

MESTRADO INTEGRADO EM MEDICINA

Definition and Predictors of Insufficient Weight Loss After Metabolic Bariatric Surgery: a Systematic Review and Meta-Analysis

Mariana Lopes Constante

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Metabolic Bariatric Surgery: a Systematic Review and Meta-
Analysis

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Doutor Filipe Amorim Cruz

E sob Coorientação de:
Professor Doutor Bernardo Sousa Pinto
Doutor Hugo Santos Sousa

Trabalho organizado de acordo com as normas da revista:
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Eu, Mariana Lopes Constante, abaixo-assinado, nº mecanográfico 200906927, estudante do 6º ano do Ciclo de Estudos Integrado em Medicina, na Faculdade de Medicina da Universidade do Porto, declaro ter atuado com absoluta integridade na elaboração do meu trabalho de Dissertação ou Monografia.

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Cirurgia

TÍTULO DISSERTAÇÃO/MONOGRAFIA (riscar o que não interessa)

Definition and Predictors of Insufficient Weight Loss After Metabolic Bariatric Surgery: a Systematic Review and Meta-Analysis

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É AUTORIZADA A REPRODUÇÃO INTEGRAL DESTA TRABALHO APENAS PARA EFEITOS DE INVESTIGAÇÃO, MEDIANTE DECLARAÇÃO ESCRITA DO INTERESSADO, QUE A TAL SE COMPROMETE.	☐
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Faculdade de Medicina da Universidade do Porto, 20/06/2025

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Eu, Mariana Lopes Constante, abaixo assinado, nº mecanográfico 200906927, estudante do 6º ano do Ciclo de Estudos Integrado em Medicina, na Faculdade de Medicina da Universidade do Porto, declaro que:

- ☒ Não procedi à utilização de ferramentas de *chatbox* generativo baseadas em *large language models* para nenhuma das tarefas no contexto do meu trabalho de Dissertação ou Monografia
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Neste sentido, confirmo que a eventual utilização de ferramentas de *chatbox* generativo baseadas em *large language models* no contexto do meu trabalho de Dissertação ou Monografia foi exclusivamente descrita na sequência de *prompts* e respostas transcritos em anexo e nas aplicações indicadas.

Faculdade de Medicina da Universidade do Porto, 20/06/2025

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Mariana Lopes Constante

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Definition and Predictors of Insufficient Weight Loss After Metabolic Bariatric Surgery: a Systematic Review and Meta-Analysis

Shortened title: Predictors of Insufficient Weight Loss after Bariatric Surgery

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Abstract

Background: Metabolic and bariatric surgery (MBS) is the most effective long-term treatment for severe obesity and related health issues. Despite its efficacy, a significant proportion of patients experience insufficient weight loss (IWL), a clinical challenge affecting surgical success and comorbidity resolution. IWL definitions vary widely, ranging from less than 50% excess weight loss (%EWL) to less than 20% total weight loss (%TWL), which limits comparability between studies and the development of robust predictive models. This study aims to systematically define IWL and identify important predictors to enhance patient counseling.

Methods: We conducted a systematic review and meta-analysis following PRISMA guidelines. We searched PubMed, Scopus, and Web of Science and primary studies reporting IWL after primary MBS were included. Meta-analyses of pre-, intra-, and postoperative factors were performed using random-effects models. Heterogeneity was evaluated with the I^2 statistic and Cochran's Q test.

Results: The analysis included 65 studies with 26,804 patients. IWL prevalence was 27% (95% CI: 23–33%) when using %EWL<50 and 20% (95% CI: 12–32%) with %TWL<20. Despite differences, several preoperative factors—such as type 2 diabetes, hypertension, and baseline BMI—were consistently associated with IWL across both definitions. Psychiatric disorders were linked to IWL only in models based on %TWL. Intraoperatively, Roux-en-Y gastric bypass (RYGB) reduced IWL risk in %TWL studies (RR=0.71). Postoperatively, higher nadir BMI was associated with IWL (MD=7.94; 95% CI [6.16, 9.72]).

Conclusion: This meta-analysis highlights how differing anthropometric definitions of IWL (%EWL vs %TWL) influence both prevalence estimates and associated predictors. Comorbidities

and baseline BMI, as preoperative factors, were consistent across IWL's definitions. was associated with a lower risk of IWL, particularly in studies using %TWL. Nadir BMI may serve as a marker of IWL. Standardizing IWL criteria is crucial to improve predictions and surgical outcomes.

Key Points:

- Insufficient Weight Loss (IWL) – failing to achieve anticipated weight loss targets after metabolic bariatric surgery (MBS).
- The multiple definitions of IWL significantly impact prevalence estimates and predictor identification. IWL predictors vary by definition, with RYGB being protective in %TWL cases and nadir BMI being a consistent postoperative marker.

Keywords:

Obesity; Metabolic Bariatric surgery (MBS); Insufficient Weight Loss (IWL); Predictors; Excess Weight Loss (EWL); Total Weight Loss (TWL); Body Mass Index (BMI); Roux-en-Y Gastric Bypass (RYGB); Systematic review (SR); Meta-analysis

Introduction

Metabolic bariatric surgery (MBS) is currently the most effective long-term treatment for severe obesity and its related metabolic complications. Despite the effectiveness of bariatric procedures, some patients fail to achieve the anticipated weight loss targets after surgery. This phenomenon, often referred to as "insufficient weight loss" (IWL), remains a significant clinical challenge with implications for patient satisfaction, resolution of comorbidities, and overall surgical success [1].

Definitions of IWL vary across the literature, reflecting the lack of a standardized consensus, ranging from less than 50% excess weight loss (%EWL) to less than 20% total weight loss (%TWL) at various time points postoperatively. Some studies further distinguish "suboptimal weight loss" from "weight regain," although both may coexist and contribute to long-term treatment failure. This lack of consensus hampers the interpretation of outcomes and limits the development of reliable predictive models. In response to this challenge, the 2024 International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) introduced a more clinically inclusive definition of IWL: a "suboptimal initial clinical response," characterized by a maximum %TWL of less than 20%, and/or the absence of improvement—or even worsening—of any pre-existing obesity-related complications. This definition emphasizes that weight-based metrics alone are insufficient and that metabolic outcomes must also be considered when assessing surgical success [2, 3].

Multiple factors have been implicated as predictors of IWL following MBS. These include preoperative variables such as higher baseline Body Mass Index (BMI), older age, lower socioeconomic status, and certain psychological disorders (e.g., depression, binge eating). Surgical factors, including the type of procedure performed and technical nuances, also influence outcomes.

Postoperative behaviors, especially poor dietary adherence, inadequate physical activity, and lack of follow-up, are consistently associated with suboptimal weight trajectories. Understanding the multifactorial etiology of insufficient weight loss is critical to optimizing patient selection, perioperative counseling, and postoperative management.

This review aims to synthesize current definitions of IWL in recent literature and examine its most consistently identified predictors, highlighting areas for intervention and further research.

Methods

This systematic review (SR) and meta-analysis were conducted according to the PRISMA 2020 statement guidelines and the recommendations of the Cochrane Handbook for Systematic Reviews [4, 5].

Eligibility Criteria

We included all observational studies (OBSs) involving adults (>18 years) who underwent MBS and reported IWL after surgery. MBS was defined as an obesity treatment for patients with a BMI ≥ 40 kg/m² or a BMI ≥ 35 kg/m² with weight-related comorbidities. As there is no standard definition of IWL, the most common definitions, based on the American Society for Metabolic and Bariatric Surgery (ASMBS) Task Force's and IFSO guidelines, were collected (Supplementary Table S1) [2, 3].

As maximum Weight Loss (WL) is usually reported at 12-24 months after primary MBS, studies with a follow-up more than 12 months after MBS were included.

Exclusion criteria were the following ones: (i) systematic reviews, case reports, editorials, letters to authors, ecological studies; (ii) studies in which data could not be extracted from the pooled results; (iii) studies focused solely on description of revisional MBS techniques; (v) studies stating IWL after revisional MBS.

Search Strategy

In March 2024, a SR of the available literature was conducted using three search databases - PubMed, Scopus, and Web of Science. Search queries are detailed in Supplementary Table S2. In addition, references of included primary articles and other relevant reviews were hand-searched.

No restrictions were set for language or publication year.

Study selection

After removing the duplicates, study selection was conducted independently by two authors (M.C. and A.M.) in two separate phases. First, the articles were searched by title and abstract. Then, articles not excluded in the first phase were selected based on a full-text reading. Any disagreements were discussed between the reviewers and a third author (F.A.C.).

Data collection process

Data were independently extracted by two authors (M.C. and A.M) from selected studies using a predefined form purposely built for this SR. For each primary study, the following information was retrieved: authors identification, year of publication, years of enrollment, study design, country, eligibility and exclusion criteria of each study, number of enrolled patients, definition of IWL in each study, anthropometric criteria, type of primary MBS, patients social, epidemiological

and clinical characteristics, follow-up period, number of patients with and without IWL after MBS, based on ASMBS or IFSO guidelines [2, 3].

For the identification of clinically significant predictors of IWL, the additional following information was retrieved: (i) preoperative predictors: age, gender, preoperative weight and BMI, smoking, comorbidities such as diabetes mellitus type 2 (T2DM), hypertension (HT), dyslipidemia, cardiovascular disease, obstructive sleep apnea (OSA) and psychiatric disorders; (ii) intraoperative factors – type of primary MBS used; (iii) postoperative factors nadir BMI, %EWL at 6 months and physical activity.

If different eligible publications reported data on the same patient cohort, the more recent and largest cohort was included. Authors were contacted whenever full texts were not available or to provide the relevant missing information. In study selection or data extraction, any disagreements between reviewers were resolved by consulting a third reviewer (F.A.C.).

Quality Assessment

The quality of the studies was independently evaluated by two reviewers (M.C. and A.M.) using the National Institutes of Health quality assessment criteria for cohort studies [6]. This tool consists of a series of 14 yes-or-no questions that lead to a final quality rating (Good, Fair, or Poor) (Supplementary Table S3 and S3.1). To reach a consensus, differing opinions regarding the quality assessment were discussed with a third reviewer (F.A.C.).

Synthesis of Results

A random-effects meta-analysis was conducted to synthesize the results of multiple cohort studies. Given the potential heterogeneity among studies, the DerSimonian and Laird random-effects model was applied, allowing for variations in true effect sizes across studies rather than assuming a single common effect [7].

Risk ratio (RR) with 95% confidence intervals (CIs) were used to quantify the association between different factors and the outcome of interest. Statistical significance was assessed using p-values, with a threshold of $p < 0.05$. If a risk factor was pooled in three or more primary studies, a meta-analysis was performed. Heterogeneity was assessed using the Q-Cochran test statistic, p-value, and the I^2 statistic. For the Q-Cochran test statistic, p-values < 0.10 were considered to indicate significant heterogeneity. For the I^2 statistic, I^2 values above 50% indicate substantial heterogeneity, suggesting that the variation in results is not solely due to chance [5]. Heterogeneity sources were explored through leave-one-out sensitivity analyses. Statistical analysis was performed using R statistical software (version 2025.05.0), with the use of the “meta”, “metafor”, and “dmetar” packages [8].

Results

Study Selection

The electronic literature search yielded 12,486 articles, of which 7,777 were duplicates. After excluding 4,709 records during the screening phase, 471 articles were fully reviewed. Ultimately, 66 studies [9-74] were included in the qualitative synthesis, while 65 [9-73] were included in the quantitative synthesis (Figure 1).

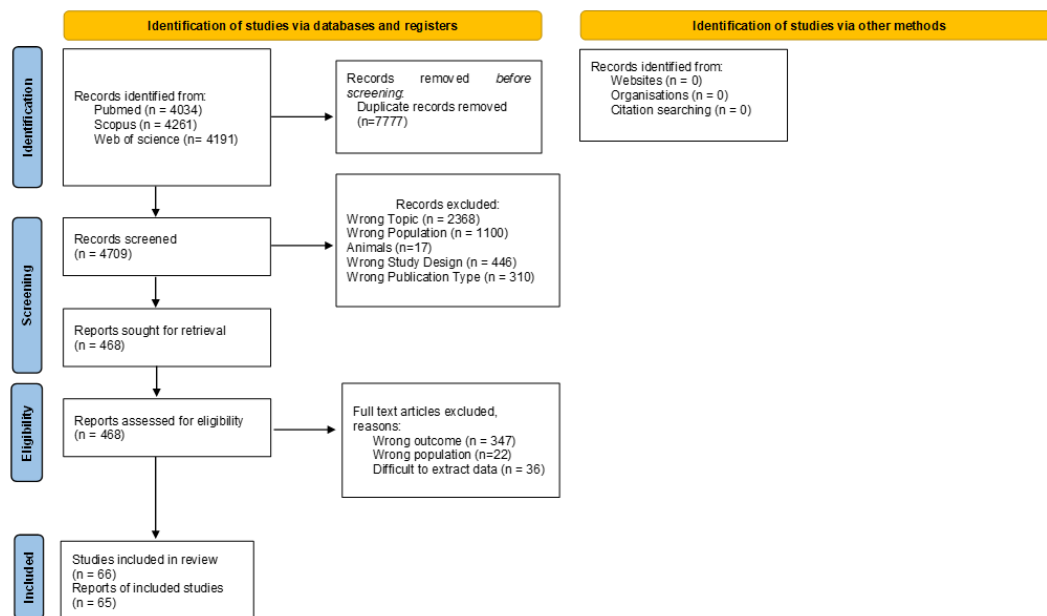


Figure 1 – Flow diagram illustrating the study selection process. Adapted from [4]

Study Characteristics

A summary of included studies is presented in Table 1. Of the 65 articles included, 15 were cross-sectional studies [14, 15, 17, 19, 27, 28, 31, 43, 48, 53-55, 59, 72, 74], 15 were prospective cohort studies [9, 12, 13, 22, 30, 35, 36, 42, 49, 51, 56, 64, 66, 69-71], and 36 were retrospective cohort studies [10, 11, 16, 18, 20, 21, 23-26, 29, 32-34, 37-41, 44-47, 50, 52, 57, 58, 60-63, 65, 67, 68, 73]. The included studies were published between 2002 and 2024, with a cumulative sample size of 26,804 patients. Sample sizes vary greatly, ranging from 6 to 14,404. The average patient age is in the early to mid-40s (36.2 to 52 years), with a predominance of female participants (n=20,837; 77.74%). The most frequently performed MBS procedure in the included studies was Sleeve Gastrectomy (SG) (n=12,019; 44.84%), followed by Roux-en-Y Gastric Bypass (RYGB) (n=11,512; 42.95%), though other techniques like One-Anastomosis Gastric Bypass (OAGB) and Biliopancreatic Diversion (BPD) are also represented. Follow-up durations range widely, with most studies reporting outcomes at 12 to 24 months.

Table 1 - Description of Studies and Patients' Data Included in the Systematic Review and characteristics of patients (year and country of publication, study design, number of patients, mean age, gender distribution, type of surgery, follow-up, definition of IWL, and number of patients with and without IWL)

Author, Year Country	Study Design	Sample size, no	Age Mean, no (SD)	Gender M/F, no	Type of surgery, no	Follow-up (months)	IWL Def	IWL/without IWL
Al-Khyatt W. et al. 2017 United Kingdom	R	227	48.8 (11)	63/164	RYGB	12	I	32/195

Alvarez-Bermudez M.D. et al. 2020 Spain	R	329	44 (9.9)	103/226	SG (83) BPD (66)	12	I	64/265
Angrisani L. et al. 2011 Italy	P	121	38.8(10.9)	41/78	SG	6	I	29/26
Ansar H. et al 2019 Iran	P	1309	39 (10.2)	384 /1317	OAGB	12	I	48 /1261
Benaiges et al. 2020 Spain	R	212	45.4 (8.9)	36 /176	SG (81) RYGB (131)	60	I	43 /169
Ben-Porat T. et al. 2021 Israel	R	212	39.7 (12)	65 /147	SG	96	I	84 /128
Bioletto et al. 2021 Italy	R	300	44.6 (10.3)	32 /268	SG (233) RYGB (67)	24	I	56 /244
Cadena-Obando et al. 2020 Mexico	R	130	48 (9)	24 /106	SG (17) RYGB (49)	12	I	26 /104
Cao Y. et al. 2024 China	R	51	40.5 (12.41)	30 /21	SG (18) RYGB (33)	12	II	27 /24
Cazzo E. et al. 2014 Brazil	R	187	40 (10.3)	33 /154	RYGB	24	I	21 /166
Chen et al. 2023 China	CS	23	NR	17 /9	SG	12	I	13 /13
Ching et al. 2015 Singapore	R	165	38.5 (11.4)	88 /112	SG	12	I	41 /124
Christou NV. et al. 2005 Canada	CS	36	36.5	4 /32	RYGB	48	III	16 /20
Ciudin et al. 2021 Spain	R	416	48.3 (10.3)	68 /348	SG (137) RYGB (280)	15	I	115 /301
Coleman et al. 2010 USA	R	110	44.4 (10.6)	15 /95	RYGB	32	I	7 /103
Coleman et al. 2014 USA	CS	860	46.9 (10.5)	157 /703	RYGB	56	I	406 /454
Coppedè et al. 2018 Italy	P	45	43 (12)	13 /32	RYGB	12	I	22 /23
D'Eusebio C. et al. 2021 Italy	R	300	44.6 (10.3)	32 /268	SG (233) RYGB (67)	24	I	56 /244
Dilektasli E. et al.	R	100	NR	19 /81	SG	6	I	52 /48

2016 Turkey								
Fink M. et al. 2023 Germany	R	14404	43.9 (11.6)	3756 /10648	SG (6805) OAGB (1877) RYGB (5722)	12	II	1119 /13285
Fox et al. 2015 USA	R	97	48.6 (12)	17 /80	RYGB	12	I	30 /67
Furtado et al. 2018 Brazil	CS	105	43.3	17 /88	RYGB	51	I	41 /64
Gadducci A.V. et al. 2024 Brazil	P	79	45 (10)	NR	RYGB	36	I	20 /59
Garofalo F. et al. 2016 Canada	R	25	67.2	14 /16	SG	53	I	12 /13
Geerts et al. 2020 Netherlands	CS	140	47.5 (9.8)	14 /126	RYGB	38	I	27 /105
Gerken A.L.H. et al. 2020 Germany	P	176	42	49 /127	SG (59) RYGB (117)	12	I	45 /131
Grandt et al. 2022 Germany	R	170	NR	32 /138	SG (121) RYGB (49)	12	I	84 /86
Guerra et al. 2002 Spain	P	75	NR	21 /54	BPD	60	I	9 /66
Gutiérrez- Repiso C. et al. 2019 Spain	CS	24	45.6	3 /21	RYGB	100	I	6 /6
Hanvold et al. 2015 Norway	CS	165	44 (8.6)	42 /123	RYGB	24	I	28 /137
Hany et al. 2022 Egypt	CS	100	NR	22 /78	SG	6	I	72 /28
Herrera-López S. et al. 2023 Colombia	R	187	NR	20 /167	SG (70) RYGB (117)	54	I	10 /177
Huang CW. et al. 2019 Taiwan	R	67	36.2	27 /40	SG	12	I	32 /35
Kashihara H. et al. 2023 Japan	R	13	42.7	5 /8	SG	12	I	8 /5
Khattab M. H. et al. 2024 Egypt	P	100	36.98 (10.05)	0 /100	SG	12	II	14 /86

Koca AO. et al. 2023 Turkey	R	1137	NR	194 /943	SG	12	I	89 /1048
Li et al. 2023 China	R	26	NR	17 /9	SG	12	I	13 /13
Li K. et al. 2019 China	R	97	35.3 (11.8)	45 /52	SG	6	II	44 /53
Lim et al. 2020 South Korea	R	189	34.6 (10.7)	54 /135	SG (43) RYGB (146)	12	I	62 /127
Livhits et al. 2010 United States	R	148	45.9	24 /124	RYGB	40	I	70 /78
Lucocq J. et al. 2024 United Kingdom	P	280	NR	69 /211	SG (146) RYGB (134)	24	I	56 /224
Mallio et al. 2023 Italy	P	62	NR	18 /44	SG	24	I	18 /24
Mundi MS. et al. 2013 USA	CS	118	NR	22 /96	RYGB	12	I	69 /49
Nelbom B. et al. 2010 Denmark	P	87	NR	21 /68	RYGB	12	I	11 /76
Novais et al. 2011 Brazil	CS	141	44 (9)	0 /141	RYGB	24-84	I	22 /119
Novelli et al. 2017 Brazil	CS	95	47.3 (9.7)	0 /95	RYGB	60	I	28 /67
Nymo et al. 2022 Norway	CS	75	49 (9.9)	16 /59	RYGB	120-180	I	25 /25
Nymo S. et al. 2022 Norway	CS	50	51.4	12 /63	RYGB	156	I	25 /25
Nymo S. et al. 2024 Norway	CS	50	51.5 (8)	7 /43	RYGB	156	I	25 /25
Ohira M. et al. 2020 Japan	R	90	42.97 (9.45)	44 /46	SG	12	II	18 /72
Park JY. et al. 2024 South Korea	R	311	35.3 (10.4)	225 /540	SG (491) RYGB (274)	12	II	24 /287
Raaff CAL. et al. 2016 Netherlands	R	816	44.4 (10.6)	162 /654	SG (50) RYGB (766)	12	I	149 /667
Romeijn et al. 2021 Netherlands	R	172	44.9 (10.2)	28 /144	RYGB	24	I	11 /161
Ruiz-Lozano T. et al.	P	270	52 (11)	57 /213	SG (67) RYGB (203)	72	I	29 /183

2016 Spain								
Saiki A. et al. 2020 Japan	R	89	41.9 (9)	42 /47	SG	36	II	20 /69
Saiki et al. 2019 Japan	R	322	47.5 (10.8)	144 /179	SG	24	II	59 /263
Stefura et al. 2020 Poland	P	31	43.5 (12.3)	11 /20	SG (25) RYGB (6)	6	I	11 /20
Stefura et al. 2023 Poland	P	32	42.38 (10.61)	12 /20	SG (18) RYGB (14)	12	I	17 /15
Stefura T. et al. 2022 Poland	P	6	43.2	4 /2	RYGB	6	I	2 /4
Stefura T. et al. 2021 Poland	P	30	42.7 (10.4)	11 /19	SG	6	I	11 /19
Testa G. et al. 2019 Italy	CS	69	42.6 (11.6)	9 /60	SG	12	I	17 /52
van Wezenbeek M.R. et al. 2016 Netherlands	R	98	39.4	11 /87	VBG	107	I	62 /36
Velázquez et al. 2017 Mexico	R	58	39.3 (10.2)	22 /36	RYGB	12	I	13 /45
Voglino et al. 2022 Italy	R	443	NR	101 /342	SG (241) RYGB (123)	36	II	76 /367
Wuyun Q. et al. 2023 China	R	104	41.71 (11.87)	51 /53	RYGB	60	I	26 /78
Yamaguchi T. et al. 2022 Japan	R	248	43 (11)	107 /141	SG	12	II	28 /220

CS – cross – sectional; IWL – Insufficient Weight Loss; LAGB - Laparoscopic adjustable gastric band; P – Prospective; R – Retrospective; RYGB – Roux-en-Y gastric bypass; SG – Sleeve gastrectomy; IWL Definition: I - Excess Weight Loss (EWL) of less than 50%; II - Total Weight Loss (TWL) of less than 20%; III - BMI of 35 kg/m² or more.

Definition of Insufficient Weight Loss Based on Different Anthropometric Criteria

The most commonly used definition of IWL after MBS was %EWL<50, observed in 55 studies [9-32, 34-37, 39, 42-48, 50-56, 59, 61-67, 69, 71, 72], and %TWL < 20%, in 10 studies [33, 38, 40, 41, 57, 58, 60, 68, 70, 73].

Firstly, focusing on %EWL<50, through meta-analysis, a total of 10,613 patients were included, revealing a pooled proportion of IWL after MBS of 27% (95% CI: 23%–33%, Supplementary Figure S1), indicating that more than one in four patients may not achieve satisfactory weight loss outcomes postoperatively. High heterogeneity was observed ($I^2 = 95.7\%$, Q Cochran test $p < 0.0001$). Each study contributes approximately equally to the overall analysis (around 1.9%), with slight variations based on sample size and variance.

Regarding %TWL < 20%, a total sample size of 15,844 patients across 10 primary studies was included in this quantitative analysis. The pooled IWL proportion, following MBS, was 20% (95% CI: 12%–32%, Supplementary Figure S2), based on a random-effects model. The results show significant heterogeneity among the studies ($I^2 = 97.4\%$, $p < 0.0001$), indicating considerable variation in study outcomes.

Predictors of Insufficient Weight Loss after MBS

This meta-analysis investigated the association of preoperative, intraoperative, and postoperative factors with insufficient weight loss (IWL) following MBS, using percentage of excess weight loss (%EWL) and percentage of total weight loss (%TWL) as the outcome metrics, separately.

Based on % EWL

Of 10,613 patients, a total of 2,400 patients, after primary MBS, had insufficient weight loss, based on the anthropometric definition “%EWL<50”. Through meta-analysis, the following risk factors were studied (Table 2-4): (i) preoperative predictors - average participants’ age, gender, preoperative weight and BMI, smoking, patients’ comorbidities (T2DM, HT, dyslipidemia, cardiovascular disease, OSA and psychiatric disorders), (ii) intraoperative predictors – type of primary MBS (RYGB vs SG), (iii) postoperative factors – %EWL at 6 months after MBS, nadir BMI and physical activity.

Table 2 - Preoperative Factors Associated with IWL after Metabolic Bariatric Surgery

Preoperative factors associated with IWL	Studies (n)	Total Patients (n)	Patients with IWL (n)	Random effects model	I ²	Q Cochran p test
<i>Age</i>	33	6681	1666	MD = 0.79 (95%C [-2.58; 4.16])	96.4 %	< 0.0001
<i>Gender</i>	46	8426	2017	RR = 0.97 (95%C [0.83; 1.13])	68.4 %	< 0.0001
<i>Preoperative BMI</i>	31	5242	1095	MD = 2.24 (95%C [1.00; 3.49])	84.7 %	< 0.0001
<i>Preoperative Weight</i>	10	3307	494	MD = -1.25 (95%C [-7.64; 5.24])	83.0%	< 0.0001
<i>Current Smoker</i>	9	1804	681	RR = 0.96 (95%C [0.78; 1.17])	0%	0.70
<i>Hypertension</i>	24	4434	817	RR = 1.20 (95%C [1.07; 1.33])	43%	0.02
<i>Dyslipidemia</i>	18	3429	622	RR = 1.14 (95%C [1.05; 1.24])	0%	0.79
<i>Diabetes Mellitus type 2</i>	30	5987	1063	RR = 1.28 (95%C [1.12; 1.45])	38.3%	0.02
<i>Cardiovascular disease</i>	4	288	82	RR = 1.51 (95%C [0.94; 2.42])	0%	0.59

Obstructive Sleep Apnea	13	3159	515	RR = 1.22 (95%C [1.05; 1.43])	14.3%	0.01
Psychiatric disorders	8	2356	399	RR = 1.12 (95%C [0.88; 1.44])	59.7%	0.02

n = number of patients; RR = risk ratio; BMI – Body Mass Index

Table 3 - Intraoperative Factors Associated with IWL after Metabolic Bariatric Surgery

Intraoperative factors associated with IWL	Studies (n)	Total Patients (n)	Patients with IWL (n)	Random effects model	I ²	Q Cochran p test
<i>RYGB</i>	34	5536	1156	RR = 0.98 (95%C [0.93; 1.02])	94.5 %	< 0.0001
<i>SG</i>	46	4813	1019	RR = 1 (95%C [0.99; 1.02])	18 %	0.2

n = number of patients; RR = risk ratio; RYGB - RYGB – Roux-en-Y gastric bypass; SG – Sleeve gastrectomy

Table 4 - Postoperative Factors Associated with IWL after Metabolic Bariatric Surgery

Postoperative factors associated with IWL	Studies (n)	Total Patients (n)	Patients with IWL (n)	Random effects model	I ²	Q Cochran p test
%EWL at 6 months	4	661	134	MD = - 29.54 (95%C [-33.64; -25.13])	0%	0.85
Nadir BMI	5	734	189	MD = 7.94 (95%C [6.16; 9.72])	60.9%	0.04
Physical Activity	7	1623	647	RR = 0.81 (95%C [0.60; 1.10])	70.4	0.002

n = number of patients; RR = risk ratio; EWL - Excess Weight Loss; BMI – Body Mass Index

Among the preoperative variables analyzed, a higher baseline BMI is significantly associated with an increased risk of IWL (MD = 2.24; 95% CI [1.00, 3.49], I²=84.7%; Q Cochran test *p* < 0.0001, Supplementary Figure S3), suggesting that patients undergoing MBS with a higher level of obesity are more likely to experience suboptimal postoperative outcomes. Likewise, several comorbidities were linked to IWL. Significant correlations were found between a higher likelihood of IWL and HT (RR = 1.20; 95% CI [1.07, 1.33], I²=43.0%; Q Cochran test *p* = 0.02, Supplementary Figure

S4), dyslipidemia (RR = 1.14; 95% CI [1.05, 1.24], $I^2=0\%$; Q Cochran test $p = 0.79$, Supplementary Figure S5), T2DM (RR = 1.28; 95% CI [1.12, 1.45], $I^2=38.3\%$; Q Cochran test $p = 0.02$, Supplementary Figure S6), highlighting the possible influence of metabolic dysfunction on weight outcomes. Additionally, OSA demonstrated a significant correlation with IWL (RR = 1.22; 95% CI [1.05, 1.43], $I^2=14.7\%$; Q Cochran test $p = 0.01$, Supplementary Figure S7), indicating that the efficacy of surgical intervention may be limited by coexisting systemic comorbidities.

However, IWL did not significantly correlate with age (MD = 0.79; 95% CI [-2.58, 4.16], $I^2=96.4\%$; Q Cochran test $p<0.0001$, Supplementary Figure S8), gender (RR = 0.97; 95% CI [0.83, 1.13], $I^2=68.4\%$; Q Cochran test $p<0.0001$, Supplementary Figure S9), preoperative weight (MD = -1.25; 95% CI [-7.64, 5.24], $I^2=83.0\%$; Q Cochran test $p<0.0001$, Supplementary Figure S10), current smoking status (RR = 0.96; 95% CI [0.78, 1.17], $I^2=0\%$; Q Cochran test $p=0.7019$, Supplementary Figure S11), cardiovascular disease (RR = 1.51; 95% CI [0.94, 2.42], $I^2=0\%$; Q Cochran test $p=0.5867$, Supplementary Figure S12), or psychiatric disorders (RR = 1.12; 95% CI [0.88, 1.44], $I^2=59.7\%$; Q Cochran test $p=0.0153$, Supplementary Figure S13). These results suggest that while some comorbidities appear to play an important role, other demographic or clinical characteristics are not independent factors in predicting weight loss failure.

Regarding the surgical technique, no significant differences were found in the incidence of IWL. RYGB was associated with a relative risk of 0.98 (95% CI [0.93, 1.02], $I^2=94.5\%$; Q Cochran test $p<0.0001$, Supplementary Figure S14), while SG showed a neutral risk (RR = 1.00; 95% CI [0.99, 1.02], $I^2=18.0\%$; Q Cochran test $p = 0.2060$; Supplementary Figure S15). These findings suggest that the surgical technique alone is not a decisive factor in predicting long-term weight outcomes.

Postoperative data showed that patients with IWL had a significantly lower %EWL at 6 months (MD = -29.54; 95% CI [-33.64, -25.13]; I²=0%; Q Cochran test p = 0.8497; Supplementary Figure S16), highlighting the importance of early postoperative weight loss as a predictor of long-term success. Furthermore, a significantly higher nadir BMI was observed in patients who had IWL (MD = 7.94; 95% CI [6.16, 9.72]; I²=60.9%; Q Cochran test p = 0.0365; Supplementary Figure S17), thereby reinforcing the importance of sustained weight reduction beyond the initial postoperative phase.

The present study demonstrated that physical activity post-surgery exhibited a tendency to decrease the likelihood of IWL, although this decrease did not attain statistical significance (RR = 0.81; 95% CI [0.60, 1.10], I²=70.4%; Q Cochran test p = 0.0025; Supplementary Figure S18).

Based on % TWL

Of 15,844 patients, a total of 1,405 patients, after primary MBS, had insufficient weight loss, based on the anthropometric definition “%TWL<20”. Through meta-analysis, the following risk factors were studied (Table 5,6): (i) preoperative predictors - average participants’ age, gender, preoperative weight and BMI, patients’ comorbidities (T2DM, HT, OSA and psychiatric disorders), (ii) intraoperative predictors – type of primary MBS (RYGB vs SG).

Table 5 - Preoperative Factors Associated with IWL after Metabolic Bariatric Surgery

Preoperative factors associated with IWL	Studies (n)	Total Patients (n)	Patients with IWL (n)	Random effects model	I ²	Q Cochran p test
<i>Age</i>	6	14990	1250	MD = 2.5984 (95%CI [-2.44; 7.64])	92 %	< 0.0001
<i>Gender</i>	9	15844	1491	RR = 1.15 (95%CI [0.90; 1.47])	81.8 %	< 0.0001
<i>Preoperative BMI</i>	7	15401	1329	MD = -1.36	69.2 %	0.003

				(95%C [-2.68; -0.05])		
Preoperative Weight	6	15350	1302	MD = -6.92 (95%C [-11.75; -2.09])	56.6%	0.04
Hypertension	4	15146	7604	RR = 1.17 (95%C [1.08; 1.26])	7.6%	0.36
Diabetes Mellitus type 2	4	15185	4196	RR = 1.4558 (95%C [1.28; 1.65])	23.2%	0.27
Obstructive Sleep Apnea	3	1013	543	RR = 1.0727 (95%C [0.80; 1.43])	77%	0.01
Psychiatric disorders	4	1102	325	RR = 1.3275 (95%C [1.08; 1.63])	0%	0.96

n = number of patients; *RR* = risk ratio; *BMI* – Body Mass Index

Table 6 - Intraoperative Factors Associated with IWL after Metabolic Bariatric Surgery

Intraoperative factors associated with IWL	Studies (n)	Total Patients (n)	Patients with IWL (n)	Random effects model	I ²	Q Cochran p test
RYGB	3	14898	1222	RR = 0.71 (95%C [0.55; 0.92])	46 %	0.16
Sleeve	9	15844	8010	RR = 1.11 (95%C [0.93; 1.33])	98.9 %	< 0.0001

n = number of patients; *RR* = risk ratio; *RYGB* - *RYGB* – Roux-en-Y gastric bypass; *SG* – Sleeve gastrectomy

Analysis of preoperative characteristics revealed a significant association between T2DM and an increased risk of IWL after MBS (RR = 1.46; 95% CI [1.28, 1.65]; I²=23.2%; Q Cochran test p = 0.2716; Supplementary Figure S19), suggesting that underlying metabolic dysregulation may negatively influence weight loss outcomes despite surgical intervention. Similarly, HT was also significantly related to IWL (RR = 1.17; 95% CI [1.08, 1.26], I²=7.6%; Q Cochran test p = 0.3553; Supplementary Figure S20), reinforcing the influence of cardiometabolic dysfunction in attenuating the benefits of surgery. These findings emphasize that the presence of metabolic comorbidities can compromise the surgical response, even in technically successful procedures.

Psychiatric disorders also showed a significant association with a higher risk of IWL (RR = 1.33; 95% CI [1.08, 1.63], $I^2=0\%$; Q Cochran test $p = 0.9568$; Supplementary Figure S21), suggesting that mental health plays a central role in adherence to the lifestyle changes required in the postoperative period. This result reinforces the need for structured psychological assessment in the preoperative period and continued support after surgery.

From an anthropometric point of view, an inverse association was observed between preoperative BMI and preoperative weight and the risk of IWL. Patients who experienced IWL had significantly lower preoperative BMI (MD = -1.36; 95% CI [-2.68, -0.05]; $I^2=69.2\%$; Q Cochran test $p = 0.0034$; Supplementary Figure S22) and preoperative weight (MD = -6.92; 95% CI [-11.75, -2.09], $I^2=56.6\%$; Q Cochran test $p = 0.0419$; Supplementary Figure S23). This paradox can be explained by the fact that individuals with less severe obesity have a smaller absolute weight margin and/or different metabolic profiles, which may put them at greater risk of failing to reach clinically meaningful weight loss thresholds.

In contrast, variables such as age (MD = 2.60; 95% CI [-2.44, 7.64]; $I^2=92.0\%$; Q Cochran test $p < 0.0001$; Supplementary Figure S24), gender (RR = 1.15; 95% CI [0.90, 1.47], $I^2=81.1\%$; Q Cochran test $p < 0.0001$; Supplementary Figure S25) were not significantly associated with IWL, although heterogeneity across studies was considerable. Similarly, OSA showed no significant association (RR = 1.07; 95% CI [0.80, 1.43]; $I^2=77.0\%$; Q Cochran test $p = 0.0130$; Supplementary Figure S26), although the data for this condition were limited to three studies and exhibited moderate heterogeneity.

Regarding intraoperative factors, patients undergoing RYGB were significantly less likely to experience IWL compared to other procedures (RR = 0.71; 95% CI [0.55, 0.92]; $I^2=46.0\%$; Q Cochran test $p=0.1569$; Supplementary Figure S27) when compared to other techniques, namely SG, which showed no significant effect (RR = 1.11; 95% CI [0.93, 1.33]; $I^2=98.8\%$; Q Cochran test $p=0.0680$; Supplementary Figure S28). However, the high degree of heterogeneity among the studies that evaluated SG shows substantial variability in the results, which limits generalization.

Risk of Bias of Individual Studies

The results of the risk of bias assessments for included primary observational studies are presented in Supplementary Table S2, detailed description is reported in Supplementary Table S2.1. Overall, this study was considered to have an intermediate risk of bias. The assessment of individual observational studies varied significantly, with 29 studies classified as Good, 33 as Fair, and 4 as Poor. Many studies did not include a sample size justification (Q5) and in several studies, the exposure of interest was not measured before the outcome (Q6). Furthermore, blinding to the exposure status (Q12) was rarely reported. Finally, a significant number of studies did not make a multivariable adjustment (Q14), which limits the ability to identify confounding factors that may influence weight loss outcomes.

Discussion

The main findings of our study were the following: (i) The prevalence of insufficient weight loss (IWL) after metabolic and bariatric surgery varies significantly depending on the definition used, with pooled rates of 27% using %EWL<50 and 20% using %TWL<20, highlighting the impact of definitional heterogeneity on reported outcomes; (ii) T2DM, hypertension, and preoperative BMI emerged as consistent preoperative predictors of IWL across both definitions; (iii) RYGB was associated with a significantly lower risk of IWL in %TWL studies; (iv) Higher nadir BMI was associated with IWL in %EWL-defined studies, though this reflects an expected outcome.

Absence of Standardization in IWL Criteria

IWL following MBS is increasingly recognized as a distinct and multifactorial clinical issue. An intricate interplay of metabolic, psychological, and procedural factors shapes it. However, a major obstacle in understanding and managing IWL is the lack of a standardized definition across studies. While many define it as EWL<50%, others opt for TWL<20%, creating inconsistencies that challenge the identification of reliable, independent predictors. This variability in definitions is a well-documented limitation in recent studies, including reviews by Franken et al.[75] and El Ansari et al.[76], highlighting how diverse criteria impede the development of universal predictors and treatment thresholds. This inconsistency in definitions affects the reliability of risk models and emphasizes the critical need for agreed-upon criteria [73].

IFSO's recent proposal for standardization is a necessary step forward, as it promotes greater uniformity between studies, allowing more consistent conclusions and best evidence to support therapeutic decisions. According to IFSO, IWL should be called "suboptimal initial response" and defined as TWL<20% or an abnormally modest improvement in a clinically significant

complication of obesity. The use of %TWL is based on the fact that it is a more consistent metric to assess weight loss results after MBS, since it is less affected by the patient's preoperative weight [3].

Predictors of IWL

While weight regain (WR) often occurs after successful initial weight loss and is typically linked to behavioral or anatomical changes, IWL is characterized by a suboptimal response from the outset. This distinction is important both clinically and mechanistically: whereas WR tends to reflect challenges in long-term maintenance, IWL may be a reflection of underlying patient or procedural factors that limit initial efficacy [76-78].

Preoperative Predictors of IWL

El Ansari et al [76] review, along with several primary studies [11-13, 16, 18-21, 23, 24, 26, 28, 32, 34, 35, 40, 41, 43, 44, 46-48, 50, 52-55, 58, 60, 65, 70-73] have attempted to identify a common set of predictors for IWL, frequently citing older age, higher preoperative BMI, the presence of comorbidities, and behavioral factors as contributing elements. However, a major limitation across these studies lies in the absence of a standardized definition of IWL, as well as the tendency to conflate two distinct phenomena - IWL and WR - under the broader label of "weight recurrence," thereby obscuring meaningful clinical and mechanistic differences between them.

In terms of comorbidities and preoperative anthropometric criteria, our study identified T2DM, HT, and higher preoperative BMI as key predictors of IWL, emphasizing metabolic dysfunction's role in limiting weight loss after MBS. This underscores the need for comprehensive preoperative metabolic assessments. These comorbidities may blunt weight loss by altering hormonal responses

postoperatively or limiting the degree of energy expenditure adaptation. For example, El Ansari et al.[76] noted that patients with T2DM and HT were more likely to experience IWL than those without such conditions, possibly due to persistent insulin resistance, chronic inflammation, and altered appetite-regulatory mechanisms.

In contrast, this meta-analysis found no significant association between IWL and demographic characteristics such as age, gender, smoking, and preoperative weight. Almasi et al [79]., a 2025 observational study, reported that older age emerged among the significant predictors of IWL following MBS. However, age is not universally confirmed as a predictor of IWL after MBS because its influence appears to be context-dependent and modulated by multiple interacting confounders such as baseline BMI, type of surgery, metabolic comorbidities, or behavioral factors. This further reinforces the importance of metabolic and procedural factors over demographic characteristics in predicting poor surgical response.

Intraoperative Predictors of IWL

Regarding surgical technique, our study found that RYGB was statistically significantly associated with a lower risk of IWL, particularly in studies using %TWL. This supports prior research suggesting that RYGB, with its combined restrictive and malabsorptive effects, may be better suited for patients with significant metabolic dysfunction. Nevertheless, sleeve gastrectomy showed more variable outcomes, and it did not have a significant effect on IWL.

A key point of debate in the literature concerns the role of SG as a potential risk factor for IWL [34, 57, 60, 79, 80]. Although SG is currently the most widely performed bariatric procedure globally, its association with IWL remains controversial. Our analysis based on %EWL and

%TWL revealed no statistically significant differences between the surgical technique and IWL. Some reasons can be pointed out as important factors. First, SG outcomes are known to be highly variable across patient populations and clinical settings. Differences in sleeve size, surgical technique, and follow-up duration contribute to outcome variability. Second, when SG is compared to RYGB, a procedure with stronger hormonal and malabsorptive components, it may appear less effective, especially in metabolically complex patients. Indeed, several studies have reported SG as a predictor of IWL in unadjusted models, but this association often disappears in multivariate analyses that control for baseline comorbidities and BMI. This suggests that the relationship between SG and IWL is likely mediated by patient selection and not the procedure alone.

Our findings do, however, reinforce the protective role of RYGB against IWL, particularly in %TWL-based models. The procedure's dual mechanism, restrictive and malabsorptive, likely contributes to more substantial and sustained weight loss. This supports existing evidence favoring RYGB in patients with more severe metabolic disease or those at higher risk of suboptimal outcomes [81]. Therefore, the choice of the type of surgery should be weighed up considering the patient's metabolic and behavioral profile, with procedures with a malabsorptive component being a potentially more effective option in certain subgroups, although more research is needed to confirm this hypothesis.

Postoperative Predictors of IWL

This review identified several lifestyle behaviors linked to IWL after MBS, including non-compliance with nutritional instructions [53] and physical inactivity [55]. In this meta-analysis,

the practice of physical activity in the postoperative period showed a protective trend, although it did not reach statistical significance, indicating the need for further studies on the subject.

Patients with IWL had an average %EWL at 6 months 29.54 percentage points lower than patients without IWL, confirming that the initial weight loss trajectory is critical for long-term success. This data highlights the importance of a rigorous clinical follow-up in the first six months after surgery. A focus on early identification of suboptimal weight loss patterns allows the implementation of interventions to aid weight loss. Finally, though our analysis showed that a higher nadir BMI is significantly associated with IWL, this is an expected finding rather than a novel insight. By definition, patients with IWL will not reach a low postoperative nadir BMI. While it remains a useful retrospective marker of surgical response, it does not function as a true predictor and thus should not be overstated in clinical decision-making.

Strengths

This systematic review and meta-analysis provide valuable insight into the multifactorial nature of IWL after MBS. This is, to date, one of the most comprehensive SR with meta-analysis focused on predictors of IWL after MBS. The methodology used was rigorous, integrating both qualitative reviews and quantitative meta-analysis, reinforcing the reliability of the findings.

Separating the analysis based on anthropometric criteria (%EWL vs %TWL) is an additional strength, enabling consistent outcome evaluations. This separation provides a more standardized way to assess predictors using anthropometric criteria, facilitating data interpretation that aligns better with clinical practice and adheres to the latest guidelines endorsed by IFSO [3].

Limitations

This study has several important limitations. One of the main challenges was the wide variability in how IWL was defined across studies, some used %EWL while others used %TWL, which made it difficult to compare results directly and likely influenced the pooled outcomes. In addition, there was a lack of consistency in how predictor variables were reported, which limited our ability to standardize data for analysis. Another key limitation is that most of the included studies did not use multivariate models, which raises concerns about confounding factors that may have influenced the results. We were also limited by the scarcity and quality of data on postoperative factors, many of which were self-reported and vulnerable to bias. Finally, the high level of heterogeneity across studies and the inclusion of some lower-quality evidence mean that our conclusions should be interpreted with caution.

Conclusion

This systematic review and meta-analysis identified pre, intra and postoperative clinical factors associated with IWL after MBS. Metabolic comorbidities and RYGB stand out as central elements in IWL. These findings reinforce the need for a multidimensional approach to monitoring these patients, with a close early follow-up and interventions aimed at the groups most at risk of IWL. Standardizing the definition of IWL, as well as integrating behavioral variables and generating predictive models of IWL, should be a priority in future research to optimize outcomes after MBS.

Supplementary Information

Supplementary Data is available in the following pages.

Statements

Conflict of Interest: The authors declare that they have no conflict of interest.

Ethics Approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent: For this type of study, formal consent is not required.

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Supplementary Material

Table S2 –Summary of definitions of Insufficient Weight Loss

Metric	Threshold
<i>EWL</i>	<50%
<i>TWL</i>	<20%
<i>BMI</i>	<35 kg/m ²
<i>AWL</i>	<p15.9

EWL Excess Weight Loss, TWL Total Weight Loss, BMI Body Mass Index, AWL Alterable Weight Loss, <15.9 is defined as below percentile 15.9 of distribution of the achievable weight loss distribution for a particular surgical technique

Table S3 - Search terms and queries.

MEDLINE/Pubmed	((("bariatric Surgery"[All Fields] OR "Bariatric"[All Fields] OR "Metabolic Surgery"[All Fields] OR "obesity surgery"[All Fields] OR "bariatric surgery"[Majr] OR "bariatric surgery"[Title/Abstract] OR "metabol* surgery"[Title/Abstract] OR "weight loss surgery"[Title/Abstract] OR "obes* surgery"[Title/Abstract] OR "Gastric Bypass"[All Fields] OR "Gastric Bypass"[MeSH Terms] OR "Roux-en-Y Gastric Bypass"[All Fields] OR "gastric band*" [All Fields] OR "Vertical Banded Gastroplasty"[All Fields] OR "Gastric Sleeve"[All Fields] OR "Sleeve Gastrectomy"[All Fields] OR "biliopancreatic diversion"[All Fields] OR "biliopancreatic diversion"[MeSH Terms] OR "duodenal switch"[All Fields] OR "anastomosis roux-en-y"[All Fields] OR "mini* bypass"[All Fields] OR
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	"duodenal switch"[All Fields] OR "sadi-s"[All Fields] OR "sasi-s"[All Fields]) AND ("weight recidivism"[All Fields] OR "insufficient weight loss"[All Fields] OR "inadequate weight loss"[All Fields] OR "weight loss failure"[All Fields] OR "poor weight loss"[All Fields] OR "unsatisfactory weight loss"[All Fields] OR "suboptimal weight loss"[All Fields] OR "excess weight loss"[All Fields] OR "total weight loss"[All Fields] OR "alterable weight loss"[All Fields] OR "reinhold criteria"[All Fields] OR "biron criteria"[All Fields]))
Web of Science	TS=(((("bariatric surgery" OR "Bariatric" OR "Metabolic Surgery" OR "obesity surgery" OR "Gastric Bypass" OR "Roux-en-Y Gastric Bypass" OR "gastric band*" OR "Vertical Banded Gastroplasty" OR "Gastric Sleeve" OR "Sleeve Gastrectomy" OR "biliopancreatic diversion" OR "duodenal switch" OR "anastomosis roux-en-y" OR "mini* bypass" OR "sadi- s" OR "sasi-s"))) AND (("weight recidivism" OR "insufficient weight loss" OR "inadequate weight loss" OR "weight loss failure" OR "poor weight loss" OR "unsatisfactory weight loss" OR "suboptimal weight loss" OR "excess weight loss" OR "total weight loss" OR "alterable weight loss" OR "reinhold criteria" OR "biron criteria"))))
Scopus	(TITLE-ABS-KEY("bariatric surgery" OR "Bariatric" OR "Metabolic Surgery" OR "obesity surgery" OR "Gastric Bypass" OR "Roux-en-Y Gastric Bypass" OR "gastric band*" OR "Vertical Banded Gastroplasty" OR "Gastric Sleeve" OR "Sleeve Gastrectomy" OR "biliopancreatic diversion" OR "duodenal switch" OR "anastomosis roux-en-y" OR "mini* bypass" OR "sadi- s" OR "sasi-s"))) AND (TITLE-ABS-KEY("weight recidivism" OR "insufficient weight loss" OR

	"inadequate weight loss" OR "weight loss failure" OR "poor weight loss" OR "unsatisfactory weight loss" OR "suboptimal weight loss" OR "excess weight loss" OR "total weight loss" OR "alterable weight loss" OR "reinhold criteria" OR "biron criteria"))
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Table S3 – Quality rating (risk of bias) of individual primary studies included in the systematic review for the evaluation of predictors of IWL after MBS

Studies	Quality Rating	Quality Rating
	G/F/P	Y/N
Diaz-Guerra CSC	FAIR	7/3
Christou NV	FAIR	8/4
Coleman KJ	FAIR	9/2
Livhits M	FAIR	9/3
Nelbom B	FAIR	11/2
Angrisani L	FAIR	10/4
Novais PFS	FAIR	6/4
Mundi MS	POOR	6/6
Cazzo E	FAIR	11/2
Coleman KJ	FAIR	10/2
Ching SS	FAIR	10/3
Fox B	FAIR	9/4
Hanvold SE	FAIR	7/4
Dilektasli E	GOOD	11/2
Garofalo F	GOOD	11/2
Raaff CAL	GOOD	11/2
Ruiz-Lozano T	GOOD	12/1
van Wezenbeek MR	GOOD	11/2
Al-Khyatt W	GOOD	10/3
Novelli IR	FAIR	10/3
Vázquez-Velázquez V	GOOD	11/2
Coppedè F	GOOD	11/2
Furtado MCMB	FAIR	10/3
Ansar H	GOOD	12/1

Gutiérrez-Repiso C	FAIR	10/3
Huang CW	FAIR	10/3
Testa G	GOOD	11/2
Li K	GOOD	12/1
Saiki A	GOOD	12/1
Alvarez-Bermudez MD	FAIR	9/2
Benaiges D	FAIR	10/3
Ohira M	GOOD	11/2
Saiki A	GOOD	12/1
Cadena-Obando D	GOOD	11/2
Geerts MM	FAIR	8/3
Gerken ALH	FAIR	9/2
Lim H	GOOD	13/0
Stefura T	FAIR	10/3
Ben-Porat T	FAIR	9/4
Bioletto F	GOOD	12/1
Ciudin A	GOOD	11/2
D'Eusebio C	GOOD	13/0
Romeijn MM	FAIR	9/4
Stefura T	FAIR	10/3
Voglino C	GOOD	12/1
Yamaguchi T	GOOD	12/1
Grandt J	FAIR	10/2
Hany M	POOR	9/4
Nymo S	FAIR	10/3
Nymo S	FAIR	9/4
Stefura T	FAIR	10/3
Fink M	GOOD	12/1
Chen G	GOOD	11/2
Herrera-López S	POOR	6/6
Kashihara H	FAIR	11/2
Koca AO	GOOD	11/2
Li K	GOOD	12/1
Mallio CA	FAIR	10/3
Stefura T	FAIR	10/3
Wuyun Q	FAIR	11/2

Cao Y	GOOD	10/2
Khattab MH	GOOD	12/1
Park JY	FAIR	10/2
Gadducci AV	FAIR	10/2
Lucocq J	FAIR	10/3
Nymo S	FAIR	11/2

The National Institutes of Health's (NIH) quality assessment criteria for observational studies are based on 14 yes/no/not applicable/not reported/cannot decide questions and a quality rating of G (good), F (fair), and P (poor). The ratio of questions with positive (Y=yes) and negative (N=no) responses is known as Y/N [6]

Table S3.1 - Details of risk of bias assessments for included primary studies regarding predictors of IWL after MBS

Studies	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Quality Rating
Diaz-Guerra CSC	Y	Y	NR	CD	N	Y	Y	Y	CD	N	Y	NR	Y	N	FAIR
Christou NV	Y	Y	NR	Y	N	Y	Y	N	Y	N	Y	NR	Y	N	FAIR
Coleman KJ	Y	Y	NR	Y	N	Y	Y	Y	CD	Y	Y	NR	Y	N	FAIR
Livhits M	Y	Y	Y	Y	N	N	CD	Y	Y	N	Y	NR	Y	Y	FAIR
Nelbom B	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	N	FAIR
Angrisani L	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	N	Y	FAIR
Novais PFS	Y	Y	CD	Y	N	N	CD	Y	Y	N	Y	NR	CD	N	FAIR
Mundi MS	Y	Y	N	Y	N	N	Y	Y	CD	N	Y	NR	N	N	POOR
Cazzo E	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	NR	Y	N	FAIR
Coleman KJ	Y	Y	Y	Y	Y	N	Y	Y	CD	N	Y	NR	Y	Y	FAIR
Ching SS	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	N	Y	FAIR
Fox B	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	NR	N	Y	FAIR
Hanvold SE	Y	Y	N	Y	N	CD	Y	Y	CD	N	Y	NR	N	Y	FAIR
Dilektasli E	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Garofalo F	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Raaff CAL	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Ruiz-Lozano T	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Wezenbeek MR	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	N	GOOD
Al-Khyatt W	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	N	GOOD
Novelli IR	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	NR	Y	Y	FAIR
Vázquez-Velázquez V	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Coppedè F	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD

Furtado MCMB	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	NR	Y	Y	FAIR
Ansar H	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Gutiérrez-Repiso C	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	NR	Y	Y	FAIR
Huang CW	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	NR	Y	Y	FAIR
Testa G	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Li K	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Saiki A	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Alvarez-Bermudez MD	Y	Y	CD	Y	N	Y	Y	Y	Y	N	Y	NR	CD	Y	FAIR
Benaiges D	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	NR	N	Y	FAIR
Ohira M	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Saiki A	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Cadena-Obando D	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Geerts MM	Y	Y	CD	Y	N	N	Y	Y	Y	N	Y	NR	CD	Y	FAIR
Gerken ALH	Y	Y	CD	Y	N	Y	Y	Y	Y	N	Y	NR	CD	Y	FAIR
Lim H	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Stefura T	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	N	FAIR
Ben-Porat T	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	NR	N	Y	FAIR
Bioletto F	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Ciudin A	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
D'Eusebio C	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Romeijn MM	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	NR	N	Y	FAIR
Stefura T	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	N	FAIR
Voglino C	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Yamaguchi T	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Grandt J	Y	Y	CD	Y	N	Y	Y	Y	Y	Y	Y	NR	N	Y	FAIR
Hany M	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	NR	Y	N	POOR
Nymo S	Y	Y	Y	Y	Y	N	N	Y	Y	N	Y	NR	Y	Y	FAIR
Nymo S	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	NR	Y	Y	FAIR
Stefura T	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	N	FAIR
Fink M	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Chen G	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Herrera-López S	Y	Y	N	Y	N	N	N	Y	CD	N	Y	NR	N	Y	POOR
Kashihara H	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	N	FAIR
Koca AO	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Li K	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD
Mallio CA	Y	Y	Y	Y	N	N	Y	Y	Y	N	Y	NR	Y	Y	FAIR
Stefura T	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	NR	Y	N	FAIR
Wuyun Q	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	N	FAIR
Cao Y	Y	Y	CD	Y	N	Y	Y	Y	Y	N	Y	NR	Y	Y	GOOD
Khattab MH	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	Y	Y	GOOD

Park JY	Y	Y	CD	Y	N	Y	Y	Y	Y	Y	Y	NR	N	Y	FAIR
Gadducci AV	Y	Y	CD	Y	N	Y	Y	Y	Y	Y	Y	NR	N	Y	FAIR
Lucocq J	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	NR	N	N	FAIR
Nymo S	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	NR	Y	Y	FAIR

Q: Question; Y: yes; N: No; CD: cannot determine; NA: non-applicable; NR: not reported

Risk of bias assessments are based on National Institutes of Health quality (NIH) assessment criteria for observational studies - this tool consists of a form with 14 Y(yes) or N (no) questions (related to the research question, study population, exposure, outcome, blinding, follow-up, and statistical analyses) and a final quality rating – G (good), F (fair), P (poor), classifying the study according to its potential risk of bias [6].

Q1. Was the research question or objective in this paper clearly stated? Q2. Was the study population clearly specified and defined?

Q3. Was the participation rate of eligible persons at least 50%?

Q4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?

Q5. Was a sample size justification, power description, or variance and effect estimates provided?

Q6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?

Q7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?

Q8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?

Q9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?

Q10. Was the exposure(s) assessed more than once over time?

Q11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?

Q12. Were the outcome assessors blinded to the exposure status of participants? Q13. Was loss to follow-up after baseline 20% or less?

Q14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?

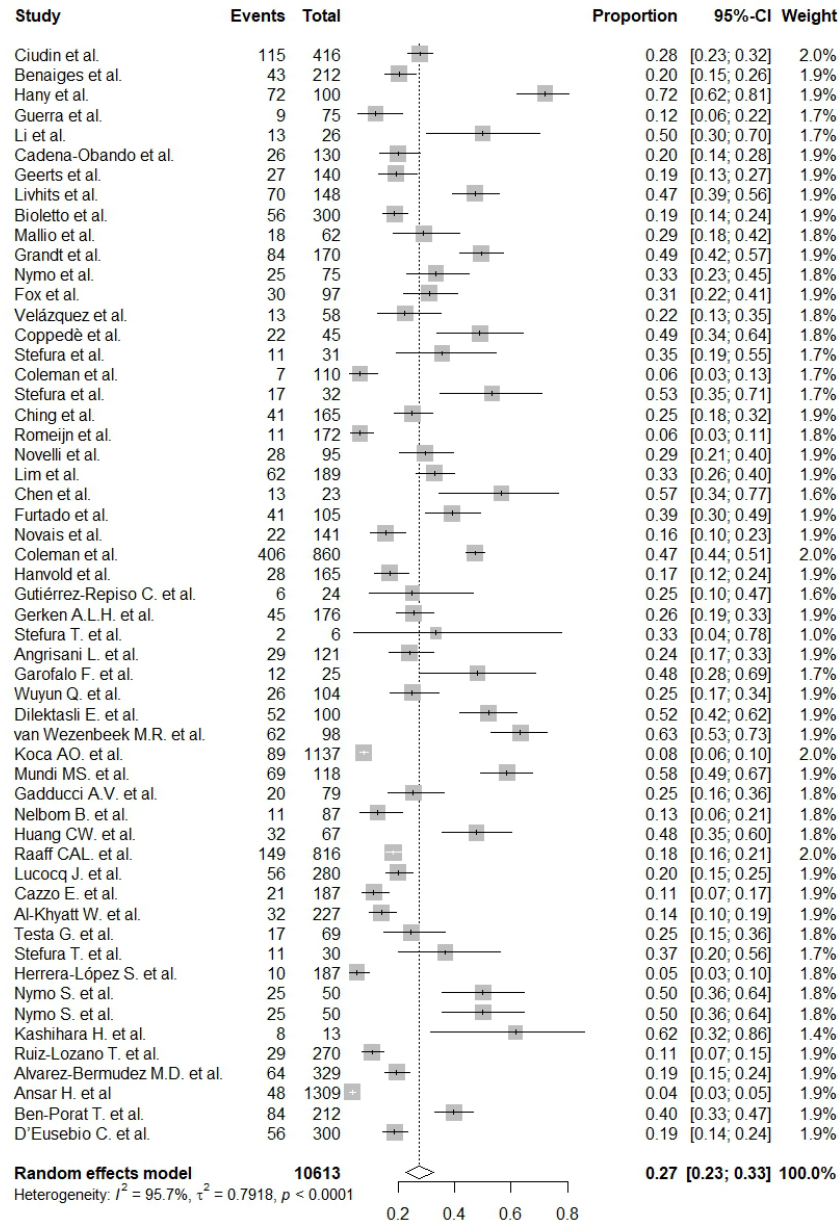


Figure S1- Forest Plot illustrating the prevalence of IWL following MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the proportion and 95% confidence intervals (CI) from fifty-five studies evaluating the prevalence of IWL following MBS, using the anthropometric criteria of EWL < 50%. The pooled proportion from the random-effects model is 0.27 (95%CI: 0.23 - 0.33; $I^2 = 95.7\%$; Q Cochran test $p < 0.0001$)

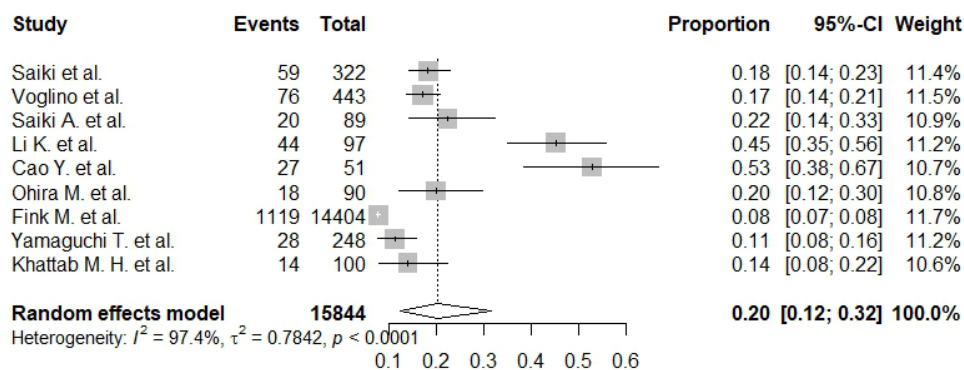


Figure S2 - Forest Plot illustrating the prevalence of IWL following MBS, using the anthropometric criteria $TWL < 20\%$. This forest plot presents the proportion and 95% confidence intervals (CI) from nine studies evaluating the prevalence of IWL following MBS, using the anthropometric criteria $TWL < 20\%$. The pooled proportion from the random-effects model is 0.20 (95%CI: 0.12-0.32; $I^2 = 97.4\%$; Q Cochran test $p < 0.0001$)

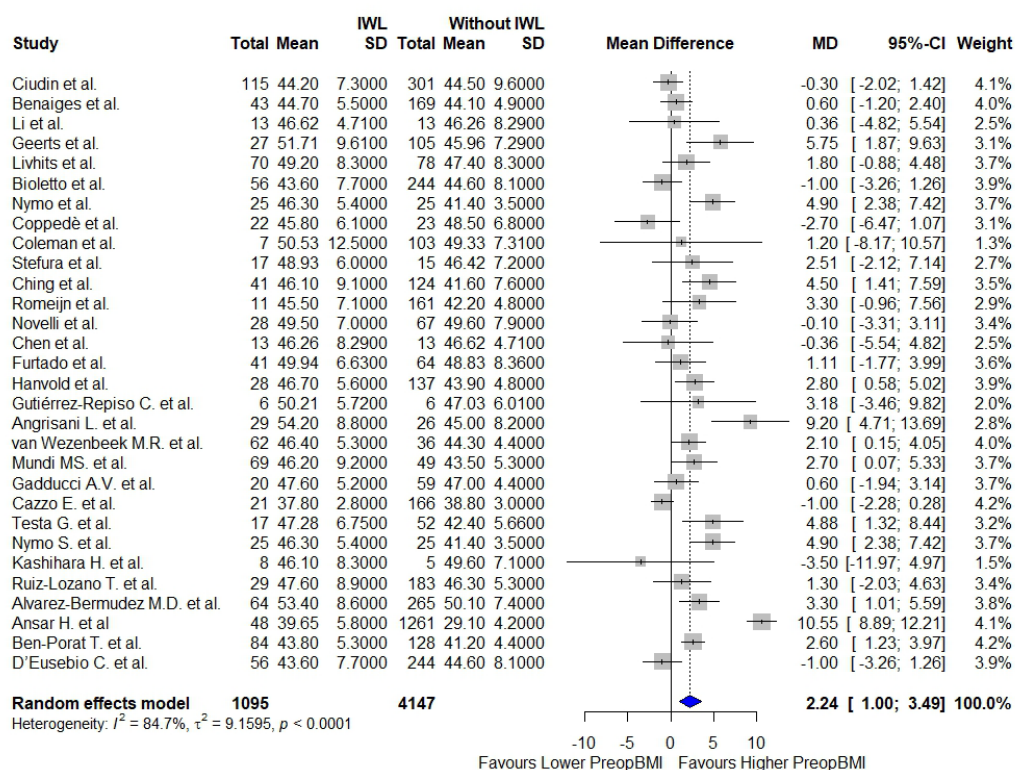


Figure S3 - Forest Plot illustrating the preoperative BMI of patients undergoing MBS, using the anthropometric criteria of $EWL < 50\%$ for IWL. This forest plot presents the Mean Difference (MD) and 95% confidence intervals (CI) from thirty-one studies evaluating preoperative BMI of patients undergoing MBS, using

the anthropometric criteria of EWL < 50% for IWL. The pooled MD from the random-effects model is 2.24 (95%CI: 1.00 – 3.49; $I^2=84.7\%$; Q Cochran test $p < 0.0001$)

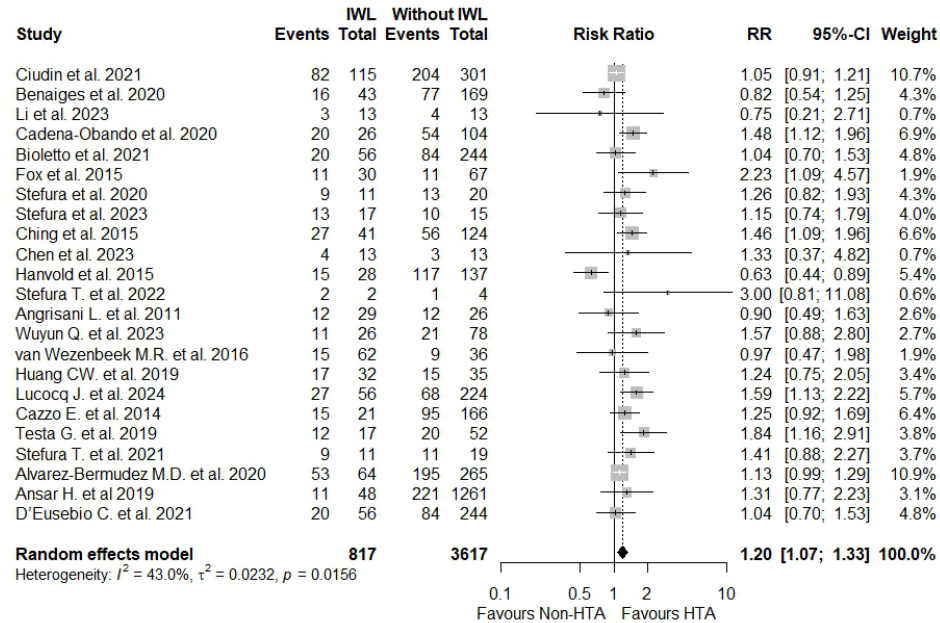


Figure S4- Forest Plot illustrating the association between HT and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from twenty-four studies evaluating the association between HT and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 1.20 (95% CI: 1.07–1.3; $I^2=43.0\%$; Q Cochran test $p = 0.0156$)

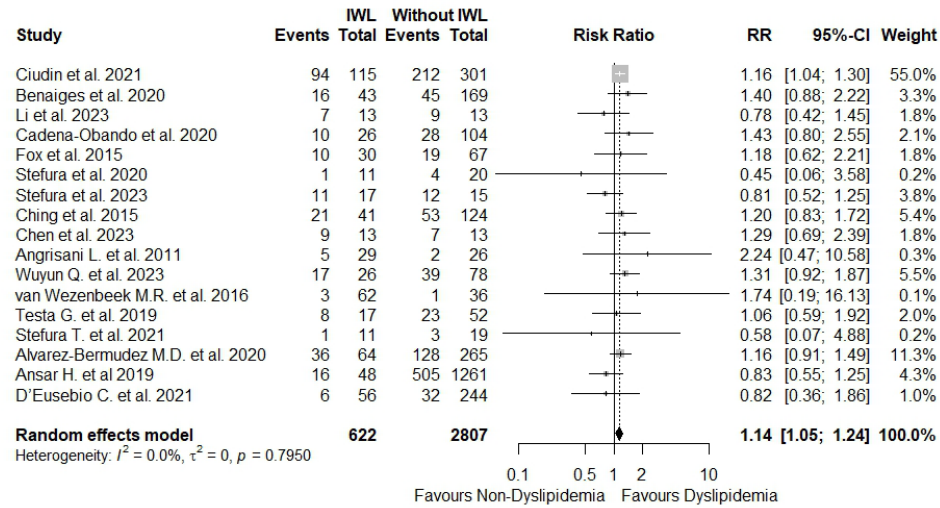


Figure S5 - Forest Plot illustrating the association between dyslipidemia and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from eighteen studies evaluating the association between dyslipidemia and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 1.14 (95% CI: 1.05–1.24; $I^2=0\%$; Q Cochran test $p = 0.7950$)

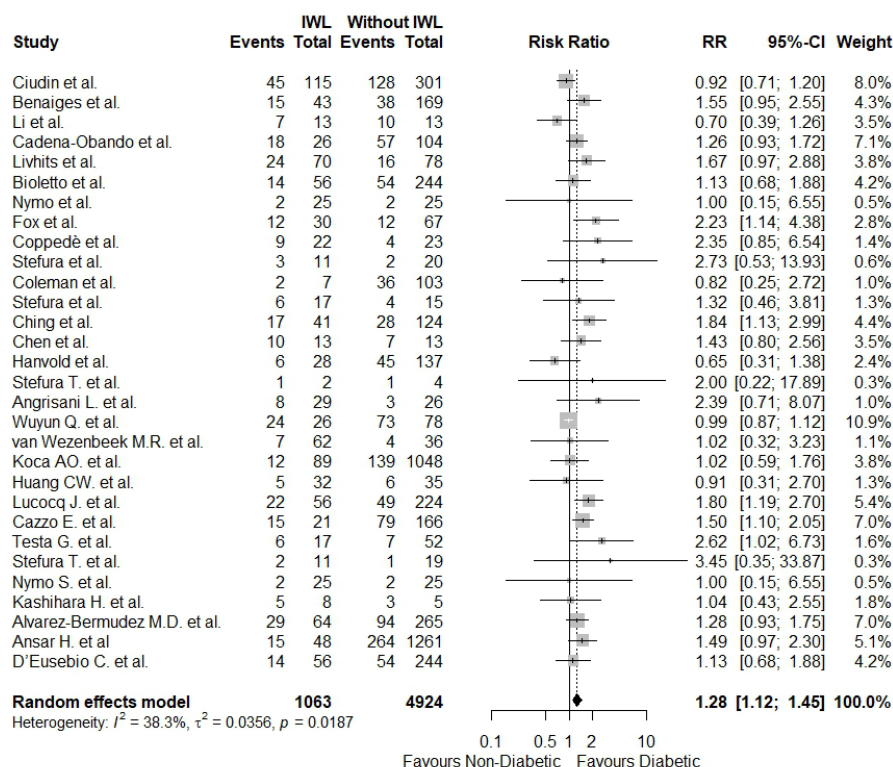


Figure S6 - Forest Plot illustrating the association between T2DM and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from thirty studies evaluating the association between T2DM and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 1.28 (95% CI: 1.12–1.45, $I^2=38.3\%$; Q Cochran test $p = 0.0187$)

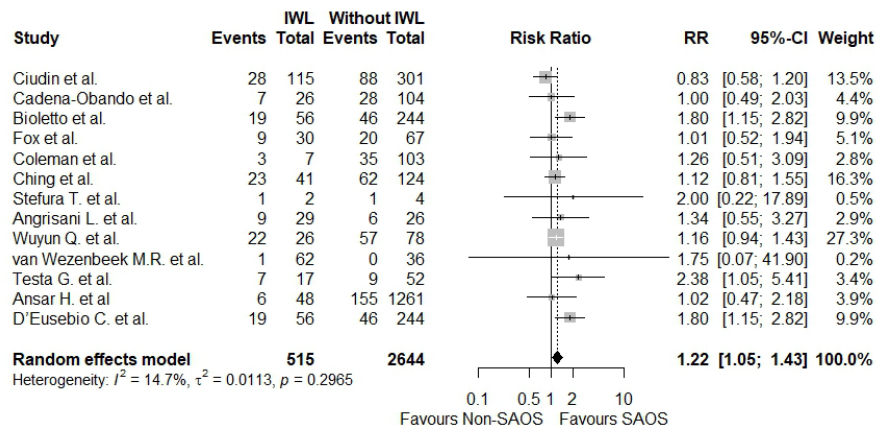


Figure S7 - Forest Plot illustrating the association between OSA and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from twelve studies evaluating the association between OSA and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 1.22 (95% CI: 1.05–1.43, $I^2=14.7\%$; Q Cochran test $p = 0.0113$)

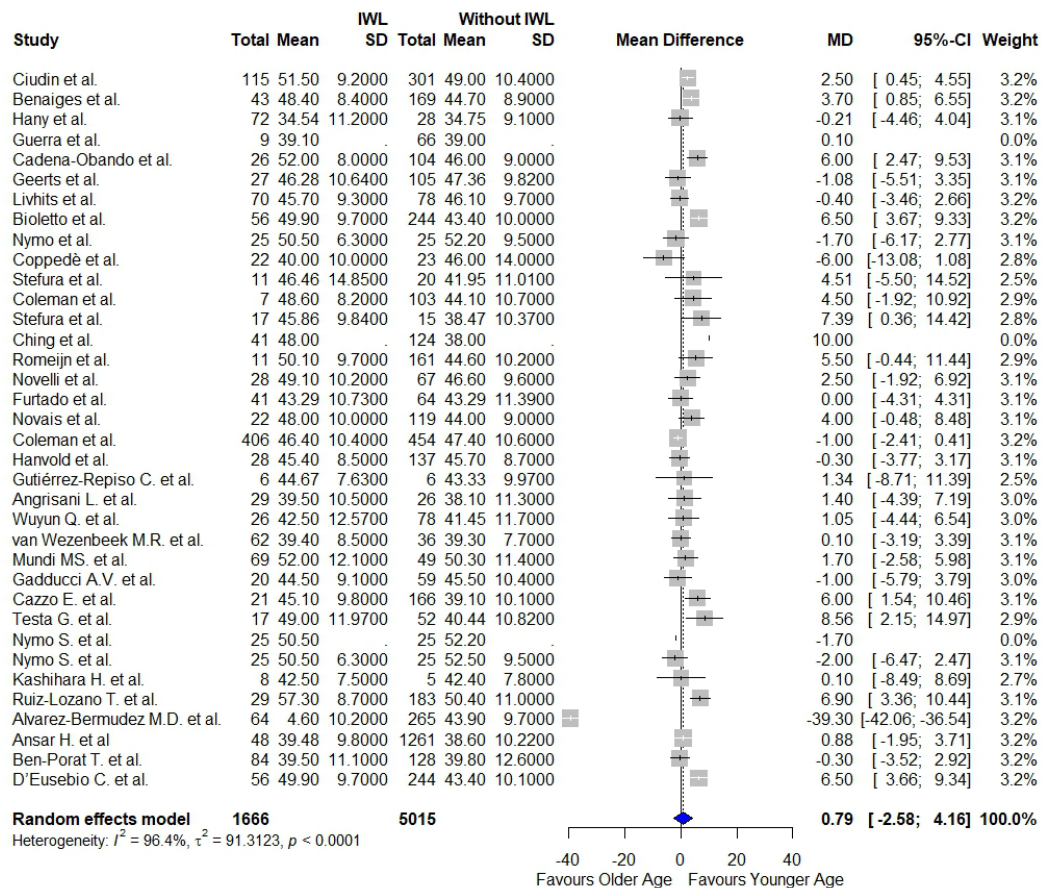


Figure S8 - Forest Plot illustrating the mean age of patients undergoing MBS, using the anthropometric criteria of EWL < 50% for IWL. This forest plot presents the Mean Difference (MD) and 95% confidence intervals (CI) from thirty-five studies evaluating the mean age of patients undergoing MBS, using the anthropometric criteria of EWL < 50% for IWL. The pooled MD from the random-effects model is 0.79 (95% CI: -2.58–4.16, $I^2=96.4\%$; Q Cochran test $p<0.0001$)

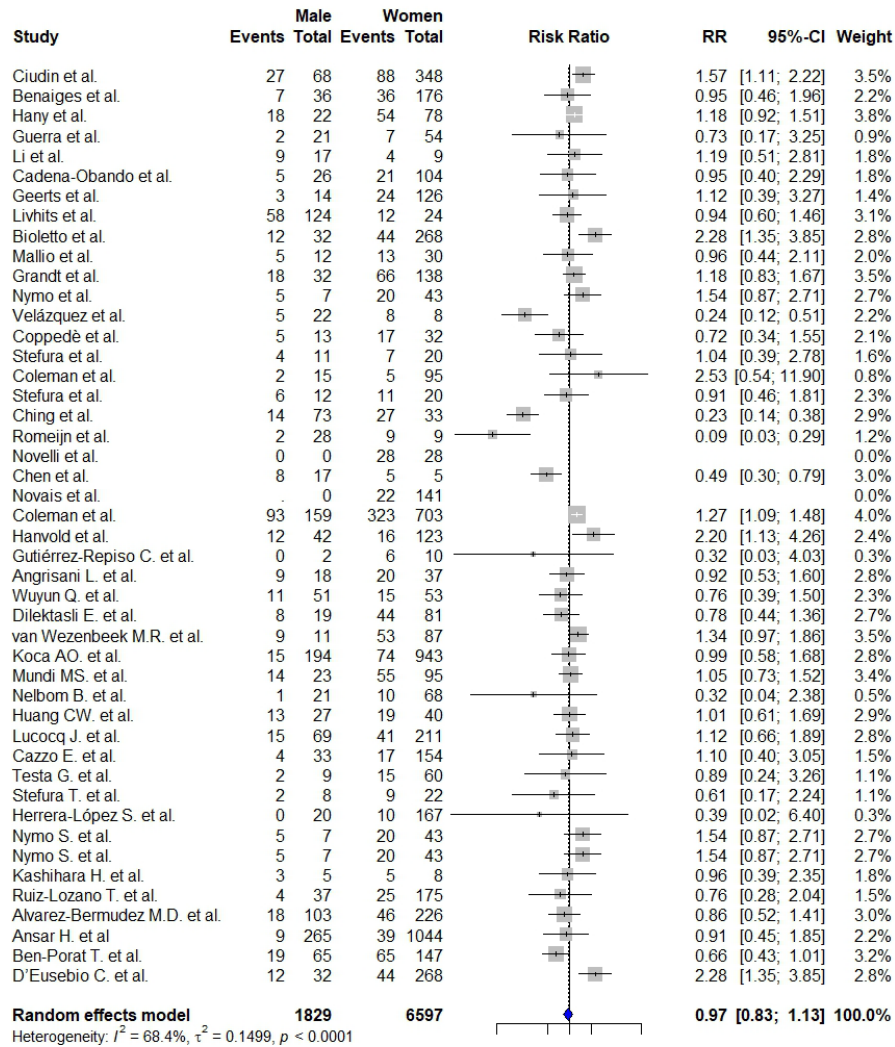


Figure S9 - Forest Plot illustrating the association between gender and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from forty-two studies evaluating the association between gender and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 0.97 (95% CI: 0.83–1.13, $I^2=68.4\%$; Q Cochran test $p<0.0001$)

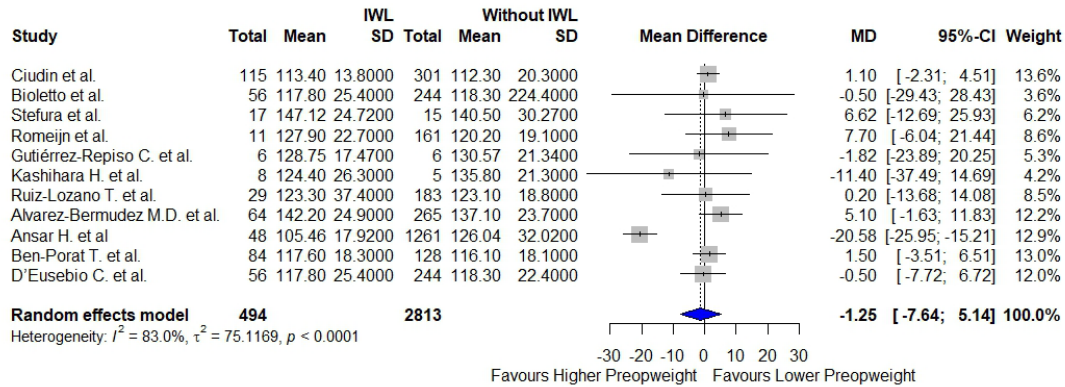


Figure S10 - Forest Plot illustrating the preoperative weight of patients undergoing MBS, using the anthropometric criteria of EWL < 50% for IWL. This forest plot presents the Mean Difference (MD) and 95% confidence intervals (CI) from ten studies evaluating preoperative weight of patients undergoing MBS, using the anthropometric criteria of EWL < 50% for IWL. The pooled MD from the random-effects model is -1.25 (95% CI: -7.64 – 5.14; $I^2=83.0\%$; Q Cochran test $p<0.0001$)

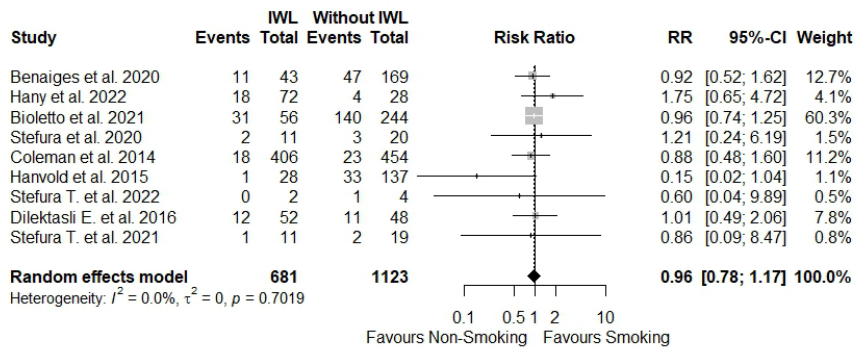


Figure S11 - Forest Plot illustrating the association between smoking and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from nine studies evaluating the association between smoking and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 0.96 (95% CI: 0.78–1.17; $I^2=0\%$; Q Cochran test $p=0.7019$)

Leave-one-out meta-analysis

	RR	95%-CI	p-value	tau ²	tau I ²			
Omitting Cludin et al. 2021	1.1115	[0.9807; 1.2598]	0.0980	0	0	0%		
Omitting Benaiges et al. 2020	1.1303	[1.0377; 1.2311]	0.0050	0	0	0%		
Omitting Li et al. 2023	1.1464	[1.0532; 1.2478]	0.0016	0	0	0%		
Omitting Cadena-Obando et al. 2020	1.1327	[1.0405; 1.2330]	0.0040	0	0	0%		
Omitting Fox et al. 2015	1.1376	[1.0451; 1.2382]	0.0029	0	0	0%		
Omitting Stefura et al. 2020	1.1400	[1.0481; 1.2399]	0.0023	0	0	0%		
Omitting Stefura et al. 2023	1.1535	[1.0589; 1.2567]	0.0011	0	0	0%		
Omitting Ching et al. 2015	1.1349	[1.0410; 1.2372]	0.0041	0	0	0%		
Omitting Chen et al. 2023	1.1356	[1.0433; 1.2361]	0.0033	0	0	0%		
Omitting Angrisani L. et al. 2011	1.1360	[1.0443; 1.2356]	0.0030	0	0	0%		
Omitting Wuyun Q. et al. 2023	1.1290	[1.0355; 1.2309]	0.0059	0	0	0%		
Omitting van Wezenbeek M.R. et al. 2016	1.1375	[1.0458; 1.2373]	0.0027	0	0	0%		
Omitting Testa G. et al. 2019	1.1398	[1.0471; 1.2408]	0.0025	0	0	0%		
Omitting Stefura T. et al. 2021	1.1394	[1.0476; 1.2393]	0.0023	0	0	0%		
Omitting Alvarez-Bermudez M.D. et al. 2020	1.1349	[1.0381; 1.2408]	0.0054	0	0	0%		
Omitting Ansar H. et al. 2019	1.1543	[1.0593; 1.2578]	0.0011	0	0	0%		
Omitting D'Eusebio C. et al. 2021	1.1422	[1.0497; 1.2428]	0.0020	0	0	0%		
Random effects model	1.1382	[1.0465; 1.2380]	0.0025	0	0	0%		

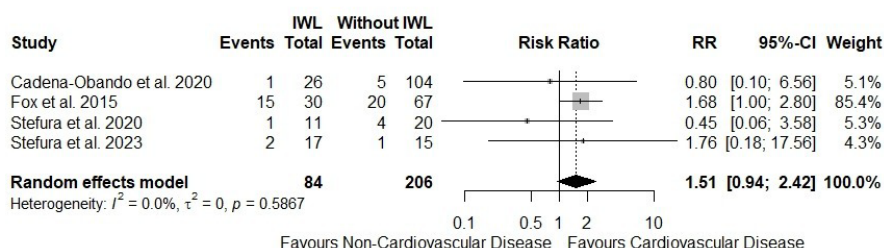


Figure S12 - Forest Plot illustrating the association between cardiovascular disease and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from four studies evaluating the association between cardiovascular disease and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 1.51 (95% CI: 0.94–2.42; $I^2=0\%$; Q Cochran test $p=0.5867$)

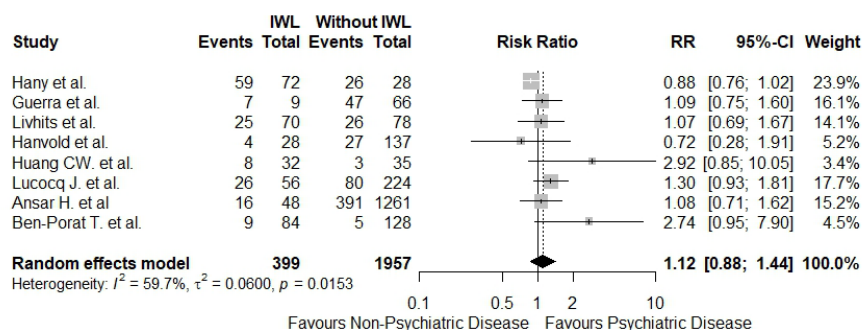


Figure S13 - Forest Plot illustrating the association between psychiatric disorders and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from eight studies evaluating the association between psychiatric disorders and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 1.12 (95% CI: 0.88–1.44; $I^2=59.7\%$; Q Cochran test $p=0.0153$)

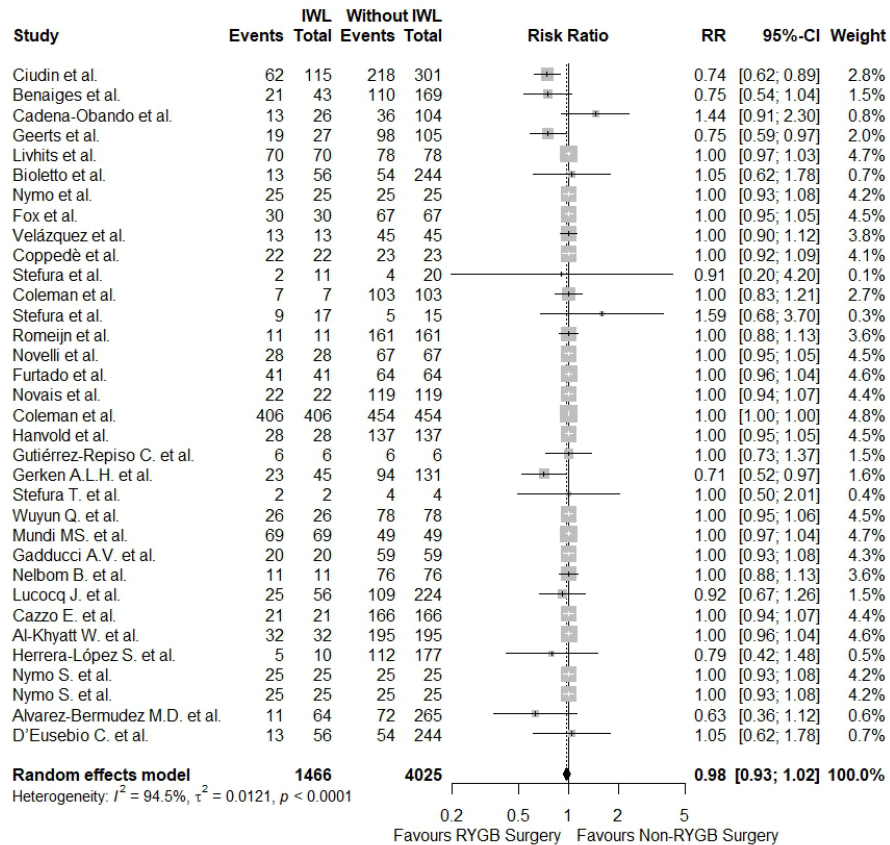


Figure S14- Forest Plot illustrating the association between RYGB and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from thirty-five studies evaluating the association between RYGB and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 0.98 (95% CI: 0.93–1.02; $I^2=94.5\%$; Q Cochran test $p<0.0001$)

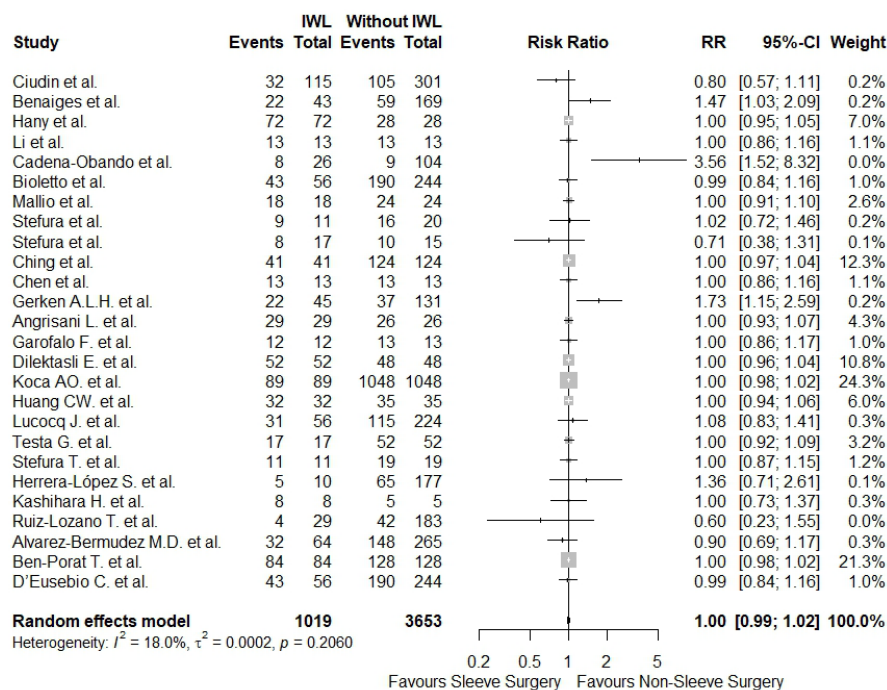


Figure S15 - Forest Plot illustrating the association between SG and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from twenty-five studies evaluating the association between SG and IWL, after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 1.00 (95% CI: 0.99–1.02; $I^2=18.0\%$; Q Cochran test $p = 0.2060$)

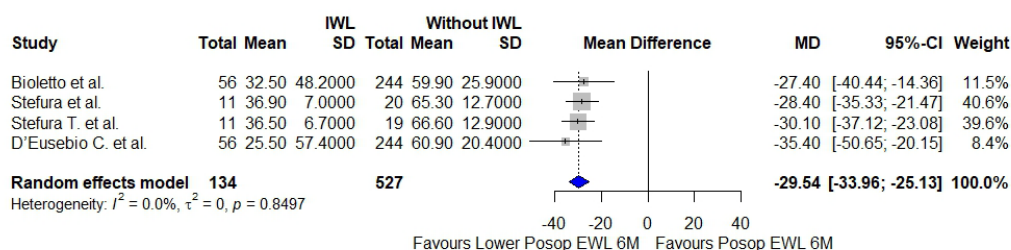


Figure S16 - Forest Plot illustrating the %EWL six months of patients undergoing MBS, using the anthropometric criteria of EWL < 50% for IWL. This forest plot presents the Mean Difference (MD) and 95% confidence intervals (CI) from four studies evaluating %EWL six months of patients undergoing MBS, using the anthropometric criteria of EWL < 50% for IWL. The mean difference is -29.54% (95% CI: -33.96 - -25.13; $I^2=0\%$; Q Cochran test $p = 0.8497$)

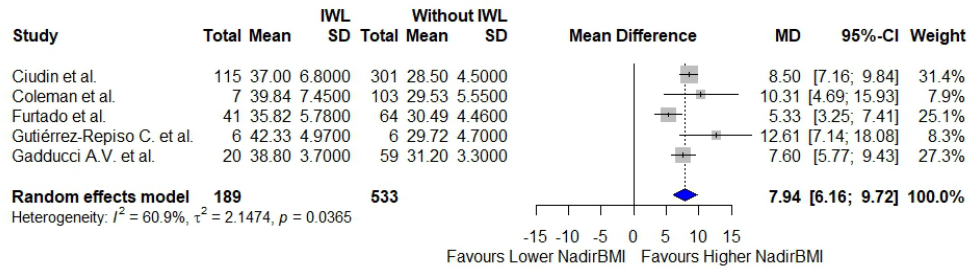


Figure S17 - Forest Plot of nadir BMI of patients undergoing MBS, using the anthropometric criteria of EWL < 50% for IWL. This forest plot presents the Mean Difference (MD) and 95% confidence intervals (CI) from four studies evaluating nadir BMI of patients undergoing MBS, using the anthropometric criteria of EWL < 50% for IWL. The mean difference is 7.94% (95%CI: 6.16-9.72; $I^2=60.9\%$; Q Cochran test $p = 0.0365$)

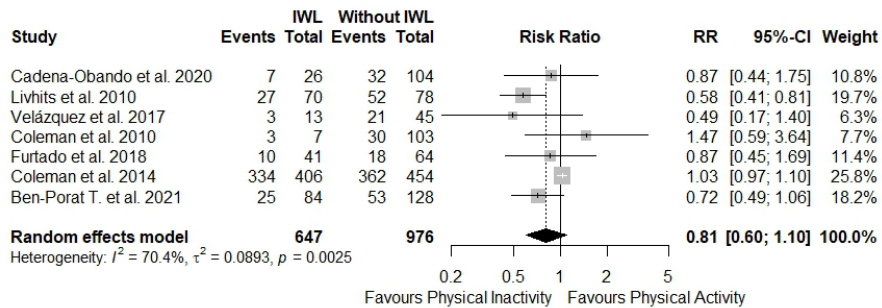


Figure S18 - Forest Plot illustrating the association between physical activity and IWL after MBS, using the anthropometric criteria of EWL < 50%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from seven studies evaluating the association between physical activity and IWL after MBS, using the anthropometric criteria of EWL < 50%. The pooled RR from the random-effects model is 0.81 (95%CI: 0.60–1.10; $I^2=70.4\%$; Q Cochran test $p = 0.0025$)

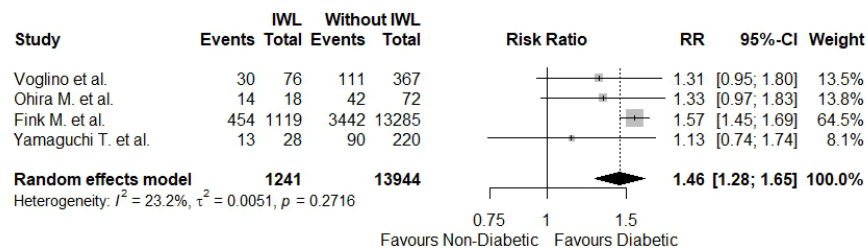


Figure S19 - Forest Plot association between T2DM and IWL after MBS, using the anthropometric criteria of TWL<20%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from four studies evaluating the association between T2DM and IWL after MBS, using the anthropometric criteria of

TWL<20%. The pooled RR from the random-effects model is 1.46 (95% CI: 1.28–1.65; $I^2=23.2\%$; Q Cochran test $p = 0.2716$)

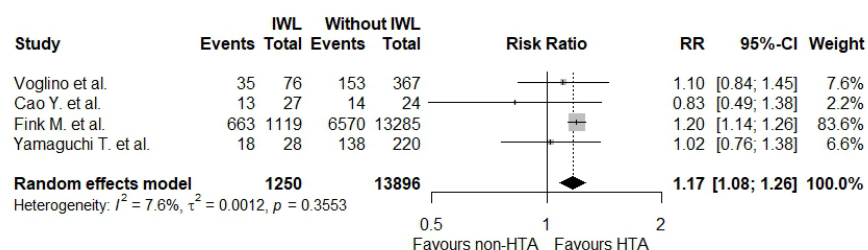


Figure S20 - Forest Plot illustrating the association between HT and IWL after MBS, using the anthropometric criteria of TWL<20%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from four studies evaluating the association between HT and IWL after MBS, using the anthropometric criteria of TWL<20%. The pooled RR from the random-effects model is 1.17 (95% CI: 1.08–1.26; $I^2=7.6\%$; Q Cochran test $p = 0.3553$)

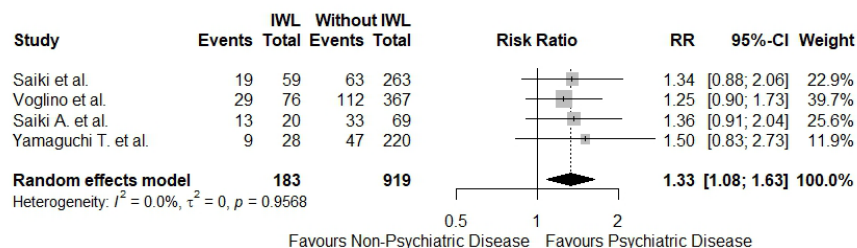


Figure S21 - Forest Plot illustrating the association between Psychiatric Disorders and IWL after MBS, using the anthropometric criteria of TWL<20%. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from four studies evaluating the association between psychiatric disorders and IWL after MBS, using the anthropometric criteria of TWL<20%. The pooled RR from the random-effects model is 1.33 (95% CI: 1.08–1.63; $I^2=0\%$; Q Cochran test $p = 0.9568$)

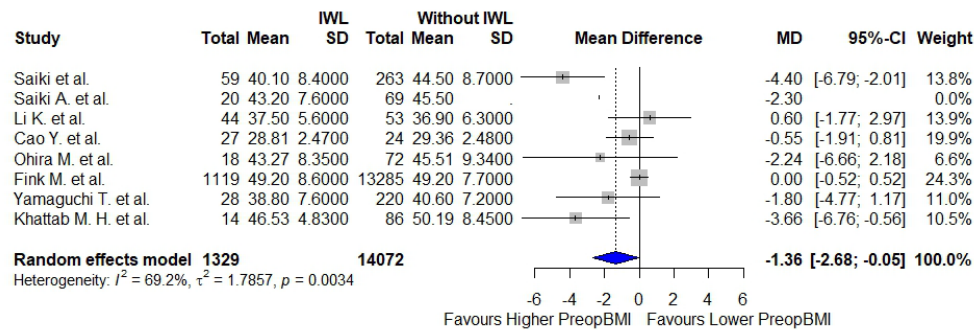


Figure S22 - Forest Plot illustrating the preoperative BMI of patients undergoing MBS, using the anthropometric criteria of $TWL < 20\%$ for IWL. This forest plot presents the Mean Difference (MD) and 95% confidence intervals (CI) from eight studies evaluating preoperative BMI of patients undergoing, using the anthropometric criteria of $TWL < 20\%$ for IWL. The mean difference is -1.36 (95%CI: -2.68 - -0.05; $I^2 = 69.2\%$; Q Cochran test $p = 0.0034$)

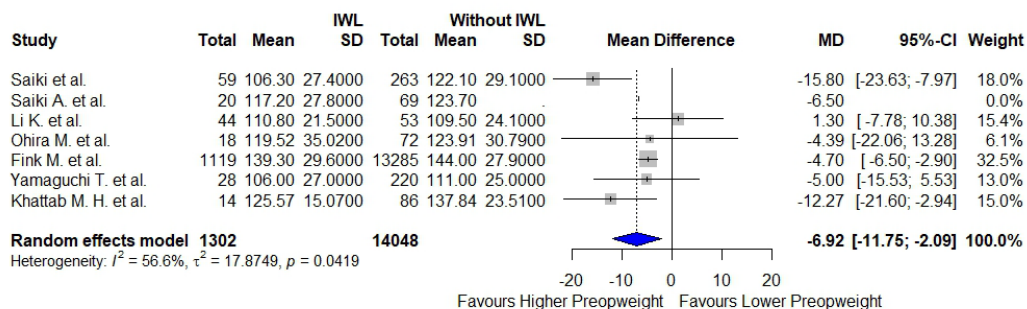


Figure S23 - Forest Plot illustrating the preoperative weight of patients undergoing MBS, using the anthropometric criteria of $TWL < 20\%$ for IWL. This forest plot presents the Mean Difference (MD) and 95% confidence intervals (CI) from seven studies evaluating preoperative weight and IWL after MBS, using the anthropometric criteria of $TWL < 20\%$ for IWL. The mean difference is -6.92 (95%CI: -11.75 - -2.09; $I^2 = 56.6\%$; Q Cochran test $p = 0.0419$)

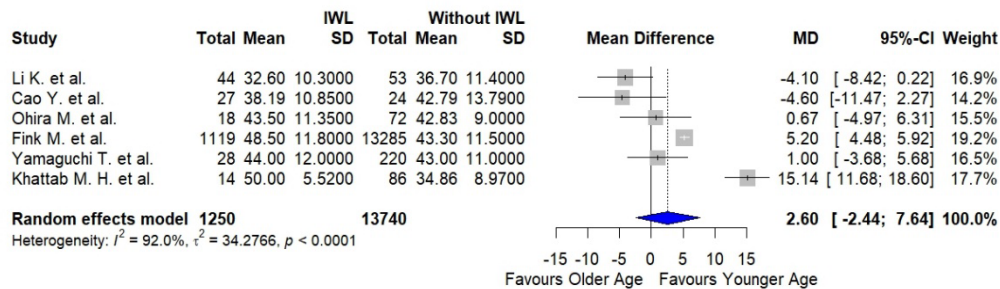


Figure S24 - Forest Plot illustrating the age of patients undergoing MBS, using the anthropometric criteria of $TWL < 20\%$ for IWL. This forest plot presents the Mean Difference (MD) and 95% confidence intervals (CI) from six studies evaluating the age of patients undergoing MBS, using the anthropometric criteria of $TWL < 20\%$ for IWL. The mean difference is 2.6 (95%CI: -2.44 - 7.64; $I^2 = 92.0\%$; Q Cochran test $p < 0.0001$)

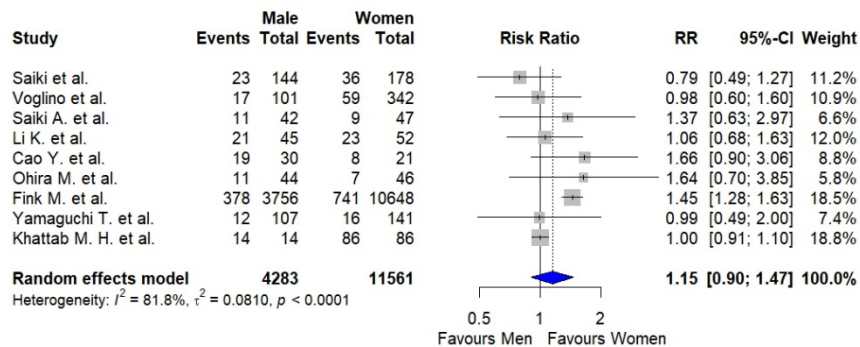


Figure S25 - Forest Plot illustrating the association between gender and IWL after MBS, using the anthropometric criteria of $TWL < 20\%$. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from nine studies evaluating the association between gender and IWL, using the anthropometric criteria of $TWL < 20\%$. The pooled RR from the random-effects model is 1.15 (95% CI: 0.90–1.47; $I^2 = 81.1\%$; Q Cochran test $p < 0.0001$)

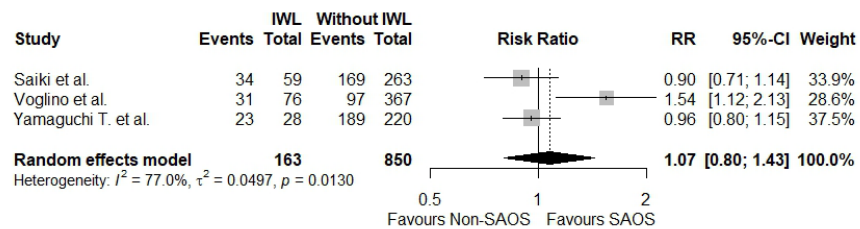


Figure S26 - Forest Plot illustrating the association between OSA and IWL after MBS, using the anthropometric criteria of $TWL < 20\%$. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from three studies evaluating the association between OSA and IWL, using the anthropometric criteria of $TWL < 20\%$. The pooled RR from the random-effects model is 1.07 (95% CI: 0.80–1.43; $I^2 = 77.0\%$; Q Cochran test $p = 0.0130$)

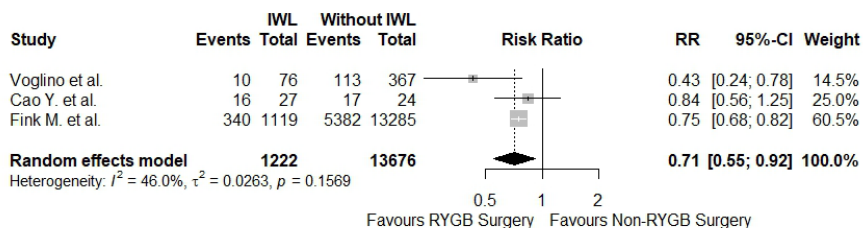


Figure S27 - Forest Plot illustrating the association between RYGB and IWL after MBS, using the anthropometric criteria of $TWL < 20\%$. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from three studies evaluating the association between RYGB and IWL, using the anthropometric criteria of $TWL < 20\%$. The pooled RR from the random-effects model is 0.71 (95% CI: 0.55–0.92; $I^2 = 46.0\%$; Q Cochran test $p = 0.1569$)

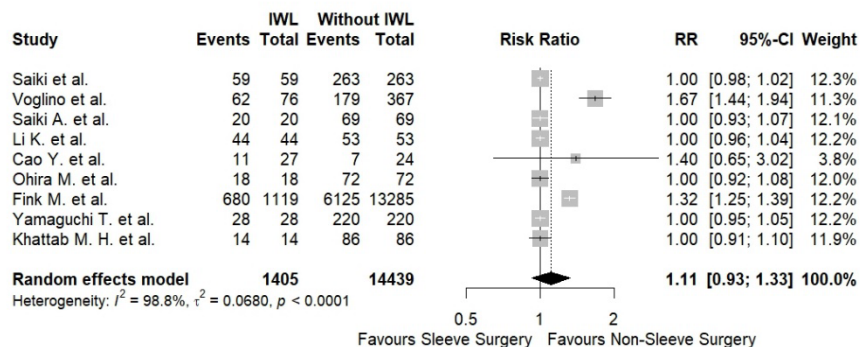


Figure S28 - Forest Plot illustrating the association between SG and IWL after MBS, using the anthropometric criteria of $TWL < 20\%$. This forest plot presents the risk ratios (RR) and 95% confidence intervals (CI) from nine studies evaluating the association between SG and IWL, using the anthropometric criteria of $TWL < 20\%$.

intervals (CI) from nine studies evaluating the association between SG and IWL, using the anthropometric criteria of TWL<20%. The pooled RR from the random-effects model is 1.11 (95% CI: 0.93–1.33; $I^2=98.8\%$; Q Cochran test $p=0.0680$)



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page and paragraph/ table #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	Page 1, 2, 4 & 7
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria; participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	Page 8 & 9
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	Page 10 (paragraph 2 & 3)
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	Page 10 "This review aims to synthesize current definitions of IWL in recent literature and examine its most consistently identified predictors."
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Not registered
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	Page 11 (Paragraph 2,3) "We included all observational studies (OBSs) involving adults (>18 years) who underwent MBS and reported IWL after surgery. MBS was defined as an obesity treatment for patients with a BMI $\geq$ 40 kg/m ² or a BMI $\geq$ 35 kg/m ² with weight-related comorbidities. As there is no standard definition of IWL, the most common definitions, based on the American Society for Metabolic and

			Bariatric Surgery (ASMBS) Task Force's and IFSO guidelines, were collected (Table S1) [2, 3]. Exclusion criteria were the following ones: (i) systematic reviews, case reports, editorials, letters to authors, ecological studies; (ii) studies in which data could not be extracted from the pooled results; (iii) studies focused solely on description of revisional MBS techniques; (v) studies stating IWL after revisional MBS."
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	Page 11 (paragraph 4,5) & 12 "In March 2024, a SR of the available literature was conducted using three search databases - PubMed, Scopus, and Web of Science. Search queries are detailed in Table S2). In addition, references of included primary articles and other relevant reviews were hand-searched. No restrictions were set for language or publication year."
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Page 11 (Paragraph 4; Supplementary Table S2) "Search queries are detailed in Table S2."
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	Page 12 (Paragraph 1): "After removing the duplicates, study selection was conducted independently by two authors (M.C. and A.M.) in two separate phases. Firstly, the articles were searched by title and abstract. Subsequently, articles not excluded in the first phase were selected based on their full-text reading. Any disagreements were discussed between the reviewers and a third author (F.A.C.)."
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	Page 12 (Paragraph 2) "Data were independently extracted by two authors (M.C. and A.M.) from selected studies (...)"
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	Page 12 (Paragraph 2) "For each primary study, the following information was retrieved: authors identification, year of publication, years of enrollment, study design, country, eligibility and exclusion criteria of each study, number of enrolled patients, definition of IWL in each study, anthropometric criteria, type

			of primary MBS, patients social, epidemiological and clinical characteristics, follow-up period, number of patients with and without IWL after MBS, based on ASMBS or IFSO guidelines [2, 3]. For the identification of clinically significant predictors of IWL, the additional following information was retrieved: (i) preoperative predictors: age, gender, preoperative weight and BMI, smoking, comorbidities such as diabetes mellitus type 2 (DMT2), hypertension (HT), dyslipidemia, cardiovascular disease, obstructive sleep apnea (OSA) and psychiatric disorders; (ii) intraoperative factors – type of primary MBS used; (iii) postoperative factors nadir BMI, %EWL at 6 months and physical activity.”
Risk of bias in individual studies / Risk of bias across studies	12/ 15	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	Page 13 (paragraph 2) “The quality of the studies was independently assessed by two reviewers (M.C. and A.M.) using the National Institutes of Health quality assessment criteria for OBSs (8). This tool consists of a series of 14 yes-or-no questions (about the research question, study population, exposure, outcome, blinding, follow-up and statistical analysis) resulting in a final quality rating (Good, Fair, or Poor) (Supplementary Table S3 and S3.1). To reach a consensus, divergent opinions regarding quality assessment were discussed with a third reviewer (F.A.C.).
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	Page 13 (paragraph 3) “A random-effects meta-analysis was conducted to synthesize the results of multiple cohort studies. Given the potential heterogeneity among studies, the DerSimonian and Laird random-effects model was applied, allowing for variations in true effect sizes across studies rather than assuming a single common effect [7].”
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	Page 13 (paragraph 4) “Risk ratio (RR) with 95% confidence intervals (CIs) were used to quantify the association between different factors and the outcome of interest. Statistical significance was assessed using p-

			values, with a threshold of $p < 0.05$. If a risk factor was pooled in three or more primary studies, a meta-analysis was performed. Heterogeneity was assessed using the Q-Cochran test statistic, p-value, and the I ² statistic. For the Q-Cochran test statistic, p-values < 0.10 were considered to indicate significant heterogeneity. For the I ² statistic, I ² values above 50% indicate substantial heterogeneity, suggesting that the variation in results is not solely due to chance [5]. Heterogeneity sources were explored through leave-one-out sensitivity analyses. Statistical analysis was performed using R statistical software (version 2025.05.0), with the use of the “meta”, “metafor”, and “dmetar” packages [8]
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	Not
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Page 16 (paragraph 1) “The electronic literature search yielded 12,486 articles, of which 7,777 were duplicates. After excluding 4,709 records during the screening phase, 471 articles were fully reviewed. Ultimately, 66 studies [9-74] were included in the qualitative synthesis, while 65 [9-73] were included in the quantitative synthesis (Figure 1).”
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Page 16 (paragraph 2) “A summary of included studies is presented in Table 1. Of the 66 articles included, 15 were cross-sectional studies [14, 15, 17, 19, 27, 28, 31, 43, 48, 53-55, 59, 72, 74], 15 were prospective cohort studies [9, 12, 13, 22, 30, 35, 36, 42, 49, 51, 56, 64, 66, 69-71], and 36 were retrospective cohort studies [10, 11, 16, 18, 20, 21, 23-26, 29, 32-34, 37-41, 44-47, 50, 52, 57, 58, 60-63, 65, 67, 68, 73].”
Risk of bias within and across studies	19/22	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Page 21 (paragraph 3) “The results of the risk of bias assessments for included primary observational studies are presented in Table S2, detailed description is reported in Table S2.1. Overall, this study was considered to have an intermediate risk of bias. The

			assessment of individual observational studies was very varied with 29 studies classified as Good, 33 as Fair and 4 as Poor. Many studies did not include a sample size justification (Q5) and in several studies, the exposure of interest was not measured prior to the outcome (Q6). Furthermore, blinding to the exposure status (Q12) was rarely reported. Finally, a significant number of studies did not make a multivariable adjustment (Q14), limiting the ability to find confounding factors that may influence weight loss outcomes."
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	(a) Page 9,10 (b) Page 14-20
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	Page 14: "Firstly, focusing on %EWL<50, through meta-analysis, a total of 10,613 patients were included, revealing a pooled proportion of IWL after MBS of 27% (95% CI: 23%–33%, Supplementary Figure S1), indicating that more than one in four patients may not achieve satisfactory weight loss outcomes postoperatively. High heterogeneity was observed ($I^2 = 95.7\%$, Q Cochran test $p<0.0001$). Each study contributes approximately equally to the overall analysis (around 1.9%), with slight variations based on sample size and variance" Page 15: "Regarding %TWL < 20%, a total sample size of 15,844 patients across 10 primary studies was included in this quantitative analysis. The pooled IWL proportion, following MBS, was 20% (95% CI: 12%–32%, Supplementary Figure S2), based on a random-effects model. The results show significant heterogeneity among the studies ($I^2 = 97.4\%$, $p < 0.0001$), indicating considerable variation in study outcomes." Page 17: "However, IWL did not significantly correlate with age (MD = 0.79; 95% CI [-2.58, 4.16], $I^2=96.4\%$; Q Cochran test $p<0.0001$,

		Supplementary Figure S8), gender (RR = 0.97; 95% CI [0.83, 1.13], I²=68.4%; Q Cochran test p<0.0001, Supplementary Figure S9), preoperative weight (MD = -1.25; 95% CI [-7.64, 5.24], I²=83.0%; Q Cochran test p<0.0001, Supplementary Figure S10), current smoking status (RR = 0.96; 95% CI [0.78, 1.17], I²=0%; Q Cochran test p=0.7019, Supplementary Figure S11), cardiovascular disease (RR = 1.51; 95% CI [0.94, 2.42], I²=0%; Q Cochran test p=0.5867, Supplementary Figure S12), or psychiatric disorders (RR = 1.12; 95% CI [0.88, 1.44], I²=59.7%; Q Cochran test p=0.0153, Supplementary Figure S13). These results suggest that while some comorbidities appear to play an important role, other demographic or clinical characteristics are not independent factors in predicting weight loss failure. Regarding the surgical technique, no significant differences were found in the incidence of IWL. RYGB was associated with a relative risk of 0.98 (95% CI [0.93, 1.02], I²=94.5%; Q Cochran test p<0.0001, Supplementary Figure S14), while SG showed a neutral risk (RR = 1.00; 95% CI [0.99, 1.02], I²=18.0%; Q Cochran test p = 0.2060; Supplementary Figure S15). These findings suggest that the surgical technique alone is not a decisive factor in predicting long-term weight outcomes. Postoperative data showed that patients with IWL had a significantly lower %EWL at 6 months (MD = -29.54; 95% CI [-33.64, -25.13]; I²=0%; Q Cochran
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		test $p = 0.8497$; Supplementary Figure S16), highlighting the importance of early postoperative weight loss as a predictor of long-term success. Furthermore, a significantly higher nadir BMI was observed in patients who had IWL (MD = 7.94; 95% CI [6.16, 9.72]; $I^2=60.9\%$; Q Cochran test $p = 0.0365$; Supplementary Figure S17), thereby reinforcing the importance of sustained weight reduction beyond the initial postoperative phase. The present study demonstrated that physical activity post-surgery exhibited a tendency to decrease the likelihood of IWL, although this decrease did not attain statistical significance (RR = 0.81; 95% CI [0.60, 1.10], $I^2=70.4\%$; Q Cochran test $p = 0.0025$; Supplementary Figure S18).” Page 19: “Analysis of preoperative characteristics revealed a significant association between T2DM and an increased risk of IWL after MBS (RR = 1.46; 95% CI [1.28, 1.65]; $I^2=23.2\%$; Q Cochran test $p = 0.2716$; Supplementary Figure S19), suggesting that underlying metabolic dysregulation may” Page 20: “negatively influence weight loss outcomes despite surgical intervention. Similarly, HT was also significantly related to IWL (RR = 1.17; 95% CI [1.08, 1.26], $I^2=7.6\%$; Q Cochran test $p = 0.3553$; Supplementary Figure S20), reinforcing the influence of cardiometabolic dysfunction in attenuating the benefits of surgery. These findings emphasize that the presence of metabolic comorbidities can compromise the surgical response, even in technically
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		successful procedures. Psychiatric disorders also showed a significant association with a higher risk of IWL (RR = 1.33; 95% CI [1.08, 1.63], I²=0%; Q Cochran test p = 0.9568; Supplementary Figure S21), suggesting that mental health plays a central role in adherence to the lifestyle changes required in the postoperative period. This result reinforces the need for structured psychological assessment in the preoperative period and continued support after surgery. From an anthropometric point of view, an inverse association was observed between preoperative BMI and preoperative weight and the risk of IWL. Patients who experienced IWL had significantly lower preoperative BMI (MD = -1.36; 95% CI [-2.68, -0.05]; I²=69.2%; Q Cochran test p = 0.0034; Supplementary Figure S22) and preoperative weight (MD = -6.92; 95% CI [-11.75, -2.09], I²=56.6%; Q Cochran test p = 0.0419; Supplementary Figure S23). This paradox can be explained by the fact that individuals with less severe obesity have a smaller absolute weight margin and/or different metabolic profiles, which may put them at greater risk of failing to reach clinically meaningful weight loss thresholds. In contrast, variables such as age (MD = 2.60; 95% CI [-2.44, 7.64]; I²=92.0%; Q Cochran test p <0.0001; Supplementary Figure S24), gender (RR = 1.15; 95% CI [0.90, 1.47], I²=81.1%; Q Cochran test p <0.0001; Supplementary Figure S25) were not significantly associated with IWL, although heterogeneity across studies was
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			considerable. Similarly, OSA showed no significant” Page 21: “association (RR = 1.07; 95% CI [0.80, 1.43]; I2=77.0%; Q Cochran test p =0.0130; Supplementary Figure S26), although the data for this condition were limited to three studies and exhibited moderate heterogeneity. Regarding intraoperative factors, patients undergoing RYGB were significantly less likely to experience IWL compared to other procedures (RR = 0.71; 95% CI [0.55, 0.92]; I2=46.0%; Q Cochran test p =0.1569; Supplementary Figure S27) when compared to other techniques, namely SG, which showed no significant effect (RR = 1.11; 95% CI [0.93, 1.33]; I2=98.8%; Q Cochran test p =0.0680; Supplementary Figure S28).”
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	Not
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	Page 22: “The main findings of our study were the following: (i) The prevalence of insufficient weight loss (IWL) after metabolic and bariatric surgery varies significantly depending on the definition used, with pooled rates of 27% using %EWL<50 and 20% using %TWL<20, highlighting the impact of definitional heterogeneity on reported outcomes; (ii) T2DM, hypertension, and preoperative BMI emerged as consistent preoperative predictors of IWL across both definitions; (iii) RYGB was associated with a significantly lower

			risk of IWL in %TWL studies; (iv) Higher nadir BMI was associated with IWL in %EWL-defined studies, though this reflects an expected outcome.” Page 22-27
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	Page 26,27
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	Page 28: " This systematic review and meta-analysis identified pre, intra and postoperative clinical factors associated with IWL after MBS. Metabolic comorbidities and RYGB stand out as central elements in IWL. These findings reinforce the need for a multidimensional approach to monitoring these patients, with a close early follow-up and interventions aimed at the groups most at risk of IWL. Standardizing the definition of IWL, as well as integrating behavioral variables and generating predictive models of IWL, should be a priority in future research to optimize outcomes after MBS."
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Page 27: “Conflict of Interest: The authors declare that they have no conflict of interest.

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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OBESITY SURGERY - INSTRUCTIONS FOR AUTHORS

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1. ABOUT OBSU

Obesity Surgery is published by Springer Nature and is the official journal of the International Federation for the Surgery of Obesity and metabolic disorders (IFSO). Requirements are in accordance with the "Uniform Requirements for Manuscripts submitted to Biomedical Journals," www.icmje.org.

Atualizado em 04/2025 - <https://www.icmje.org/icmje-recommendations.pdf>

All manuscripts submitted to OBSU are blind-reviewed and decisioned through Editorial Manager (EM) <http://www.editorialmanager.com/obsu>. Letters to the Editor and Invited Letter Replies do not need to be blinded. Articles accepted for publication are done so with the understanding that they or their substantive contents have not been and will not be submitted to any other publication.

Obesity Surgery is a specialty journal, and the readership is well versed in the world statistics about the prevalence of obesity and metabolic/bariatric surgery, as well as other broad interdisciplinary topics. The Editorial Board, therefore, asks that submissions for publication adhere to what is new to be told. Focus the introduction and discussion of an article on the specific knowledge gap. Aim current studies toward sharpening reader attention to any new information provided. Brevity will also favor acceptance of a submission.

2. FILE SUBMISSION CHECKLIST

Before you begin your submission, make sure to have ready for upload all the file items described in the submission checklist below. Please use American English spelling. If any of the required file items listed below are missing, not correctly blinded, or otherwise incorrect, and/or if the English grammar is insufficient, your manuscript will be returned to you for correction.

For File Item descriptions, see section 4c., [MANUSCRIPT SECTIONS AND FILE ITEM TYPES](#).

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- ☒ **Text-based Manuscript** (Word, RTF, TXT), **include, as applicable:**

- ☐ Textual Abstract and 3 to 4 Key Points (different from Keywords, in bullet-point format)
- ☐ The complete manuscript text (must be blinded for review purposes – no author/affiliation details)
- ☐ Blinded statements for Conflict of Interest, Ethical/Board approval, and Informed Consent (as applicable)
- ☐ References in PubMed[®] style
- ☐ Optional: Embedded tables, schemes, figures, and captions
- ☐ Dynamic (supplementary) Video, if present, is not to exceed three (3) minutes in length; must be blinded and clearly narrated in English
- ☐ If present, video must be in either .MP4 or .MOV format.

If you are submitting a...

- ☒ **Video-based Manuscript** (Multimedia Article in MP4 or MOV), **include:**

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- ☒ **Figures/Images/Media** (JPG, EPS, TIFF)

- ☐ No identifying information about patients or logos unless permission specifically provided.
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- ☒ Revised/blinded text, tables, figures

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- ☐ One annotated copy

- ☒ A blinded, Point-by-Point Reply to Reviewer Comments (Word, RTF, TXT)

- ☒ Only required for Original Contributions and New Concepts: A blinded Graphical Abstract (Word, PPT, JPG, EPS, TIFF). This should be primarily graphic and consist of icons (not just text). You may use the Graphical Abstract template provided [here](#) and see [example here](#).
(Note re: terminology - “Graphical Abstract” = “Visual Abstract”)

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3a. SYSTEM REQUIREMENTS

Authors will need the following items to use EM:

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Once your manuscript is correctly submitted, it will be assigned to an editor, and the review process will begin.

3d. SUPPORT AND ASSISTANCE

If you have questions or need assistance at any point during the submission and review process, contact our OBSU Managing Editor:

Attn: Deana Rodriguez, Managing Editor, OBSU Editorial Office Phone: +001 (562) 961-9928 E-mail: obsu.rodriguez@gmail.com

4. MANUSCRIPT PREPARATION

- Authors must use person-first language: e.g., "patients with obesity" rather than "obese patients."
- Double-space the text and set page borders at one inch.
- Number all pages.
- Use a normal, plain font (e.g., 12-point Times Roman) for text.
- Express all scientific units in SI units.
- Abbreviations may be used but must be spelled out the first time the term is mentioned.

4a. MANUSCRIPT TYPES AND FORMAT

The manuscript types that Obesity Surgery accepts include Original Contribution, New Concept, Review Article, Brief Communication, Letter to the Editor, and Multimedia Article. You may submit your manuscript following the format requirements detailed in the MANUSCRIPT FORMATS table below.

Each manuscript type requires specific submission format and file types. When required by the nature of the report, manuscripts that do not follow these formats may be considered. Please note that the page, word, and figure limits in the table below are a guideline rather than a rule; the editors and reviewers make the final evaluations. Please remain succinct in your wording.

MANUSCRIPT FORMATS

The double-spaced page and word counts below are a guideline rather than a rule. Title Page, references, figures, legends, and tables are not considered in the page/word counts below. See section 4c below, [MANUSCRIPT SECTIONS AND FILE ITEM TYPES](#), for descriptions of each file item.

MANUSCRIPT	Description	Pp/Words	Blinded Manuscript Text Contents	Figures
Original Contribution	Paper involves clinical or basic science research	8pp/2400 words	- Title - Structured textual Abstract, includes subheadings (250 words) 3 to 4 one-line, bulleted Key Points (different from Keywords) - Graphical Abstract (required upon revision) - Introduction/Purpose - Materials/ Methods/ Results/ Conclusion - Blinded COI/Ethics/ Consent Statements required - References - Figure Legends (if any) - Tables (if any) - Supplementary video (if any)	Up to 6
New Concept	Innovative technologies, devices, procedures, or treatment protocols; should include a detailed description of the procedure and the results.			
Review Article	A scholarly literature review of a current topic. May be solicited or unsolicited.	10pp/3000 words	- Title - One-Paragraph textual Abstract (125 words) 3 to 4 one-line Key Points - Graphical Abstract (optional, upon revision) - Format may vary based on topic - Blinded COI/Ethics/ Consent Statements required - References - Figure Legends (if any)	Up to 6
Brief Communication	A short report that presents research, an innovated concept, or a procedure.	3pp / 800 words	- Title - No Textual Abstract, but - Yes 3 to 4 one-line Key Points at beginning of text - Graphical Abstract (optional, upon revision) - Methods /Results/ Conclusion - Blinded COI/Ethics/ Consent Statements required - Limit references to eight (8) - Figure Legends (if any)	Up to 2
Letter to the Editor	A short report, case series, or opinion, or an unstructured comment on a published paper. The editors reserve the right to accept, reject or excerpt letters without changing the views expressed by the author(s).	4pp/ 1200 words	- Title page and main text do <u>not</u> need to be blinded. - No Textual Abstract, No Graphical Abstract - Unstructured - COI/Ethics/ Consent Statements required - Limited number of references	Up to 3

MANUSCRIPT	Description	Pp/Words	Blinded Manuscript Content	Figures
Multimedia Article	Manuscripts submitted as dedicated Multimedia Articles must be accompanied by a textual Abstract that briefly describes the video.	2pp / 500 words	• Title • No Graphical Abstract • Blinded Video Abstract includes Title, Key Points, Introduction, Materials/ Methods/ Results/ Conclusion/ Blinded Statements required, References (if any) • Blinded video(s) in .mp4 or .mov format only; not to exceed 10 minutes/500 MB, with narration required, in English.	N/A

4b. TERMINOLOGY

Please follow the mandatory manuscript terminology standards.

- Weight loss must be expressed as change in BMI or %total weight loss (%TWL)
- The term for the operative procedure that was previously labeled “Mini Gastric Bypass (MGB)” should no longer be used. Instead, use the accepted term “One Anastomosis Gastric Bypass (OAGB)”.
- Authors must use person-first language: e.g., “patients with obesity” or “patients with a BMI over 50 kg/m²” rather than “obese patients.”
- We support uniform, defined reporting of the sex used for human, animal, tissue, and cell research in ALL manuscripts published in our journals. If only one sex is reported, authors must include a justification statement as to why only a single-sex study was conducted.
- Patient data extending beyond 30 days must include “lost to follow-up” information in the Abstract and Results section, including all tables and figures, with the denominator provided as to how many patients were available at **each time point** and the number of patients actually seen.
- Avoid using stigmatizing language (e.g., use the term “extreme” or “clinically severe” rather than “morbid”).

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- Any grant information and acknowledgment of grant support.
- Acknowledgments*: Should only be included on this separate Title Page. List individuals other than authors who directly participated in the work. *Acknowledgment(s) require written permission from the person(s) being acknowledged. Any dedications should also be included here.
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III. File Item: Blinded Manuscript – Main Text (*required*; blinded for review)

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- a. *For Original Contributions and New Concepts:* Abstract must be structured in four paragraphs (Introduction/Methods/Results/Conclusion) and limited to 250 words. Three to four bulleted, one-sentence Key Points should be included at the end of the Abstract text.
- b. *For Reviews:* Abstract must be one paragraph of up to 125 words and include 3 to 4 bulleted, one-sentence Key Points at the end of the Abstract text.
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**For Multimedia Articles:* No separate Abstract is needed. You will instead submit a Blinded Video Abstract that includes all other headings listed in this section 4b. III. and include Key Points at the beginning of the text.

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- **Introduction/Purpose; Materials and Methods; Results; Conclusion.**
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- [Statements](#) regarding ethics and consent. (see Section 5b. for details)
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1. Yoon DY, Mansukhani NA, Stubbs VC, Helenowski IB, Woodruff TK, Kibbe MR. Sex bias exists in basic science and translational surgical research. *Surgery*. 2014;156(3):508-516.
2. U.S. Government Accountability Office. National Institutes of Health: Better Oversight Needed to Help Ensure Continued Progress Including Women in Health Research. 2015
3. Mansukhani NA, Yoon DY, Teter KA, Stubbs VC, Helenowski IB, Woodruff TK, Kibbe MR. Determining If Sex Bias Exists in Human Surgical Clinical Research. *JAMA Surg*. 2016 Nov 1;151(11):1022-1030.
4. National Institutes of Health Office of Extramural Research. Consideration of Sex as a Biological Variable in NIH-funded Research. 2015

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