Original Article

Effect of Bariatric Surgery on Gut Microbiota: A Scientometric Analysis

Miguel Cabanillas-Lazo[1,2], Carlos Quispe-Vicuña[1,2], Milagros Pascual-Guevara[2,3], Maria Eugenia Guerrero[4], John Barja-Ore[5], Fran Espinoza-Carhuancho[6], Frank Mayta-Tovalino[6]

[1]Grupo Peruano de Investigación Epidemiológica, Unidad Para la Generación y Síntesis de Evidencias en Salud, Universidad San Ignacio de Loyola, [2]Sociedad Científica de San Fernando, [3]Facultad de Medicina, Universidad Nacional Mayor de San Marcos, [4]Department of Medical Surgical, Universidad Nacional Mayor de San Marcos, [5]Academic Department, Universidad Privada del Norte, [6]Grupo de Bibliometría, Evaluación de evidencia y Revisiones Sistemáticas (BEERS), Human Medicine Career, Universidad Cientifica del Sur, Lima, Peru

Abstract

Objective: To perform a bibliometric analysis of the scientific production related to intestinal microbiota and bariatric surgery between January 2016 and December 2022.

Materials and Methods: A bibliographic search was performed in the Scopus database to identify published papers. Free and controlled terms (MeSH and Emtree) were used. The information collected was analyzed with SciVal.

Results: A total of 518 published papers were included in the analysis. Carel Le Roux was the author with the highest scientific production; however, Edi Prifti had the highest impact. French National Institute of Health and Medical Research (*Institut national de la santé et de la recherche médicale*) was the institution with the highest number of published articles. Six of the 10 institutions with the highest production were in France, yet the United States had the highest volume of scientific production in this research topic. Most papers were published in first quartile journals. Articles with international collaboration had the highest impact. There is a sustained increase in the number of publications since 2019.

Conclusions: The study found that the vast majority of research on gut microbiota changes following bariatric surgery are conducted in the United States and European countries. In addition, the sustained increase in production coupled with the articles being published in high-quality journals and having good citation impact are indictors of the current interest in this research field.

Keywords: Bariatric surgery, bibliometric analysis, gastrointestinal microbiome, probiotics, trends

Address for correspondence: Dr. Frank Mayta-Tovalino, Av. Paseo de la República 5544, Miraflores 15074, Lima, Peru.
E-mail: fmaytat@cientifica.edu.pe

Submitted: 01-Apr-2023 **Revised:** 21-Jul-2023 **Accepted:** 08-Oct-2023 **Published:** 15-Jan-2024

INTRODUCTION

The World Health Organization has declared obesity a global epidemic. Obesity results in costly treatments and comorbidities such as arterial hypertension, neoplasms, and diabetes mellitus.[1] In addition, it has been reported that 75% of morbidly obese people have altered intestinal microbiota with a predominance of Firmicutes/Bacteroidetes, which contributes to increased inflammation

Access this article online	
Quick Response Code:	Website: https://journals.lww.com/sjmm
	DOI: 10.4103/sjmms.sjmms_146_23

How to cite this article: Cabanillas-Lazo M, Quispe-Vicuña C, Pascual-Guevara M, Guerrero ME, Barja-Ore J, Espinoza-Carhuancho F, *et al*. Effect of bariatric surgery on gut microbiota: A scientometric analysis. Saudi J Med Med Sci 2024;12:65-70.

and body mass index.[2] Although lifestyle change is usually the initial measure, it requires adherence and its effects are observed over longer term, and thus it may not dramatically reduce the risk of cardiometabolic complications in the earlier stages.[3] Bariatric surgery represents one of the most effective and long-lasting options for a rapid weight reduction. In bariatric surgery, gastric bypass is the gold standard technique, but gastric sleeve is the most used technique.[4]

Modifications in the gastrointestinal anatomy may also modify the gut microbiota, especially in the first 1–3 months.[5] Administration of probiotics may help in enhancing the gut flora, and thus reduce inflammation,[6] enhance digestion of complex nutrients, synthesis of vitamins, and increase of defenses.[2]

In this sense, it is important to understand the progress made regarding this association. Bibliometric studies are useful for such purposes, as they provide information on scientific activity at the level of countries, regions or institutions and facilitate comparisons of scientific productivity,[7] the degree of collaboration with repercussions on the impact of the publications, and the evolution of the quality and quantity of the disseminating sources through their indicators.[8] In the literature, bibliometric studies have been published regarding the trends of bariatric surgery publications during the period 2010–2014[9] and 1980-2016.[10] However, to the best of the authors' knowledge, no bibliometric study is available regarding the effect of bariatric surgery on the gut microbiota, and thus the current study was conducted to fill this gap in the literature.

MATERIALS AND METHODS

Study design and database

For this bibliometric study, the Scopus database (available at: https://www.scopus.com/) was chosen because of its wider coverage of journals worldwide, better citation analysis compared with other databases,[11] and presence of features that allow retrieval of data and its analysis relevant for the current study.

Search strategy

Initially, two authors independently tested their search strategies. Then, by consensus, a single strategy was obtained. The TITLE and ABS field restrictions were used for terms located in the title or abstract. In addition, the AUTHKEY constraint was added, which collects documents with keywords assigned by the authors. Free and controlled terms (MeSH [PubMed] and Emtree [Embase] related to bariatric surgery and its types [roux Y gastric bypass, gastric bypass, gastric banding, etc.] and gut microbiota [microbiome, probiotics, prebiotics, synbiotics, etc.]) were used. In addition, the wildcard "*" was used to identify phrases with zero or more characters added to the root phrase. The Boolean operators "OR" and "AND" were used to combine the strategies [Supplementary Material 1].

The chosen study period was January 2016 to December 2022. The rationale for evaluating this period is that it represents a time of rapid advancements and changes in the field of gut microbiota and bariatric surgery research. By evaluating this specific period, scientists can gain a deeper understanding of the trends, collaboration, and impact of scientific publications in this rapidly developing field.

Data analysis

The publications corresponding to the selected study period were downloaded and exported via .xls file. The information of each publication was analyzed with the SciVal tool (available at: https://www.scival.com/). Documents not identified by SciVal were excluded from the analysis. The following variables were analyzed: the number of documents, institutions, and countries; research collaboration; and citations per document. Finally, this information was synthesized and presented in figures and summary tables.

RESULTS

A total of 595 documents were identified, 47 were excluded because they could not be exported to SciVal due to an incompatibility of the available metadata record. Finally, 552 articles related to the effect of bariatric surgery on gut microbiota were analyzed. In terms of authorship, most articles were published in this research area by Carel Le Roux (n = 16), Karine Clément (13), and Max Nieuwdorp (9); however, Edi Prifti was the author with the highest impact (36.7 citations per paper) [Table 1].

The 10 institutions with the highest number of publications are summarized in Table 2. French National Institute of Health and Medical Research was the institution with the highest scientific output (33 papers), while the University of Gothenburg had the highest impact (39.9 citations per paper). The Centre National de la Recherche Scientifique was the second most productive institution with 20 papers. Six of the top 10 institutions were from France.

The journal *Obesity Surgery* had the highest number of publications (49 papers), while *Obesity Reviews* was the journal with the highest number of citations per paper. The second and third journals with the highest production

were *Surgery for Obesity and Related Diseases* and *Nutrients* with 35 and 18 papers, respectively [Table 3].

According to CiteScore, Table 3 shows the number of documents according to the quartile of the journal. An increase in publications was observed from 2019 onward. The number of papers published in the first quartile far exceeded those in the other quartiles [Figure 1].

Figure 2 shows the type of collaboration and its bibliometric indicators. Most of the retrieved papers only had national collaboration (204 papers; 39.5%), followed by only institutional collaboration (149 papers; 28.9%), and international collaboration (127 papers; 24.6%). However, in terms of impact, articles with international collaboration (25.4 citations per document) outperformed those with national (16.3 citations per document) and institutional (14.9 citations per document) collaborations. The remaining papers belong to the "single-authored" or "non-collaborative" category (36 papers: 7.0%).

Figure 3 describes the countries with the highest productivity on gut microbiota in bariatric surgery. The United States (147 papers; 3420 citations), China (60 papers; 1445 citations) and France (48 papers; 666 citations) were countries that led the production ranking.

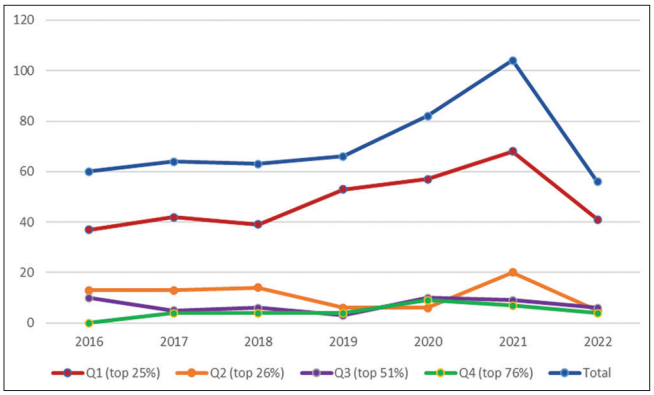

Figure 1: Documents published on gut microbiota and bariatric surgery according CiteScore quartile

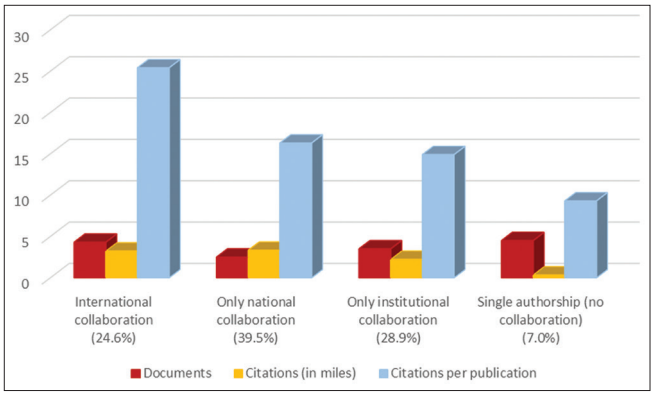

Figure 2: Production and impact of the published articles according to type of collaboration

Table 1: Top 10 authors publishing on gut microbiota and bariatric surgery

Rank	Author	Documents, *n* (%)	Total citation	Citations per document	h-Index	FWCI	Country
1	Le Roux, Carel W	16 (1.3)	294	18.4	62	1.4	Ireland
2	Clement, Karine	13 (1.1)	340	26.2	99	2.7	France
3	Nieuwdorp, Max	9 (0.8)	180	20.0	58	2.1	The Netherlands
4	Moreno-Indias, Isabel	9 (0.8)	142	15.8	23	1.7	Spain
5	Seyfried, Florian Johannes David	8 (0.7)	86	10.8	18	1.4	Germany
6	Aron-Wisnewsky, Judith	8 (0.7)	275	34.4	34	3.9	France
7	Gutiérrez-Repiso, Carolina	8 (0.7)	69	8.6	21	1.5	Spain
8	Prifti, Edi	7 (0.6)	257	36.7	22	4.4	France
9	Raoult, Didier A	7 (0.6)	39	5.6	159	0.4	France
10	Tinahones, Francisco José	7 (0.6)	51	7.3	19	1.6	Spain

FWCI – Field-weighted citation impact

Table 2: Top ten productive institutions on gut microbiota and bariatric surgery

Rank	Institution	Country	Documents, *n* (%)	Total citation	Authors	Citations per document	FWCI
1	INSERM	France	33 (2.3)	464	82	14.1	1.6
2	CNRS	France	20 (1.4)	365	50	18.3	2.2
3	Imperial College London	The United Kingdom	20 (1.4)	345	64	17.3	1.7
4	INRAE	France	17 (1.2)	321	17	18.9	2.0
5	Sorbonne Université	France	16 (1.1)	356	36	22.3	2.7
6	Institu de Recherche Pour le développement	France	16 (1.1)	310	20	19.4	2.1
7	University College Dublin	Ireland	16 (1.1)	294	8	18.4	1.4
8	Assitance Publique – Hôpitaux de Paris	France	15 (1.0)	353	28	23.5	2.7
9	University of Gothenburg	Sweden	15 (1.0)	598	22	39.9	2.2
10	Instituto de Salud Carlos III	Spain	14 (1.0)	92	32	6.6	1.1

FWCI – Field-weighted citation impact; INSERM – Institu National de la Santé et de la Recherche Médicale; CNRS – Centre national de la recherche scientifique

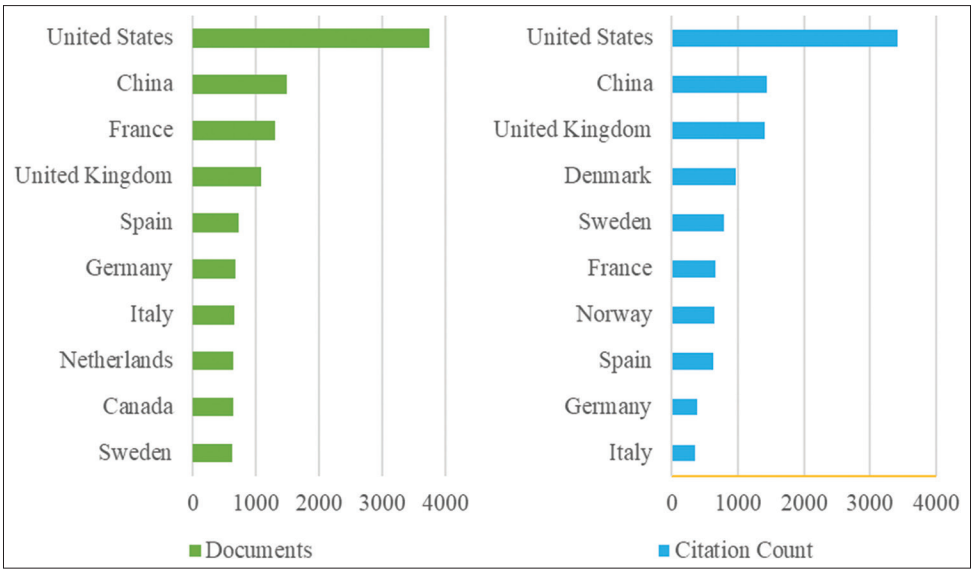

Figure 3: Top 10 productive countries on gut microbiota and bariatric surgery

Table 3: Bibliometric indicators of production and impact on journals on gut microbiota and bariatric surgery

Rank	Journals	Documents, *n* (%)	Citations	Authors	Citations per document	Cite score 2020	SJR
1	*Obesity Surgery*	49 (14.0)	699	320	14.3	5.3	1.5
2	*Surgery for Obesity and Related Diseases*	35 (10.0)	383	203	10.9	6.1	1.7
3	*Nutrients*	18 (5.2)	197	144	10.9	6.4	1.4
4	*Scientific Reports*	8 (2.3)	39	73	4.9	7.1	1.2
5	*International Journal of Obesity*	7 (2.0)	229	77	32.7	7.9	1.7
6	*Obesity Reviews*	6 (1.7)	206	40	34.3	13.7	2.8
7	*Gut Microbes*	6 (1.7)	10	65	1.7	8.9	3.3
8	*Molecular Metabolism*	6 (1.7)	34	79	5.7	10.7	2.8
9	*Frontiers in Endocrinology*	6 (1.7)	89	27	14.8	5.1	1.5
10	*New Microbes and New Infections*	6 (1.7)	39	16	6.5	3	0.6

SJR – Scimago Journal Rank

DISCUSSION

Bibliometric studies make it possible to collect, describe, and analyze publications in specialized scientific fields and even newly developed areas.[12] These analyses allow institutions and policymakers to identify trends and gaps in research that can help formulate research priorities for a region.[13]

Carel Le Roux was the author with the largest scientific output. His most recent publication was a narrative review on the mechanism of weight loss after obesity surgery, where he discussed various interventions such as the release of intestinal peptides and changes in microbiota and bile acids that may explain the efficacy of this surgery.[14] Furthermore, in a bibliometric analysis, this author was the most productive in the field of gastric bypass.[15] Edi Prifti was the author with the greatest impact. His most cited article was a study where he described the dysbiosis associated with severe obesity and the impact of two types of bariatric surgery on the microbiota. The authors concluded that the main alterations of the microbiota include a decrease in intestinal microbial genes and altered functional pathways, and that the two types of bariatric surgery did not completely rescue the microbial ecosystem, and thus additional strategies are needed to have a significant improvement.[16]

INSERM was the institution with the highest output, while the University of Gothenburg had the highest impact. As reported in other bibliometric analyses, INSERM was also among the institutions with the highest output in gut microbiota and Parkinson's disease and diabetes.[17,18] Collectively, this indicates that INSERM is at the forefront of microbiome-related research worldwide.

Obesity Surgery was the journal that published the highest number of papers related to microbiota and bariatric surgery; however, *Obesity Reviews* had the highest impact. The latter journal is also among the most productive in a recent bibliometric analysis on microbiota and type 2 diabetes.[19] Regarding the quartile of the journals, the vast majority of publications are in the first quartile. In addition,

there is a sustained increase in the number of publications since 2019, suggesting that the topic related to microbiota and bariatric surgery has received increased interest.

Regarding collaboration, publications with authors from a single country had a higher number of publications; however, those articles with international collaboration had a higher impact.[18,20] This result had a similar distribution in other bibliometric analyses. Therefore, in the future, research in collaboration with recognized authors from different countries is likely to have a greater impact.

The production by country was led by the United States, which had double the production of the second placed country, China. This finding is in agreement with other bibliometric studies on the role of gut microbiota and depression, inflammatory bowel disease, and obesity.[21-23] Although the majority of the top 10 institutions were French, the overall production from the country placed it in third place. This could be due to the large international collaboration of American authors with foreign institutions and researchers.[24] Similar to our results, other studies have shown that while Latin American scientific production on bariatric surgery has increased in recent years, there is yet a need for greater participation and collaboration in the region.[25-27]

Limitations

Our study has some limitations that should be considered. First, the period of document collection was from 2016 to 2022, so the totality of publications was not analyzed. Despite this, this study period comprised about 80% of the total production. Second, the database used for our analysis was Scopus, so documents published in other databases were not included. However, Scopus offers a better bibliometric analysis than other data sources. Finally, we did not exclude editorials, letters, and notes; therefore, although these publications are eligible for inclusion in the analysis, they would not provide significant contribution.

CONCLUSIONS

This study found that overall, articles related to bariatric surgery and intestinal microbiota are majorly published by authors affiliated to American institutions, despite individual French institutions leading the world scientific production on this topic. In addition, the vast majority of publications are published in the first quartile, indicating substantial interest in this subject. International collaboration had a greater impact and should be considered in future research.

Ethical considerations

This scientometric study has no ethical implications because it uses data openly available in the Scopus database.

Peer review

This article was peer-reviewed by two independent and anonymous reviewers.

Data availability statement

The data that support the findings of this study are openly available in Scopus at https://www.scopus.com/.

Author contributions

Conceptualization: M.C-L, C.Q-V, and M.P-G; Methodology: J.B-O, F.M-T, M.E-G, and F.E.C.; Data analysis: J.B-O and F.M-T; Writing–original draft preparation: M.C-L and C.Q-V; Writing – review and editing: J.B-O, F.M-T, and M.E-G.

All authors have read and agreed to the published version of the manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Drapkina OM, Kim OT, Dadaeva VA. A history of obesity: From a fertility symbol to a global public health problem. Profilakticheskaya Meditsina 2021;24:98-103.
2. Swierz MJ, Storman D, Staskiewicz W, Gorecka M, Jasinska KW, Swierz AM, *et al*. Efficacy of probiotics in patients with morbid obesity undergoing bariatric surgery: A systematic review and meta-analysis. Surg Obes Relat Dis 2020;16:2105-16.
3. Santos HO, Lavie CJ. Weight loss and its influence on high-density lipoprotein cholesterol (HDL-C) concentrations: A noble clinical hesitation. Clin Nutr ESPEN 2021;42:90-2.
4. Lee Y, Doumouras AG, Yu J, Aditya I, Gmora S, Anvari M, *et al*. Laparoscopic sleeve gastrectomy versus laparoscopic Roux-en-Y gastric bypass: A systematic review and meta-analysis of weight loss, comorbidities, and biochemical outcomes from randomized controlled trials. Ann Surg 2021;273:66-74.
5. Ilhan ZE, DiBaise JK, Dautel SE, Isern NG, Kim YM, Hoyt DW, *et al*. Temporospatial shifts in the human gut microbiome and metabolome after gastric bypass surgery. NPJ Biofilms Microbiomes. 2020;6:12.
6. Meldrum DR, Morris MA, Gambone JC. Obesity pandemic: Causes, consequences, and solutions-but do we have the will? Fertil Steril 2017;107:833-9.
7. Gauthier É. Bibliometric Analysis of Scientific and Technological Research: A User×s Guide to the Methodology. Science and Technology Redesign Project Statistics, Ottawa, Ontario, Canada: Observatoire des Sciences et des Technologies (CIRST); 1998.
8. González de Dios J, Moya M, Mateos Hernández MA. Bibliometric indicators: Characteristics and limitations of the analysis of scientific activity. An Esp Pediatr 1997;47:235-44.

9. Dabi Y, Darrigues L, Katsahian S, Azoulay D, De Antonio M, Lazzati A. Publication trends in bariatric surgery: A bibliometric study. Obes Surg 2016;26:2691-9.
10. Ozsoy Z, Demir E. The evolution of bariatric surgery publications and global productivity: A bibliometric analysis. Obes Surg 2018;28:1117-29.
11. Falagas ME, Pitsouni EI, Malietzis GA, Pappas G. Comparison of Pubmed, Scopus, web of science, and Google scholar: Strengths and weaknesses. FASEB J 2008;22:338-42.
12. Donthu N, Kumar S, Mukherjee D, Pandey N, Lim WM. How to conduct a bibliometric analysis: An overview and guidelines. J Bus Res 2021;133:285-96.
13. de Oliveira OJ, da Silva FF, Juliani F, Barbosa LC, Nunhes TV. Bibliometric method for mapping the state-of-the-art and identifying research gaps and trends in literature: An essential instrument to support the development of scientific projects. In: Kunosic S and Zerem E, eds. Scientometrics Recent Advances. London, UK: IntechOpen; 2019.
14. Akalestou E, Miras AD, Rutter GA, le Roux CW. Mechanisms of weight loss after obesity surgery. Endocr Rev 2022;43:19-34.
15. Ozsoy Z, Demir E. Which bariatric procedure is the most popular in the world? A bibliometric comparison. Obes Surg 2018;28:2339-52.
16. Aron-Wisnewsky J, Prifti E, Belda E, Ichou F, Kayser BD, Dao MC, *et al*. Major microbiota dysbiosis in severe obesity: Fate after bariatric surgery. Gut 2019;68:70-82.
17. Tian J, Li M, Lian F, Tong X. The hundred most-cited publications in microbiota of diabetes research: A bibliometric analysis. Medicine (Baltimore) 2017;96:e7338.
18. Cabanillas-Lazo M, Quispe-Vicuña C, Barja-Ore J, Fernandez-Giusti A, Munive-Degregori A, Retamozo-Siancas Y, *et al*. A 10-year bibliometric analysis of global research on gut microbiota and Parkinson's disease: Characteristics, impact, and trends. Biomed Res Int 2022;2022:4144781.
19. Dehghanbanadaki H, Aazami H, Ejtahed HS, Sohrabi A, Raftar SK, Tarashi S, *et al*. The global scientific publications on gut microbiota in type 2 diabetes; a bibliometric, Scientometric, and descriptive analysis. J Diabetes Metab Disord 2022;21:13-32.
20. Tantengco OA. Investigating the evolution of COVID-19 research trends and collaborations in Southeast Asia: A bibliometric analysis. Diabetes Metab Syndr 2021;15:102325.
21. Zhu X, Hu J, Deng S, Tan Y, Qiu C, Zhang M, *et al*. Bibliometric and visual analysis of research on the links between the gut microbiota and depression from 1999 to 2019. Front Psychiatry 2020;11:587670.
22. Xu P, Lv T, Dong S, Cui Z, Luo X, Jia B, *et al*. Association between intestinal microbiome and inflammatory bowel disease: Insights from bibliometric analysis. Comput Struct Biotechnol J 2022;20:1716-25.
23. Yao H, Wan JY, Wang CZ, Li L, Wang J, Li Y, *et al*. Bibliometric analysis of research on the role of intestinal microbiota in obesity. PeerJ 2018;6:e5091.
24. Tracking the collaborative networks of five leading science nations. Nature 2022;603:S10-1.
25. Toro-Huamanchumo CJ, Morán-Mariños C, Salazar-Alarcon JL, Barros-Sevillano S, Huamanchumo-Suyon ME, Salinas-Sedo G. Latin American research on bariatric surgery: A bibliometric study. Obes Surg 2021;31:1869-76.
26. Paolino L, Pravettoni R, Epaud S, Ortala M, Lazzati A. Comparison of surgical activity and scientific publications in bariatric surgery: An epidemiological and bibliometric analysis. Obes Surg 2020;30:3822-30.
27. Song Y, Ni Z, Li Y, Li Z, Zhang J, Guo D, *et al*. Exploring the landscape, hot topics, and trends of bariatric metabolic surgery with machine learning and bibliometric analysis. Ther Adv Gastrointest Endosc 2022;15:26317745221111944.

Supplementary Material 1: Search strategy

(TITLE-ABS(“Bariatric Surg*” OR “Metabolic Surg*” OR “Stomach Stapl*” OR “bariatric operat*” OR “bariatric proced*” OR “obesity operat*” OR “obesity surg*” OR “weight loss operat*” OR “weight loss surg*” OR “weight reduction operat*” OR “weight reduction surg*” OR “Gastric Bypass*” OR “Gastrojejunostom*” OR “Roux-en-Y” OR “Roux en Y” OR “Gastroileal Bypass*” OR “stomach bypass*” OR Gastroplast* OR “Jejunoileal Bypass*” OR “Jejuno-Ileal Bypass*” OR “Jejuno Ileal Bypass*” OR “Ileojejunal Bypass*” OR “Intestinal Bypass*” OR “biliopancreatic bypass*” OR “biliopancreatic divers*” OR “duodenal switch*” OR “pancreatobiliary bypass*” OR “gastric band*” OR “stomach band*” OR “sleeve gastrectomy*” OR “sleeve surger*” OR “gastric sleeve surger*” OR “gastric sleeve gastrectomy*” OR “laparoscopic adjustable silicone banding*”) OR AUTHKEY(“Bariatric Surg*” OR “Metabolic Surg*” OR “Stomach Stapl*” OR “bariatric operat*” OR “bariatric proced*” OR “obesity operat*” OR “obesity surg*” OR “weight loss operat*” OR “weight loss surg*” OR “weight reduction operat*” OR “weight reduction surg*” OR “Gastric Bypass*” OR “Gastrojejunostom*” OR “Roux-en-Y” OR “Roux en Y” OR “Gastroileal Bypass*” OR “stomach bypass*” OR Gastroplast* OR “Jejunoileal Bypass*” OR “Jejuno-Ileal Bypass*” OR “Jejuno Ileal Bypass*” OR “Ileojejunal Bypass*” OR “Intestinal Bypass*” OR “biliopancreatic bypass*” OR “biliopancreatic divers*” OR “duodenal switch*” OR “pancreatobiliary bypass*” OR “gastric band*” OR “stomach band*” OR “sleeve gastrectomy*” OR “sleeve surger*” OR “gastric sleeve surger*” OR “gastric sleeve gastrectomy*” OR “laparoscopic adjustable silicone banding*”)) AND (TITLE-ABS(“lactobacill*” OR “bifidobacter*” OR “saccharom*” OR “probiot*” OR “Prebiot*” OR “Dietary Fiber*” OR “Wheat Bran*” OR “Roughage*” OR “Dietary Carbohydrate*” OR “Synbiot*” OR “dysbios*” OR “gut intestine* flora” OR “microbiot*” OR “microbiom*” OR “microflora” OR “flora” OR “gut microflora” OR “brain-gut axis*” OR “brain and gut axis*” OR “brain-gut-microbio*” OR “gut and brain axis*” OR “gut-brain axis*” OR “gut-brain-microbio*” OR “microbiome-brain-gut*” OR “microbiome-gut-brain*” OR “microbiota gut-and-brain*” OR “microbiota-brain-gut*” OR “microbiota-gut-brain*”) OR AUTHKEY(“lactobacill*” OR “bifidobacter*” OR “saccharom*” OR “probiot*” OR “Prebiot*” OR “Dietary Fiber*” OR “Wheat Bran*” OR “Roughage*” OR “Dietary Carbohydrate*” OR “Synbiot*” OR “dysbios*” OR “gut intestine* flora” OR “microbiot*” OR “microbiom*” OR “microflora” OR “flora” OR “gut microflora” OR “brain-gut axis*” OR “brain and gut axis*” OR “brain-gut-microbio*” OR “gut and brain axis*” OR “gut-brain axis*” OR “gut-brain-microbio*” OR “microbiome-brain-gut*” OR “microbiome-gut-brain*” OR “microbiota gut-and-brain*” OR “microbiota-brain-gut*” OR “microbiota-gut-brain*”))