



Dumping Syndrome Following Gastric Bypass: Validation of the Dumping Symptom Rating Scale

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Published online: 14 January 2013
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Abstract There is a lack of prevalent data for dumping syndrome (DS) and methods discriminating between different symptoms of the DS. A self-assessment questionnaire, the Dumping Symptom Rating Scale (DSRS), was developed. The aim was to measure the severity and frequency of nine dumping symptoms and to evaluate the construct validity of the DSRS. Pre- and 1 and 2 years after Roux-en-Y gastric bypass surgery, 47 adults and 82 adolescents completed the DSRS. Cognitive interview was performed. Reliability and construct validity were tested. Effect sizes (ES) of changes were calculated. Patients found the questionnaire relevant. A high proportion of the respondents reported no symptoms affecting them negatively at all (floor effects). However, 12 % stated, quite severe, severe, or very severe problems regarding fatigue after meal and half of them were so tired that they needed to lie down. Nearly 7 % reported quite severe, severe, or very severe problems dominated by nausea and 6 % dominated by fainting esteem. The internal consistency reliability was adequate for both severity (0.81–0.86) and

frequency (0.76–0.84) scales. ES were small, since some subjects experienced symptoms already preoperatively. Although most patients reported no or mild dumping symptoms 1 and 2 years after gastric bypass surgery, around 12 % had persistent symptoms, in particular, postprandial fatigue, and needed to lie down. Another 7 % had problems with nausea and 6 % had problems with fainting esteem. The DSRS is a reliable screening tool to identify these patients.

Keywords Roux-en-Y gastric bypass · Dumping syndrome · Gastrointestinal symptoms · Construct validity

Introduction

Dumping syndrome (DS) is a well-known complication of upper gastrointestinal (GI) surgery. Bariatric surgery is currently the most common cause of postoperative DS, and with the rapidly increasing number of patients undergoing bariatric surgery, the incidence of DS is likely to increase. Symptoms of DS can be classified as early or late, depending on how soon after ingestion they occur. Early symptoms occurs about 10–30 min [1, 2] postprandial and comprise both GI and vasomotor symptoms. GI symptoms include abdominal pain, diarrhea, borborygmi, nausea, and bloating. Vasomotor symptoms include fatigue, a desire to lie down after meals, facial flushing, palpitations, perspiration tachycardia, hypotension, and syncope. Late symptoms (which we prefer to label as late postprandial symptoms rather than dumping symptoms) occur 1–3 h after ingestion of a meal and include symptoms like perspiration, palpitations, hunger, fatigue, confusion, aggression, tremor, and syncope [3]. There are major differences in the reporting of prevalence of DS, from 10 % of

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patients after gastric surgery [4] to 75 % after Roux-en-Y gastric bypass (gastric bypass) [5]. An increased risk of hospitalization for postgastric bypass hypoglycemia compared with a reference population and banding procedures has been demonstrated after gastric bypass, although only 0.2 % of patients seek medical care [6]. The underlying mechanisms for DS are not completely understood, although symptoms of DS and late postprandial symptoms are considered having distinct underlying pathophysiology [7, 8]. DS has been suggested as a possible cause for weight loss after gastric bypass through negative conditioning for consuming high energy-dense foods (similar to negative conditioning of particular dishes, tastes, and smells that have been associated with vomiting and with nausea). However, clinically, it has been shown that the amount of weight loss following gastric bypass doesn't correlate with the severity of DS [5, 9, 10].

In 1970, Sigstad proposed a diagnostic index based on the occurrence of different symptoms of DS [11], which has been used to examine the association between dumping and weight loss after gastric bypass [5]. This index is designed to be used in a provocation test as the questions are expressed in the present tense and therefore, it is not suitable for measuring DS in a retrospective perspective, for example, during the last week. Diagnosis has also been based on clinical information [12] or a one-item ordinal scale [13]. None of these methods can discriminate between different qualities/symptoms of the DS.

Increasing body mass index (BMI) is associated with increased prevalence of upper GI symptoms, like bloating and diarrhea [14]. It seems that morbidly obese subjects experience more intense GI symptoms compared to normal-weight persons, and many of these symptoms can be reversed both short time [15] and long-term [16] after laparoscopic gastric bypass. It is not known if the increased prevalence of GI symptoms in obese persons is due to a diminished perception of satiety sensations facilitating overeating or whether excessive food intake cause GI symptoms.

Existing methods to capture the DS do not provide sufficient information about the magnitude and frequency of the various dimensions over time. Therefore, we lack prevalence and severity data regarding the symptoms of the DS making the term vague. We developed a self-assessment questionnaire to enable discrimination between the various symptoms of early DS. The primary aim of this paper was to describe symptom severity and frequency of different qualities of early DS in adults and adolescents 1 and 2 years after gastric bypass. The second aim was to evaluate the construct validity of the Dumping Symptom Rating Scale (DSRS). Thirdly, we examined associations between

upper GI symptoms (GSRS) and early dumping symptoms (DSRS).

Methods

Study Design

Data was collected from two longitudinal intervention studies of adults and adolescents undergoing gastric bypass surgery in the treatment of morbid obesity. The study of adults was conducted at Sahlgrenska University Hospital in Gothenburg, while the study of adolescents was a multicenter study including three childhood obesity clinics in Sweden: Sahlgrenska University Hospital, Karolinska Institute in Stockholm, and the University Hospital in Malmö. However, all patients were operated by the same surgical team using the same surgical technique.

Participants

Altogether 47 adult patients (35 women and 12 men), mean (SD) age 43 [10] years and BMI 44.5 (4.9) kg/m², were enrolled between April 2004 and April 2008. The purpose was to investigate food intake, eating behavior, and GI symptoms in a laboratory setting with a meal experiment [17]. Inclusion criterion was BMI 35–50 kg/m² and exclusion criteria were inability to understand oral and written instructions as well as severe medical conditions, e.g., insulin-treated type 2 diabetes mellitus. Of the 47 enrolled, 43 completed the protocol. Two females were excluded from analysis due to unrealistic reported energy intake in a food frequency questionnaire. In addition, two females were excluded due to development of breast cancer and chronic obstructive pulmonary, respectively, during the study. The adults were examined before and 6 weeks and 1 and 2 years after gastric bypass. Under the postoperative follow-up, one subject could not attend the 6-week visit due to cholecystectomy. At 1 year, one subject was pregnant and three patients did not receive the questionnaire. At 2 years, one patient was breastfeeding.

In the second sample, 94 eligible obese adolescents were offered gastric bypass treatment [18]. Twelve declined surgical treatment and the remaining 82 were enrolled in the study (53 women and 29 men; mean age 16.5 (1.2) years; BMI 45.5 (6.0) kg/m²) between February 2006 and April 2009. Inclusion criteria were a completed psychological evaluation, puberty status (Tanner score 4–5), and at least 1 year with active conservative treatment that had failed. Exclusion criteria were lack of compliance, specific obesity syndrome: Prader–Willis, obesity due to brain injury, and severe general disease and specific genetic defects (MC4R, leptin deficiency). Of the 82 enrolled, one refused surgery

on the day of the operation; thus, 81 individuals underwent surgery and were included in the statistical analysis of the DSRS. The adolescents were examined before and 1 and 2 years after Roux-en-Y gastric bypass (RYGB). The DSRS was not answered preoperatively in 17 % of subjects (21 of 124 visits) and postoperatively in 14 % of subjects (36 of 248 visits) due to administrative mistakes in which the questionnaire was not distributed to all subjects.

A group of 32 healthy volunteers (21 women and 11 men), mean age 37.8 (13.6) years, BMI 23.7 (2.7) kg/m², served as a normal weight reference group. The reference group was examined at one time point.

The study protocols were approved by the Regional Ethical Review Board in Gothenburg (Dnr: S 674-03 and Dnr: S 584-07) and all subjects signed an informed consent. Parents signed informed consent for adolescents who were below 18 years of age.

Operation Technique

The surgical procedures were all primary bariatric procedures completed laparoscopically. The Roux-en-Y gastric bypass technique, as described in detail elsewhere [19], included an antecolic–antegastric Roux-en-Y construction with a 10- to 20-ml gastric pouch and a 100–150-cm Roux limb.

Debriefing/Subject Payment

No economical or other compensation were given to the intervention groups. Reference subjects received 50 Euros each for participation in the study.

Measurements

The data was collected by research dietitians and research nurses specially trained for clinical trials.

Dumping Symptom Rating Scale

DSRS is a self-assessment questionnaire developed by a multidisciplinary team of experts with many years' experience of working with patients treated with gastric bypass. DSRS covers questions regarding 11 common symptoms associated with the DS. Nine items concern symptoms that may occur shortly after meals (about 10–30 min), one item concern symptoms related to drinking fluids during meals, and one item measures symptoms related to consuming heavily sweetened drinks. The severity of each symptom during the past week is graded on a seven-point Likert-scale, which ranges from “no trouble at all” [1] to “very severe problems” [7]. The frequency of 9 of the DS symptoms in the last 2 weeks is measured on a six-point Likert-scale,

from “no trouble at all” [1] up to “several times a day” [6] (Appendix 1). The severity items are summed to a severity scale and the frequency items are summed to a frequency scale. Also, each severity item is multiplied by the respective frequency item to a DSRS total index. Finally, the questionnaire includes three questions concerning any avoidance of foods that may cause problems associated with meals and in that case, which type of foods and what kind of problems this food may cause.

Gastrointestinal Symptom Rating Scale

GSRS includes questions regarding 16 common GI symptoms that are summed into six dimensions: abdominal pain (three items), reflux (two items), diarrhea (three items), indigestion (four items), constipation (three items), and eating dysfunction (one item). The magnitude of the symptoms during the past week is graded on a seven-point Likert-scale, where the highest score [7] denotes the most pronounced symptoms and [1] no symptoms. A mean score (range 1–7) is calculated for each domain. GSRS was originally developed to measure bowel function in patients with irritable bowel syndrome (IBS) [20]. GSRS is widely used and the reliability and validity have been reported to be acceptable in reflux and dyspepsia [21] and excellent in IBS [22].

Anthropometric Measurements

Height was measured to the nearest 0.01 m. Weight was measured to the nearest 0.1 kg with calibrated scales. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m²). Excess body weight was defined as BMI > 25 kg/m² and percentage Excessive Body Mass Index Loss (%EBMIL) was calculated using the formula: %EBMIL = 100 – [(follow-up BMI – 25/beginning BMI – 25) × 100] [23].

Cognitive Interviewing

A cognitive interview was conducted to test the content validity of the DSRS and to make sure that the responders interpreted the questions as intended. Interviews were conducted with 20 consecutive gastric bypass adult patients who completed their regular 2-year visit. They first completed the DSRS and were then interviewed regarding their thoughts and opinions on the questionnaire.

Statistical and Psychometric Analyses

Cross-validation was performed by analyzing adults and adolescents separately, i.e., if similar psychometric results are obtained in two different samples, the validation of the instrument is more trustworthy. Cronbach's α coefficients

were computed to estimate the internal consistency reliability of scale scores. A coefficient of at least 0.70 is considered adequate [24]. To further test the reliability of the DSRS, test–retest was performed in 17 consecutive gastric bypass adult patients who completed their regular 2-year visit in the study. The DSRS was first completed at the hospital visit and at home 7 days later. The intraclass correlation coefficient (ICC), using a two-way mixed model with absolute agreement, was calculated for each item to assess test–retest reliability. The reference values for the strength of agreement are from Altman who considers <0.20 as poor agreement, 0.21–0.40 as fair, 0.41–0.60 as moderate, 0.61–0.80 as good, and 0.81–1.00 as a very good agreement [25].

Item-total correlations were calculated for test of scaling assumptions. Item-scale convergent validity is indicated if each item correlates substantially ($r \geq 0.40$, corrected for overlap) with its own scale. The frequency distribution of the DSRS symptom severity and frequency items was calculated and floor and ceiling effects (i.e., respondents obtaining minimum and maximum scores, respectively) were examined. Known-groups validity was tested with the Mann–Whitney *U* test by comparing DSRS total index between gastric bypass patients (adult and adolescents) 2 years postoperatively and a reference group of normal-weight persons. Effect size (ES) of change was calculated from baseline to 2 years postoperatively using the standardized response mean (SRM), which is the mean of the change in scores (recorded at assessment of the same subject at two different times) divided by the SD of these changes in scores. $SRM < 0.2$ is considered “trivial,” 0.2 to <0.5 “small,” 0.5 to <0.8 “moderate,” and >0.8 “large.” Significant differences of the various dimensions of GSRS between pre- and postoperative states of the normal-weight reference group were calculated by analysis of variances (ANOVA) with Bonferroni correction in order to avoid type I errors. Spearman’s correlations were used for testing of significant associations between the DSRS total index and the GSRS domains. Criteria for interpreting the magnitudes of correlation were taken from Guyatt et al. [26]. Spearman’s correlation was also used to investigate the association between the DSRS total index and %EBMIL. Descriptive statistics were reported as means (SD). SPSS version 18.0 (SPSS, Chicago, IL, USA) was used for statistical analysis.

Results

Body Weight Change

BMI in adults was reduced from 44.5 (4.9) to 30.3 (4.9) and in adolescents from 45.4 (6.0) to 30.1 (4.8) 2 years after surgery ($P < 0.001$).

Content Validity of the Dumping Symptom Rating Scale

None of those interviewed experienced the questions as difficult to understand, difficult to answer, or unclear. No questions were seen as upsetting or irritating. One patient remarked that there were too many response choices in terms of severity of symptoms. The patients felt that the questionnaire was relevant and no one had any additions in terms of content, for example, other symptoms.

Test–Retest Reliability

ICC ranged from 0.47 to 0.94 for the severity items and from 0.27 to 0.94 for the frequency items. One severity item had an ICC value <0.60, four items were between 0.61 and 0.80, and four items were >0.81. One frequency item had a value <0.40, two items were between 0.41 and 0.60, three items were between 0.61 and 0.80, and three items had values >0.81.

Internal Consistency Reliability

Cronbach’s alpha demonstrated good reliability with values >0.80 for the severity scale in adolescents and adults at 1 and 2 years (Table 1). Alphas for the frequency scale were >0.80 in adolescents and between 0.75 and 0.80 in adults.

Construct Validity

At 2 years, all item-total correlations for the symptom severity and frequency scales were satisfactory ($r \geq 0.40$) in adolescents. A few scaling errors were noted in adults; one item-scale correlation in the severity scale (diarrhea) and two correlations in the frequency scale (sweating, flushing and diarrhea) were below the minimum desired level (Table 1).

Dumping Symptoms in Adults vs. Adolescents

Comparison between adults and adolescents of the severity and frequency of symptoms displayed no significant differences at 1- and 2-year follow-up (Table 2). However, differences were noted preoperatively, where adolescents reported greater severity of palpitation, sweating or “flush,” cold sweat and paleness, nausea, “cramp” in the stomach, and higher frequency of palpitation than the adults.

Severity and Frequency of Dumping Syndrome Symptoms

Since no significant differences were observed between adults and adolescents postoperatively, the item frequency

Table 1 Cronbach's alpha and item-total correlations (corrected for overlap) for DSRS symptom and frequency items in adults and adolescent at 1- and 2-year follow-up after RYGB

Symptom items	Adults		Adolescents	
	1-year follow-up (n=39)	2-year follow-up (n=42)	1-year follow-up (n=66)	2-year follow-up (n=65)
Severity scale				
Alpha	0.82	0.81	0.84	0.86
Item-total correlation				
Fatigue	0.66	0.60	0.68	0.59
Palpitations	<i>0.34</i>	0.44	0.63	0.45
Sweating, flushing, ("flush")	0.62	0.44	0.56	0.63
Cold sweats, paleness	0.68	0.63	0.51	0.54
Need to lie down	0.70	0.52	0.68	0.68
Diarrhea	<i>0.25</i>	<i>0.13</i>	0.44	0.57
Nausea and/or vomiting feeling	0.63	0.63	0.56	0.61
"Cramp" in the stomach	<i>0.30</i>	0.45	<i>0.30</i>	0.51
Fainting esteem or "shaky"	0.59	0.59	0.47	0.52
Pain, vomiting, stop-feeling	<i>0.15</i>	0.43	0.48	0.58
Frequency scale				
Alpha	0.77	0.76	0.81	0.84
Item-total correlation				
Fatigue	0.63	0.62	0.59	0.57
Palpitations	0.40	0.50	0.57	0.44
Sweating, flushing, ("flush")	0.51	<i>0.31</i>	0.58	0.58
Cold sweats, paleness	0.63	0.61	0.43	0.59
Need to lie down	0.65	0.51	0.58	0.70
Diarrhea	<i>0.18</i>	<i>0.07</i>	<i>0.37</i>	0.49
Nausea, vomiting feeling	<i>0.25</i>	0.61	0.50	0.57
"Cramp" in the stomach	<i>0.25</i>	0.49	<i>0.29</i>	0.62
Fainting esteem or "shaky"	0.55	0.55	0.65	0.51

Correlations below 0.40 are expressed in italics. A Cronbach's alpha coefficient of at least 0.70 is considered adequate (in bold)

distribution (percent) of the severity and the frequency of early dumping symptoms are reported for both samples together. The frequency distribution (percent) 2 years postoperatively showed that a high percentage reported "no trouble at all." Thus, substantial floor effects were noted for most symptoms (Table 3), and 22 % to 70.4 % reported "no trouble at all" (floor) on the different symptoms. The proportion who reported minor inconvenience and mild trouble ranged from 7.5 % to 23.9 %. The most common symptoms were fatigue and need to lie down. Two years postoperatively, 11.9 % of the adults and adolescents reported quite severe problems, severe, or very severe problems with fatigue shortly after meals. Another 23.9 % reported moderate trouble with fatigue after meals. The proportion of subjects who stated that they had to lie down after meals (quite severe, severe, and very severe problems) was 5.6 %, and another 22.0 % reported moderate trouble. Quite severe problems or worse of nausea and/

or vomiting feeling (6.6 %) and severe problems or worse of fainting esteem and/or "shaky" (5.5 %) were indicated.

Known-groups Validity

At 2 years postoperatively, the gastric bypass group (adults and adolescents) generally reported more problems than the normal-weight reference group. Differences according to the DSRS total index were nonsignificantly higher for fatigue 10.4 vs. 7.8 ($P=0.244$), diarrhea 4.34 vs. 1.96 ($P=0.144$), and "cramp" in the stomach 3.29 vs. 1.77 ($P=0.125$), and significantly higher for palpitations 3.65 vs. 1.19 ($P=0.001$); sweating, flushing ("flush") 3.93 vs. 1.08 ($P<0.001$); cold sweats, paleness 4.08 vs. 1.12 ($P=0.001$); need to lie down 8.19 vs. 3.31 ($P=0.002$); nausea and/or vomiting feeling 5.21 vs. 1.73 ($P<0.001$); and fainting esteem or "shaky" 3.76 vs. 1.04 ($P=0.001$).

Table 2 Mean values (SD) and significant differences between adults and adolescents in magnitude and frequency of the various dumping symptoms, preoperatively and 1 and 2 years postop

	Adults			Adolescents			P value*		
	Preop (n=34)	1 year (n=41)	2 years (n=42)	Preop (n=69)	1 year (n=66)	2 years (n=65)	Preop	1 year	2 years
Severity scale									
Fatigue	2.63 (1.45)	2.59 (1.45)	2.69 (1.33)	2.74 (1.57)	2.86 (1.32)	3.01 (1.45)	0.769	0.199	0.225
Palpitations	1.13 (0.55)	1.33 (0.70)	1.62 (0.94)	1.44 (0.90)	1.62 (1.05)	1.61 (0.98)	0.044	0.110	0.806
Sweating, flushing	1.19 (0.54)	1.69 (0.98)	1.83 (1.10)	1.65 (1.23)	1.79 (1.21)	1.86 (1.36)	0.019	0.994	0.989
Cold sweats, paleness	1.06 (0.36)	1.67 (1.13)	1.64 (0.98)	1.35 (0.91)	1.83 (1.31)	1.87 (1.27)	0.022	0.346	0.506
Need to lie down	2.16 (1.46)	2.31 (1.38)	2.31 (1.37)	2.03 (1.47)	2.71 (1.42)	2.61 (1.40)	0.479	0.103	0.178
Diarrhea	1.94 (1.34)	1.49 (0.91)	1.57 (0.99)	1.62 (1.11)	1.61 (1.20)	1.76 (1.39)	0.446	0.962	0.782
Nausea	1.19 (0.64)	1.92 (1.33)	1.76 (1.06)	1.66 (1.15)	2.39 (1.47)	2.24 (1.46)	0.019	0.055	0.057
“Cramp” in the stomach	1.31 (1.03)	1.69 (1.10)	1.48 (0.94)	1.62 (1.06)	1.64 (1.22)	1.64 (1.12)	0.031	0.609	0.495
Fainting esteem	1.19 (0.74)	1.59 (1.31)	1.62 (1.10)	1.32 (1.01)	1.70 (0.96)	1.74 (1.29)	0.590	0.068	0.793
Summary severity scale	15.88 (4.84)	20.92 (8.21)	21.00 (6.81)	17.61 (6.00)	21.87 (9.30)	21.74 (9.50)	0.205	0.568	0.955
Frequency scale									
Fatigue	2.63 (1.66)	2.54 (1.39)	2.93 (1.49)	2.74 (1.46)	3.08 (1.40)	3.08 (1.53)	0.695	0.051	0.619
Palpitations	1.13 (0.55)	1.51 (0.94)	1.86 (1.12)	1.37 (0.94)	1.67 (1.13)	1.67 (1.41)	0.046	0.401	0.411
Sweating, flushing	1.09 (0.30)	1.87 (1.17)	1.76 (1.08)	1.46 (1.14)	1.83 (1.18)	1.66 (1.14)	0.189	0.766	0.472
Cold sweats, paleness	1.06 (0.25)	1.61 (1.05)	1.71 (0.97)	1.29 (0.85)	1.85 (1.06)	1.75 (1.20)	0.065	0.157	0.624
Need to lie down	2.09 (1.51)	2.49 (1.36)	2.55 (1.48)	1.81 (1.24)	2.69 (1.32)	2.61 (1.46)	0.406	0.284	0.752
Diarrhea	2.09 (1.38)	1.62 (1.09)	1.71 (1.27)	1.59 (1.11)	1.62 (1.20)	1.73 (1.27)	0.128	0.976	0.847
Nausea	1.16 (0.52)	1.72 (1.19)	1.76 (1.07)	1.40 (0.88)	1.97 (1.18)	1.95 (1.20)	0.040	0.135	0.194
“Cramp” in the stomach	1.34 (0.90)	1.56 (0.97)	1.62 (0.99)	1.25 (0.74)	1.48 (1.00)	1.55 (1.00)	0.906	0.515	0.718
Fainting esteem	1.09 (0.39)	1.49 (1.07)	1.50 (0.94)	1.25 (0.87)	1.65 (0.99)	1.61 (1.16)	0.515	0.092	0.962
Summary frequency scale	13.69 (4.28)	16.34 (6.12)	17.44 (6.27)	14.03 (6.80)	17.50 (6.80)	17.06 (7.20)	0.808	0.293	0.542
DSRS total index									
Fatigue	8.56 (8.53)	8.23 (7.84)	9.38 (7.80)	8.82 (8.58)	10.03 (8.38)	10.97 (9.10)	0.636	0.153	0.483
Palpitations	1.28 (0.89)	2.54 (3.14)	3.76 (4.19)	2.57 (4.15)	3.45 (4.91)	3.58 (5.12)	0.053	0.168	0.514
Sweating, flushing	1.38 (1.07)	4.15 (5.00)	4.14 (4.76)	3.35 (6.64)	4.46 (5.66)	3.83 (4.75)	0.046	0.887	0.771
Cold sweats, paleness	1.09 (0.39)	3.68 (5.94)	3.57 (4.09)	2.31 (5.21)	4.43 (5.34)	4.46 (6.69)	0.017	0.168	0.986
Need to lie down	6.38 (8.41)	7.36 (7.02)	7.60 (7.95)	5.10 (7.52)	8.74 (7.78)	8.56 (8.15)	0.555	0.295	0.426
Diarrhea	5.56 (6.48)	3.18 (5.17)	3.74 (5.40)	3.51 (5.52)	3.86 (6.90)	4.67 (7.99)	0.213	0.824	0.770
Nausea	1.66 (2.36)	4.31 (5.23)	3.98 (4.74)	3.13 (5.30)	5.94 (6.71)	5.82 (7.65)	0.020	0.101	0.120
“Cramp” in the stomach	2.44 (4.78)	3.46 (4.25)	3.05 (3.96)	2.65 (5.25)	3.43 (6.18)	3.48 (5.09)	0.125	0.689	0.935
Fainting esteem	1.53 (2.48)	3.62 (7.33)	3.29 (5.11)	2.35 (5.64)	3.60 (4.14)	4.11 (7.16)	0.576	0.149	0.945

Mann–Whitney *U* test. DSRS total index=each severity item multiplied by the respective frequency score

P<0.05 in bold

Changes in Dumping Symptom Rating Scale from Baseline to 2 Years

ES of change between preoperative state and 2 years were calculated for determining clinically meaningful change. All ES were “trivial” or “small.” Three severity symptoms

demonstrated “trivial” change and six demonstrated “small” change. All ES, except one for the frequency items, demonstrated “small” change. For the total index, three symptoms demonstrated “trivial” change (sweating, flushing, (“flush”), diarrhea and “cramp” in the stomach) and six symptoms “small” change.

Table 3 Item frequency distribution (%) of the severity and the frequency of early dumping symptoms in adults ($n=42$) and adolescents ($n=65$) 2 years postoperatively

DSRS	Item frequency distribution % in each category ^a						
	1	2	3	4	5	6	7
Severity scale							
Fatigue	22.0	18.3	23.9	23.9	9.2	1.8	0.9
Palpitations	65.1	14.7	14.7	4.6	0.9		
Sweating, flushing	53.7	21.3	13.9	8.3	2.8		
Cold sweats, paleness	60.6	14.7	14.7	8.3	0.9		0.9
Need to lie down	36.7	12.8	22.9	22.0	2.8	2.8	
Diarrhea	67.9	13.8	7.3	7.3	0.9	1.8	0.9
Nausea and/or vomiting feeling	49.1	18.5	19.4	7.4	2.8	1.9	0.9
“Cramp” in the stomach	70.4	12.0	11.1	3.7	1.9	0.9	
Fainting esteem and/or “shaky”	67.6	11.1	13.0	2.8	4.6		0.9
Pain, vomiting, stop-feeling	67.6	16.7	8.3	6.5	0.9		
Sweet drinks>problems in the abdomen, faintness or fatigue	64.5	7.5	8.4	2.8	2.8	0.9	
DSRS	Item frequency distribution % in each category ^b						
Frequency scale	1	2	3	4	5	6	
Fatigue	22.2	19.4	13.0	30.6	9.3	5.6	
Palpitations	61.1	18.5	8.3	10.2	0.9	0.9	
Sweating, flushing	62.6	18.7	7.5	9.3	0.9	0.9	
Cold sweats, paleness	58.9	23.4	5.6	10.3	0.9	0.9	
Need to lie down	31.5	22.2	17.6	17.6	7.4	3.7	
Diarrhea	66.7	14.8	5.6	8.3	1.9	2.8	
Nausea, vomiting-feeling	50.5	27.1	11.2	7.5	2.8	0.9	
“Cramp” in the stomach	68.2	15.0	8.4	7.5	0.9		
Fainting esteem and/or shaky	70.4	14.8	7.4	4.6	0.9	1.9	

^a 1=no trouble at all, 2=minor inconvenience, 3=mild trouble, 4=moderate trouble, 5=quite severe problems, 6=severe problems, 7=very severe problems

^b 1=no trouble at all, 2=less than once a week, 3=once a week, 4=a few times per week, 5=once per day, 6=several times a day

Gastrointestinal Symptoms

The Gastrointestinal Rating Scale (GSRs) was answered pre- and postoperatively by the adults (Fig. 1). ANOVA with Bonferroni correction revealed no significant changes in GI symptoms postoperatively except for reflux that decreased after 6 weeks and 1 year postoperatively.

Correlations Between the Dumping Symptom Rating Scale Total Index and Gastrointestinal Symptoms in Adults

Correlation analysis between symptom scores of the DSRS total index 2 years postoperatively and the GSRs domains displayed several strong ($r_s \geq 0.50$) associations for GSRs

abdominal pain, diarrhea, and eating dysfunction, while trivial or small correlations ($r_s < 0.35$) were noted for GSRs reflux, indigestion, and constipation (Table 4). GSRs abdominal pain showed strong relations with “cold sweats, paleness,” “nausea/vomiting feeling,” and “cramp in the stomach” and moderate ($r_s = 0.35-0.49$) relations to “sweating/flushing,” diarrhea, and “fainting esteem/shaky.” Besides a strong correlation between GSRs diarrhea and DSRS diarrhea, there was a moderate correlation between GSRs diarrhea and DSRS “nausea/vomiting feeling,” “cramp in the stomach,” and “fainting esteem/shaky.” Finally, GSRs eating dysfunction displayed strong associations to DSRS fatigue, “nausea/vomiting feeling,” and fainting esteem/shaky,” and moderate correlations to “cold sweats, paleness,” “need to lie down,” and “cramp in the stomach”.

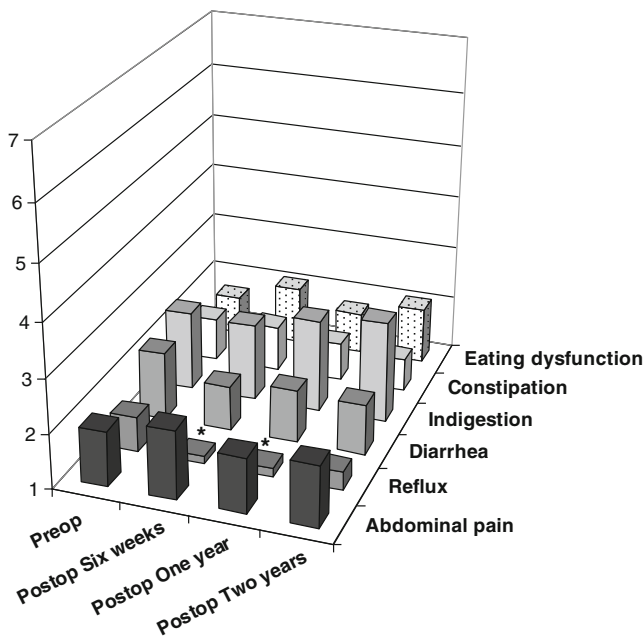


Fig. 1 Mean values of the magnitude of gastrointestinal symptoms (GSRs) in adults preoperatively and postoperatively after 6 weeks, 1, and 2 years. GSRs scale range: 1 no symptoms and 7 the most pronounced symptoms. ANOVA with Bonferroni correction $*=P<0.05$, all other dimensions demonstrated no significant difference

Foods Avoided

One and 2 years postoperatively, 73.8 (2.2) % (adults and adolescents) reported avoiding certain foods to prevent or decrease problems associated with meals. Foods frequently avoided were fatty foods 54.8 (5.1) %, sugar-rich products 36.3 (8.4) %, sweet drinks 33.3 (11.9) %, and milk and milk products 32.5 (9.7) %. Foods less frequently avoided were high fiber-rich foods 5.5 (2.1) %, whole meat 4.8 (3.9) %, raw vegetables 1.8 (1.0) %, and fruits 1.5 (2.4) %.

Correlation Between Dumping Symptom Rating Scale Total Index and Excessive Body Mass Index Loss

No significant associations between symptoms of the DSRS total index and %EBMIL were found 2 years postoperatively.

Discussion

Herein, we have presented a novel self-assessment tool to assess symptoms of early DS. Patients found the

Table 4 Correlation between the various symptoms of GSRs and the total index of DSRS two years postoperatively

DSRS	GSRs					
	Abdominal pain	Reflux	Diarrhea	Indigestion	Constipation	Eating dysfunction
Total index (severity×frequency)						
Fatigue	0.25 <i>0.105</i>	0.19 <i>0.226</i>	0.02 <i>0.922</i>	0.04 <i>0.809</i>	-0.02 <i>0.911</i>	0.52 <i><0.001</i>
Palpitations	0.25 <i>0.104</i>	0.26 <i>0.100</i>	0.15 <i>0.357</i>	0.12 <i>0.444</i>	0.00 <i>0.977</i>	0.24 <i>0.129</i>
Sweating, flushing	0.40 <i>0.008</i>	0.05 <i>0.766</i>	0.13 <i>0.404</i>	0.31 <i>0.049</i>	0.33 <i>0.033</i>	0.24 <i>0.130</i>
Cold sweats, paleness	0.51 <i>0.001</i>	0.08 <i>0.592</i>	0.19 <i>0.228</i>	0.34 <i>0.028</i>	0.19 <i>0.225</i>	0.47 <i>0.002</i>
Need to lie down	0.33 <i>0.035</i>	0.14 <i>0.360</i>	0.15 <i>0.350</i>	-0.07 <i>0.652</i>	0.01 <i>0.935</i>	0.44 <i>0.004</i>
Diarrhea	0.35 <i>0.022</i>	-0.14 <i>0.364</i>	0.72 <i><0.001</i>	0.17 <i>0.291</i>	0.06 <i>0.698</i>	0.30 <i>0.051</i>
Nausea/vomiting feeling	0.58 <i><0.001</i>	0.19 <i>0.240</i>	0.37 <i>0.018</i>	0.08 <i>0.629</i>	0.19 <i>0.231</i>	0.52 <i>0.001</i>
“Cramp” in the stomach	0.61 <i><0.001</i>	0.22 <i>0.170</i>	0.41 <i>0.007</i>	0.27 <i>0.080</i>	0.27 <i>0.083</i>	0.42 <i>0.005</i>
Fainting esteem/“shaky”	0.44 <i>0.004</i>	0.24 <i>0.133</i>	0.39 <i>0.011</i>	0.28 <i>0.070</i>	0.14 <i>0.386</i>	0.58 <i><0.001</i>

Criteria for interpreting the magnitudes of correlation coefficients [26]: <0.20 “trivial,” 0.20–0.34 “small,” 0.35–0.49 “moderate,” >0.50 “strong.” P-values in italics. r_s in bold

DSRS Dumping Symptom Rating Scale, GSRs Gastrointestinal Symptom Rating Scale

DSRS questionnaire relevant in the cognitive interview. Item-total correlations for the severity and frequency items were high for most symptoms, indicating that all items measure the same underlying latent variable. ES from baseline to 2-year change were small, since subjects experienced symptoms in relation to meals already preoperatively. Although substantial floor effects (no problems) were noted for most of the symptoms, about 12 % reported quite severe problems or worse concerning fatigue, in which half felt the need to lie down after meal. Furthermore, 9 % of adolescents indicated quite severe problems or worse of nausea. We were unable to demonstrate any association between DS and magnitude of weight loss.

It seems that the vast majority learn how to regulate dietary intake and eating behavior in order to avoid DS soon after RYGB. However, although most patients reported no, minor, or mild symptoms, there was a small percentage, 2.5 to 12 % depending on symptom, who reported quite severe problems or worse even up to 2 years after surgery. This number corresponds well with previous reports [5]. The most frequent symptoms were fatigue (around 12 % in adults and adolescents), need to lie down (7 % of the adults and 4.5 % of the adolescents), and nausea and/or vomiting feelings (9 % of the adolescents). It appears important to identify patients with severe symptoms and offer additional nutritional or behavioral therapy to minimize problems associated with the DS [3]. DSRS could preferably be used as a clinical screening instrument to identify patients with pronounced dumping problems, for example, at 6-month and/or 1-year follow-up after gastric bypass.

The patients experienced some “dumping” symptoms already preoperatively, particularly fatigue, need to lie down after a meal, and diarrhea, resulting in minor ES of postoperative changes. The DSRS severity scale displayed only “trivial” changes for fatigue, while the frequency scale and total index displayed “small” increase. The association between obesity and postprandial fatigue is not surprising, since previous studies have shown a relationship [27, 28] and a relationship between obesity and diarrhea has also been previously demonstrated [14, 29]. This could at least partly explain why neither the severity nor the frequency of diarrhea deteriorated postoperatively.

The gastric bypass group (adults and adolescents) reported significantly more problems for most of the symptoms of the DSRS total index 2 years postoperatively compared to the normal-weight reference group. However, it should be noted that the reference group also reported high

levels of fatigue after meals and the between-group difference was nonsignificant.

The GSRS eating dysfunction question (which assesses early satiety, difficulties in eating normal portions, and postprandial pain) did not deteriorate postoperatively, indicating that changes in eating conditions after RYGB are well tolerated. However, eating dysfunction had moderate to strong association to six of the nine symptoms of the DSRS total index. Also, the strong to moderate relationship between GSRS abdominal pain and several of the dumping symptoms could indicate that those who had difficulty limiting their portions also were those who experienced severe DS. There was no significant correlation between GSRS reflux and the various dumping symptoms which is logical, since reflux improves significantly after RYGB [30].

In line with previous studies [5, 9, 10], there was no significant relationship between the DS and weight loss. This does not mean that the DS could not play any role [31], since it is possible that those who report severe problems with DS are also those who have problems with their eating behavior.

The seven-point response scale used in the DSRS is equivalent with the format used in the GSRS, a validated and frequently used instrument for measuring GI symptoms. However, after evaluating the DSRS item frequency distribution in both adults and adolescents, we consider fewer response alternatives to be satisfactory for measuring DS symptoms and suggest that a four-point scale (no trouble at all, mild trouble, moderate trouble, and severe problems) to be used in future studies. This alteration simplifies the questionnaire without loss of information.

This is, to our knowledge, the first study that, in detail, has been able to discriminate between the different qualities of dumping symptoms and assess how often symptoms occur. A limitation of the study is the relatively small sample sizes, particularly the number of subjects answering the GSRS. Another limitation is missing data in adolescents.

Conclusion

Although most patients reported no or mild dumping symptoms 1 and 2 years after gastric bypass surgery, around 12 % had persistent symptoms, in particular, postprandial fatigue, and half of them were so tired that they needed to lie down. Another 7 % had problems with nausea

and 6 % had problems with fainting esteem. The DSRS is a reliable clinical screening instrument that can be used to identify patients with pronounced dumping symptoms, for example, at 6 months and/or 1 year after bariatric surgery.

Disclosures Anna Laurenius has received travel support from Johnson & Johnson. Torsten Olbers has received lecture fees from Johnson & Johnson and Covidien and travel support from Johnson & Johnson.

Appendix

The Dumping Symptoms Rating Scale (DSRS)

The following section is about inconvenience, troubles or problems that you may have had with meals. Read each question and mark a cross (X) for the option that best fits you.

1. Have you during the past week, been bothered by fatigue short (about 10-30 minutes) after meals:
 - ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems

2. Have you during the past week, been bothered by palpitations short (about 10-30 minutes) after meals:
 - ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems

3. Have you during the past week, been bothered by sweating, flushing, ("flush") short (about 10-30 minutes) after meals:
 - ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems

4. Have you during the past week, been bothered by cold sweats, paleness short (about 10-30 minutes) after meals:
- ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems
5. Have you during the last week felt a need to lie down for a while short (about 10-30 minutes) after meals:
- ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems
6. Have you during the last week suffered from diarrhea short (about 10-30 minutes) after meals:
- ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems

7. Have you during the last week suffered from nausea and / or vomiting feeling short (about 10-30 minutes) after meals:
- ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems
8. Have you during the last week suffered from "cramp" in the stomach short (about 10-30 minutes) after meals:
- ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems
9. Have you during the last week suffered from fainting-esteem and / or "shaky" short (about 10-30 minutes) after meals:
- ₁ No trouble at all
 - ₂ Minor inconvenience
 - ₃ Mild trouble
 - ₄ Moderate trouble
 - ₅ Quite severe problems
 - ₆ Severe problems
 - ₇ Very severe problems

10. Have you during the last week suffered pain, vomiting, "stop", if you drink fluids in moderate amount in relation to a meal:

- ₁ No trouble at all
- ₂ Minor inconvenience
- ₃ Mild trouble
- ₄ Moderate trouble
- ₅ Quite severe problems
- ₆ Severe problems
- ₇ Very severe problems

11. If you during the last week hastily drank heavily sweetened drinks do you have then suffered from sudden problems in the abdomen, faintness or fatigue:

- ₁ No trouble at all
- ₂ Minor inconvenience
- ₃ Mild trouble
- ₄ Moderate trouble
- ₅ Quite severe problems
- ₆ Severe problems
- ₇ Very severe problems
- ₈ I have not been drinking heavily sweetened drinks

12. Over the past two weeks, how often have you experienced the following problems short (about 10-30 minutes) after meals?

problem:	No trouble at all	Less than once a week	Once a week	A few times per week	Once per day	Several times a day
a. fatigue	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
b. palpitations	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
c. sweating, flushing ("flush")	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
d. cold sweats, paleness	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
e. need to lie down	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
f. diarrhea	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
g. nausea vomiting feelings	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
h. "cramp" in the stomach	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
i. fainting-esteem, "shaky"	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆

13. Do you avoid certain foods to avoid or alleviate problems associated with food?

- ₁ No, I eat everything
₂ Yes, I avoid certain foods

14. If you answered yes to question 13, mark a cross on the foods that you avoid to avoid or alleviate problems associated with food: (please check one or more)

- ₁ fatty foods
₂ whole meat
₃ high-fiber foods (eg. wholemeal bread)
₄ fruits
₅ sugar-rich products (such as candy, cakes, stewed fruit)
₆ raw vegetables
₇ sweet drinks
₈ milk and milk products

If there are any foods that you avoid to avoid or alleviate problems associated with meals that do not fit into the above, you can specify it here:

15. If you filled out food in question 14, which inconveniences, troubles or problems is it that you mainly want to avoid?

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