in the prevalence of early or late dumping in patients without type 2 diabetes, patients cured of type 2 diabetes, or those with persistent diabetes after operation. As noted by Banerjee et al., we also found no differences in weight loss or regain between patients with or without symptoms of late dumping in our large cross-sectional study [9].

We also studied differences in self-treatment by changing dietary patterns. Patients with a high suspicion of early and late dumping reported a significant change in the composition, of their meals—but no differences were seen in the intake of carbohydrates or sugars, as would be expected of efficient self-treatment for symptoms of late dumping. This is most likely explained by the global character of this part of the questionnaire, lacking in depth information. It is also worth noting that self-reported food questionnaires have a reputation for being inaccurate.

QoL after weight loss surgery is improved in comparison with that of obese volunteers not having had weight loss surgery [1,14–16]. In addition, the improved QoL after weight loss surgery is reported to be relatively stable for years after operation [15]. This is the first study showing that early and late dumping is associated with a markedly reduced health-related QoL and mood. In addition, less patients with high suspicion of early and late dumping were satisfied with the results of their weight loss surgery, despite similar weight loss results compared with the low-suspicion groups, and more patients would not undergo the operation again.

Some limitations of our study need to be addressed. First, it is a single-center study and therefore its generalizability can be questioned. However, the patient selection, preoperative procedures, operative technique, and postoperative care are in line with IFSO criteria and are highly comparable to those of other centers [17]. Despite this, it would be very useful to confirm our data in a multicenter study. Also, the effect on early and late dumping of pouch size, limb length, and diameter of anastomoses is not yet known. In our center, a standardized operation technique is used—but details will always be different between surgeons. We think that these minor differences will not affect dumping, but this needs to be a subject of further study.

Secondly, although almost 60% of the invited patients responded to our questionnaire, it is possible that patients with postoperative complaints were more willing to participate in this study and this inclusion bias may have resulted in an overestimation of the dumping prevalence. Patients were asked to report symptoms of dumping within the past month, which may be a long time for respondents to accurately recall symptoms. This could have biased our results, although it remains unclear in which direction. However, this period was chosen to stay in line with the well validated RAND-36, MFI, and HADS in which the period of recall is also 4 weeks.

Thirdly, self-reported data on weight may also be less accurate, although a comparison between self-reported weights with the weight measured at the outpatient clinic revealed no difference between the two.

The difference in duration of follow-up per patient could be another limitation. If the prevalence of dumping is affected by time, this may influence our results. It would be necessary to carry out longitudinal studies to gain more insight into this aspect.

The fifth and perhaps the most important limitation is that there is no validated questionnaire available for early and late dumping. The best-known questionnaire is the Sigstad score, which was initially developed as a clinical score for early dumping to be administered by a doctor [34]. Since then, some have used a modified Sigstad score as a patient questionnaire for postgastrectomy patients in case of ulcer disease [7,8]. It is not widely used for late dumping. As indicated earlier, the Edinburgh hypoglycemia questionnaire is also not validated for late dumping. A newer and potentially more useful patient questionnaire is the Dumping Severity Score developed by Arts et al. [18]. This questionnaire is used for the evaluation of treatment response in patients with late dumping. Validated cutoff levels are not available. It is the only questionnaire available

that differentiates between patients with early and late dumping.

For the purposes of this study, we used an arbitrary predefined cutoff level for early and late dumping. This level was based on the presence of at least moderate complaints in 3 of 8 subscales for early dumping with at least one autonomic symptom and 3 of 6 subscales for late dumping with at least one neuroglycemic symptom. The rationale for these cutoff points is the self-reported burden of (daily) symptoms on more than one scale. Furthermore, the mandatory character of the presence of a symptom in any of the subscales leads to recognition of early and late dumping with enhanced specificity, thus excluding other diseases. It seems reasonable that this definition should identify a population that is at high suspicion for early and late dumping. It may even be that our definition is too strict, leading to an underestimation of the prevalence, considering that 20% of the patients in our group reported low glucose by means of self-measurement. Alternatively, validation of late dumping by verification of hypoglycemic episodes may also not yield a proper comparison, since late dumping after an oral glucose or mixed-meal tolerance test is reported to be up to 68% [11]. This high figure may reflect the ability of patients to respond with a hyperinsulinemic hypoglycemia after a certain stimulus but it is not likely to match daily complaints. In general, the validation of questionnaires is a limitation in this field. The same applies for the HFS-II we used. This is only validated in a population with type 1 diabetes and not in a population of patients after gastric bypass surgery. Caution must therefore be applied in the interpretation of these results.

We compared our group of patients with healthy non-obese volunteers. This choice was made deliberately because we anticipated that obese prebariatric volunteers have a higher incidence of the after-dinner dip, because of different eating manners. We also did not ask our presurgical patients because they were already in the screening procedure and could therefore see the questionnaire as an application form for bariatric surgery which, in our opinion, would also have biased the results. This, however, should however be subject of future research.

The prevalence of dumping varies with the different definitions of early and late dumping (i.e., whether it is self-reported, self-measured glucose, after tolerance test, etc.). Severe late-dumping syndrome complaints requiring hospitalization are rare but the full spectrum of this disease is wider. Our results show that clinically significant complaints of dumping are prevalent and they can affect QoL and satisfaction with the operation. Therefore, we need to tell our patients before the operation that 1 in 5 will suffer from complaints that have an effect on overall wellbeing in daily life. In follow-up consultations, symptoms of early and late dumping must be checked so that advice and treatment can be given and a better QoL achieved. In future research, we have to find out whether screening for early and late dumping can identify more patients whose QoL could be improved with dietary advice, treatment, and information on these syndromes.

Conclusion

In this descriptive cohort study, self-reported complaints suggestive of early and late dumping of moderate to severe intensity were, respectively, 18.8% and 11.7% in a cohort after primary gastric bypass surgery and were associated with markedly reduced health related QoL.

Disclosures

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

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