gastrointestinal disorders

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*Article*

# Scientific and Public Interest in Bariatric Surgery for Obesity: The Italian Scenario

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**Abstract:** Background: Obesity is an escalating concern in our society. Bariatric surgery appears to be the only feasible alternative for severe obesity. This study aims to conduct an integrative analysis of the Italian context concerning bariatric surgery, with a specific focus on the surgical procedures of sleeve gastrectomy, mini-gastric bypass, and gastric bypass. Methods: The analysis is based on bibliometric data extracted from the Scopus database to find Italian publications in this field from 2012 to 2022. Along with scientific interest, it is essential to assess the level of public interest in these topics. Google Trends is the most extensively utilized free tool for the analysis of online behavior. Using Google Trends data, we analyzed the amount of internet volume searches (Relative Search Volume = RSV) for the Italian terms "sleeve gastrectomy", "mini-gastric bypass" and "gastric bypass", both temporally (from 2012 to 2022 years) and geographically. Furthermore, to illustrate the Italian landscape, we compared Google Trends data with data from the Italian registry "Società Italiana di Chirurgia dell'Obesità e delle malattie metaboliche" (SICOB), which includes information about bariatric surgery procedures performed in the country. Results: Over the past decade, there has been a significant increase in the scientific literature on sleeve gastrectomy, mini-gastric bypass, and gastric bypass surgeries in Italy. Google Trends data has shown an increase in online public interest in these surgical procedures, from 2012 to 2022. The examination of the Google Trends information combined with the SICOB data demonstrated a remarkable association between the two data sets. Conclusions: Bariatric surgery has increased quickly in Italy in terms of scientific research and surgical interventions. The analysis of Google Trends data in conjunction with data from SICOB has revealed an interesting correlation between the two datasets therefore, Google Trends can be useful for estimating the demand for bariatric surgical procedures.

**Keywords:** obesity; bariatric surgery; sleeve gastrectomy; mini-gastric bypass; gastric bypass; bibliometric analysis; Scopus; Bibliometrix; Biblioshiny; Google Trends



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## 1. Introduction

Obesity is a multifactorial health condition caused by an abnormal accumulation of body fat [1,2]. In our society, obesity is a growing problem affecting people of all ages, races, and socioeconomic backgrounds [3,4]. The incidence has nearly tripled worldwide in the last 30 years [4], to the point where we can speak of an "obesity pandemic" [5]. Regarding the epidemiologic situation in Italy, according to World Health Organization data, the proportion of men and women who were obese was 21.2% and 18.5%, respectively [6]. Medical and behavioral modifications may not be effective for a large number of obese patients when considering weight loss strategies. Bariatric surgery appears to be the only feasible alternative for severe obesity [7,8]. The term "bariatric surgery" refers to a class of surgical procedures designed to aid obese patients in losing weight. These techniques

encompass alterations to the digestive system with the aim of limiting caloric intake and absorption, alongside the suppression of hunger signals transmitted from the digestive system to the brain [9]. In the past few decades, bariatric surgery has expanded globally, as evidenced by the rise in surgical society membership and the number of academic publications [10–13]. According to the "Società Italiana di Chirurgia dell'Obesità e Malattie Metaboliche" (SICOB) registry, sleeve gastrectomy, gastric bypass, and mini-gastric bypass have been the most frequently performed bariatric surgery procedures in Italy over the last few years [14]. Sleeve gastrectomy, also known as vertical sleeve gastrectomy, removes a large piece of the stomach along the primary curve, reducing its capacity to about 15%. The stomach is then sculpted into a tube or sleeve using surgical staples, sutures, or a mix of both [15]. Roux-en-Y gastric bypass (gastric bypass) creates a tiny gastric pouch attached to the small intestine. After a gastric bypass, food enters a smaller gastric pouch and goes directly to the small intestine, bypassing most of the stomach and the first part of the small intestine [9,16]. The one-anastomosis mini-gastric bypass is a modern version of the conventional gastric bypass [17]. It circumvents 200 cm of the small intestine, simplifying the procedure. Due to the single anastomosis, this approach has a lower risk of staple line leak than the usual gastric bypass [17,18].

Bibliometric analysis is an efficient method for measuring scientific contributions in multiple fields [19–21]. Some bibliometric studies have examined scientific contributions in the field of bariatric surgery [22,23]. On the other hand, it is challenging to evaluate population-level interest in bariatric surgery, even though it may be a successful weight loss option for patients with extreme obesity. The analysis of Google Trends data may provide healthcare systems with valuable information regarding the interest of internet users in bariatric surgical procedures. Google Trends is the most popular free tool for analyzing online behavior, and it can also provide real-time data about trends and changes in online interest over time for various terms and topics [24–26]. The scientific community has frequently used Google Trends to conduct infodemiological and epidemiological analyses [24–26]. Linkov et al. collected Google Trends data from 2004 to 2012 for "bariatric surgery", "gastric bypass", "gastric sleeve", "gastric plication", and "lap band" in order to examine temporal relationships with relevant media events, economic variations, and policy changes [27]. Rahiri et al. conducted a study utilizing Google Trends to examine the level of interest among the New Zealand population in bariatric surgery [28]. In a more recent study, Aleman et al. used Google Trends as a tool to analyze the US general population's interest in bariatric surgery [29]. They concluded that the utilization of Google Trends enhances the comprehension of the level of interest pertaining to bariatric surgery.

Our research aims to conduct an integrative analysis of the Italian context concerning bariatric surgery, with a specific focus on sleeve gastrectomy, mini-gastric bypass, and gastric bypass surgeries. This analysis will utilize bibliometric data extracted from the Scopus database, and Google Trends data to determine the level of public interest. As previously aforementioned, the SICOB registry encompasses information about bariatric surgeries performed in Italy [14,30]. To examine the Italian landscape in relation to bariatric surgery, we conducted a comparative analysis between Google Trends data and data obtained from SICOB. The objective was to establish a correlation between the public interest data and the data about bariatric interventions, specifically "sleeve gastrectomy", "mini-gastric bypass", and "gastric bypass", within the Italian context. The analysis was conducted over a period of ten years, from 2012 to 2022.

## 2. Results

### *2.1. Publication Trends*

A total of 929 articles from the Scopus database were retrieved based on the specified search parameter, encompassing the years 2012–2022. In the previous ten-year period, except for intermittent variations between 2014 and 2018, there has been a notable and rapid rise in the number of publications in this field. This trend indicates a growing focus on obesity and its surgical treatment options within the context of Italy, as depicted in Figure 1A.

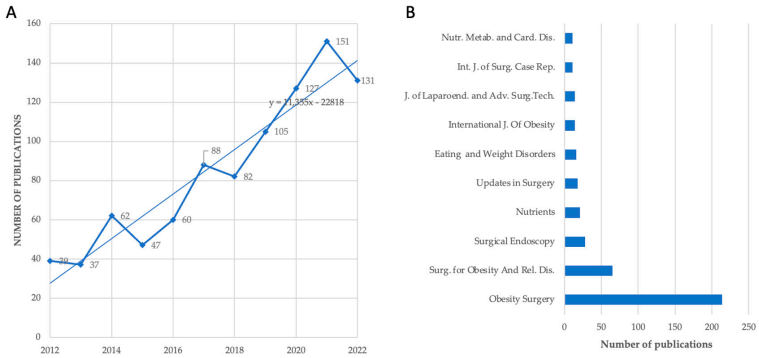


**Figure 1.** (**A**) The number of Italian-relevant publications between 2012 and 2022; the linear trend line and related equation are indicated. (**B**) the top ten most productive journals in terms of publications; Surg. for Obesity and Rel. Dis. = Surgery for Obesity and Related Diseases; J. Of Laparoend. and Adv. Surg. Tech. = Journal of Laparoendoscopic and Advanced Surgical Techniques; Int. J. of Surg. Case Rep. = International Journal of Surgery Case Reports; Nutr. Met. and Card. Dis. = Nutrition, Metabolism & Cardiovascular Diseases. All numbers are derived from Scopus on 17 April 2023.

In the preceding decade 785 articles and 144 reviews, authored by Italian scientists, have been disseminated across 253 academic journals. Figure 1B illustrates the ranking of the ten most prolific journals concerning publications pertaining to sleeve gastrectomy, mini-gastric bypass, and gastric bypass surgeries. The three most prolific journals, ranked by number of publications, are *Obesity Surgery* (published by Springer Nature), *Surgery for Obesity and Related Diseases* (published by Elsevier), and *Surgical Endoscopy* (also published by Springer Nature). A total of 412 articles were published in the top 10 journals, accounting for 44.3% of the total number of documents retrieved. The journal *Obesity Surgery* exhibits the most extensive publication record among the 253 journals.

As shown in Figure 2, the analysis of the trend in the publication of each of the ten most productive journals listed in Figure 1B reveals that some journals have had a growing interest in the field in the last few years, and among these, in particular, is *Eating and Weigh Disorders* and *Nutrients*. As for Obesity Surgery, which has had the highest volume of publications, there has been a reduction in the last two years (2021–2022).

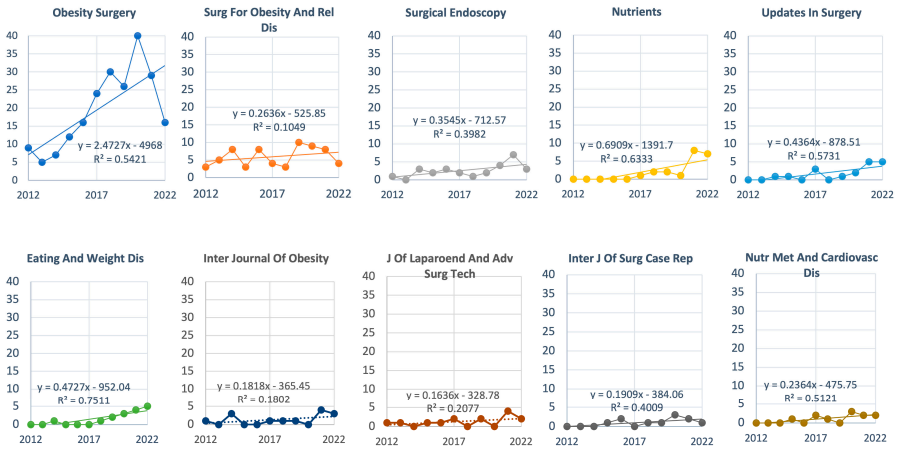


**Figure 2.** The publication trend of the ten most prolific journals relative to the last ten years. The Y-axis represents the number of publications. For each graph, the linear trend line and related equation are indicated. Surg for Obesity and Rel Dis = Surgery For Obesity And Related Diseases; Eating and Weight Dis = Eating and Weight Disorders; J Of Laparoend And Adv Surg Tech = Journal of Laparoendoscopic and Advanced Surgical Techniques; Inter J Of Surg Case Rep = International Journal of Surgery Case Reports; Nutr Met And Cardiovasc Dis = Nutrition, Metabolism & Cardiovascular Diseases. All numbers are derived from Scopus on 17 April 2023.

### *2.2. Italian Institutions and Author's Productivity*

The top 10 affiliations published 696 documents, which represent about 75% of the total (Figure 3). The most prolific is the University of Sapienza in Rome with 290 documents, followed by the University of Milan with 160 and the University of Pisa with 153 documents.

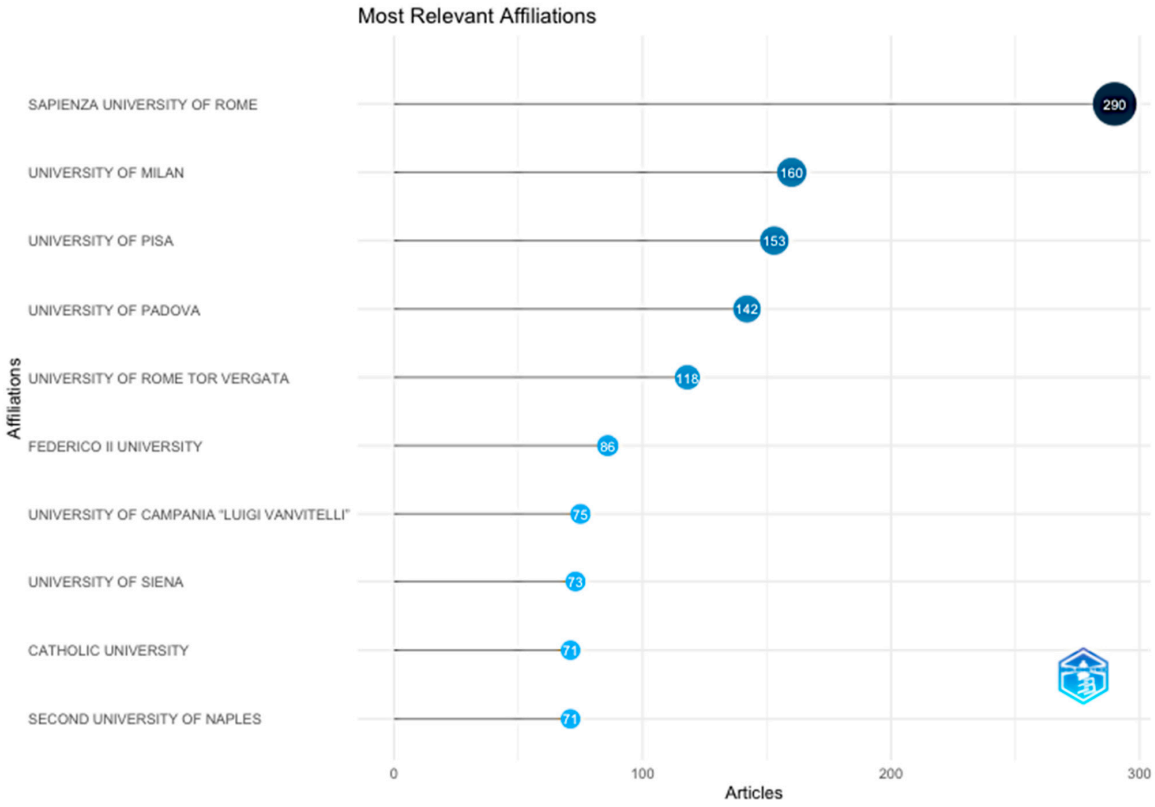


**Figure 3.** The top 10 institutions in terms of publications. All numerical data were obtained from Scopus on 17 April 2023. The data were analyzed using Bibliometrix and Biblioshiny.

The results of the ten most prolific Italian authors in the field of sleeve gastrectomy, mini-gastric bypass, and gastric bypass surgeries from 2012 to June 2022 are shown in Figure 4A. These scholars have consistently contributed to this field's body of research. The outcome demonstrated that Mario Musella of the University "Federico II" had produced a total of 52 documents and received the maximum number of citations, 1273. The first article by Musella was published in 2012 and received 6.75 total citations (TC) per year. Gianfranco Silecchia of the University of La Sapienza in Rome is the second-most prolific Italian author in this discipline. Silecchia has published a total of 49 works. As for the first-ranking author, Silecchia began publishing in the field in 2012 with a single publication; however, the years 2018 and 2020, with 8 and 7 publications, respectively, account for the majority of his publications. Similarly, third-ranked Gertrude Mingrone from the Catholic University of the Sacred Heart (Rome) published her first article in 2012, which received 113.3 total citations per year. Figure 4B presents a visual representation of the productivity and total number of citations achieved by the top ten authors over the depicted years, as demonstrated in the accompanying line graph. This graph serves as an indication of the authors' chronological progression. There is a direct correlation between the size of a bubble and the number of documents that an author produces on an annual basis. The chromatic intensity of the bubble is in direct correlation with the cumulative annual count of citations received. The first data point on the line graph represents the author's initial publications in the respective field.

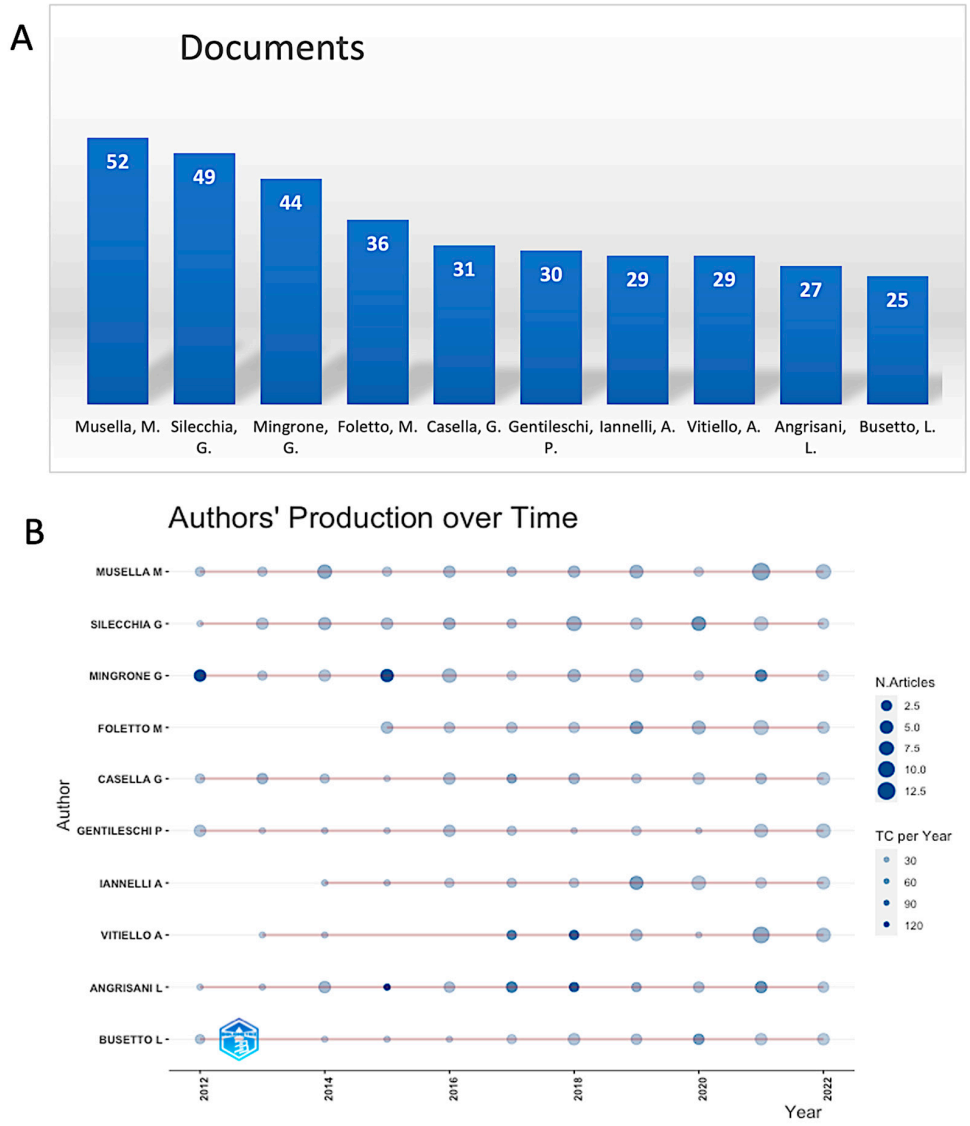


**Figure 4.** (**A**) The authors are ranked in descending order based on the number of publications, with the top ten authors listed. (**B**) The productivity and total number of citations of the top ten authors over the years are depicted in the line graph, which illustrates the authors' chronological progression. The size of the bubble corresponds to the number of articles published annually, while the intensity of color within the bubbles indicates the magnitude of citation counts. TC: total citations. All numerical data were obtained from Scopus on 17 April 2023. The data were analyzed using Bibliometrix and Biblioshiny.

In our analysis, we illustrate the author's collaboration network (Figure 5). Relationships between Italian scientists are delineated by the number of articles they have co-authored, which provides clear information regarding existing collaborations. The diameter of the concentric circle represents the number of documents each author has published, while the presence of connection lines signifies collaboration. The number of connected lines represents author collaboration. There are a total of thirteen distinct color clusters; the larger the box, the larger the author's collaboration network. The results indicate that prominent academicians in the field, such as Musella and Silecchia, have an extensive collaboration network. Furthermore, the analysis of cooperation indicates that multiple authors affiliated with the same institution establish collaborative workgroups.

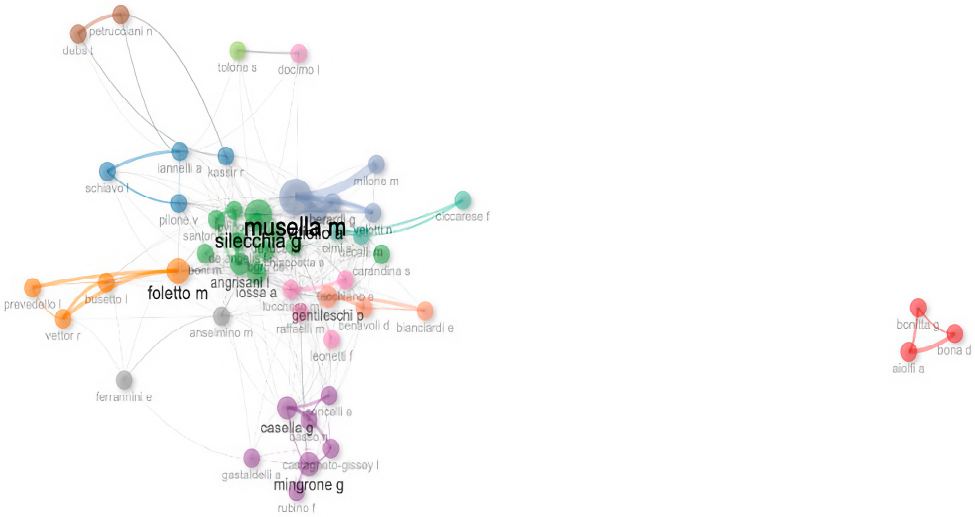


**Figure 5.** Mapping of authors' collaboration network. The scientific community defines the relationship between scientists based on the number of articles they have co-authored. This metric serves as a clear indicator of existing collaborations. The concentric circle's diameter denotes the number of documents published by each author, and the existence of connection lines indicates collaborative effort. The level of collaboration among authors can be determined by the number of interconnected lines. There are a total of 14 unique color clusters. All numerical data were obtained from Scopus on 17 April 2023. The data were analyzed using Bibliometrix and Biblioshiny.

### *2.3. Analysis of the Most Cited Italian Articles and Italian Trend Scientific Topics*

The number of citations is an essential indicator of an article's significance in a particular research field. The number of citations in these 929 articles was counted and ranked, and Table 1 lists the top 10 original articles. Among the articles, the paper entitled "Bariatric surgery versus conventional medical therapy for type 2 diabetes" had major citations [31] followed by the papers titled "Bariatric Surgery Worldwide 2013" [32] and "Bariatric–metabolic surgery versus conventional medical treatment in obese patients with type 2 diabetes: 5 year follow-up of an open-label, single-centre, randomised controlled trial" [33].

Concerning the analysis of Italian trend topics, it was conducted using the author's keywords from the dataset. During the analysis, the following parameters were configured: the time period was set from 2012 to 2022, the minimum frequency of words was set to 5, and the number of words per year was set to 3. Article keywords, which authors define, are typically associated with such publication content and are sufficient to derive pertinent aspects of a field. This analysis provides additional insight into topical trends based on the frequency of keyword occurrences in the field over time. As shown in Figure 6, the analysis highlighted a shift to the following topics in the last two years: "adverse event", "esophagitis", "meta-analysis", "heart failure", "pylorus stenosis" and "pandemic".

**Table 1.** The ten most cited articles of a total of 926. All numerical data were obtained from Scopus on 17 April 2023. The data were analyzed using Bibliometrix and Biblioshiny.

| Authors | Title | Source Title | Year | Citation | DOI |
|---|---|---|---|---|---|
| Mingrone G | Bariatric surgery versus conventional medical therapy for type 2 diabetes | New England Journal of Medicine | 2012 | 1360 | 10.1056/Nejmoa1200111 |
| Angrisani L | Bariatric Surgery Worldwide 2013 | Obesity Surgery | 2015 | 1086 | 10.1007/S11695-015-1657-Z |
| Mingrone G | Bariatric-metabolic surgery versus conventional medical treatment in obese patients with type 2 diabetes: 5 year follow-up of an open-label, single-centre, randomised controlled trial | Lancet | 2015 | 830 | 10.1016/S0140-6736(15)00075-6 |
| Angrisani L | IFSO Worldwide Survey 2016: Primary, Endoluminal, and Revisional Procedures | Obesity Surgery | 2018 | 578 | 10.1007/S11695-018-3450-2 |
| Rubino F | Metabolic Surgery in the Treatment Algorithm for Type 2 Diabetes: A Joint Statement by International Diabetes Organizations | Diabetes Care | 2016 | 573 | 10.2337/Dc16-0236 |
| Angrisani L | Bariatric Surgery and Endoluminal Procedures: IFSO Worldwide Survey 2014 | Obesity Surgery | 2017 | 464 | 10.1007/S11695-017-2666-X |
| Genco A | Gastroesophageal reflux disease and Barrett's esophagus after laparoscopic sleeve gastrectomy: a possible, underestimated long-term complication | Surgical Obesisity Relative Disorder | 2017 | 251 | 10.1016/J.Soard.2016.11.029 |
| Nannipieri M | Roux-en-Y Gastric Bypass and Sleeve Gastrectomy: Mechanisms of Diabetes Remission and Role of Gut Hormones | The Journal of Clinical Endocrinology and Metabolism | 2013 | 203 | 10.1210/Jc.2013-2538 |
| Di Lorenzo N | Clinical practice guidelines of the European Association for Endoscopic Surgery (EAES) on bariatric surgery: update 2020 endorsed by IFSO-EC, EASO and ESPCOP | Surgical Endoscospy | 2020 | 165 | 10.1007/S00464-020-07555-Y |
| Mingrone G | Metabolic surgery versus conventional medical therapy in patients with type 2 diabetes: 10-year follow-up of an open-label, single-centre, randomised controlled trial | Lancet | 2021 | 159 | 10.1016/S0140-6736(20)32649-0 |

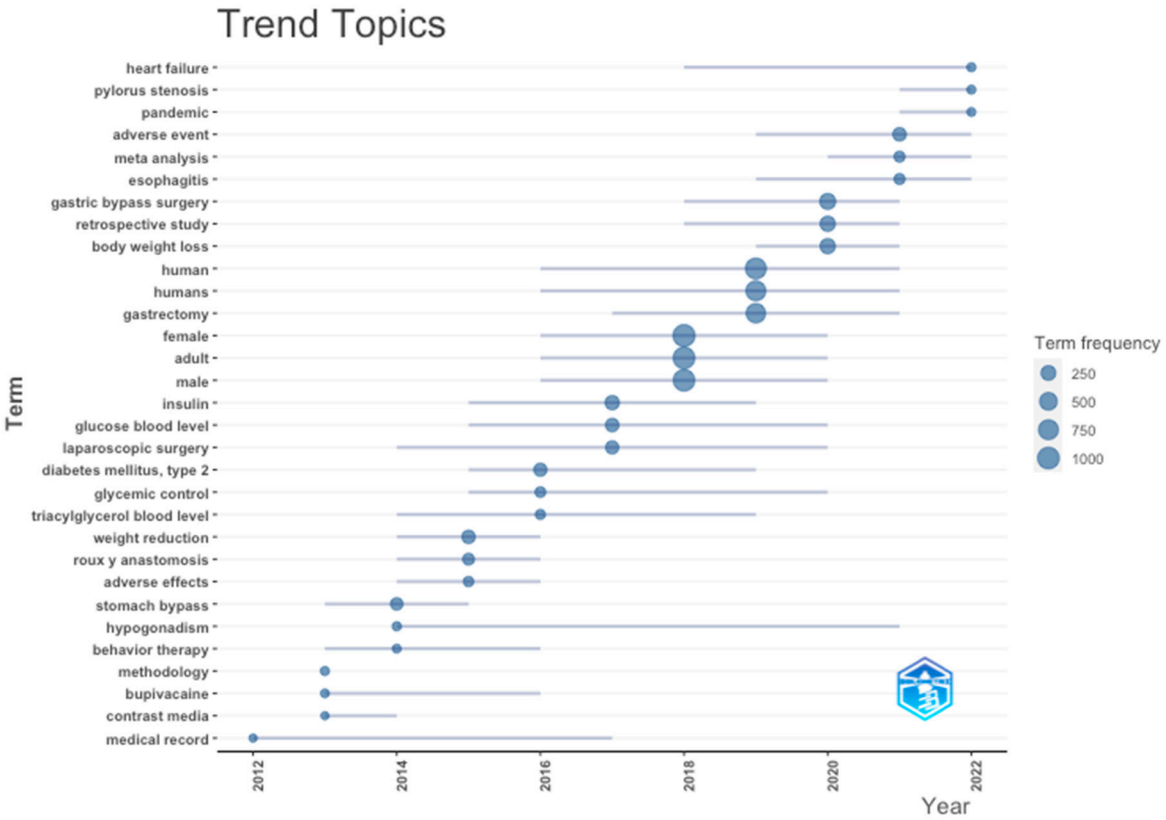


**Figure 6.** Trend topics progression from 2012 to 2022. The hierarchical arrangement of topics in the field discussed by scholars per year. All numerical data were obtained from Scopus on 17 April 2023. The data were analyzed using Bibliometrix and Biblioshiny.

### *2.4. Italian Public Interest in Sleeve Gastrectomy, Mini-Gastric Bypass and Gastric Bypass Surgeries: The Google Trends Data*

Figure 7 depicts the Italian RSV trends for all three search terms from 2012 to 2022. We assist in an evident increase in Italian public interest (expressed as RSV) in sleeve gastrectomy, which may be divided into four "ages": the period from 2012 to 2016, characterized by a slight increase, the period from 2016 to 2017, characterized by an exponential increase, the period from 2017, characterized by a live increase in the three years 2018–2020 and finally, the period from 2020 to 2022 characterized by a recovery of the average RSV. Regarding RSV for the terms mini-gastric bypass and gastric bypass from January 2012 to December 2022, we have a stationary situation with a slight increase from 2021 for mini-gastric bypass and gastric bypass. According to the data presented in Figure 7B, there appears to be a heightened level of interest in bariatric surgery, as indicated by RSV, particularly in the southern regions of Italy, including Sicily, Campania, and Latium. This trend is particularly evident in the context of mini-gastric bypass and gastric bypass surgeries. The regions of Apulia, Campania, Liguria, and Sicily have demonstrated a notable level of public interest in sleeve gastrectomy.

### *2.5. SICOB Surgical Procedure Data vs. Relative Search Volume (RSV) Data*

The Italian trends for sleeve gastrectomy, mini-gastric bypass, and gastric bypass surgeries are shown in Figure 8. The number of sleeve gastrostomy surgical procedures has increased from 2383 to 12,760; also, the number of mini-gastric bypass and gastric bypass procedures has grown, although less markedly, from 348 to 2244 and from 1593 to 2564, respectively.

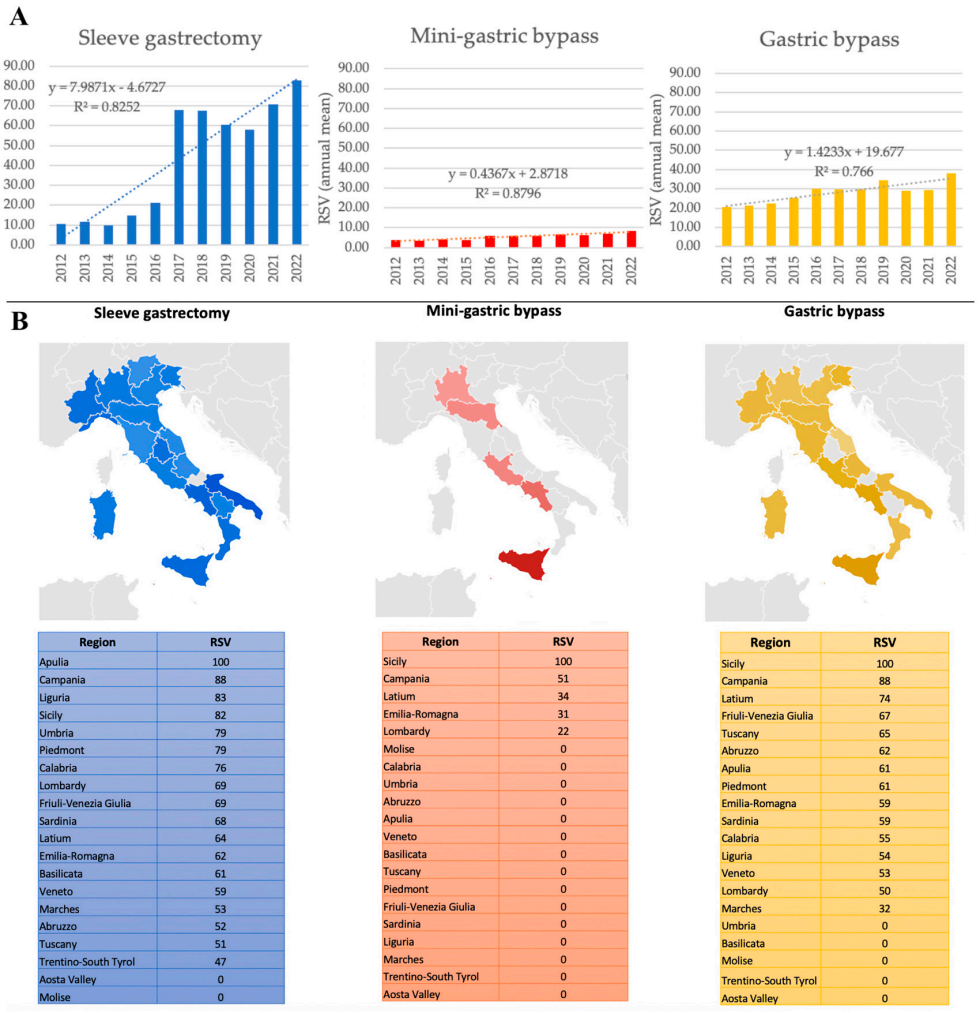


**Figure 7.** (**A**) The Italian annual mean of RSV from January 2012 until December 2022 for the searched terms: sleeve gastrectomy (colored in blue), mini-gastric bypass (colored in red), and gastric bypass (colored in yellow) from Google Trends (https://www.google.com/trends, accessed on 17 April 2023); the linear trend line and related equation are indicated; (**B**) Italian regions RSV value for searched terms: sleeve gastrectomy (regions colored in blue), mini-gastric bypass (regions colored in red), and gastric bypass (regions colored in yellow); Data source: Google Trends (https://www.google.com/trends, accessed on 17 April 2023).

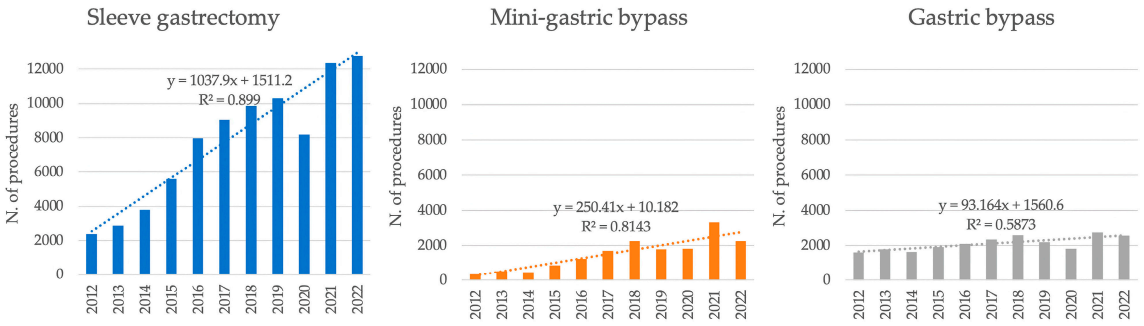


**Figure 8.** Annual trend (number of surgical procedures) of sleeve gastrectomy (colored in blue), mini-gastric bypass (colored in orange), and gastric bypass (colored in grey); the linear trend line and related equation are indicated. Data were obtained from the annual SICOB survey [30].

The graphical representation depicted in Figure 9 illustrates the trend of RSV and bariatric surgeries between the years 2012 and 2022. The value of RSV in sleeve gastrectomy

is found to be consistent with the surgical intervention data recorded in Italy during the corresponding time frame. The aforementioned statement holds true for both data on mini-gastric bypass and gastric bypass procedures. The analysis of the Google Trends data in conjunction with the SICOB data revealed a significant correlation between the two datasets. Furthermore, the RSV trend was found to be analogous to the data pertaining to surgical interventions.

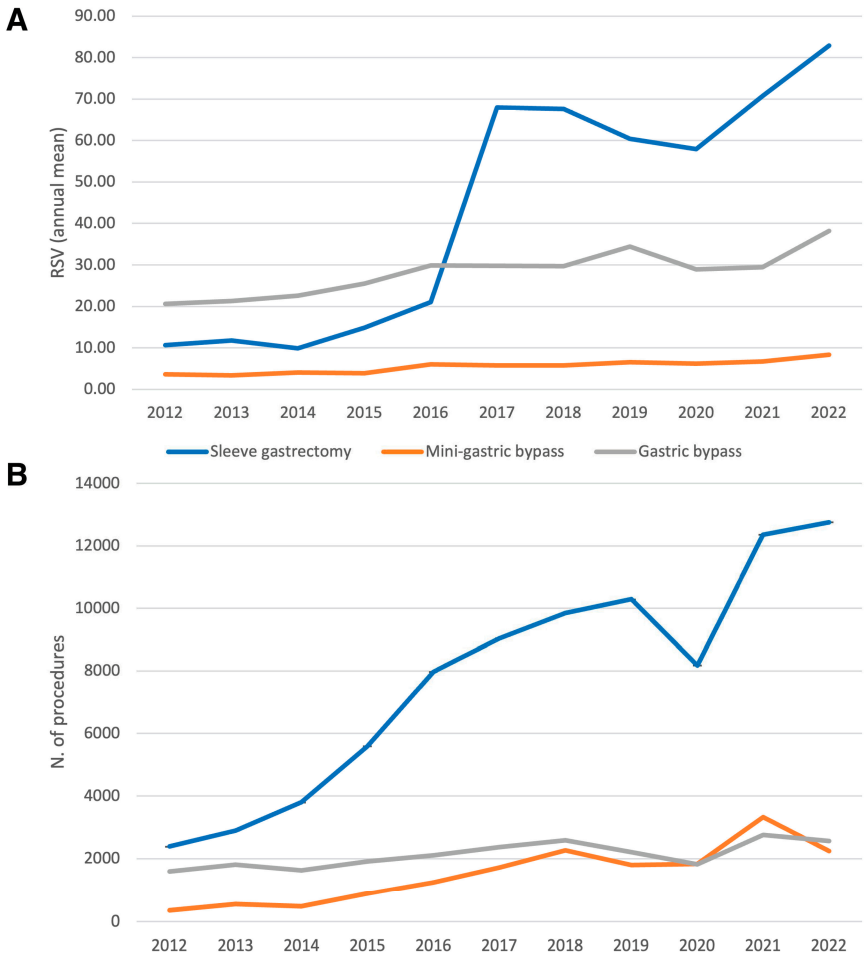


**Figure 9.** (**A**) RSV expressed as an annual mean between 2012 and 2022 in Italy, and relative to sleeve gastrectomy (colored in blue), mini-gastric bypass (colored in orange), and gastric bypass (colored in grey). (**B**) The number of bariatric surgical procedures performed between 2012 and 2022 in Italy relative to sleeve gastrectomy (colored in blue), mini-gastric bypass (colored in orange), and gastric bypass (colored in grey). RSV data were from Google Trends (https://www.google.com/trends, accessed on 17 April 2023) and data on procedures were from the annual SICOB survey [30].

## 3. Discussion

In our study, we found 929 Italian scientific articles in the searched field from 2012 to 2022. The overall publication number has increased considerably in the last few years. As shown in Figure 1A, besides some fluctuation between 2014 and 2016, from 2018 to 2021, we expect an increase of above 50% with 151 publications in 2021. This increase is partially attributable to the expanding interest in determining how the pandemic may affect bariatric surgery. In 2022, we assisted in a moderate reduction in the number of publications. The two most prolific journals (Figure 1B), Obesity Surgery and Surgery for Obesity and Related Diseases publish articles, respectively, on the latest research and surgical and laparoscopic techniques for the treatment of massive obesity and metabolic disorders and techniques for the treatment of severe obesity. As shown in Figure 2, the

analysis of the trend in the publication of each of the ten most productive journals listed in Figure 1B reveals that some journals have had a growing interest in the field in the last few years, in particular, *Eating and Weight Disorders* and *Nutrients*. The journals *Nutrient* and *Eating and Weight Disorders* publish, respectively, on the fields of human nutrition, eating disorders, obesity, and the significant relations between them. As for *Obesity Surgery*, which has the highest volume of publications, there has been a reduction in the last two years, 2021–2022. According to the top 10 Italian institutions (Figure 3), the University of Sapienza in Rome is the most productive Italian organization, followed by the University of Milan and the University of Pisa. The ten most prolific Italian authors in the field of sleeve gastrectomy, mini-gastric bypass, and gastric bypass surgeries from 2012 to 2022 are shown in Figure 4. Although the number of published papers is not the only criterion that should be considered to assess scientific value, these scholars have consistently contributed to the research body of this field, and most of them work at institutions that are among the top ten. On the other hand, growing attention to the impact of COVID-19 on bariatric surgery has resulted in an elevated level of scholarly output by some authors during the pandemic period. For instance, Musella et al. have contributed a substantial number of manuscripts from 2020 to 2022, focusing on the investigation of this infection within the field of bariatric surgery. The cooperation analysis reveals that several authors from the same institution form collaboration workgroups (Figure 5). The ten most cited articles are listed in Table 1. The first ranked article was written by Mingrone et al. in 2012 [31]; in this paper titled "Bariatric surgery versus conventional medical therapy for type 2 diabetes" [31], the authors concluded that in morbidly obese people with type II diabetes mellitus, surgical treatment was more effective than medical treatment at controlling blood glucose levels. The author Angrisani contributes with his papers to several surveys to illustrate the evolution of bariatric surgery [32,34,35]. In their papers published in 2015 and 2016, Mingrone et al. and Rubino et al. supported the inclusion of metabolic surgery among anti-diabetes interventions for people with type 2 diabetes and obesity, demonstrating that surgery was superior to drugs for long-term glycemic control. Currently, in accordance with SICOB's guidelines [14,30], bariatric surgery is recommended for all patients with type II diabetes mellitus and a body mass index (BMI) of 30 or higher. However, it should be noted that neither sufficient nor robust studies exist to affirm the direct superiority of one intervention over another. In their study, Nannipieri et al. [16] concluded that gastric bypass and sleeve gastrectomy have comparable effects on diabetes remission. According to International Federation for the Surgery of Obesity (IFSO) surveys conducted as early as 2015 [32], sleeve gastrectomy was the most commonly performed operation.

One of the most intriguing components of a bibliometric analysis is data on developing topics. We can illustrate the most essential themes and predict potential future trends using keyword analysis. As previously stated, the examination revealed a transition towards the subsequent topics during the past two years (Figure 6): heart failure, pylorus stenosis, pandemic, adverse event, meta-analysis, and esophagitis.

*Heart failure* is an important topic because bariatric surgery can reduce the risk of major cardiovascular events and death in patients with cardiovascular disease and severe obesity. The surgical intervention exhibits the capacity to improve cardiovascular physiology through direct mechanical reduction in weight and other physiological pathways [36,37]. Bariatric surgery is a safe and highly effective intervention for individuals with obesity who are experiencing severe heart failure [38,39]. The surgical procedure leads to notable improvements in both cardiac function and symptoms [38,39]. A clinical study has demonstrated that bariatric surgery improves the cardiac function of individuals who are morbidly obese and suffer from severe cardiomyopathy [40]. In an independent study, bariatric surgery was found to be associated with a statistically significant decrease in the occurrence of major adverse cardiovascular events, all-cause mortality, cardiovascular mortality, coronary events, and hospitalizations resulting from heart failure [41].

The *stenosis of the pylorus* is an important emerging topic in the field of bariatric surgery due to its potential to occur as a postoperative complication [42]. Pyloric stenosis is a

medical condition characterized by the constriction of the pylorus, which is the aperture that connects the stomach to the small intestine [43]. This constriction results in the obstruction of food passage through the pylorus [43]. The gastric bypass surgical procedure has been associated with both short-term and long-term complications, one of which is the development of pyloric stenosis [42]. When diagnosing surgical emergencies in post-bariatric patients, acute care surgeons should take into account the possibility of pyloric stenosis as a potential cause of symptoms [44].

As far as the term *pandemic*, the COVID-19 pandemic has significantly impacted healthcare services, including metabolic and bariatric surgery, making it a crucial topic in the field of bariatric surgery. The IFSO released guidelines in April 2020, suggesting that healthcare providers delay bariatric surgery procedures during the pandemic period [45]. The pandemic has had an impact on the dietary patterns of individuals who have undergone bariatric surgery, as evidenced by a correlation between heightened intake of energy-dense foods during periods of confinement and a greater likelihood of failing to reduce body mass index by at least.

*Adverse events* are an important theme for bariatric surgery because the surgery is associated with risks and complications [46,47]. Complications following bariatric surgery may encompass hemorrhage, infection, untoward responses to anesthesia, thromboembolic events, respiratory distress, and gastrointestinal anastomotic leaks. Identifying risk factors for adverse events after bariatric surgery can help define high-risk groups to improve patient safety [47,48]. A study of adolescents with severe obesity found that adverse events after sleeve gastrectomy, were relatively common, with 21.5% of patients experiencing at least one adverse event within 30 days of surgery [49]. However, bariatric surgery has also been associated with a significantly lower incidence of major adverse cardiovascular events, all-cause mortality, cardiovascular mortality, coronary events, and heart failure hospitalizations in patients with severe obesity and cardiovascular disease [39–41,50,51]. Therefore, while adverse events are an important consideration in bariatric surgery, the surgery can also have significant benefits for certain patient populations.

The utilization of *meta-analysis* is a crucial aspect in the field of bariatric surgery as it enables a thorough and methodical evaluation of the existing data pertaining to the efficacy of various surgical interventions [52]. The utilization of meta-analyses can aid in the determination of the optimal interventions for weight reduction and the amelioration of obesity-associated comorbidities, including hyperlipidemia, hypercholesterolemia, and hypertriglyceridemia [53]. Bariatric surgery's long-term effects on all-cause and cardiovascular mortality can be assessed with their assistance [39–41,50,51]. Furthermore, meta-analytical studies can examine the potential impact of bariatric surgery on mitigating the likelihood of contracting various medical ailments, including colorectal cancer [52]. In general, meta-analysis serves as a crucial instrument for amalgamating and comprehending the existing data regarding the efficacy of bariatric surgery [54,55].

As far as the topic *esophagitis*, it is a significant one due to its potential to arise as a postoperative complication [56]. The sleeve gastrectomy has been found to have a positive correlation with the incidence of esophagitis after bariatric surgery [57,58]. Esophageal dysfunction is a common complication that arises after bariatric surgery, and the presence of gastroesophageal reflux disease (GERD) is a known risk factor for the development of esophagitis [59,60]. Theoretically, bariatric surgery should lead to a decrease in GERD by promoting lasting weight loss [59,60]. However, research has shown inconsistent outcomes regarding the effect of bariatric surgery on GERD. Thus, it is crucial to obtain medical intervention for esophagitis after bariatric surgery to avert complications and irreversible injury [61].

In our study, an analysis was conducted on Google search traffic data to examine the yearly patterns and distribution of public interest and awareness concerning sleeve gastrectomy, mini-gastric bypass, and gastric bypass surgeries in Italy. The yearly pattern of RSV demonstrated a general upward trend, punctuated by small variations, and a decrease in RSV between the years 2019 and 2020 (Figure 7). Through our observations of

various search terms, it has been determined that those related to the Italian term "sleeve gastrectomy" exhibit a notable increase in RSV value. This is subsequently followed by the Italian terms "mini-gastric bypass" and "gastric bypass".

The global prevalence of bariatric surgery has experienced significant growth over the past ten years [14,62,63]. Based on the data presented in Figure 8, it can be observed that there has been a notable rise in the frequency of sleeve gastrectomy surgical interventions within the Italian context. Additionally, both gastric micro bypass and gastric bypass surgeries have experienced an increase, although to a lesser extent. The increasing prevalence of public interest in bariatric surgery, along with the corresponding rise in the number of procedures conducted, can be attributed to heightened public awareness of this medical condition and an improved comprehension of bariatric/metabolic surgery [64]. The prevalence of obesity is also increasing [65]. The prevalence of this phenomenon in Europe has experienced a notable increase of approximately 30% over the past decade [66], with projections indicating a further rise to 42% by the year 2030 [67].

Based on the comparative graphs in Figure 9B, it was observed that there was a decline in the volume of bariatric procedures performed during the year 2020. Additionally, there was a notable decline in public interest regarding bariatric surgery, a trend that persisted throughout the years 2019 and 2020 (Figure 9A). During the initial phase of the COVID-19 pandemic, in line with the policy statement issued by IFSO, priority was given to emergency surgeries while elective procedures were deferred [68]. On the other hand, there was a complete concentration of public attention on COVID-19 and its associated symptoms. In the year 2022, there was a return to the trend observed in 2019, accompanied by a marginal rise in the utilization of sleeve gastrectomy (Figure 9B), and the data on RSV is on the rise (Figure 9A). There is an expectation that bariatric surgical procedures conducted within Italy will increase in the coming years, mirroring the evolution of public interest.

## 4. Materials and Methods

### *4.1. Bibliometric Data*

We performed a comprehensive literature search using the electronic Scopus database [69,70]. Scopus uniquely combines a comprehensive, expertly curated abstract and citation database with enriched data and linked scholarly literature across a wide variety of disciplines [69,70]. We used the appropriate keywords to identify relevant Italian literature from 2012 to 2022. To prevent bias caused by continuous database modifications, the extraction and export of documents should be completed within one day. The date of the retrieval was 17 April 2023. The research string used was the following query: (TITLE-ABS-KEY ("sleeve gastrectomy" OR "mini-gastric bypass" OR "mini gastric bypass" OR "gastric bypass" OR "one anastomosis gastric bypass" OR "roux-en-Y gastric bypass") AND (LIMIT-TO (PUBYEAR, 2012) OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2022)) AND (LIMIT-TO (DOCTYPE, "ar") OR LIMIT-TO (DOCTYPE, "re")) AND (LIMIT-TO (AFFILCOUNTRY, "Italy")) AND (LIMIT-TO (PUBSTAGE, "final"))). Data mining was performed on the title, abstract and keywords. By thoroughly examining the retrieved publications, we verified the efficacy of our search strategy. Bibliometric analyses were performed using Scopus integrated analysis tools and Bibliometrix and Biblioshiny tools [71]. Bibliometrix is an R package containing a series of functions for scientometric quantitative research [71]. The Bibliometrix R package was installed and subsequently loaded into R Studio (vs. 022.12.0 + 353). The Biblioshiny application was initiated by executing the command Biblioshiny in the R console [71]. Biblioshiny is a web-based software tool that facilitates the utilization of the Bibliometrix package of the R programming language [71]. The bibliographic data set was obtained in "CSV" format from the Scopus database and uploaded to the Biblioshiny interface.

### *4.2. Google Trends Data and Bariatric Surgical Procedure Data*

Data from Google Trends (https://www.google.com/trends, accessed on 17 April 2023) is expressed as relative search volume (RSV). The RSV is presented on a standardized scale from 0 (no search interest) to 100 (greatest search interest). We search RSV for the Italian terms for "sleeve gastrectomy", "mini-gastric bypass" and "gastric bypass" which are respectively, "gastrectomia verticale parziale", "minibypass gastrico", and "bypass gastrico". The search was limited to the period from 1 January 2012, to 31 December 2022. Data related to the public interest was downloaded in "CSV" format from the Google Trends website [72]. Since the data fluctuates over time, we have processed the data, which is shown as an annual average of the monthly values of RSV. Our analysis used the country option to determine the Italian geographical distribution of RSV for each searched term.

We extrapolate SICOB data for sleeve gastrectomy, mini-gastric bypass, and gastric bypass surgical procedures performed in Italy from 2012 to 2022 from the recent SICOB annual survey [30]. The annual report survey is carried out every year by SICOB for the monitoring of bariatric surgery activity carried out on the national territory. All Italian surgical groups can participate in the survey by accessing the SICOB national register [30].

## 5. Conclusions

The role of bariatric surgery in the management of obesity and/or metabolic disease has become a hot topic in recent years. Over the past decade, there has been a significant increase in studies in this field in Italy as well as in the rest of the world [14,62,63]. Furthermore, during the last ten years, bariatric surgery procedures have increased quickly in Italy, and our findings on Google Trends show an increase in the Italian public interest, expressed as RSV, in obesity and its surgical treatment from 2012 to 2022. As previously aforementioned, an interesting discovery pertains to the correlation between the RSV and the frequency of bariatric surgeries from 2012 to 2022. The value of RSV observed in sleeve gastrectomy is in agreement with the surgical intervention data documented in Italy during the same period. The above assertion applies to data pertaining to both mini-gastric bypass and gastric bypass procedures. The examination of the Google Trends information combined with the SICOB data demonstrated a remarkable association between the two data sets, therefore it is possible to estimate the demand for bariatric surgical procedures using Google Trends.

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