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Gastrointestinal reported outcomes following One Anastomosis Gastric Bypass based on a multicenter study

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Abstract

Objectives: To describe gastrointestinal-related side-effects reported following One Anastomosis Gastric Bypass (OAGB).

Methods: A multicenter study among OAGB patients across Israel (n=277) and Portugal (n=111) who were recruited to the study based on time elapsed since surgery was performed. An online survey with information on demographics, anthropometrics, medical conditions, and gastrointestinal outcomes was administered in both countries simultaneously.

Results: Respondents from Israel (pre-surgery age of 41.6±11.0 years, 75.8% females) and Portugal (pre-surgery age of 45.6±12.3 years, 79.3% females) presented mean excess weight loss of 51.0±19.9 and 62.4±26.5%, 89.0±22.0 and 86.2±21.4%, and 89.9±23.6 and 98.2±20.9% (P<0.001 for both countries), at 1-6 months, 6-12 months, and 1-5 years post-surgery, respectively. Median Gastrointestinal Symptom Rating Scale score was similar between time elapsed since surgery groups among respondents from Israel and Portugal (≤1.97 and ≤2.12). A notable proportion of respondents from Israel and Portugal at all time points reported 1-3 bowel movements per day (≤62.8 and ≤87.6%), Bristol stool scale categories which represent diarrhea-like stools (≤51.9 and ≤56.3%), having discomfort due to flatulence (≤79.4 and ≤90.2%), and mild to severe dyspepsia symptoms (≤50.5 and ≤73.0%).

Conclusions: A notable proportion of OAGB patients might experience certain gastrointestinal symptoms postoperatively, including flatulence, dyspepsia, and diarrhea-like stools.

Keywords: bariatric surgery, functional gastrointestinal disorders, gastric bypass, obesity, weight outcomes.

1. Introduction

One Anastomosis Gastric Bypass (OAGB) surgery is the third most commonly performed bariatric procedure worldwide, accounting for 6.6% of all procedures during 2018 (1). This procedure is based on a combination of restrictive and malabsorptive components, with the latter affected by the length of the bypassed limb as a proportion of the total small bowel length (2). OAGB is considered an effective bariatric procedure in terms of weight loss and comorbidities resolution (3). Nonetheless, only limited data exist regarding its gastrointestinal (GI) consequences (3-8). Suggested mechanisms explaining GI disorders following OAGB include anatomical configuration that reduced absorptive mucosal surface, changes in the stomach and intestinal pH, intestinal bacterial overgrowth, exocrine pancreatic insufficiency, and changes in gut transit time, but future studies are expected to confirm these pathways (8-11). GI symptoms may begin within the first few months following OAGB (6, 11) and may last for a few years after surgery (5, 7). Nevertheless, the incidence rate, severity, and time frame for these complaints are not widely understood or reported. Therefore, the primary aim of this study was to gain information on GI-related side effects reported at different time points following OAGB based on samples of patients living in two different countries (i.e., Israel and Portugal), while the secondary aims were to gain information on anthropometrics and health outcomes following this procedure.

2. Patients and methods

In this multicenter study, a survey was distributed simultaneously from June 26th, 2020, to May 9th, 2021 among patients from Israel and Portugal who undergo OAGB. OAGB patients

across Israel (n=277) and Portugal (n=111) were identified as eligible to participate in the study from patient lists in each medical center based on time elapsed since surgery [i.e., 1-6 months (1-6M), 6-12 months (6-12M) and 1-5 years (1-5Y) post-surgery]. Recruitment of patients according to defined time points was done due to a-priori expected differences in clinical outcomes at these different time periods since surgery. Patients who accepted to participate gave verbal consent and completed an anonymous online survey which was sent by email/SMS and delivered by SurveyMonkey® software. If no reply was received within 4 weeks, a reminder email/SMS was sent out.

Inclusion criteria included age ≥18 years old and patients who underwent primary OAGB in the last 5 years. Exclusion criteria included patients who had undergone other bariatric surgery, were currently pregnant, or could not consent. The local institutional review board approved the study in each medical center.

Operative Techniques of OAGB by country are described in **supplementary A**. Due to differences in surgical technique between the countries, results were presented by country. All participants received standard medical, nutritional, and lifestyle recommendations following the surgery. Proton pump inhibitors were routinely prescribed for at least 3 months in Israel, and at least 1 year in Portugal.

2.1. The survey included data on demographics, obesity-related medical conditions (i.e., type 2 diabetes, hypertension, dyslipidemia), hospitalization since the surgery, anthropometrics [i.e. weight history, and self-reported weight and height, followed by body mass index (BMI), excess weight loss (EWL), and total weight loss (TWL) percentages calculation (12)], and nutritional, lifestyle and GI outcomes.

Moreover, patients were asked to subjectively rate their overall state of health by using a 0 to 100 visual analog scale (VAS), with a score of 0 reflecting the 'worst imaginable state of health' and a score of 100 reflecting the 'best imaginable state of health (13, 14). The English

version of the whole survey is presented in **supplementary B**. The survey was distributed in Hebrew (Israel) and Portuguese (Portugal). When needed, linguistic translation and cultural adaptation of a questionnaire were performed in steps according to developed methodologies (15, 16). The work has been reported in line with the STROCSS criteria (17). This paper aimed to focus on the following GI outcomes, while most parameters were asked regarding the last month:

2.2. The degree of specific GI complaints was assessed by the Gastrointestinal Symptom Rating Scale (GSRS) which consists of 15 items and assesses 5 dimensions. Every question is rated by a seven-graded Likert-type scale (1 represents the absence of troublesome symptoms and 7 represents very troublesome symptoms), while higher scores of the whole questionnaire and by dimension represent more severe symptoms (18-20).

2.3. The severity of dyspepsia symptoms was assessed by a 4-point graded scale (0 represents absence of symptoms and 3 represents severe symptoms which interfere with normal activities) (20).

2.4. Bowel movement frequency was assessed according to acceptable categories (21) and **Defecations texture** was assessed by the 'Bristol stool scale', a diagnostic medical tool designed to classify the form of human feces into seven categories (21-24).

2.5. Usage of medication/supplement to improve GI symptoms was assessed by asking patients if since the surgery they took any medication/supplement to improve GI symptoms.

2.6. Preliminary knowledge regarding GI symptoms was assessed by asking the patients if they received explanations on the expected GI symptoms of OAGB in advance and by which multidisciplinary team member.

2.7. Statistical analyses were performed using SPSS software version 26. For continuous variables, tests of normality distribution were used. Continuous variables are presented as means±SD or median (interquartile range) as needed and categorical variables as proportions. To test differences in continuous variables between the three-time points post-

surgery the one-way ANOVA test was used or the Kruskal-Wallis test when needed. For comparison of dichotomous or categorical variables between the three-time points post-surgery the Chi-Square test or Fisher's exact test was performed. To test the correlations between the GSRS total score and reported overall state of health by VAS the Spearman correlation coefficient was used. The level of significance for all analyses was set at $p<0.05$ and Bonferroni correction was applied to take into account multiple comparisons when needed.

Power calculation When applying a sample size of N=277 (Israel survey) or N=111 (Portugal survey), a 0.05 two-sided alpha level, previously reported major GI side effect prevalence [i.e., flatulence (67%) (8)] and its prevalence in the examined population (approximately 75% and 85% for the survey in Israel and Portugal, respectively) in G*power software, a power of >0.8 was calculated.

3. Results

A total of n=277 responses from Israel and n=111 responses from Portugal were obtained for all time elapsed since surgery groups (**Figure 1**).

3.1. Pre-surgery characteristics of the survey respondents by time elapsed since surgery group and country are presented in **Table 1**. Mean reported pre-surgery age, BMI, and gender distribution (%female) were 41.6±11.0 and 45.6±12.3 years, 41.2±4.8 and 40.1±5.6 kg/m², and 75.8 and 79.3% for respondents from Israel and Portugal, respectively.

3.2. Anthropometrics and health conditions by time elapsed since surgery and country are presented in **Table 2**. Respondents from Israel and Portugal presented mean EWL of 51.0±19.9 and 62.4±26.5%, 89.0±22.0 and 86.2±21.4%, and 89.9±23.6 and 98.2±20.9% ($P<0.001$ for both countries) at 1-6M, 6-12M and 1-5Y, respectively (**Table 2**). Reports on hospitalization since surgery were higher among groups with longer-term elapsed since

surgery in Israel [8.3, 13.6, and 31.2% at 1-6M, 6-12M, and 1-5Y (P<0.001), respectively] and Portugal [5.3, 0, and 22.2% at 1-6M, 6-12M and 1-5Y (P=0.015), respectively] (**Table 2**).

3.3. GI symptoms reported in the last month by time elapsed since surgery and country are presented in **Table 3**. Median GSRS total score was similar between time elapsed since surgery groups within respondents from Israel [1.85, 1.73, and 1.97 (P=0.635) at 1-6M, 6-12M, and 1-5Y, respectively] and Portugal [2.12, 1.83, and 2.03 (P=0.274) at 1-6M, 6-12M, and 1-5Y, respectively] (**Table 3**). Higher GSRS total scores were correlated with poorer reported overall state of health by VAS among respondents from Israel (r=-0.211, P=0.035, r=-0.482, P<0.001, and r=-0.390, P<0.001 at 1-6M, 6-12M, and 1-5Y, respectively) and Portugal (r=-0.419, P=0.015, r=-0.163, P=0.632 and r=-0.449, P=0.002 at 1-6M, 6-12M, and 1-5Y, respectively). Having some level of discomfort due to specific GI symptoms by time elapsed since surgery group per country is presented in **Figure 2**. The great majority of respondents from Israel [69.8, 74.6, and 79.4% at 1-6M, 6-12M, and 1-5Y (P=0.272), respectively] and Portugal [81.1, 87.5, and 90.2% at 1-6M, 6-12M, and 1-5Y (P=0.462), respectively] reported having some level of discomfort due to flatulence with no significant differences between time groups (**Figure 2**). The great majority of respondents from Israel [50.0, 62.8 and 51.4% at 1-6M, 6-12M, and 1-5Y (P=0.428), respectively] and Portugal [54.0, 87.6 and 55.8% at 1-6M, 6-12M, and 1-5Y (P=0.073), respectively] reported 1-3 defecations per day (**Table 3**). Bristol stool type distribution by time elapsed since surgery group per country is presented in **Figure 3**. A notable number of respondents from Israel [51.9, 35.6, and 46.7% at 1-6M, 6-12M, and 1-5Y (P=0.356), respectively] and Portugal [43.2, 56.3 and 44.2% at 1-6M, 6-12M, and 1-5Y (P=0.140), respectively] reported Bristol stool scale categories which represent diarrhea **(Table 3)**.

3.4. Usage of treatments to improve GI symptoms and preliminary knowledge regarding GI symptoms by time elapsed since surgery group and country are presented in **Table 4**.

Among respondents from Israel, a trend toward a decline in the usage of medication/supplement to improve constipation was noted among groups with longer time elapsed since surgery, but this result was not significant. The great majority of respondents from Israel and Portugal reported that they received some explanation of the expected GI symptoms before the surgery from the medical team, mostly by bariatric surgeons and dietitians (**Table 4**).

4. Discussion

Data on GI disorders following OAGB to date has only received limited attention (3-8, 11). Therefore, in the present study, we aimed to describe the reported GI-related side effects up to five years following OAGB based on two cross-sectional studies that were carried out in two different countries simultaneously.

In the current study, the median GSRS total score, which represents the severity of general GI symptoms and rates from 1 (lower) to 7 (higher), was ≤1.97 and ≤2.12 for respondents from Israel and Portugal, while no significant differences were noted between time elapsed since the surgery groups in both countries. Moreover, the highest rated dimension of the GSRS scale in both countries was indigestion, the median of which was ≤2.25 for respondents in each country at all time points. These results are reasonable when compared to the existing literature as the mean GSRS total score and the mean indigestion dimension score based on a large sample from the general Swedish population (n=2,162) were 1.53 and 1.78, respectively (19). Furthermore, the mean GSRS total score and the mean indigestion dimension score among 28 patients at least one-year following biliopancreatic diversion with duodenal switch (BPD/DS) were 2.3 and 2.7, respectively (25).

Dyspepsia is a range of upper GI symptoms including postprandial fullness, early satiation, epigastric pain, or burning (26). In the present study, mild to severe dyspepsia symptoms were reported by ≤50.5 and ≤73.0% of respondents from Israel and Portugal at all time

points. These results are in line with the literature as it was estimated that approximately 25% of the general population worldwide is affected by dyspepsia from different types (26, 27), while around 60% of patients with a median follow-up of 13 months after sleeve gastrectomy (SG) reported dyspepsia (28). Although dyspepsia might be expected to have a higher prevalence among patients following OAGB when compared to SG, it is reasonable to assume that the absolute differences may be related to the varied methods that are used to assess dyspepsia among studies.

In the present study, bowel habits were assessed by both bowel movements and the 'Bristol stool scale'. In accordance with previous literature on OAGB patients, most respondents from Israel and Portugal reported 1-3 bowel movements per day in all time elapsed since surgery groups (5, 8), but only a minority reported >3 bowel movements per day. Additionally, about half of respondents from Israel and Portugal at all time points reported Bristol stool scale categories which represent diarrhea. These results are not unexpected as in a large representative sample of adults with self-reported normal bowel function, about 75% reported a Bristol stool scale categories type between 3 and 4 and only 1.4% reported >3 bowel movements per day (21). Yet, it is important to note that the great majority of patients who report diarrhea or constipation are within the normal range of bowel movement frequency (21). Furthermore, in agreement with previous findings on OAGB patients, a great majority of respondents from Israel and Portugal at all time points reported having some level of discomfort due to flatulence (8).

Data on the usage of medications or supplements to improve GI symptoms following OAGB have not been addressed so far, except for anecdotal reports (6, 9). In the current study, the most reported medications or supplements used to improve GI symptoms among respondents from Israel were for heartburn. This result is even lower than expected as patients are asked routinely to use anti-reflux medications following OAGB to prevent reflux.

Moreover, it is known that patients post OAGB are exposed to the risk of gastroesophageal reflux disease (GERD) (29-31). Nonetheless, it is important to note that the reporting of supplementation or medication usage might be inaccurate when reported by patients due to a lack of sufficient clinical knowledge.

A major component of the preparation for the bariatric surgery process involves comprehensive patient education regarding potential medical complications (32). Indeed, in the present study, the vast majority of respondents from Israel and Portugal reported that they received an explanation or partial explanation of the expected GI symptoms pre-surgery. However, some respondents reported not getting the needed explanations. These results support considering increased efforts for the provision of pre-surgical education and support for patients as they prepare for surgery (32).

As for anthropometric outcomes reported in this survey, about 51 and 62%, 89 and 86%, and 89 and 98% EWL were calculated for respondents from Israel and Portugal at 1-6M, 6-12M, and 1-5Y. These results are in line with previous literature (8), but higher than those reported by others (33). Furthermore, a substantial improvement in hypertension, dyslipidemia, and type 2 diabetes prevalence was reported by respondents from Israel and Portugal at the post-surgery time points when compared to pre-surgery as also reported previously (33, 34).

There is a debate in the literature on the proper limb length in OAGB concerning weight outcomes and nutritional complications (35-37), but data on the impact of different lengths of the biliopancreatic limb on GI side effects following OAGB besides GERD are less studied so far (34, 38). Nonetheless, standardization of biliopancreatic limb length shorter than 200 cm is presently suggested in terms of both safety and effectiveness, although for patients with extreme BMI levels, the bypass limb may be tailored (34). Furthermore, patient selection in OAGB is still a point of controversy among experts in the field (31). In the

present study, patients who underwent OAGB by several surgeons who use different techniques were included (**supplementary A**). However, it seems that no major differences were found between respondents from Israel and Portugal within the time elapsed since surgery groups in terms of TWL outcome. Nonetheless, although the trend for most GI outcomes within time elapsed since surgery groups was alike between respondents from Israel and Portugal, some differences regarding GI side effects were noticed including specific GSRS dimension scores and specific GI symptoms. These results might reflect differences in OAGB technique, clinical practice, eating habits, and culture between participants from two different countries.

The major strengths of this study include a comprehensive assessment of GI outcomes and the use of validated and acceptable study tools. However, there are some limitations to be recognized. First, convenience samples were utilized, and the response rates were not collected accurately in both studies. However, the study included two representative samples of OAGB patients in terms of pre-surgical gender, age, and BMI distribution (39). Second, data were collected in a cross-sectional manner by self-reports and some patients did not complete the whole questionnaire in each country. Therefore, social desirability bias and reporting bias cannot be ruled out. Moreover, the studies ran during the coronavirus disease 2019 (COVID-19) pandemic altered the world population routines and affected recruitment rates. Third, objective parameters such as GI examinations, fecal samples, and biochemical tests were not collected in the current study. Therefore, future large-scale studies on the diagnosis and treatment of GI symptoms following OAGB are needed.

5. Conclusions

In a multicenter study among OAGB patients across Israel and Portugal, substantial self-reported improvements in anthropometrics and health outcomes were noted in the short and mid-terms post-surgery. Nonetheless, a notable proportion of respondents from both

Israel and Portugal pointed out experiencing at least minor general GI symptoms, mild to severe dyspepsia symptoms, having 1-3 defecations per day, categorized their stool texture as diarrhea, and having some level of discomfort due to flatulence. Moreover, experiencing GI side effects may contribute to a poorer reported overall state of health. Although alike trend for most GI outcomes within time elapsed since surgery groups were found for respondents from Israel and Portugal, some differences regarding specific GSRS dimension scores and specific GI symptoms were noted and could reflect differences between the countries in terms of surgical technique, clinical practice, eating habits, and culture. More research is needed to establish a proper treatment algorithm for GI disorders following OAGB.

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Declaration of interest

RR was paid honoraria for teaching or discussion sessions about OAGB by Ethicon and Medtronic. KM has been paid honoraria by several NHS Trusts, Ethicon Inc, Medtronic Inc, Gore Inc, and Olympus Inc for educational activities related to OAGB. All other authors declare that there is no conflict of interest.

Reviewer disclosures

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Ethics statement

This study was reviewed and approved by the Assuta Medical Center Institutional Ethics Committee-#0104-19-ASMC (Israel), and the Clínica de Santo António Ethics Committee (Portugal).

Author contribution statement

The authors' responsibilities were as follows – SSD, RB, RR, TBP, KM, and YG designed the research; RB, SSD, YK, AR, HK, NS, DG, RR, CR, RB, ZS, and OV performed the research; SSD and RB analyzed the data; and SSD, RB, and TBP wrote the manuscript. All authors read and approved the final manuscript.

Data availability statement

The data that support the findings of this study are available from the corresponding author, [SSD], upon reasonable request.

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Table 1: Pre-surgery characteristics of the survey respondents by time elapsed since surgery group and country

Parameter[1,2]		1-6 months post-surgery	6-12 months post-surgery	1-5 years post-surgery	P value
Demographics					
Age (years)	Israel	40.2±10.4	38.9±11.1	44.4±11.0	**0.002**[b,c]
	Portugal	45.5±11.0	48.7±10.0	44.7±13.8	0.501
Gender (% women)	Israel	77.1	83.1	70.6	0.186
	Portugal	77.5	76.5	81.5	0.853
Marital status (% married)	Israel	67.9	71.2	65.1	0.722
	Portugal	55.0	52.9	42.6	0.457
Current occupational status (% working)[3]	Israel	83.5	83.1	92.7	0.100
	Portugal	86.5	93.8	84.3	0.697
Anthropometrics					
Weight (kg)	Israel	113.8±17.9	113.1±13.6	117.9±23.0	0.220
	Portugal	105.8±15.9	122.1±23.8	112.6±20.4	**0.019**[a]
Height (m)	Israel	1.67±0.09	1.67±0.08	1.67±0.09	0.472
	Portugal	1.68±0.08	1.68±0.07	1.66±0.09	0.401
BMI (kg/m^2)	Israel	40.9±4.3	40.9±4.2	41.6±5.6	0.526
	Portugal	37.5±4.0	42.9±6.9	40.9±5.5	**0.001**[a,b]
Obesity-related medical conditions (%)[4]					
Hypertension	Israel	26.6	22.0	26.6	0.775
	Portugal	36.8	47.1	48.1	0.540
Dyslipidemia	Israel	36.7	44.1	38.5	0.641
	Portugal	35.9	62.5	59.3	0.053
Type 2 diabetes	Israel	15.6	18.6	17.4	0.869
	Portugal	15.8	29.4	18.5	0.487

Abbreviations: Body Mass Index (BMI).

[1]Values are expressed as mean±SD, unless otherwise stated.

[2]Data were available for participants from Israel and Portugal for n=109 and n=40 respondents between 1-6 months post-surgery, n=59 and n=17 respondents between 6-12 months post-surgery and n=109 and n=54 respondents between 1-5 years post-surgery, respectively.

[3]Currently working full time/part time.

[4]Diagnosis of morbidity by a physician or taking medication for the morbidity.

[a]Significant differences between 1-6 months to 6-12 months post-surgery groups.
[b]Significant differences between 1-6 months to 1-5 years post-surgery groups.
[c]Significant differences between 6-12 months to 1-5 years post-surgery groups.

Table 2: Anthropometrics and health conditions by time elapsed since surgery group and country

Parameter[1,2]		**1-6 months post-surgery**	**6-12 months post-surgery**	**1-5 years post-surgery**	**P value**
Anthropometrics					
Weight (kg)	Israel	91.9±16.0	75.4±11.1	77.3±16.2	**<0.001**[a,b]
	Portugal	84.8±13.3	80.5±12.3	71.5±13.2	**<0.001**[b,c]
BMI (kg/m^2)	Israel	33.0±4.2	27.3±3.9	27.2±4.3	**<0.001**[a,b]
	Portugal	30.0±3.4	28.4±3.8	26.0±3.6	**<0.001**[b,c]
EWL (%)	Israel	51.0±19.9	89.0±22.0	89.9±23.6	**<0.001**[a,b]
	Portugal	62.4±26.5	86.2±21.4	98.2±20.9	**<0.001**[a,b]
TWL (%)	Israel	19.2±6.9	33.3±6.2	34.1±8.8	**<0.001**[a,b]
	Portugal	19.6±7.2	33.3±6.6	36.1±7.0	**<0.001**[a,b]
Obesity-related medical conditions (%)[3]					
Hypertension	Israel	10.1	0	4.6	**0.017**[a]
	Portugal	30.8	29.4	13.0	0.087
Dyslipidemia	Israel	11.0	6.8	5.5	0.302
	Portugal	13.2	6.3	9.3	0.755
Type 2 diabetes	Israel	3.7	1.7	0.9	0.449
	Portugal	7.9	5.9	1.9	0.365
Hospitalization since surgery (% yes)[4,5]	Israel	8.3	13.6	31.2	**<0.001**[b,c]
	Portugal	5.3	0	22.2	**0.015**
Smoking status (% current smoker)	Israel	13.8	16.9	20.2	0.630
	Portugal	12.8	0	5.6	0.353

Abbreviations: Body Mass Index (BMI), Excess Weight Loss (EWL), Total Weight Loss (TWL).
[1]Values are expressed as mean±SD, unless otherwise stated.

[2]Data were available for participants from Israel and Portugal for n=108 and n=37 respondents between 1-6 months post-surgery, n=58 and n=17 respondents between 6-12

months post-surgery and n=106 and n=52 respondents between 1-5 years post-surgery, respectively.

[3]Diagnosis of morbidity by a physician or taking medication for the morbidity.

[4]Between 1-6 months post-surgery, 66% (n=6) and 50% (n=1) participants from Israel and Portugal reported the hospitalization was related to the surgery, between 6-12 months post-surgery, 50% (n=4) and 0% (n=0) participants from Israel and Portugal reported the hospitalization was related to the surgery, and between 1-5 years post-surgery, 47% (n=16) and 17% (n=2) participants from Israel and Portugal reported the hospitalization was related to the surgery.

[5]Common reasons for hospitalizations related to surgery mentioned by free text among all time elapsed since surgery groups included gallbladder removal (Israel, n=5), herniations (Israel, n=4), bowel infraction (Portugal, n=2), stomach pain (Israel, n=2), and intestinal obstruction (Israel, n=1 and Portugal, n=1).

[a]Significant differences between 1-6 months to 6-12 months post-surgery groups.
[b]Significant differences between 1-6 months to 1-5 years post-surgery groups.
[c]Significant differences between 6-12 months to 1-5 years post-surgery groups.

Table 3: GI reported outcomes in the last month by time elapsed since surgery group and country

Parameters[1]		**1-6 months post-surgery**	**6-12 months post-surgery**	**1-5 years post-surgery**	**P value**
GSRS score [median (interquartile range)]					
Diarrhea dimension score	Israel	1.67 (1.00-2.42)	1.67 (1.00-2.33)	1.67 (1.00-2.33)	0.956
	Portugal	2.00 (1.33-3.00)	1.84 (1.33-2.83)	1.84 (1.33-2.67)	0.900
Indigestion dimension score	Israel	2.00 (1.50-2.75)	2.25 (1.50-3.00)	2.25 (1.50-3.25)	0.377
	Portugal	2.25 (2.00-2.75)	1.75 (1.50-2.50)	2.25 (1.81-3.25)	0.128
Constipation dimension score	Israel	1.33 (1.00-2.33)	1.67 (1.33-2.33)	1.33 (1.00-2.00)	0.132
	Portugal	2.33 (1.33-3.00)	1.33 (1.00-2.00)	1.67 (1.00-2.59)	0.077
Abdominal pain dimension score	Israel	2.00 (1.33-2.75)	1.67 (1.00-2.33)	1.67 (1.00-2.67)	0.093
	Portugal	1.67 (1.33-2.50)	1.33 (1.00-1.67)	1.67 (1.00-2.33)	0.064
Reflux dimension score	Israel	1.00 (1.00-1.50)	1.00 (1.00-1.50)	1.50 (1.00-2.50)	**0.001**[b,c]
	Portugal	1.50 (1.50-1.50)	2.00 (1.50-2.25)	1.50 (1.50-2.00)	0.174
Total score	Israel	1.85 (1.37-2.32)	1.73 (1.45-2.17)	1.97 (1.40-2.50)	0.635
	Portugal	2.12 (1.83-2.53)	1.83 (1.47-2.17)	2.03 (1.66-2.50)	0.274
Severity of dyspepsia symptoms (%)[2]					
None	Israel	51.9	76.3	49.5	Israel: **0.007**[a,c] Portugal: **0.015**[a]
	Portugal	27.0	75.0	51.9	
Mild	Israel	37.7	20.3	31.8	
	Portugal	59.5	25.0	36.5	
Moderate	Israel	9.4	3.4	15.0	
	Portugal	13.5	0	11.5	
Severe	Israel	0.9	0	3.7	
	Portugal	0	0	0	

Bowel movements frequency (%)					
3≥ times/week	Israel	11.3	6.8	6.5	Israel: 0.428 Portugal: 0.073
	Portugal	21.6	0	9.6	
Once in 1-2 days	Israel	30.2	25.4	30.8	
	Portugal	24.3	6.3	32.7	
1-2 times/day	Israel	31.1	49.2	37.4	
	Portugal	40.5	68.8	46.2	
2-3 times/day	Israel	18.9	13.6	14.0	
	Portugal	13.5	18.8	9.6	
>3 times/day	Israel	8.5	5.1	11.2	
	Portugal	0	6.3	1.9	
Defecations texture (Bristol scale) (%)[3]					
Diarrhea	Israel	51.9	35.6	46.7	Israel: 0.356 Portugal: 0.140
	Portugal	43.2	56.3	44.2	
Normal	Israel	38.7	54.2	44.9	
	Portugal	43.2	25.0	51.9	
Constipation	Israel	9.4	10.2	8.4	
	Portugal	13.5	18.8	3.8	

Abbreviations: Gastrointestinal (GI), Gastrointestinal Symptoms Rating Scale (GSRS).

[1]Data were available for participants from Israel and Portugal for n=106 and n=37 respondents between 1-6 months post-surgery, n=59 and n=16 respondents between 6-12 months post-surgery and n=107 and n=52 respondents between 1-5 years post-surgery, respectively.

[2]None: no symptoms; Mild: awareness of signs or symptoms, but easily tolerated; Moderate: discomfort sufficient to cause interference with normal activities; Severe: incapacitating with inability to perform normal activities.

[3]According to Bristol stool scale categories (1 or 2 for constipation, 3 and 4 for ideal stool, and 5 to 7 for diarrhea).

[a]Significant differences between 1-6 months to 6-12 months post-surgery groups.
[b]Significant differences between 1-6 months to 1-5 years post-surgery groups.
[c]Significant differences between 6-12 months to 1-5 years post-surgery groups.

Table 4: Usage of treatments to improve GI symptoms and preliminary knowledge regarding GI symptoms by time elapsed since surgery group and country

Parameters		1-6 months post-surgery	6-12 months post-surgery	1-5 years post-surgery	P value
Usage of medications/supplements to improve GI symptoms (%)[1,2]					
Heartburn	Israel	37.3	22.0	39.0	0.069
Nausea	Israel	4.0	3.4	3.0	1.000
Abdominal pain	Israel	9.0	3.5	13.0	0.143
Bloating	Israel	4.0	1.7	9.0	0.148
Flatulence	Israel	8.9	5.1	11.2	0.425
Diarrhea	Israel	3.0	1.7	9.1	0.089
Loose stools	Israel	8.0	1.8	8.2	0.241
Constipation	Israel	10.0	8.6	4.0	0.255
Explanation of the expected GI symptoms pre-surgery by the medical team (%)[3,4]					
Yes	Israel	71.2	67.8	52.3	Israel: **0.046**[b] Portugal: 0.329
	Portugal	64.9	75.0	82.0	
Partial	Israel	21.2	23.7	30.8	
	Portugal	27.0	25.0	16.0	
No	Israel	7.7	8.5	16.8	
	Portugal	8.1	0	2.0	

Abbreviations: Gastrointestinal (GI).

[1]Data were available for participants from Israel and Portugal for n=106 and n=37 respondents between 1-6 months post-surgery, n=59 and n=16 respondents between 6-12 months post-surgery and n=107 and n=52 respondents between 1-5 years post-surgery, respectively.

[2]Data were not available for respondents from Portugal.

[3]Data were available for participants from Israel and Portugal for n=104 and n=37 respondents between 1-6 months post-surgery, n=59 and n=16 respondents between 6-12 months post-surgery and n=107 and n=50 respondents between 1-5 years post-surgery, respectively.

[4]Respondents reported that the explanation was received mostly by bariatric surgeons and dietitians at all time points.

[a]Significant differences between 1-6 months to 6-12 months post-surgery groups.
[b]Significant differences between 1-6 months to 1-5 years post-surgery groups.
[c]Significant differences between 6-12 months to 1-5 years post-surgery groups.

Figure 1: Respondents by country and time elapsed since surgery[1]

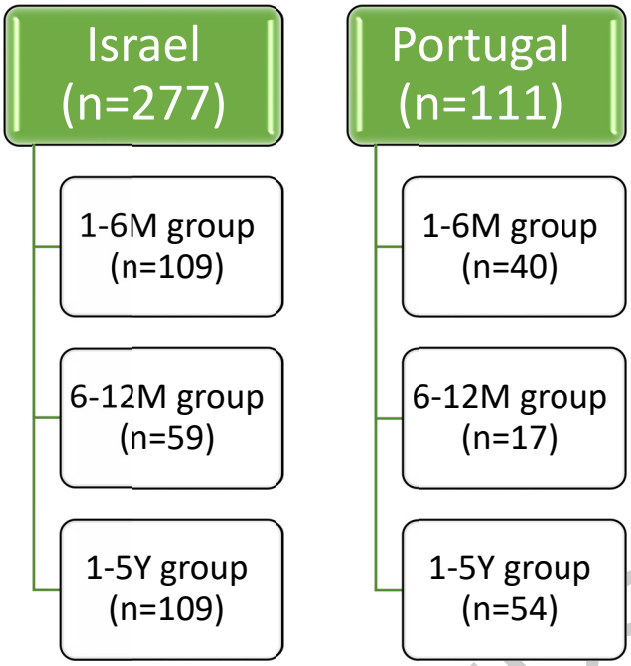


Figure 2a: Having some level of discomfort due to specific GI symptoms by time elapsed since surgery group (Israel) [1,2]

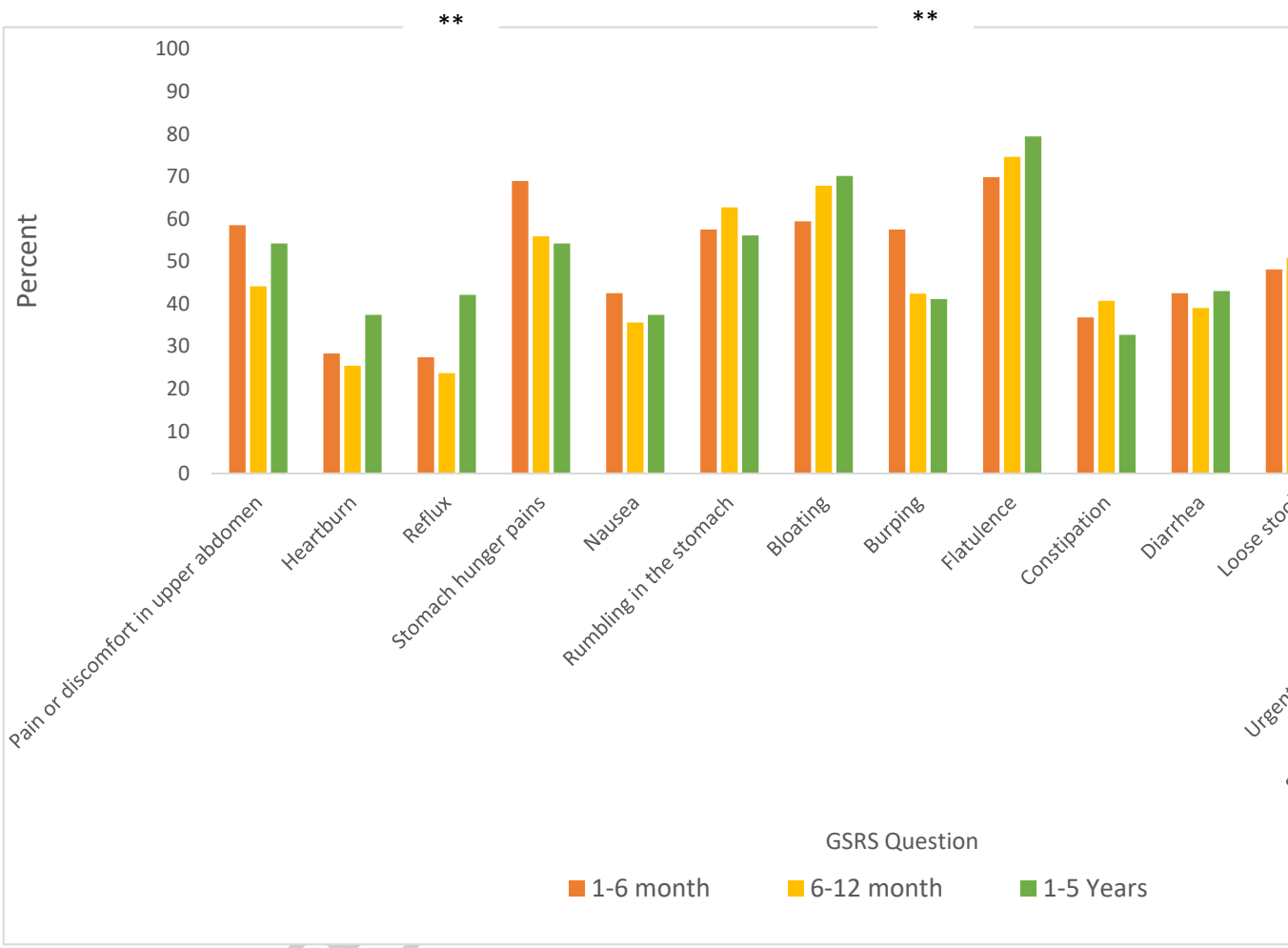
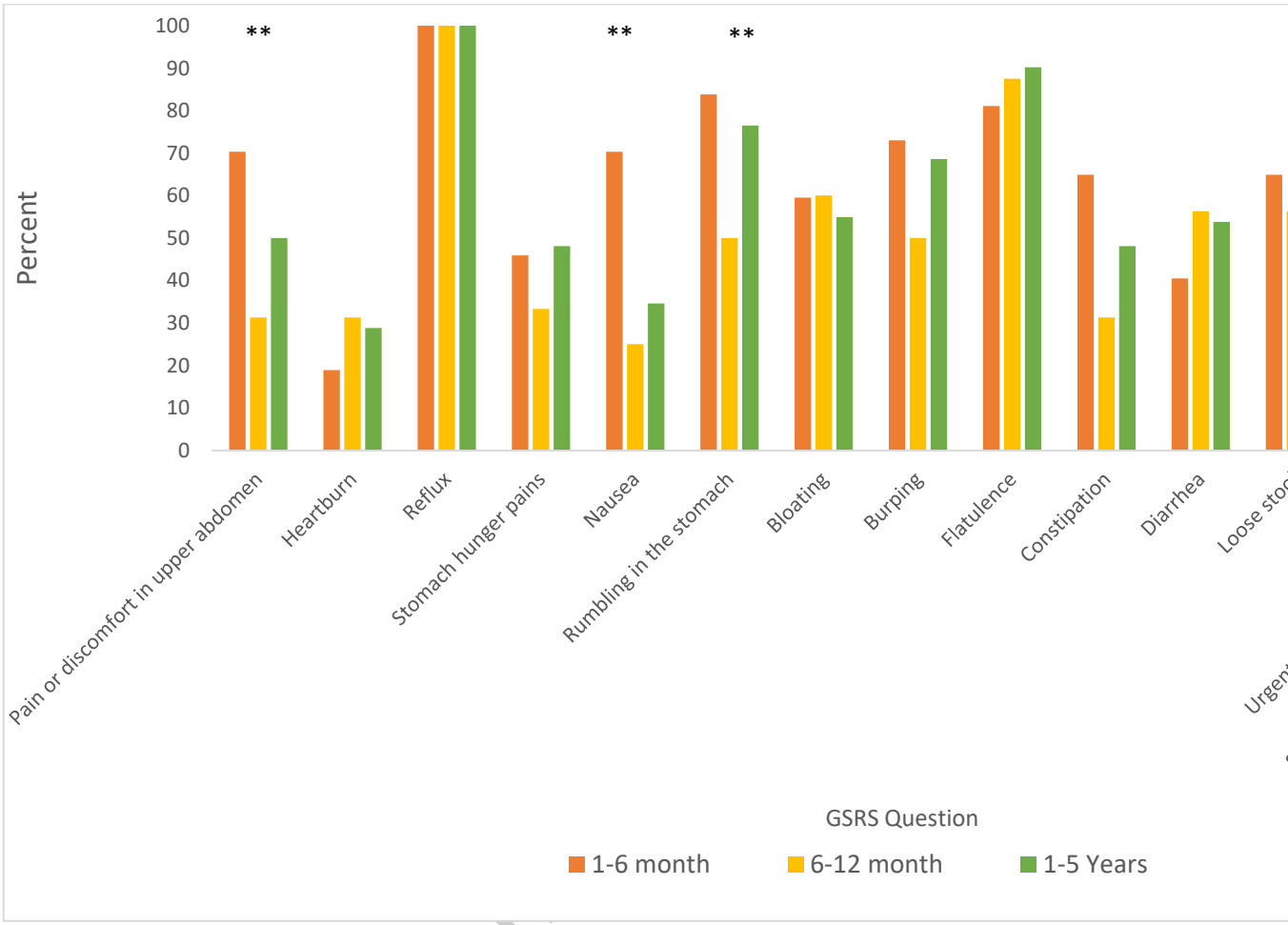


Figure 2b: Having some level of discomfort due to specific GI symptoms by time elapsed since surgery group (Portugal) [1,2]


100
90
80
70
60
50
40
30
20
10
0
Percent
**
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Pain or discomfort in upper abdomen
Heartburn
Reflux
Stomach hunger pains
Nausea
Rumbling in the stomach
Bloating
Burping
Flatulence
Constipation
Diarrhea
GSRS Question
1-6 month
6-12 month
1-5 Years

Figure 3a: Bristol stool type distribution by time elapsed since surgery group (Israel)[1]

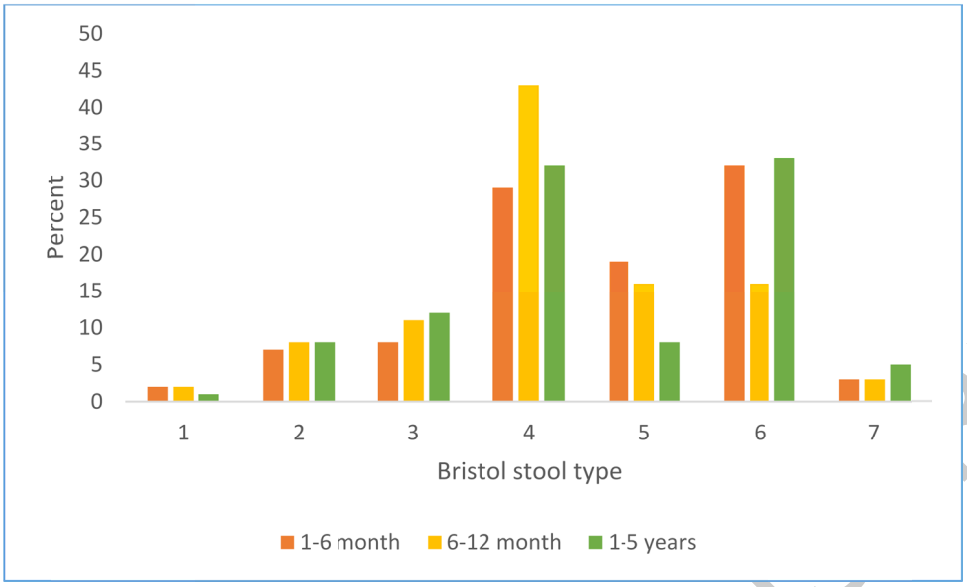

Figure 3b: Bristol stool type distribution by time elapsed since surgery group (Portugal)[1]

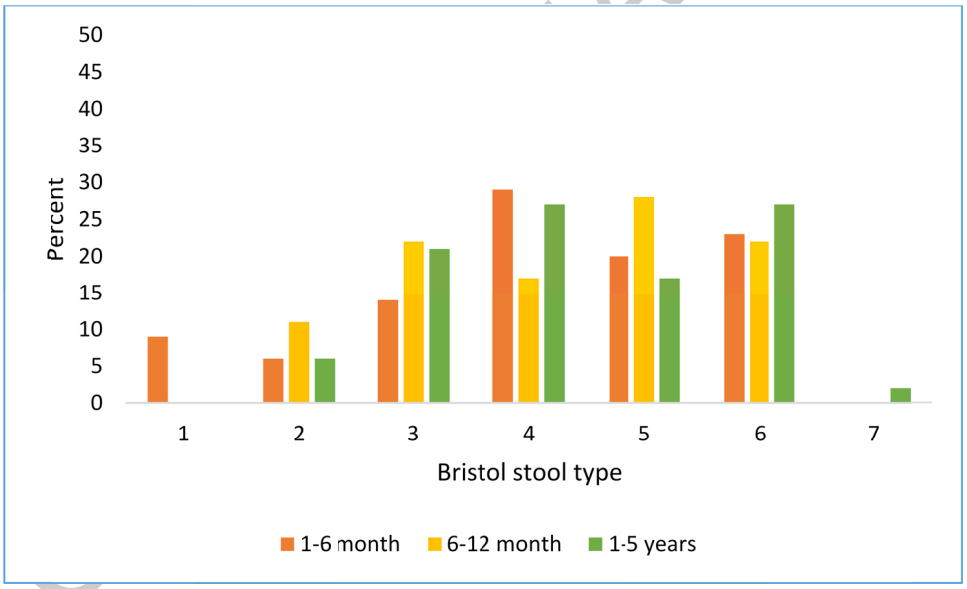

Figure 1: Respondents by country and time elapsed since surgery[1]

[1] Mean months elapsed since surgery for responses from Israel and Portugal were 3.2±1.7 and 2.5±1.7 [1-6 months post-surgery group (1-6M group)], 9.2±1.6 and 8.6±1.5 [6-12 months post-surgery group (6-12M group)], and 33.0±15.1 and 27.3±13.0 [1-5 years post-surgery group (1-5Y groups)].

Figure 2: Having some level of discomfort due to specific GI symptoms by time elapsed since surgery group per country [Figure 2a (Israel) and Figure 2b (Portugal)] [1,2]

[1]Data were available for participants from Israel and Portugal for n=106 and n=37 respondents between 1-6 months post-surgery, n=59 and n=16 respondents between 6-12 months post-surgery and n=107 and n=52 respondents between 1-5 years post-surgery, respectively.

[2]Data was based on questions from the GSRS questionnaire (**supplementary B**). Any other answer on the scale except for 'No discomfort at all' was categorized as having some level of discomfort due to the symptom.

[**]Significant differences between time elapsed since surgery groups (P<0.05).

Figure 3: Bristol stool type distribution by time elapsed since surgery group per country [Figure 3a (Israel) and Figure 3b (Portugal)][1]

[1]Data were available for participants from Israel and Portugal for n=106 and n=37 respondents between 1-6 months post-surgery, n=59 and n=16 respondents between 6-12 months post-surgery and n=107 and n=52 respondents between 1-5 years post-surgery, respectively.