The hundred most frequently cited studies on sleeve gastrectomy

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Abstract

Introduction: *Sleeve gastrectomy (SG) is one of the most popular bariatric operations and one of the most frequently studied areas in bariatric surgery.*
Aim: *To summarise the characteristics of the most frequently cited studies focusing on SG.*
Material and methods: *We used the Web of Science database to identify all studies focused on SG published from 2000 to 2018. The term "sleeve gastrectomy" and synonyms were used to reveal the 100 most cited records.*
Results: *The most frequently cited publication had 493 citations. The highest mean number of citations per year was 73.00. Studies were most frequently published in the years 2010 and 2012. Articles were most commonly published in bariatric surgery-oriented journals.*
Conclusions: *Our study indicates an increase in medical researchers' interest in the subject of SG and underlines the need to perform studies with a higher level of evidence to further analyse the outcomes and basic science behind SG.*

Key words: *bariatric surgery, bibliometrics, sleeve gastrectomy, obesity.*

Introduction

Sleeve gastrectomy (SG) has recently become one of the most common bariatric procedures worldwide. Some authors consider SG to be an ideal bariatric procedure [1–3]. In 2013, there was a significant increase in the utilisation of laparoscopic SG in the largest academic centres of the United States; as a result, the popularity of SG surpassed that of laparoscopic Roux-en-Y gastric bypass [4]. SG allows the patient to achieve satisfactory loss of excess body weight and resolution of obesity-related comorbidities, including type 2 diabetes mellitus, hypertension, and dyslipidaemia [5]. Staged approaches to the surgical treatment of morbid obesity often include SG as an initial procedure, but SG is also implemented as a singular and primary bariatric operation [6, 7]. Moreover, SG seems to be a more cost-effective choice of treatment compared with laparoscopic Roux-en-Y gastric bypass [8, 9].

Despite the high effectiveness of SG in both the short and long term, thorough scientific investigation is required to correctly understand the mechanisms underlying this bariatric procedure. These mechanisms should be the main focus of current research, in contrast to the development of new operations and techniques [10]. At present, SG is one of the most frequently and thoroughly studied areas in bariatric surgery.

Many recent publications have focused on the 100 most frequently cited papers investigating various surgical topics. The role of this type of research is to underline which authors, bariatric centres, coun-

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tries, or journals have most strongly influenced advances in surgery [11–13]. Previous studies conducting bibliometric analyses in the field of bariatric and metabolic surgery focused on this subject as a whole and had several methodological shortcomings [14]. We believe that bibliometric analysis of a specific bariatric operation, which has rapidly gained popularity in recent years, would provide valuable insight into the current development of trends in the surgical treatment of obesity.

Aim

Our objective was to analyse and summarise the characteristics of the most frequently cited studies focusing on SG.

Material and methods

Study design

We used the Web of Science database (Thomson Reuters, Philadelphia, PA, USA) to identify all studies focused on SG as a bariatric procedure, published from 2000 to 2018. The terms "sleeve gastrectomy", "vertical gastrectomy", "parietal gastrectomy", and "reduction gastrectomy" were used to conduct the search on 31 December 2018. The search strategy did not include any limitations on language and abstract availability. The inclusion criterion was an original study or secondary source (review or meta-analysis) with the primary focus on SG as a bariatric operation. The search strategy was limited to the period 2000–2018. We excluded publications that did not consider SG as a separate procedure, studies focusing on open surgeries, and animal studies. Articles were ranked based on the number of citations; if two or more articles had the same number of citations, they were then ranked based on the year of publication. We excluded studies with fewer than 50 citations. Two independent reviewers assessed the list and selected the 100 most frequently cited studies with a focus on SG by reviewing the titles and abstracts of all identified records. A third reviewer compared the two lists, discussed the differences, and resolved any conflicts. All articles included in the list of 100 were retrieved.

Outcomes of interest

Data were extracted independently by the two reviewers. When a disagreement was encountered, a consensus was reached by discussion with a third reviewer. During the full-text screening, the reviewers extracted the following data: title, primary and senior authors' names, total number of authors and their department of origin (academic/non-academic, surgical/non-surgical, and single-centre/multi-centre), year of publication, number of citations, citations per year, continent, country, journal, focus of the journal (bariatric surgery, general surgery, general medicine), journal origin, impact factor in 2017, immediacy index, study type (clinical experience, basic science, review), article type (case series, observational study, randomised clinical trial, basic science, review/expert opinion, systematic review, meta-analysis), funding source, and level of evidence (I–V) assessed in accordance with publication by Wright *et al.* [15] and the subject of the study.

Statistical analysis

Statistical analysis was performed using Statistica 12 Software (StatSoft Inc., Tulsa, OK, USA). The Shapiro-Wilk test was used to assess the data distribution. Continuous variables are presented as arithmetical means with standard deviations. Correlations were assessed using Spearman's test. The Mann-Kendall trend test was used to determine time-dependent trends. A p-value of < 0.05 was considered statistically significant.

Results

Our search strategy revealed 6845 records related to SG. Overall, 180 publications were focused on SG and contained a total of ≥ 50 citations. The 100 most frequently cited publications were included in the final list (Table I) [15–117]. A flowchart of the study is presented in Figure 1.

The most frequently cited publication was a study by Karamanakos *et al.* [16] (493 citations). The article by Ryan *et al.* [118] had the highest mean number of citations per year (73.00 citations) (Table II). Studies were most frequently published in the years 2010 (15 studies) and 2012 (13 studies) (Figure 2). Articles were most frequently cited in the years 2014 to 2016 (Figure 3). We observed a positive correlation between the citation density and time ($r = 0.314$, $p < 0.05$) (Figure 4). The number of citations per year increased with time ($r = 0.852$, $p < 0.05$). The number of articles also rose in subsequent years ($r = 0.581$, $p < 0.05$).

Table I. The 100 most cited articles in laparoscopic sleeve gastrectomy

Rank	First author	Publication year	Title	Journal	Impact factor (publication year)	Total citations
1	Karamanakos [16]	2008	Weight loss, appetite suppression, and changes in fasting and postprandial ghrelin and peptide-YY levels after Roux-en-Y gastric bypass and sleeve gastrectomy – a prospective, double blind study	Ann Surg	8.460	493
2	Himpens [20]	2006	A prospective randomized study between laparoscopic gastric banding and laparoscopic isolated sleeve gastrectomy: results after 1 and 3 years	Obes Surg	3.723	413
3	Cottam [21]	2006	Laparoscopic sleeve gastrectomy as an initial weight-loss procedure for high-risk patients with morbid obesity	Surg Endosc	1.969	396
4	Rosenthal [22]	2012	International Sleeve Gastrectomy Expert Panel Consensus Statement: best practice guidelines based on experience of > 12,000 cases	Surg Obes Relat Dis	4.121	393
5	Himpens [23]	2010	Long-term results of laparoscopic sleeve gastrectomy for obesity	Ann Surg	7.474	381
6	Ryan [118]	2014	FXR is a molecular target for the effects of vertical sleeve gastrectomy	Nature	41.456	365
7	Langer [24]	2005	Sleeve gastrectomy and gastric banding: effects on plasma ghrelin levels	Obes Surg	3.759	350
8	Peterli [25]	2009	Improvement in glucose metabolism after bariatric surgery: comparison of laparoscopic Roux-en-Y gastric bypass and laparoscopic sleeve gastrectomy a prospective randomized trial	Ann Surg	7.900	347
9	Hutter [26]	2011	First report from the American College of Surgeons Bariatric Surgery Center Network Laparoscopic Sleeve Gastrectomy has morbidity and effectiveness positioned between the band and the bypass	Ann Surg	7.492	311
10	Baltasar [27]	2005	Laparoscopic sleeve gastrectomy: a multi-purpose bariatric operation	Obes Surg	3.759	300
11	Brethauer [28]	2009	Systematic review of sleeve gastrectomy as staging and primary bariatric procedure	Surg Obes Relat Dis	3.826	287
12	Bohdjalian [29]	2010	Sleeve gastrectomy as sole and definitive bariatric procedure: 5-year results for weight loss and ghrelin	Obes Surg	3.078	268
13	Aurora [30]	2012	Sleeve gastrectomy and the risk of leak: a systematic analysis of 4,888 patients	Surg Endosc	3.427	253
14	Weiner [31]	2007	Laparoscopic sleeve gastrectomy – influence of sleeve size and resected gastric volume	Obes Surg	2.852	248
15	Melissas [32]	2007	Sleeve gastrectomy – a restrictive procedure?	Obes Surg	2.852	239
16	Lee [33]	2011	Gastric bypass vs sleeve gastrectomy for type 2 diabetes mellitus a randomized controlled trial	Arch Surg	4.422	236

Table I. Cont.

Rank	First author	Publication year	Title	Journal	Impact factor (publication year)	Total citations
17	Gagner [34]	2009	The Second International Consensus Summit for Sleeve Gastrectomy, March 19–21, 2009	Surg Obes Relat Dis	3.826	222
18	Deitel [35]	2008	The First International Consensus Summit for sleeve gastrectomy (SG), New York city, October 25–27, 2007	Obes Surg	2.913	219
19	Silecchia [36]	2006	Effectiveness of laparoscopic sleeve gastrectomy (first stage of biliopancreatic diversion with duodenal switch) on co-morbidities in super-obese high-risk patients	Obes Surg	3.723	218
20	Peterli [37]	2012	Metabolic and hormonal changes after laparoscopic Roux-en-Y gastric bypass and sleeve gastrectomy: a randomized, prospective trial	Obes Surg	3.102	217
21	Birkmeyer [38]	2010	Hospital complication rates with bariatric surgery in Michigan	JAMA	30.011	211
22	Han [39]	2005	Results of laparoscopic sleeve gastrectomy (LSG) at 1 year in morbidly obese Korean patients	Obes Surg	3.759	205
23	Nocca [40]	2010	A prospective multicenter study of 163 sleeve gastrectomies: results at 1 and 2 years	Obes Surg	2.913	200
24	DeMaria [41]	2010	Baseline data from American Society for Metabolic and Bariatric Surgery-designated Bariatric Surgery Centers of Excellence using the Bariatric Outcomes Longitudinal Database	Surg Obes Relat Dis	3.173	196
25	Deitel [42]	2011	Third International Summit: current status of sleeve gastrectomy	Surg Obes Relat Dis	3.929	194
26	Kehagias [43]	2011	Randomized clinical trial of laparoscopic Roux-en-Y gastric bypass versus laparoscopic sleeve gastrectomy for the management of patients with BMI < 50 kg/m(2)	Obes Surg	3.286	186
27	Peterli [44]	2013	Early results of the Swiss Multicentre Bypass or Sleeve Study (SM-BOSS) a prospective randomized trial comparing laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass	Ann Surg	7.188	185
28	Gehrer [45]	2010	Fewer nutrient deficiencies after laparoscopic sleeve gastrectomy (LSG) than after laparoscopic Roux-y-gastric bypass (LRYGB) – a prospective study	Obes Surg	3.078	182
29	Vidal [46]	2008	Type 2 diabetes mellitus and the metabolic syndrome following sleeve gastrectomy in severely obese subjects	Obes Surg	2.913	182
30	Saber [47]	2008	Single incision laparoscopic sleeve gastrectomy (SILS): a novel technique	Obes Surg	2.913	179
31	Gumbs [48]	2007	Sleeve gastrectomy for morbid obesity	Obes Surg	2.852	176

Table I. Cont.

Rank	First author	Publication year	Title	Journal	Impact factor (publication year)	Total citations
32	Abbatini [49]	2010	Long-term effects of laparoscopic sleeve gastrectomy, gastric bypass, and adjustable gastric banding on type 2 diabetes	Surg Endosc	3.436	175
33	Parikh [50]	2013	Surgical strategies that may decrease leak after laparoscopic sleeve gastrectomy a systematic review and meta-analysis of 9991 cases	Ann Surg	7.188	173
34	Yehoshua [51]	2005	Laparoscopic sleeve gastrectomy – volume and pressure assessment	Obes Surg	2.913	171
35	Shi [52]	2010	A review of laparoscopic sleeve gastrectomy for morbid obesity	Obes Surg	3.078	170
36	Mognol [53]	2005	Laparoscopic sleeve gastrectomy as an initial bariatric operation for high-risk patients: initial results in 10 patients	Obes Surg	3.759	169
37	Pratt [54]	2009	Best practice updates for pediatric/adolescent weight loss surgery	Obesity	3.366	163
38	Roa [55]	2006	Laparoscopic sleeve gastrectomy as treatment for morbid obesity: technique and short-term outcome	Obes Surg	3.723	162
39	Lalor [56]	2005	Complications after laparoscopic sleeve gastrectomy	Surg Obes Relat Dis	3.862	159
40	Sakran [57]	2013	Gastric leaks after sleeve gastrectomy: a multicenter experience with 2,834 patients	Surg Endosc	3.313	156
41	Gagner [58]	2008	Laparoscopic sleeve gastrectomy is superior to endoscopic intragastric balloon as a first stage procedure for super-obese patients (BMI ≥ 50)	Obes Surg	3.759	156
42	Melissas [59]	2008	Sleeve gastrectomy – a food limiting operation	Obes Surg	2.913	155
43	Lee [60]	2007	Vertical gastrectomy for morbid obesity in 216 patients: report of two-year results	Surg Endosc	2.242	150
44	Carlin [61]	2013	The comparative effectiveness of sleeve gastrectomy, gastric bypass, and adjustable gastric banding procedures for the treatment of morbid obesity	Ann Surg	7.188	149
45	Consten [62]	2004	Decreased bleeding after laparoscopic sleeve gastrectomy with or without duodenal switch for morbid obesity using a stapled buttressed absorbable polymer membrane	Obes Surg	3.726	148
46	Gagner [63]	2013	Survey on laparoscopic sleeve gastrectomy (LSG) at the Fourth International Consensus Summit on Sleeve Gastrectomy	Obes Surg	3.739	147
47	Fuks [64]	2009	Results of laparoscopic sleeve gastrectomy: a prospective study in 135 patients with morbid obesity	Surgery	3.603	143

Table I. Cont.

Rank	First author	Publication year	Title	Journal	Impact factor (publication year)	Total citations
48	D'Hondt [65]	2011	Laparoscopic sleeve gastrectomy as a single-stage procedure for the treatment of morbid obesity and the resulting quality of life, resolution of comorbidities, food tolerance, and 6-year weight loss	Surg Endosc	4.013	140
49	Langer [66]	2006	Does gastric dilatation limit the success of sleeve gastrectomy as a sole operation for morbid obesity?	Obes Surg	3.723	140
50	Gill [67]	2010	Sleeve gastrectomy and type 2 diabetes mellitus: a systematic review	Surg Obes Relat Dis	3.173	139
51	Casella [68]	2009	Nonsurgical treatment of staple line leaks after laparoscopic sleeve gastrectomy	Obes Surg	2.934	139
52	Jimenez [69]	2012	Long-term effects of sleeve gastrectomy and Roux-en-Y gastric bypass surgery on type 2 diabetes mellitus in morbidly obese subjects	Ann Surg	6.329	135
53	Nguyen [70]	2013	Changes in the makeup of bariatric surgery: a national increase in use of laparoscopic sleeve gastrectomy	J Am Coll Surg	4.454	134
54	Hamoui [71]	2006	Sleeve gastrectomy in the high-risk patient	Obes Surg	3.723	134
55	Braghetto [72]	2009	Scintigraphic evaluation of gastric emptying in obese patients submitted to sleeve gastrectomy compared to normal subjects	Obes Surg	2.934	131
56	Burgos [73]	2009	Gastric leak after laparoscopic-sleeve gastrectomy for obesity	Obes Surg	2.934	128
57	Lakdawala [74]	2010	Comparison between the results of laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass in the Indian population: a retrospective 1 year study	Obes Surg	3.078	118
58	Chiu [75]	2011	Effect of sleeve gastrectomy on gastroesophageal reflux disease: a systematic review	Surg Obes Relat Dis	3.929	114
59	Dapri [76]	2010	Reinforcing the staple line during laparoscopic sleeve gastrectomy: prospective randomized clinical study comparing three different techniques	Obes Surg	3.078	114
60	Nannipieri [77]	2013	Roux-en-Y gastric bypass and sleeve gastrectomy: mechanisms of diabetes remission and role of gut hormones	J Clin Endocrinol Metab	6.310	113
61	Franco [78]	2011	A review of studies comparing three laparoscopic procedures in bariatric surgery: sleeve gastrectomy, Roux-en-Y gastric bypass and adjustable gastric banding	Obes Surg	3.286	113
62	Serra [79]	2009	Treatment of gastric leaks with coated self-expanding stents after sleeve gastrectomy	Obes Surg	2.852	112

Table I. Cont.

Rank	First author	Publication year	Title	Journal	Impact factor (publication year)	Total citations
63	Inge [80]	2014	Perioperative outcomes of adolescents undergoing bariatric surgery. The Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) Study	JAMA Pediatr	7.148	107
64	Chen [81]	2009	Reinforcement does not necessarily reduce the rate of staple line leaks after sleeve gastrectomy. A review of the literature and clinical experiences	Obes Surg	2.934	107
65	DePaula [82]	2008	Laparoscopic treatment of type 2 diabetes mellitus for patients with a body mass index less than 35	Surg Endosc	3.231	106
66	Tucker [83]	2008	Indications for sleeve gastrectomy as a primary procedure for weight loss in the morbidly obese	J Gastrointest Surg	2.311	105
67	Csendes [84]	2010	Management of leaks after laparoscopic sleeve gastrectomy in patients with obesity	J Gastrointest Surg	2.733	102
68	DuPree [85]	2014	Laparoscopic sleeve gastrectomy in patients with preexisting gastroesophageal reflux disease a national analysis	JAMA Surg	3.936	100
69	Lee [86]	2010	Laparoscopic sleeve gastrectomy for diabetes treatment in nonmorbidly obese patients: efficacy and change of insulin secretion	Surgery	3.406	100
70	Eid [87]	2012	Laparoscopic sleeve gastrectomy for super obese patients forty-eight percent excess weight loss after 6 to 8 years with 93% follow-up	Ann Surg	6.329	98
71	Pournaras [88]	2012	Effect of the definition of type II diabetes remission in the evaluation of bariatric surgery for metabolic disorders	Br J Surg	4.839	98
72	Finks [89]	2011	Predicting risk for serious complications with bariatric surgery results from the Michigan Bariatric Surgery Collaborative	Ann Surg	7.492	98
73	Lee [90]	2011	Changes in postprandial gut hormones after metabolic surgery: a comparison of gastric bypass and sleeve gastrectomy	Surg Obes Relat Dis	3.929	98
74	Frezza [91]	2009	Complications after sleeve gastrectomy for morbid obesity	Obes Surg	2.934	98
75	Bellanger [92]	2011	Laparoscopic sleeve gastrectomy, 529 cases without a leak: short-term results and technical considerations	Obes Surg	3.286	97
76	Woelnerhanssen [93]	2011	Effects of postbariatric surgery weight loss on adipokines and metabolic parameters: comparison of laparoscopic Roux-en-Y gastric bypass and laparoscopic sleeve gastrectomy-a prospective randomized trial	Surg Obes Relat Dis	3.929	97
77	Fischer [94]	2012	Excessive weight loss after sleeve gastrectomy: a systematic review	Obes Surg	3.102	96

Table I. Cont.

Rank	First author	Publication year	Title	Journal	Impact factor (publication year)	Total citations
78	Sanchez-Santos [95]	2014	Short- and mid-term outcomes of sleeve gastrectomy for morbid obesity: the experience of the Spanish National Registry	Obes Surg	2.934	93
79	Black [96]	2013	Bariatric surgery for obese children and adolescents: a systematic review and meta-analysis	Obes Rev	3.739	93
80	Yousseif [97]	2014	Differential effects of laparoscopic sleeve gastrectomy and laparoscopic gastric bypass on appetite, circulating acyl-ghrelin, peptide YY3-36 and active GLP-1 levels in non-diabetic humans	Obes Surg	3.747	92
81	Damms-Machado [98]	2012	Pre- and postoperative nutritional deficiencies in obese patients undergoing laparoscopic sleeve gastrectomy	Obes Surg	3.102	92
82	Braghetto [99]	2007	Laparoscopic sleeve gastrectomy: surgical technique, indications and clinical results	Obes Surg	2.852	92
83	Gagner [100]	2003	Laparoscopic reoperative sleeve gastrectomy for poor weight loss after biliopancreatic diversion with duodenal switch	Obes Surg	2.421	92
84	Sarela [101]	2012	Long-term follow-up after laparoscopic sleeve gastrectomy: 8–9-year results	Surg Obes Relat Dis	4.121	91
85	Arterburn [102]	2014	Bariatric surgery for obesity and metabolic conditions in adults	Br Med J	17.445	90
86	Alqahtani [103]	2012	Laparoscopic sleeve gastrectomy in 108 obese children and adolescents aged 5 to 21 years	Ann Surg	6.329	90
87	Braghetto [104]	2010	Manometric changes of the lower esophageal sphincter after sleeve gastrectomy in obese patients	Obes Surg	3.078	90
88	Arias [105]	2009	Mid-term follow-up after sleeve gastrectomy as a final approach for morbid obesity	Obes Surg	2.934	89
89	Kotidis [106]	2006	Serum ghrelin, leptin and adiponectin levels before and after weight loss: Comparisons of three methods of treatment – a prospective study	Obes Surg	3.723	89
90	Rawlins [107]	2013	Sleeve gastrectomy: 5-year outcomes of a single institution	Surg Obes Relat Dis	4.942	88
91	Romero [108]	2012	Comparable early changes in gastrointestinal hormones after sleeve gastrectomy and Roux-En-Y gastric bypass surgery for morbidly obese type 2 diabetic subjects	Surg Endosc	3.427	88
92	Moize [109]	2013	Long-term dietary intake and nutritional deficiencies following sleeve gastrectomy or Roux-En-Y gastric bypass in a mediterranean population	J Acad Nutr Diet	2.444	87
93	Dunn [110]	2010	Decreased dopamine type 2 receptor availability after bariatric surgery: preliminary findings	Brain Res	2.623	86

Table I. Cont.

Rank	First author	Publication year	Title	Journal	Impact factor (publication year)	Total citations
94	Trastulli [111]	2013	Laparoscopic sleeve gastrectomy compared with other bariatric surgical procedures: a systematic review of randomized trials	Surg Obes Relat Dis	4.942	84
95	Manuel Ramon [112]	2012	Effect of Roux-en-Y gastric bypass vs sleeve gastrectomy on glucose and gut hormones: a prospective randomised trial	J Gastrointest Surg	2.361	84
96	Boza [113]	2012	Laparoscopic sleeve gastrectomy as a stand-alone procedure for morbid obesity: report of 1000 cases and 3-year follow-up	Obes Surg	3.102	83
97	Soricelli [114]	2013	Sleeve gastrectomy and crural repair in obese patients with gastroesophageal reflux disease and/or hiatal hernia	Surg Obes Relat Dis	4.942	82
98	Vidal [115]	2007	Short-term effects of sleeve gastrectomy on type 2 diabetes mellitus in severely obese subjects	Obes Surg	2.852	81
99	Akkary [116]	2008	Deciphering the sleeve: technique, indications, efficacy, and safety of sleeve gastrectomy	Obes Surg	2.913	80
100	Tan [117]	2010	Diagnosis and management of gastric leaks after laparoscopic sleeve gastrectomy for morbid obesity	Obes Surg	3.078	79

Overall, 64 of the included articles were observational studies, 11 were randomised clinical trials, and eight were systematic reviews. Most of the included publications reported neither commercial nor public funding (79 publications). Public foundations financed 19 studies, and commercial companies financed three studies (Table III).

The included articles were most commonly published in *Obesity Surgery* (49 articles), followed by *Surgery for Obesity and Related Diseases* (14 articles) and *Annals of Surgery* (11 articles). The scope of the journals that published the included studies was mostly focused on bariatric surgery (63 journals) or general surgery (28 journals). Most journals originated from the United States (96 journals) (Table IV).

The most frequent country of origin among the included studies was the United States (38 studies). Eight studies were conducted by institutions from Spain, six by institutions from Italy, and six from Chile (Table V). Most articles were written by authors from academic departments (51 articles). Most articles were published by authors working in a surgical institution (89 articles). They were predominantly conducted in multiple centres (65 studies). The mean number of authors in the included articles was 6.56 ±3.36. Four people were listed as the first author of three articles in our list: Italo Braghetto, Michel Gagner, Wei-Jei Lee, and Ralph Peterli (Table VI). Raul Rosenthal was a senior author in five articles, and Michel Gagner and Nicola Basso were senior authors in four publications (Table VII).

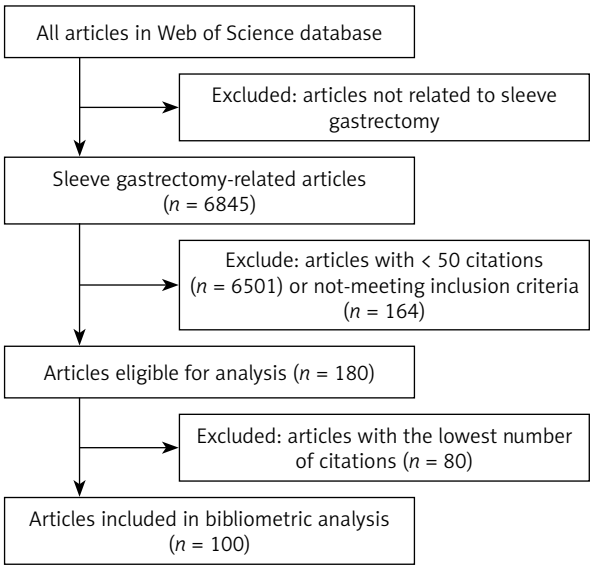

Figure 1. Study flowchart

Table II. Top 10 articles in laparoscopic sleeve gastrectomy based on average citations per year

Rank	First author	Publication year	Title	Journal	Total citations	Average citations per year
1	Ryan [118]	2014	FXR is a molecular target for the effects of vertical sleeve gastrectomy	Nature	365	73.00
2	Rosenthal [22]	2012	International sleeve gastrectomy expert panel consensus statement: best practice guidelines based on experience of >12,000 cases	Surg Obes Relat Dis	393	56.14
3	Karamanakos [16]	2008	Weight loss, appetite suppression, and changes in fasting and postprandial ghrelin and peptide-YY levels after Roux-en-Y gastric bypass and sleeve gastrectomy – a prospective, double blind study	Ann Surg	493	44.82
4	Himpens [23]	2010	Long-term results of laparoscopic sleeve gastrectomy for obesity	Ann Surg	381	42.33
5	Hutter [26]	2011	First report from the American College of Surgeons Bariatric Surgery Center Network Laparoscopic Sleeve Gastrectomy has morbidity and effectiveness positioned between the band and the bypass	Ann Surg	311	38.88
6	Aurora [30]	2012	Sleeve gastrectomy and the risk of leak: a systematic analysis of 4888 patients	Surg Endosc	253	36.14
7	Peterli [25]	2009	Improvement in glucose metabolism after bariatric surgery: comparison of laparoscopic Roux-en-Y gastric bypass and laparoscopic sleeve gastrectomy a prospective randomized trial	Ann Surg	347	34.70
8	Himpens [20]	2006	A prospective randomized study between laparoscopic gastric banding and laparoscopic isolated sleeve gastrectomy: results after 1 and 3 years	Obes Surg	413	31.77
9	Peterli [37]	2012	Metabolic and hormonal changes after laparoscopic Roux-en-Y gastric bypass and sleeve gastrectomy: a randomized, prospective trial	Obes Surg	217	31.00
10	Peterli [44]	2013	Early results of the Swiss Multicentre Bypass or Sleeve Study (SM-BOSS) a prospective randomized trial comparing laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass	Ann Surg	185	30.83

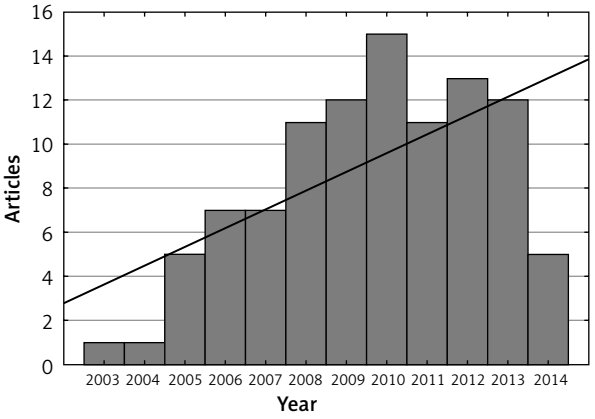

Figure 2. Total number of articles per year

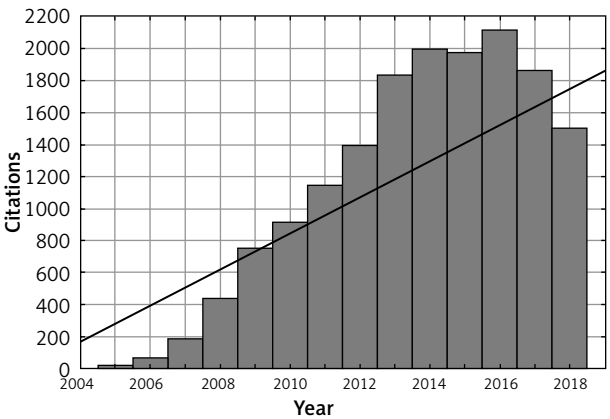

Figure 3. Number of citations per year

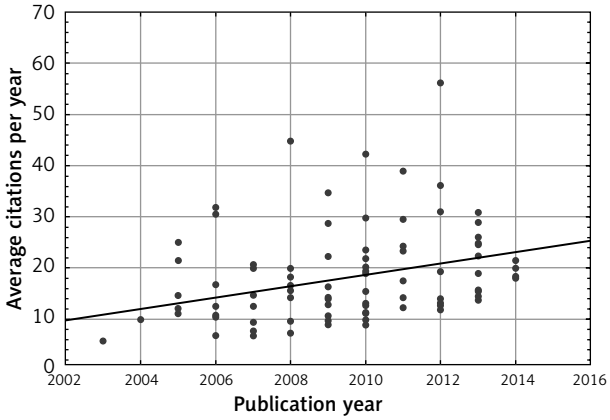

Figure 4. Time-dependent citation density trend

The most common level of evidence among the studies was III (50 studies), followed by II (29 studies) and I (10 studies) (Figure 5). The mean number of citations per year was highest among articles with a level of evidence of V (26 citations) (Figure 6). The mean number of citations per article was highest among articles with a level of evidence of I (215.4 citations) (Figure 7).

Most of the included studies focused on the short- and long-term clinical outcomes of SG (36 studies). Metabolic and hormonal changes were investigated by one-fourth (22) of the included articles. Overall, 18 of the included publications were reviews investigating the subject of SG in its entirety (Table VIII).

Discussion

The present report summarises the characteristics of the 100 most frequently cited publications focused on SG published up to date. These results may be useful in the process of designing further studies, and they provide a new understanding of the increased popularity of SG. Our study gives new insight into which articles, authors, countries, and journals have played a key role in understanding the advantages of SG and in promoting its use. Ahmad *et al.* [119] suggested the constant need to update bibliometric articles because of their limited life span. Conducting updates could help to identify changes in research trends [119]. We believe that further studies concentrating on bariatric surgery should also investigate the most popular procedures separately because of the vastness of the currently published literature devoted to bariatric surgery and the multiplicity of bariatric operations that are now performed.

Table III. Studies characteristics

Parameter	Results
Study type:	
Observational	64
Randomized clinical trial	11
Systematic review	8
Review	5
Review/expert opinion	4
Case series	3
Meta-analysis	2
Basic science	1
Case report	1
Clinical guidelines	1
Funding source:	
Neither	79
Public foundations	18
Commercial companies	2
Both	1

Some of the most frequently cited studies were reviews that considered the subject of bariatric surgery in its entirety. Such reviews allow for a new understanding of the evolution of bariatric surgery as a field of study, which has undergone considerable change during recent years [14, 119]. Academic interest in bariatric surgery has been rapidly growing since the beginning of the 21st century, although surgical treatment of obesity has been performed for more than six decades [120, 121]. Additionally, bibliometric analyses have helped to outline which publications should be included in educational programs as mandatory reading material for surgeons, surgical trainees, and allied health professionals working in the field of bariatric surgery [121].

SG (parietal gastrectomy) was first introduced in 1988 as a restrictive component of biliopancreatic diversion with duodenal switch [121, 122]. Bariatric surgeons started to consider SG as an independent bariatric operation in the 21st century. Therefore, most research investigating SG is relatively recent [123]. Most of the studies included in our list were published after 2006. Our results indicate growing

Table IV. Journals of publication

Journal	Number of articles	Impact factor (2017)	Immediacy index (2017)	Journal origin	Journals field of interest
Obesity Surgery	49	3.895	0.976	USA	Bariatric surgery
Surgery for Obesity and Related Diseases	14	3.900	0.709	USA	Bariatric surgery
Annals of Surgery	11	9.203	3.234	USA	General surgery
Surgical Endoscopy and Other Interventional Techniques	8	3.117	0.750	USA	General surgery
Journal of Gastrointestinal Surgery	3	2.813	0.577	USA	General surgery
Archives of Surgery/JAMA Surgery	2	8.498	3.000	USA	General surgery
Surgery	2	3.574	0.938	USA	General surgery
BMJ – British Medical Journal	1	23.259	9.882	Great Britain	General medicine
Brain Research	1	3.125	0.664	USA	Neurology
British Journal of Surgery	1	5.433	1.294	Great Britain	General surgery
JAMA Pediatrics	1	10.769	3.856	USA	Paediatrics
JAMA – Journal of the American Medical Association	1	47.661	10.188	USA	General medicine
Journal of Clinical Endocrinology & Metabolism	1	5.789	1.020	Great Britain	Endocrinology
Journal of the Academy of Nutrition and Dietetics	1	4.021	0.742	USA	Nutrition
Journal of the American College of Surgeons	1	4.767	0.816	USA	General surgery
Nature	1	41.577	9.700	USA	General scientific discovery
Obesity	1	4.042	0.901	Global	Obesity
Obesity Reviews	1	8.483	1.768	USA	Obesity

scientific interest in SG both in terms of the number of publications and the number of citations.

Although the receipt of external commercial funding, if clearly described, should not decrease the value of presented data, the vast majority of the most influential studies on SG were not funded commercially [124, 125].

During submission of a manuscript, it is critical to choose a journal with a scope matching the subject of the article [126]. Authors often desire to submit their work to prestigious journals. Unfortunately, there is no ideal parameter with which to measure the value of a journal. Currently, the most commonly used measure of a journal's scientific influence is the impact factor, although this parameter has multiple imperfections [127]. Previously published bibliometric analyses of bariatric surgery, as well as most of the articles included in our list, were published in the most influential journals devoted to bariatric surgery: *Surgery for Obesity and Related Diseases* (established in 2005, the official journal of the American Society for Metabolic and Bariatric Surgery) and *Obesity Surgery* (established in 1999, the official journal of the International Federation for the Surgery of Obesity and Metabolic Disorders) [14, 109].

First authorship is often vigorously pursued by researchers as confirmation of a substantial contri-

Table V. Countries of origin of included articles

Country	Number of articles
USA	38
Spain	8
Chile	6
Italy	6
Greece	5
Switzerland	5
Belgium	4
Canada	4
France	4
Austria	3
England	3
Germany	3
Taiwan	3
Israel	2
Argentina	1
Australia	1
Brazil	1
China	1
India	1
Korea	1

Table VI. Authors with more than one first-name article

First author	Number of articles
Braghetto I.	3
Gagner M.	3
Lee W.	3
Peterli R.	3
Deitel M.	2
Himpens J.	2
Langer F.B.	2
Melissas J.	2
Vidal J.	2

Table VII. Authors with more than one senior-author article

Senior author	Number of articles
Rosenthal R.	5
Basso N.	4
Gagner M.	4
Beglinger C.	3
Birkmeyer N.	3
Crosby R.	3
Prager G.	3
Schauer P.	3
Vidal J.	3
Karmali S.	2
Lacy A.	2

bution to the study and a crucial role during the research [128]. Senior authorship (last author) is usually associated with the role of supervisor or overseer of the study. According to Zbar and Frank, the senior author often has a minor or no contribution to the study; instead, he or she may have provided funding or is a laboratory head or mentor. The last author is often chosen based on seniority in the field [129]. We analysed the first and senior authorship among the included papers. Several authors repeatedly appeared in multiple publications included in our list, proving that they have played a substantial role in investigating SG and promoting advancements in bariatric surgery and recognition of SG.

Most of the included articles were published by authors from the United States. In accordance with the study by Angrisani *et al.* [1], the United States/Canada was also the region with the highest number of bariatric procedures. A recent analysis of bariatric practice in the United States demonstrated that laparoscopic SG has become the most common bariatric procedure performed in this country [130]. Moreover, it seems that academic institutions in the United States play a leading role in various fields of medical research other than bariatric surgery [131–133].

In 2003, *The Journal of Bone & Joint Surgery* introduced level of evidence ratings that have been extensively used in further publications and bibliometric analyses [15]. Most of the articles included

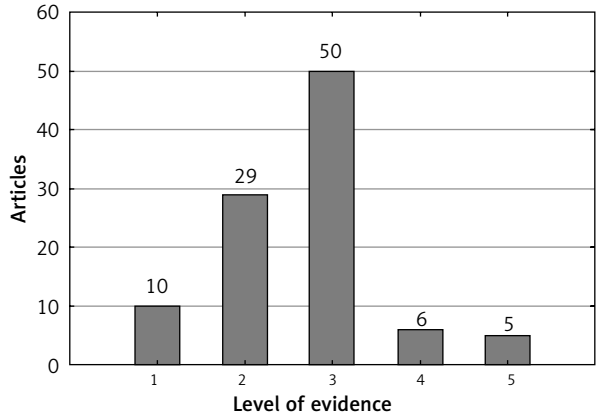

Figure 5. Level of evidence

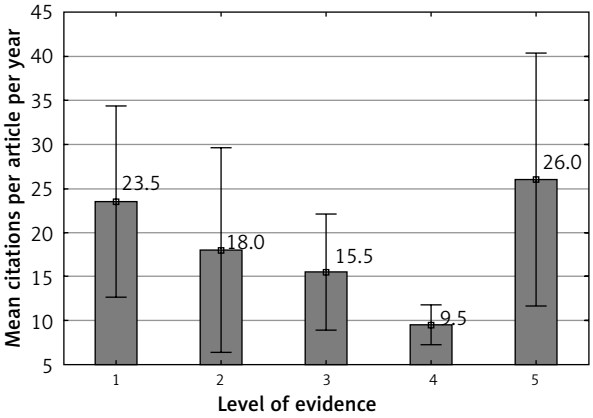

Figure 6. Mean ± SD citations per article per year based on level of evidence

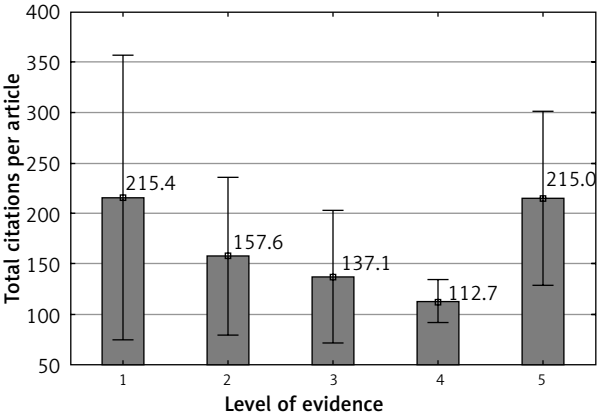

Figure 7. Mean ± SD citations per article based on level of evidence

Table VIII. Subject of the study

Subject	Number of articles
Clinical outcomes	36
Metabolic/hormonal changes	22
Review	18
Operative technique	10
Long-term outcomes	8
SG as a staged procedure	4
Clinical practice guidelines	1
Molecular mechanisms	1

in our list had a level of evidence of III. In contrast, most of the articles in the study by Ahmad *et al.* [119], who investigated bariatric surgery in general, had a level of evidence of IV. These results indicate the need to conduct further trials in bariatric surgery, preferably randomised clinical trials, because they are associated with the highest levels of evidence according to the current principles of evidence-based medicine [134].

Most of the literature included in our list comprised clinical experience/observational studies that presented outcomes of bariatric treatment in the clinical environment or metabolic and hormonal changes following the operation. Consistent with a previous publication by Carlson [10], we believe that further research should explain the mechanisms associated with SG, which would advance our current understanding of the physiological changes that occur after the procedure. Additionally, further improvement of techniques used in bariatric treatment should be encouraged [18, 19, 135].

The present study has several limitations. First, the number of citations provided by the Web of Science might not be extensive. In contrast to some previous articles, we decided not to verify the number of citations using Google Scholar. This is a database that does not standardise authors' names, that includes every citation whether scholarly or not, and includes every version of an article, resulting in multiple duplicate entries and thus a duplicated number of citations [20]. Nevertheless, a similar search strategy conducted in a different database would probably result in a different outcome. Second, the number of citations is a limited measure of the relevance of a study. Finally, recently published studies that will significantly influence the development of bariatric surgery in the future might have been omitted.

Conclusions

Our study indicates an increase in medical researchers' interest in the subject of SG since the year 2000 (especially since 2006). Crucial scientific papers investigating SG are usually observational clinical studies conducted in academic surgical centres. Influential scientific evidence seems to be authored mostly by scientists from the United States and published in bariatric surgery-oriented journals. Our study underlines the need to perform studies with a high level of evidence, preferably randomised clinical trials, to further analyse the outcomes of SG and basic science research to properly investigate the mechanism underlying metabolic changes after SG.

Conflict of interest

The authors declare no conflict of interest.

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