



Body composition changes at 12 month following type of Metabolic Bariatric Surgery bariatric surgery



Dr. Zahra Gholi

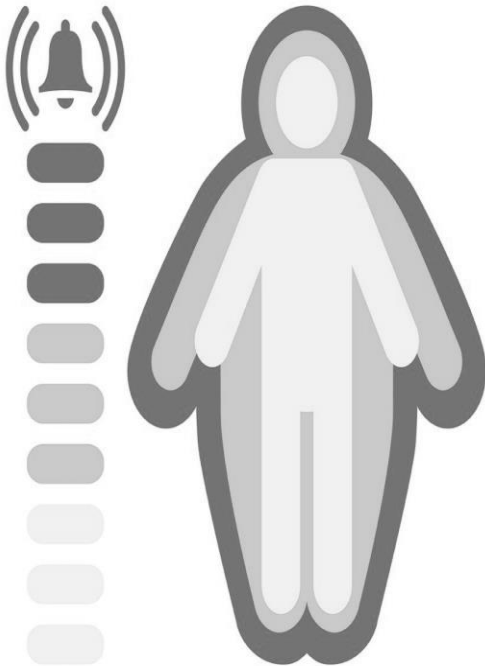
PhD of Nutrition Sciences

Minimally Invasive Surgery Research Center

Iran University of Medical Sciences



Obesity



- Metabolic complex disorder
- Risk to health
- impact nearly one-third of the world's population.
- Enhances the risk of hypertension, stroke, cardiovascular disease, type 2 diabetes mellitus (T2DM), obstructive sleep apnea, osteoarthritis, and liver disease.



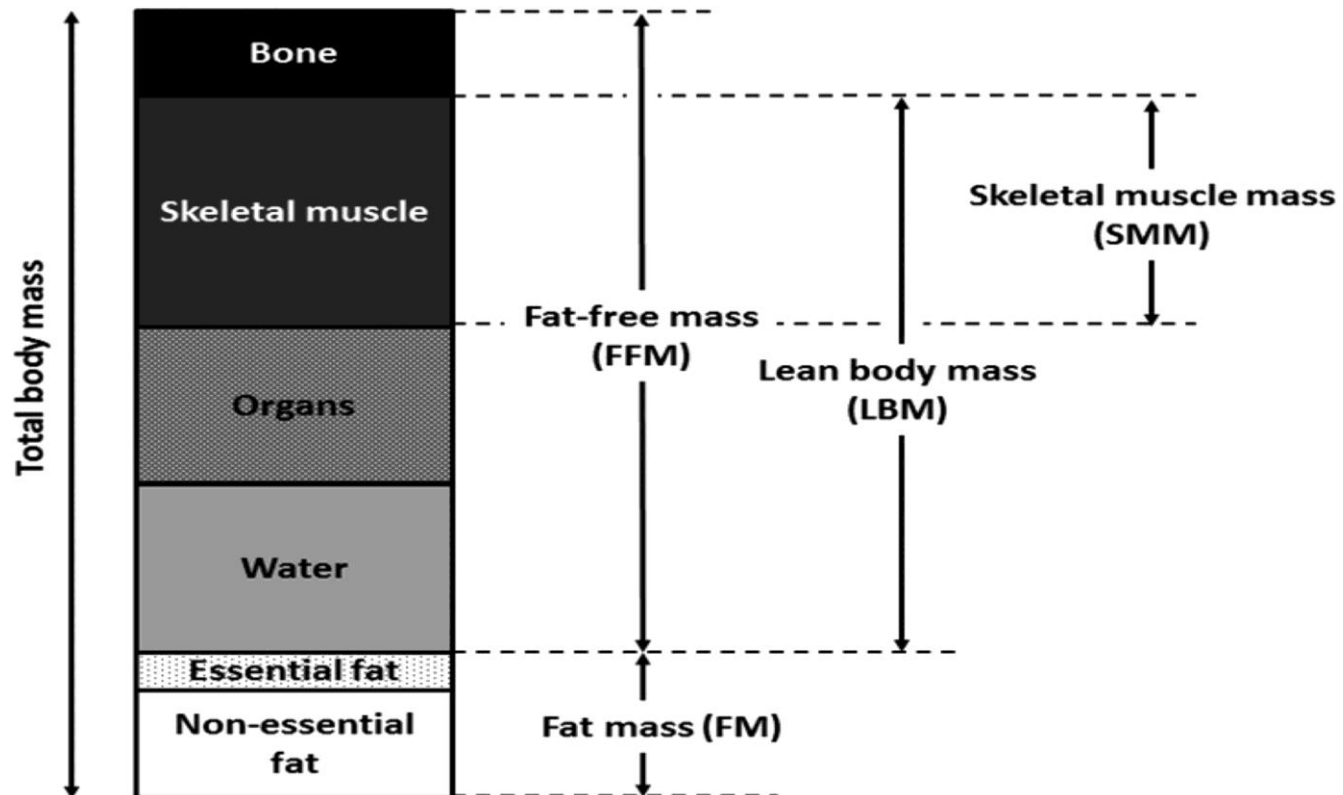
Treatment of obesity



- several types of bariatric surgery,
- Roux-en-Y gastric bypass (RYGB), sleeve gastrectomy (SG), and one anastomosis gastric bypass (OAGB), Biliopancreatic Diversion with Duodenal Switch (BPD-DS)
- Mechanism of weight loss
- restriction of food intake
- change in hormonal and signaling pathways that affect appetite and metabolism



Body Composition



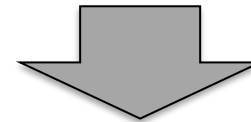
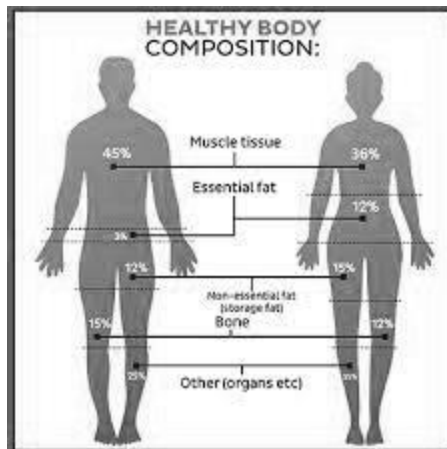


Body composition



Muscle tissue is essential for a healthy metabolism

- bone (re) modeling
- Thermoregulation
- and preservation of functional capacity and
- function as a storage for glycogen, fat, and protein.




Loss muscle tissue

- decreased basal metabolism
- functional impairment
- poorer quality of life
- negatively impacts integrity of skeletal muscle



How Does Fat Mass Change in the First Year After Bariatric Surgery? A Systemic Review and Meta-Analysis

Neda Haghighat¹ · Damoon Ashtari-Larky² · Ladan Aghakhani¹ · Omid Asbaghi³ · Hamidreza Hoseinpour¹ · Babak Hosseini¹ · Ali Shahabinezhad¹ · Arash Pourmohammad¹ · Seyed Vahid Hosseini^{1,4} · Masoud Amini¹ · Cain C.T. Clark⁵ · Alimohammad Bananzadeh^{1,4} 

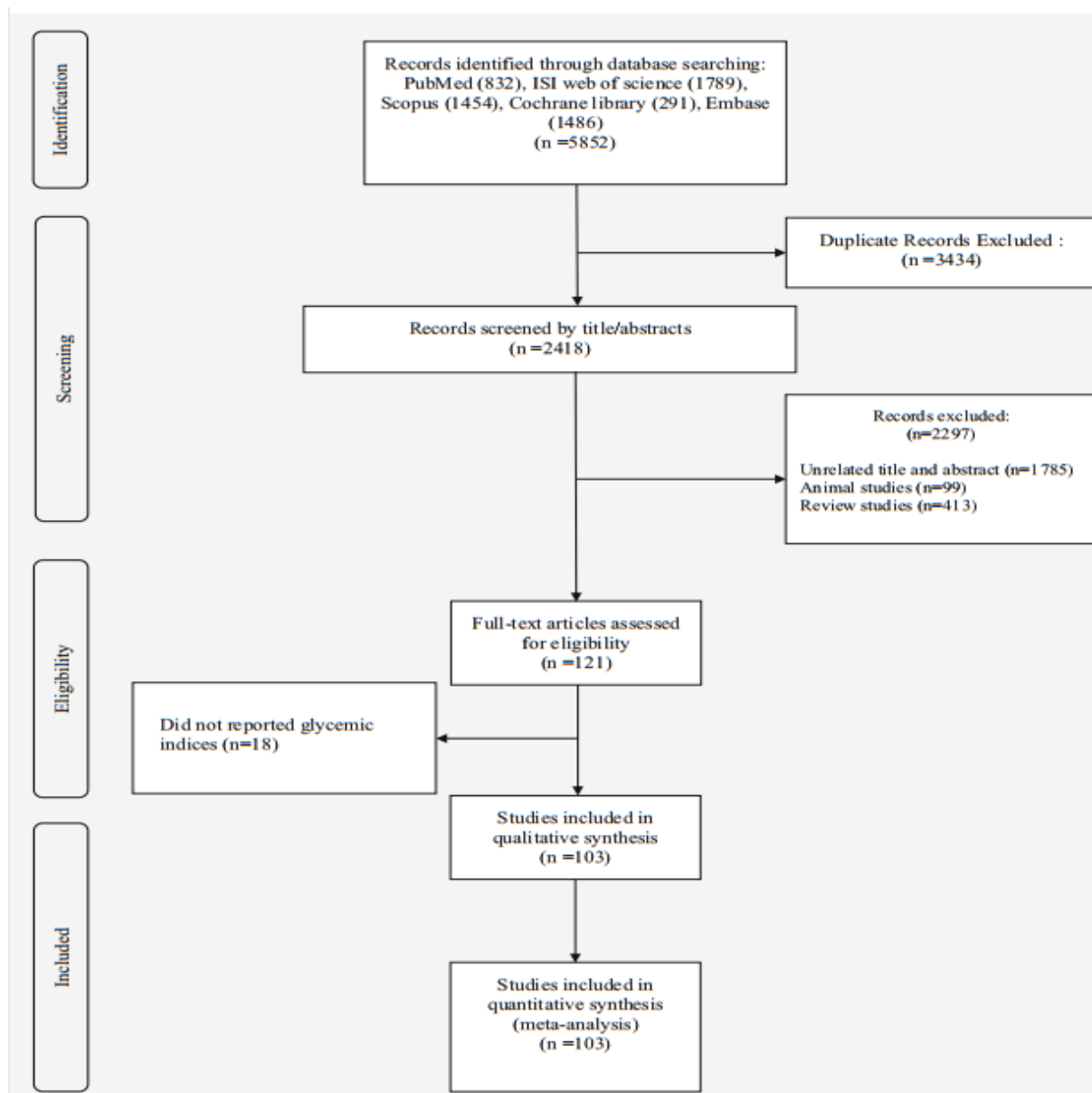
Received: 21 March 2021 / Revised: 21 May 2021 / Accepted: 26 May 2021

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2021

Abstract

This systematic review and meta-analysis investigated the time-course effect of different type of bariatric surgeries (BS) up to 1 year post-surgery on fat mass (FM) and body fat percentage (BFP) in patients with morbid obesity. We searched PubMed, Scopus, EMBASE, ISI web of science, and Cochrane databases from October 2002 until May 2020 with no restriction in the English language, to find studies examining the effect of BS on FM (kg) and BFP (%) in morbid obese patients. Meta-analysis of 103 studies carried out on data of 18,166 and 14,575 morbid obese patients following BS, showed that BS was associated with a substantial decrease in FM and BFP, respectively, in 1 month (-8.17 kg [95% CI $-9.07, -7.27$] and -1.51 % [95% CI $-2.56, -0.46$]), 3 months (-15.75 [95% CI $-17.49, -14.0$] and -4.90 [95% CI $-5.97, -3.83$]), 6 months (-22.51 [95% CI $-23.93, -21.09$] and -8.56 % [95% CI $-9.63, -7.49$]), and 12 months (-29.69 [95% CI $-31.3, -28.09$] and -13.49 % [95% CI $-14.52, -12.40$]) after the surgery. In conclusion, BS was associated with sustained declines in FM and BFP, from 1 to 12 months, with no indication of plateau phase post-surgery post-operatively. The present study emphasizes that post-bariatric care should have more focus on FM loss during 1-year post-surgery to identify the patients at risk for fat loss plateau.

Keywords Bariatric surgery · Fat mass · Meta-analysis · Obesity · Weight loss





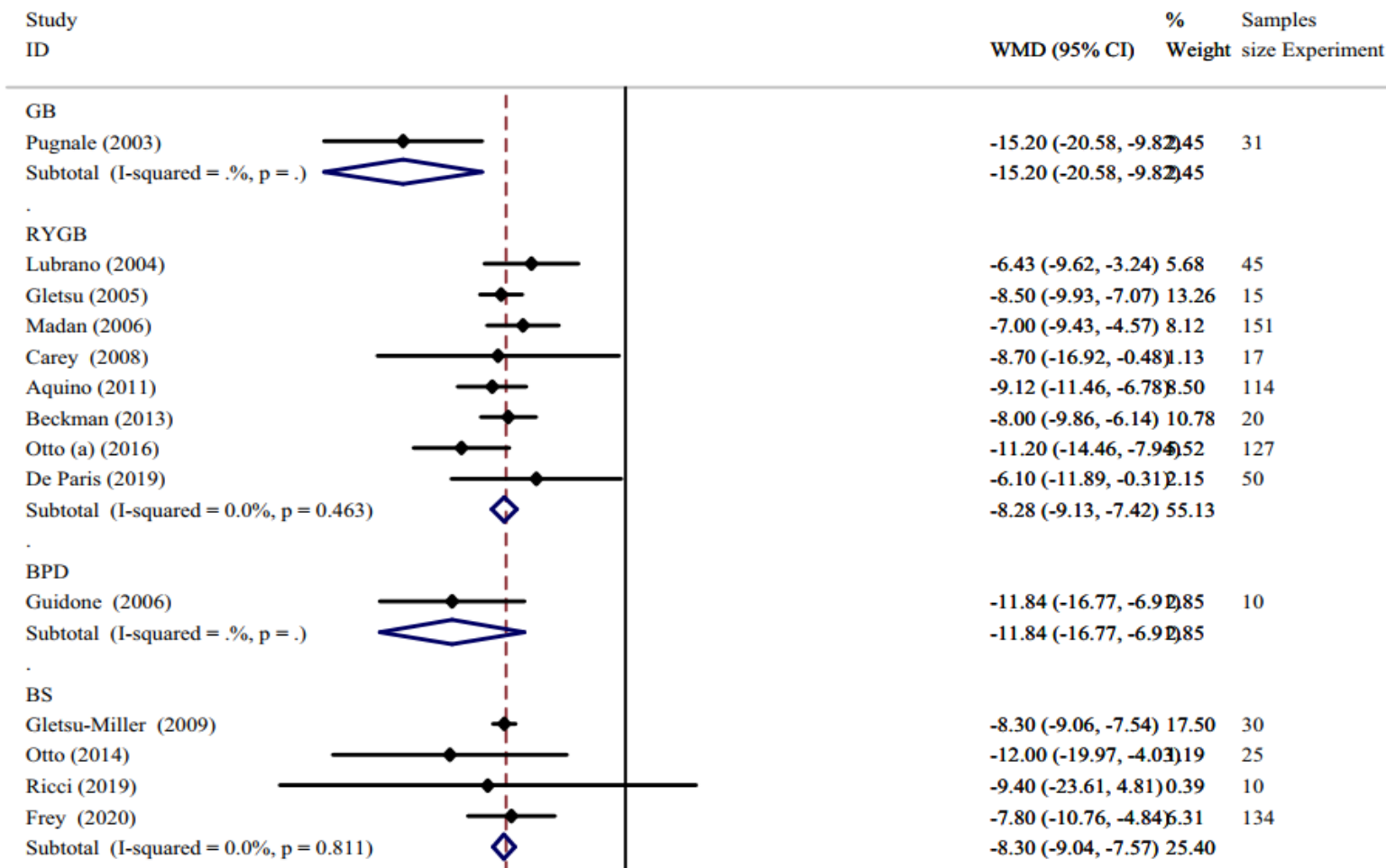
Study characteristics



Inclusion criteria	Exclusion criteria
<i>Population</i>	
<ul style="list-style-type: none">Human subjects	<ul style="list-style-type: none">Animal studies
<ul style="list-style-type: none">Bariatric procedure (including RYGB, SG, BPD, adjustable gastric banding, gastric bypass)	<ul style="list-style-type: none">Gastrectomy for other medical reasons (not focused on weight loss)
<ul style="list-style-type: none">All subjects ≥ 18 years old	<ul style="list-style-type: none">Abdominal liposuction
<ul style="list-style-type: none">Mean BMI $\geq 35 \text{ kg/m}^2$	<ul style="list-style-type: none">Other severe diseases: cancer, lung diseases, kidney diseases, gastrointestinal diseases, cardiovascular diseases or immunodeficiency diseases (except for obesity-related diseases such as diabetes mellitus type 2, hypertension, arthrosis and sleep apnea)

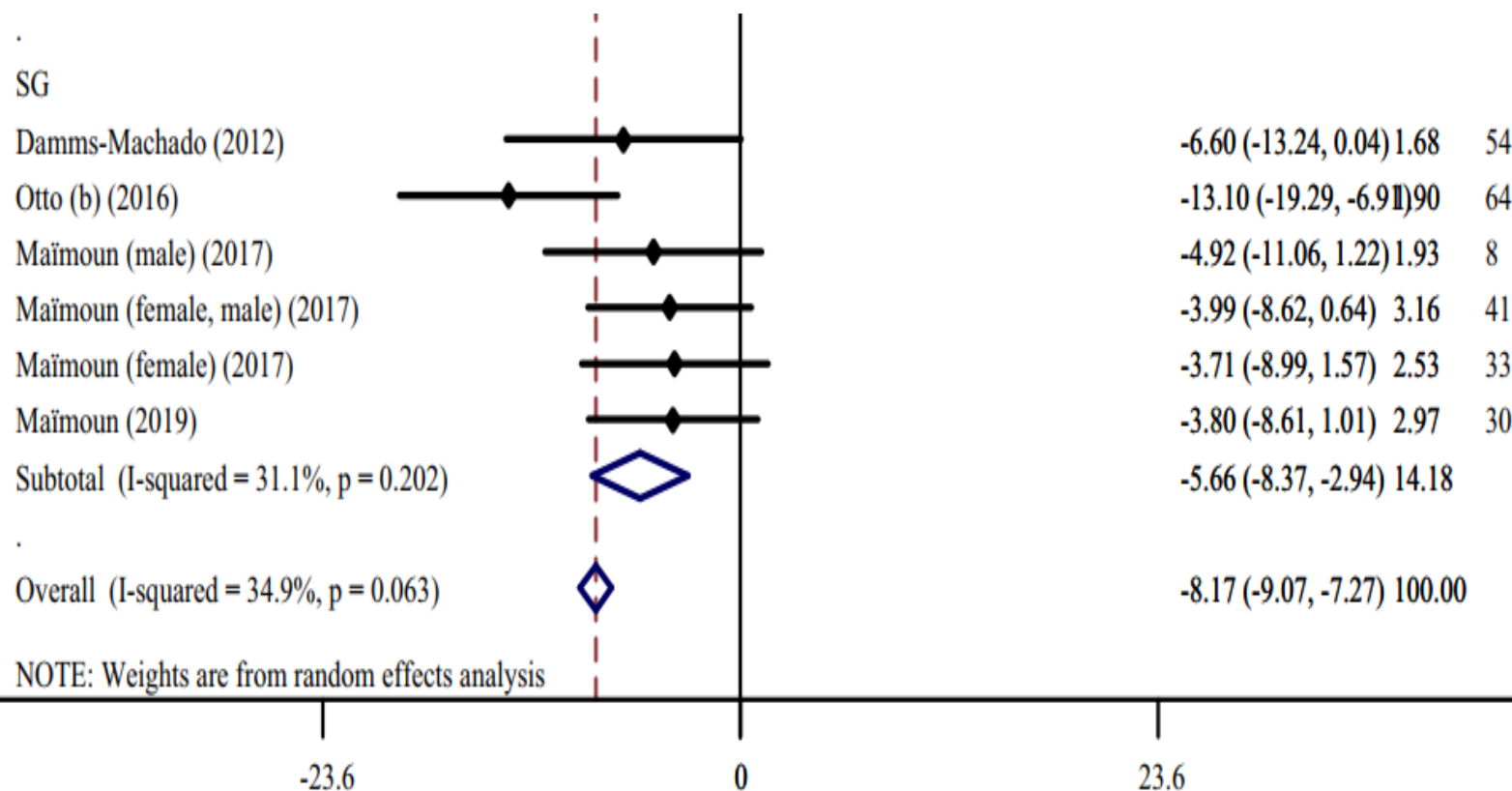


FM level at 1 month post surgery



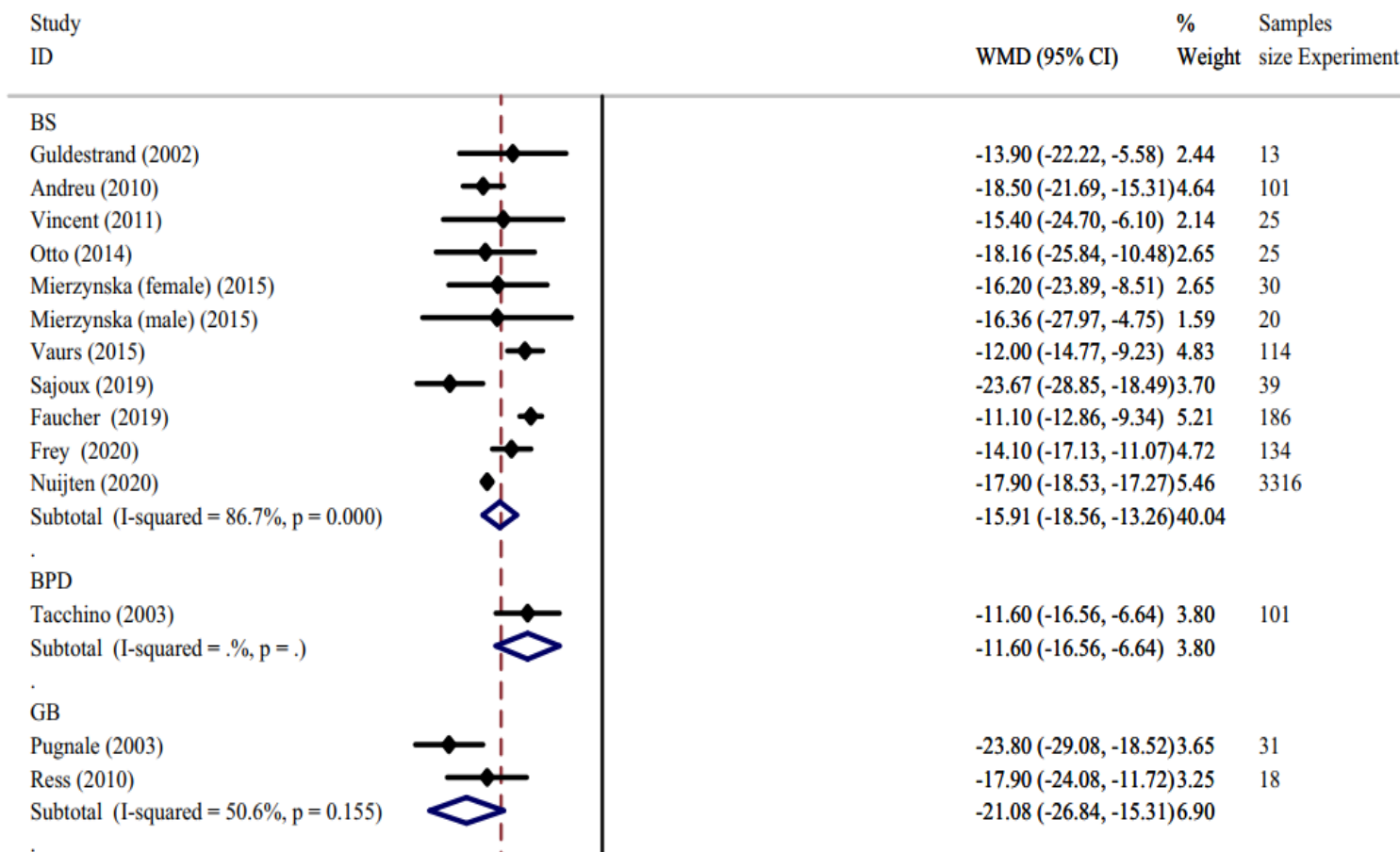


FM level at 1 month postsurgery



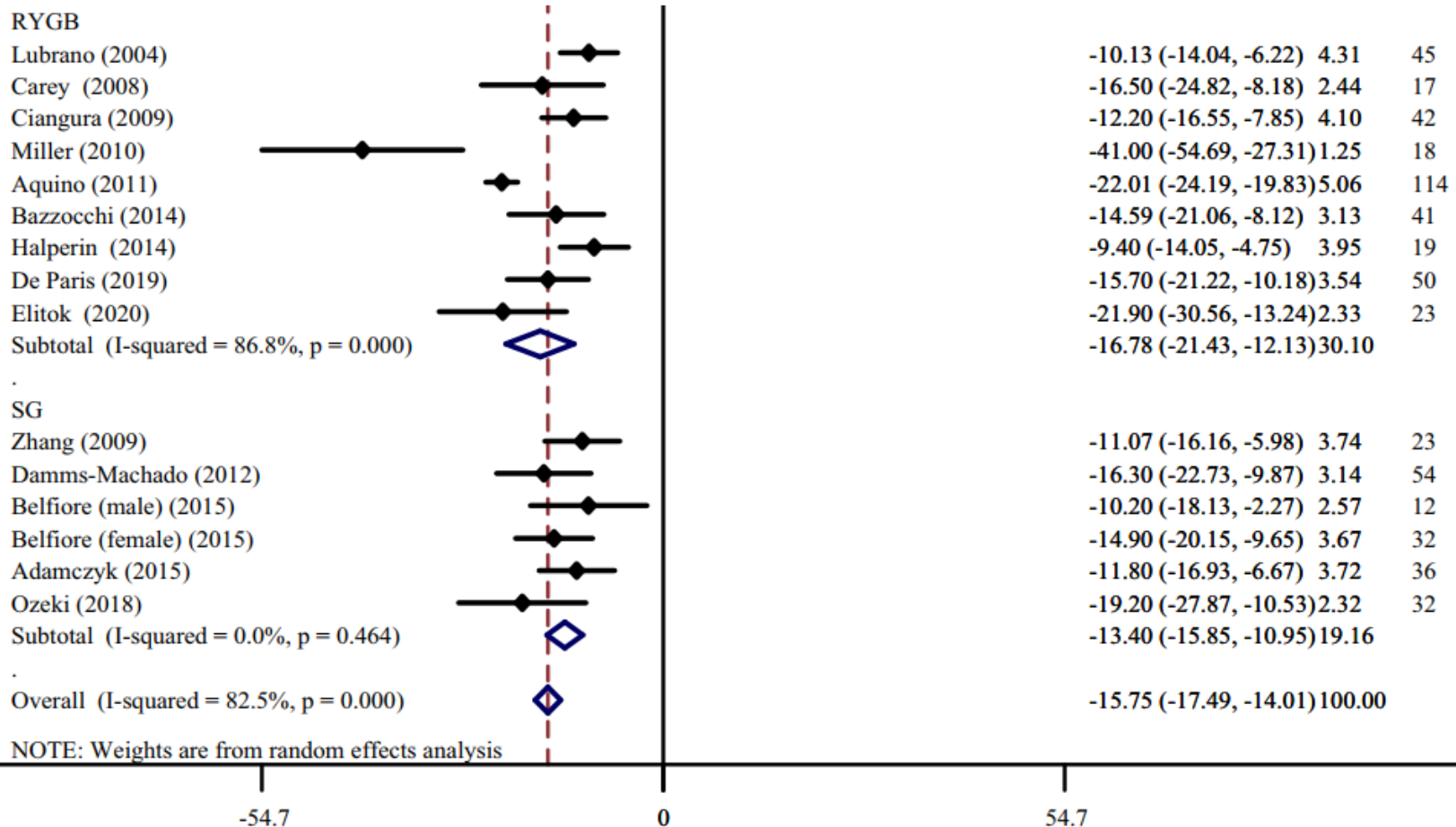


FM level at 3 months post surgery



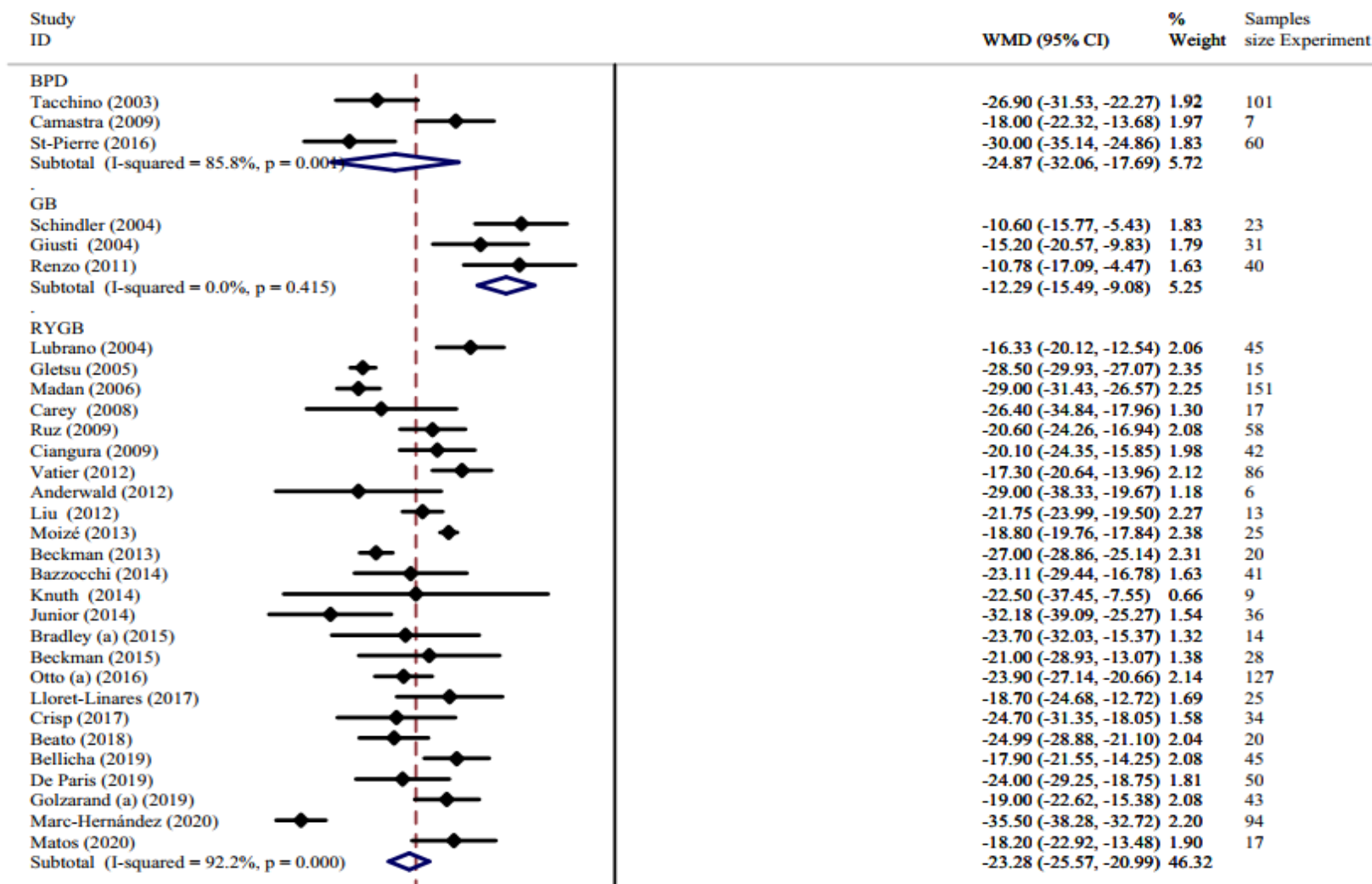


FM level at 3 months post surgery



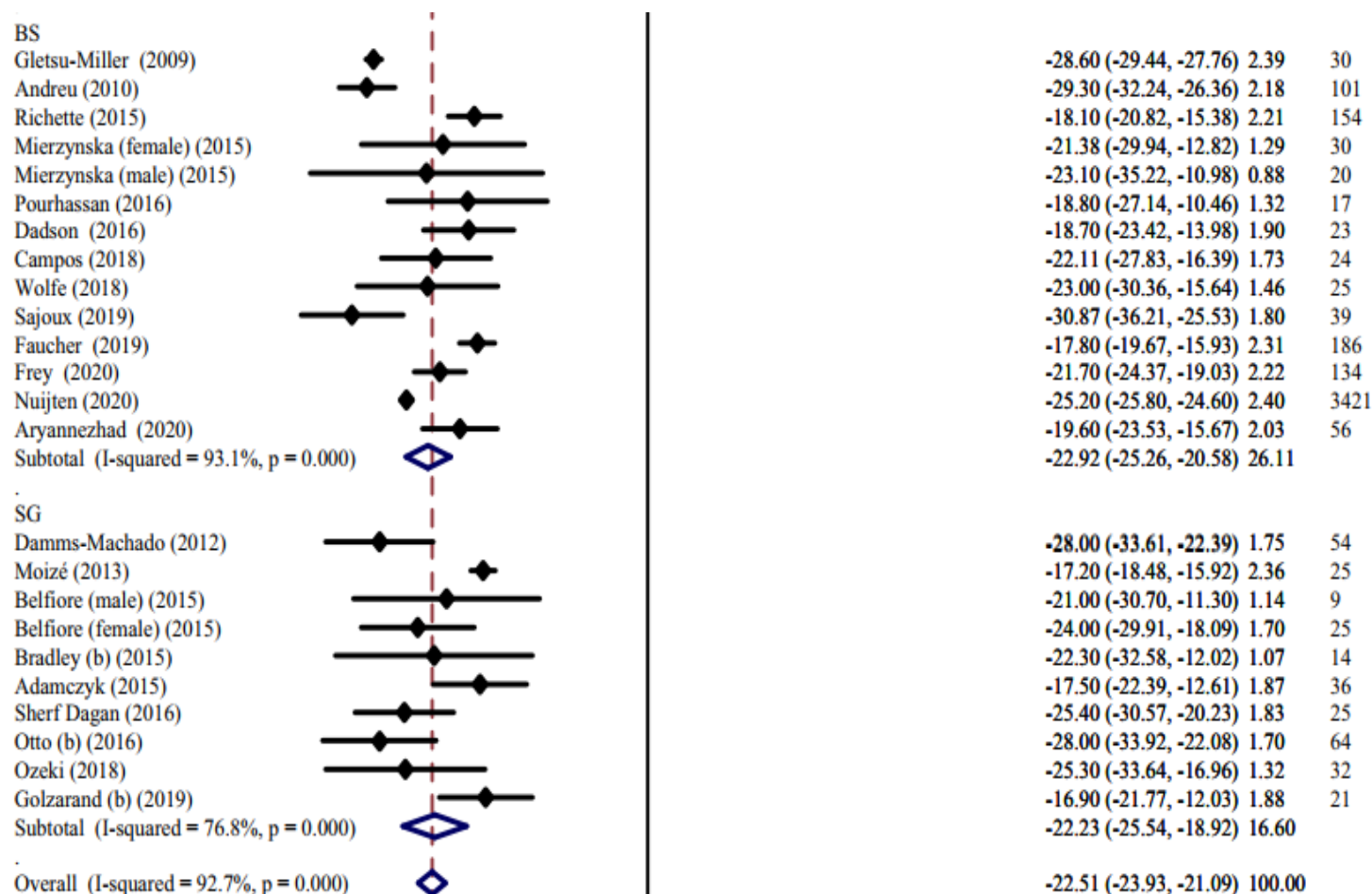


FM level at 6 months post surgery





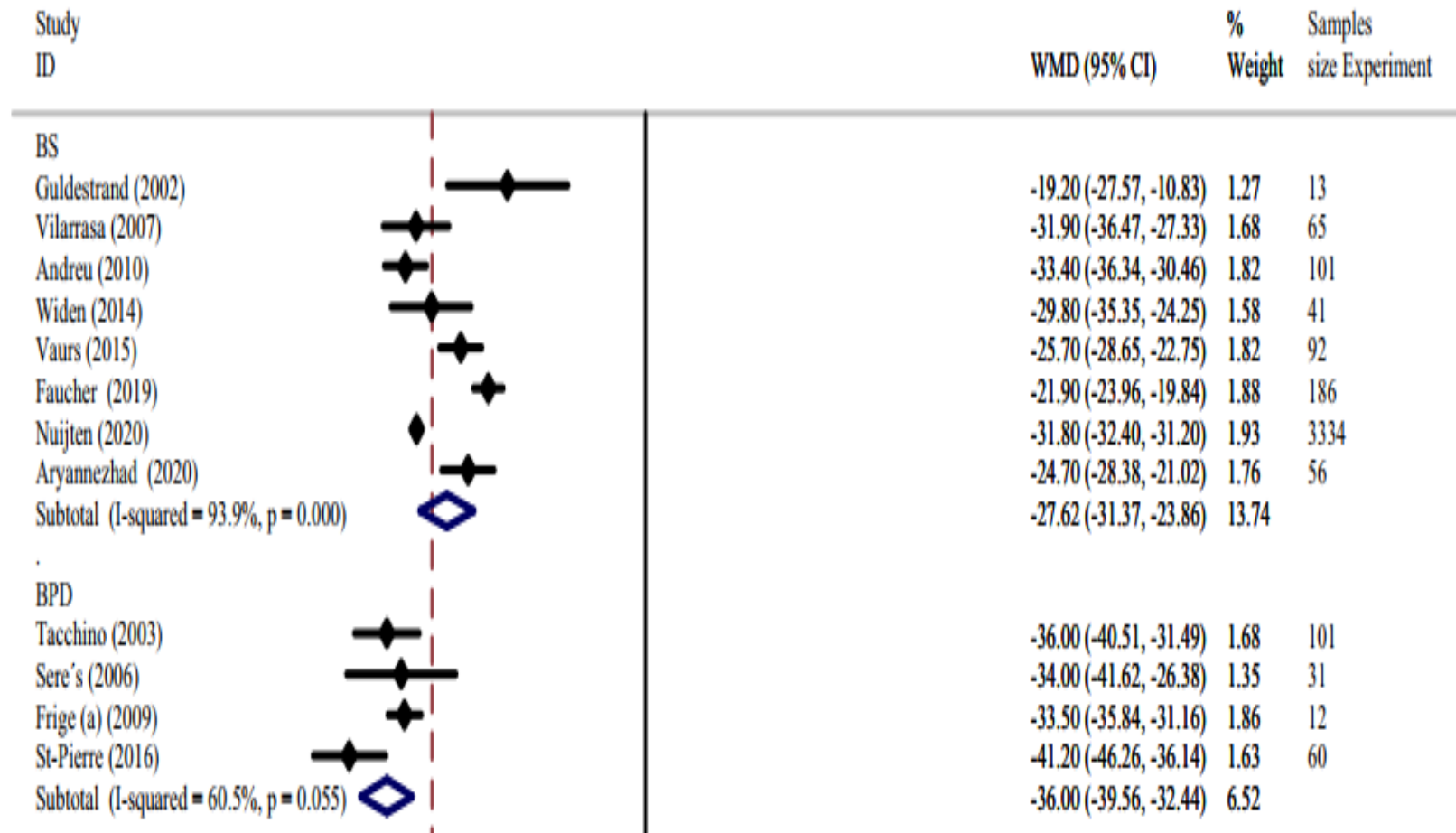
FM level at 6 months post surgery



NOTE: Weights are from random effects analysis

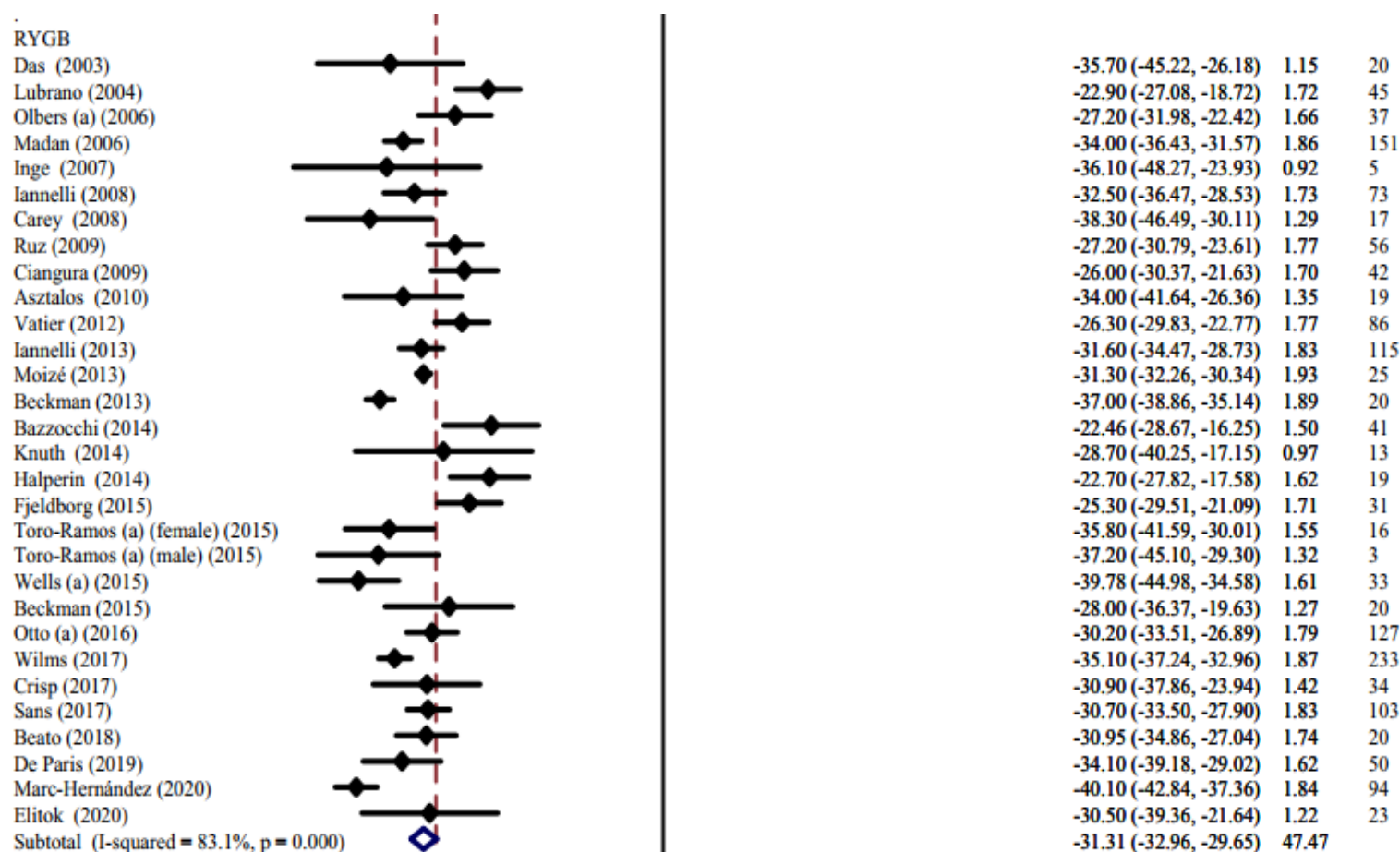


FM level at 12 months post surgery



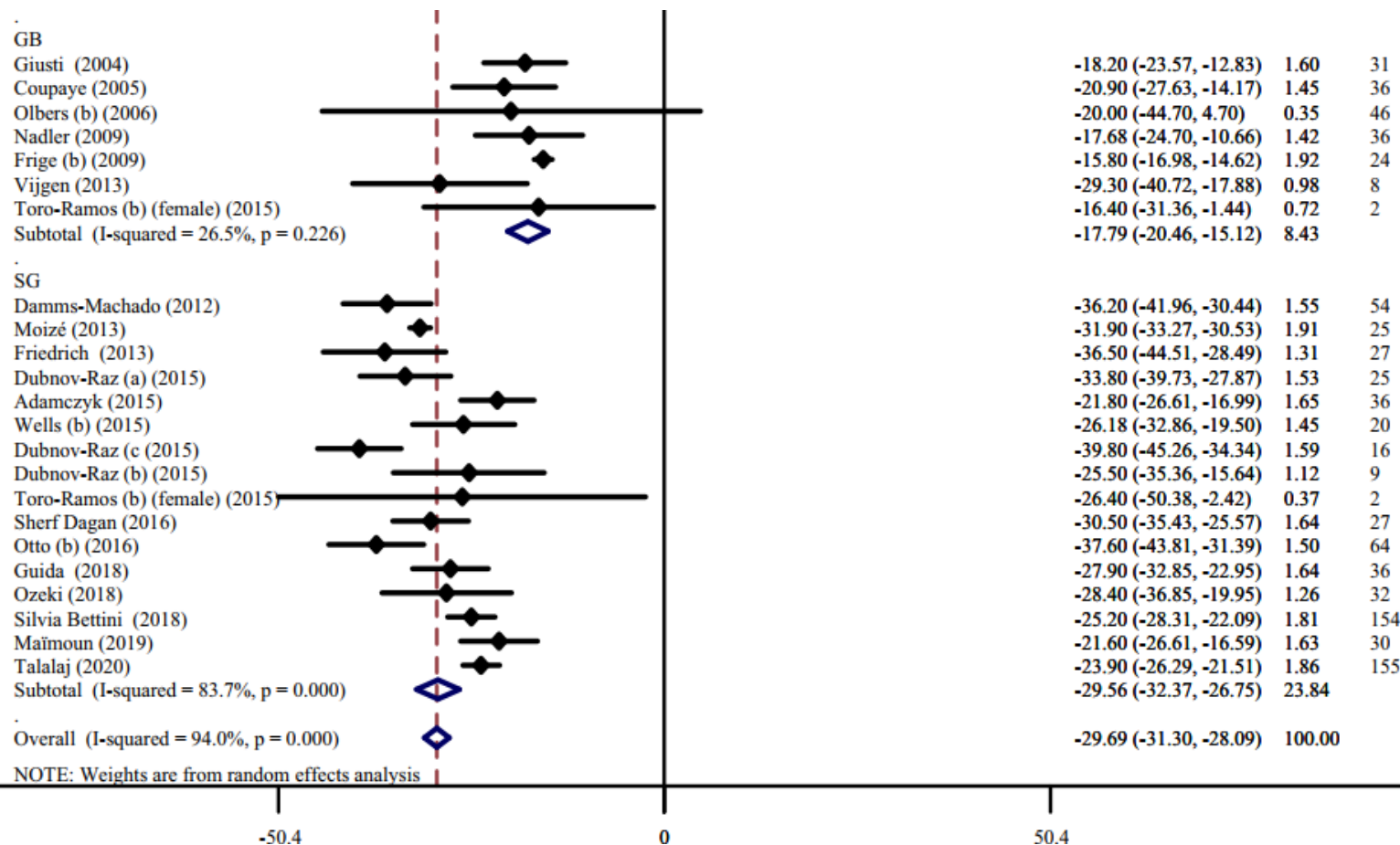


FM level at 12 months post surgery





FM level at 12 months post surgery





Result



- continuous decrease of about 8.24, 15.74, 22.51, and 29.69 kg following 1, 3, 6, and 12 months after BS, respectively.
- (from almost 8 kg FM loss in first month to about 1 kg/month during second 6 month)



Positive effects BS on FM



- Decreasing food intake and calorie restriction
- Decrease circulating leptin
- Increasing release of GLP-1
- Suppression of ghrelin !!



Received: 28 June 2021 | Revised: 9 September 2021 | Accepted: 9 September 2021

DOI: 10.1111/obr.13370

BARIATRIC SURGERY/OUTCOMES

OBESITY
Reviews

WILEY

The magnitude and progress of lean body mass, fat-free mass, and skeletal muscle mass loss following bariatric surgery: A systematic review and meta-analysis

Malou A.H. Nuijten¹ | Thijs M.H. Eijsvogels¹ | Valerie M. Monpellier² |
Ignace M.C. Janssen² | Eric J. Hazebroek³ | Maria T.E. Hopman¹

¹Radboud Institute for Health Sciences,
Department of Physiology, Radboud
University Medical Center, Nijmegen, The
Netherlands

²Nederlandse Obesitas Kliniek, Huis ter Heide,
The Netherlands

³Department of Surgery, Rijnstate Hospital/
Vitalys Clinics, Arnhem, The Netherlands

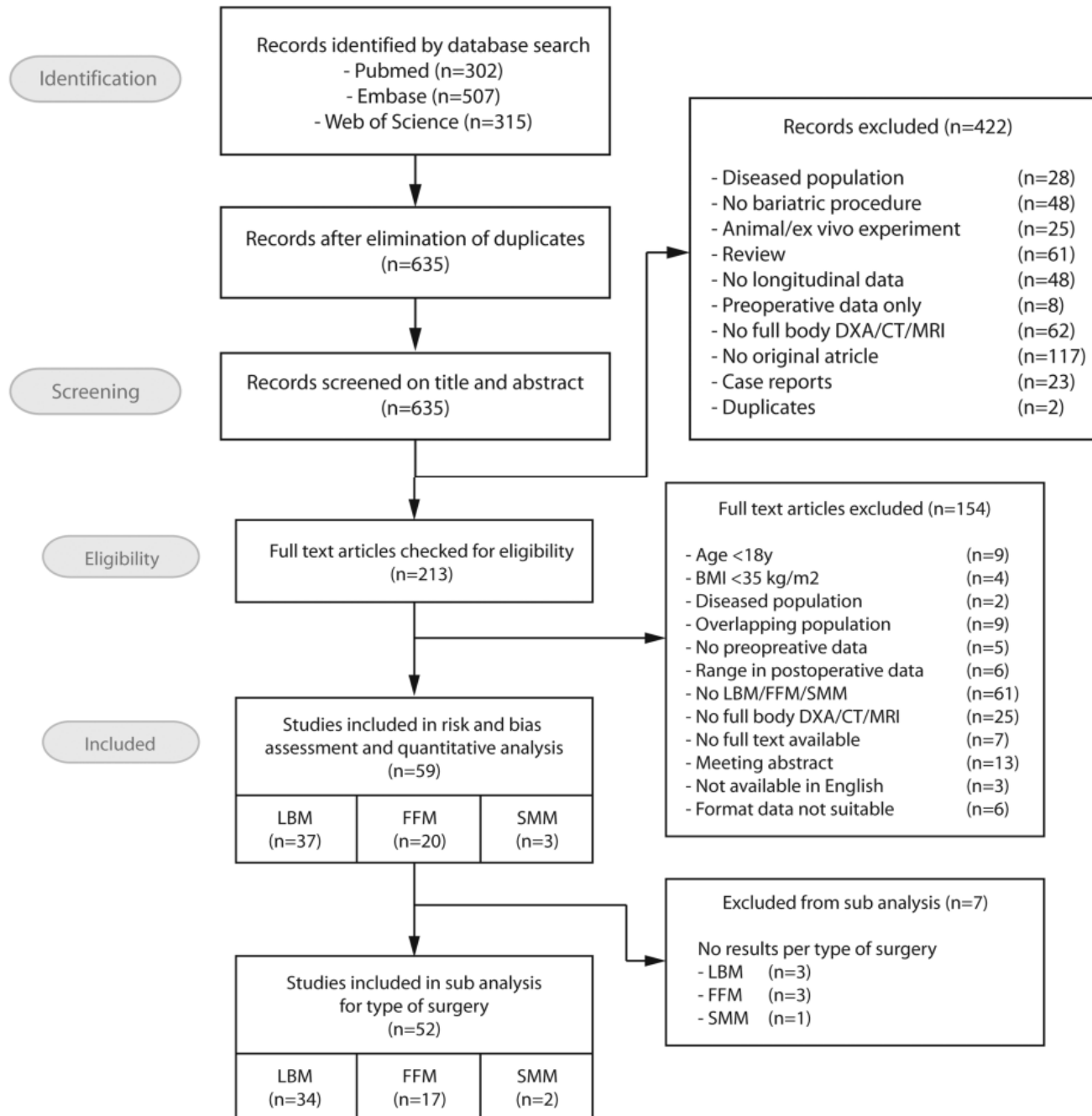
Correspondence

Maria T.E. Hopman, Department of Physiology
(392), Radboud University Medical Center,
P.O. Box 1901, 6500 HB Nijmegen, The
Netherlands.

Email: maria.hopman@radboudumc.nl

Summary

Postbariatric loss of muscle tissue could negatively affect long-term health due to its role in various bodily processes, such as metabolism and functional capacity. This meta-analysis aimed to unravel time-dependent changes in the magnitude and progress of lean body mass (LBM), fat-free mass (FFM), and skeletal muscle mass (SMM) loss following bariatric surgery. A systematic literature search was conducted in Pubmed, Embase, and Web of Science. Fifty-nine studies assessed LBM ($n = 37$), FFM ($n = 20$), or SMM ($n = 3$) preoperatively and ≥ 1 time points postsurgery. Random-effects meta-analyses were performed to determine pooled loss per outcome parameter and follow-up time point. At 12-month postsurgery, pooled LBM loss was -8.13 kg [95%CI -9.01 ; -7.26]. FFM loss and SMM loss were -8.23 kg [95%CI -10.74 ; -5.73] and -3.18 kg [95%CI -5.64 ; -0.71], respectively. About 55% of 12-month LBM loss occurred within 3-month postsurgery, followed by a more gradual decrease up to 12 months. Similar patterns were seen for FFM and





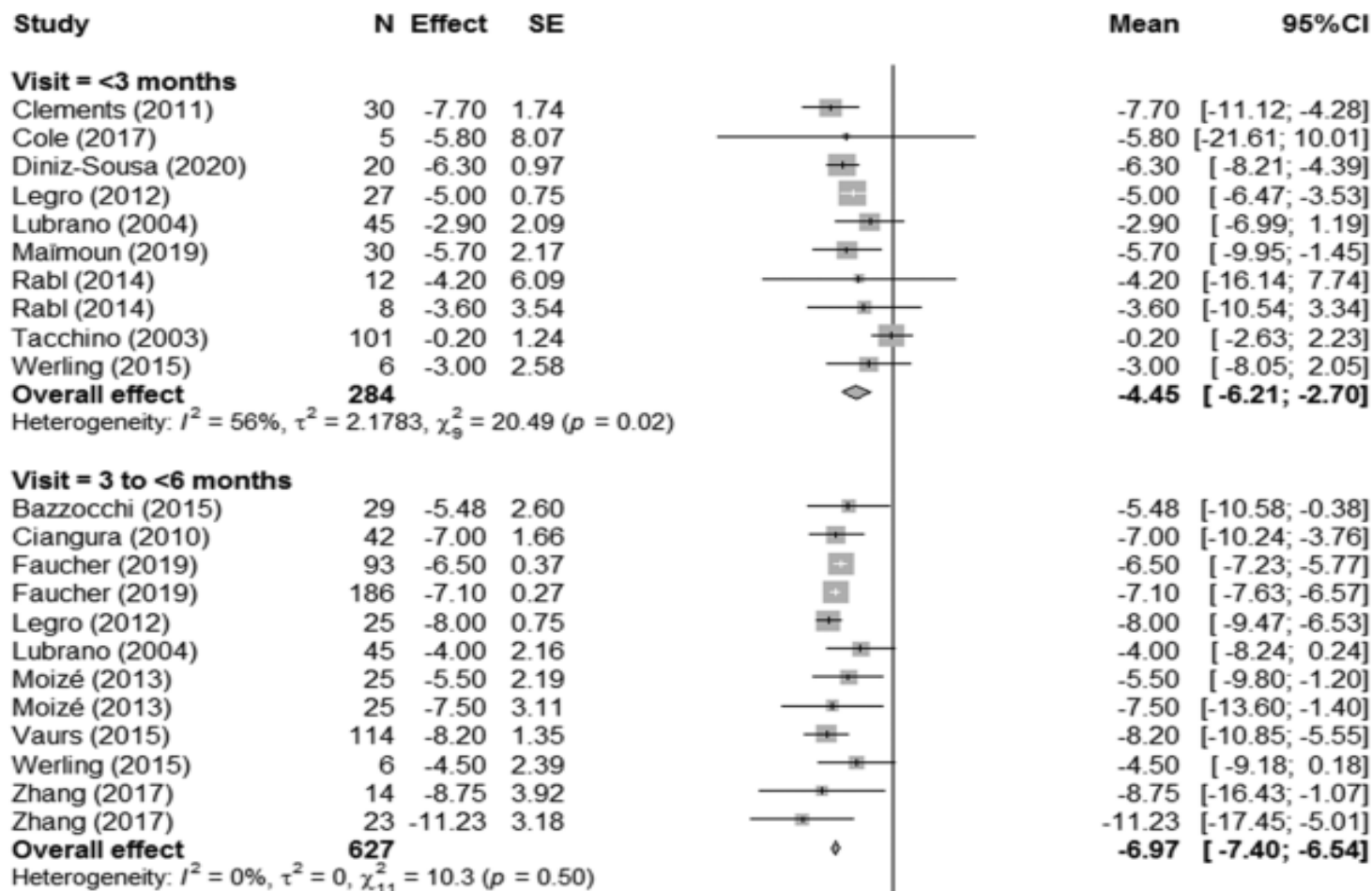
Cohort characteristics



Total patient	2270	Origin of the studies	Europe (n = 38), North America (n = 12), Asia (n = 5), South America (n = 3), Australia (n = 1)
BMI	44.2 kg/m ² (37.79 -51.20 kg/m ²)		
Mean LBM	58.2 kg (49 to 69 kg)	Type of surgery	RYGB (n = 27), adjustable gastric band (n = 6), SG (n = 7), BPD (n = 5), 14 studies ≥2 procedures.
Mean FFM	63.1 kg (55 to 89 kg)		
Mean SMM	27.1 kg (22 to 37 kg)	Measurement of Outcomes	DXA (n = 56), MRI (n=3)



Lean Body Mass loss





Lean Body Mass loss



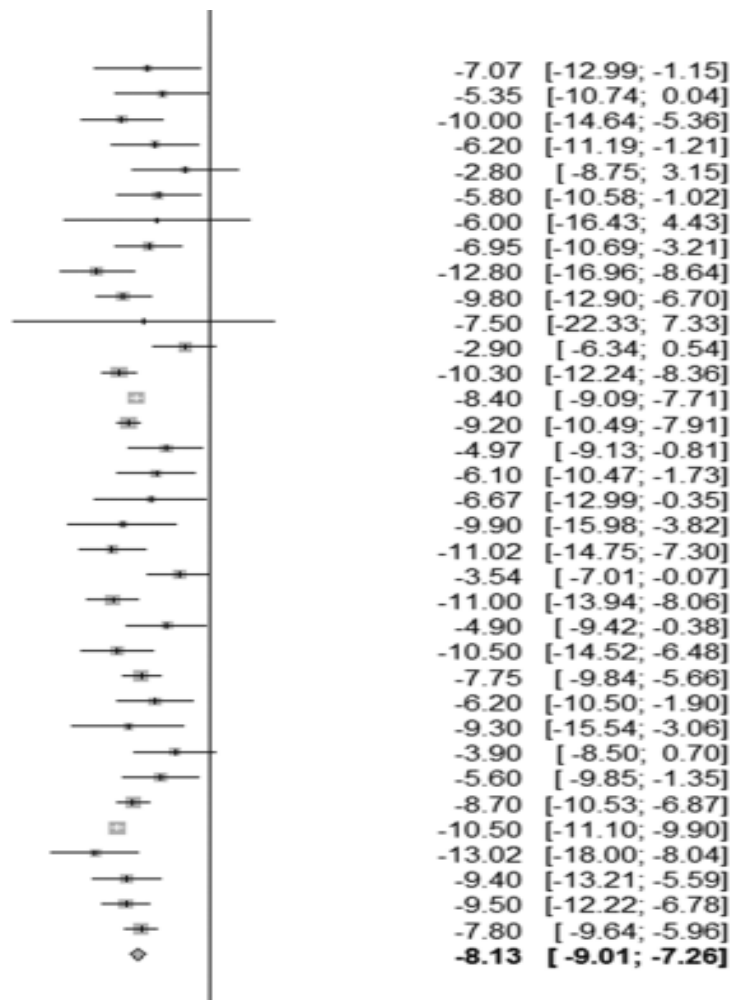
Visit = 12 months

Arhire (2018)	26	-7.07	3.02
Bazzocchi (2015)	29	-5.35	2.75
Beckman (2017)	20	-10.00	2.37
Blom-Høgestøl (2020)	34	-6.20	2.55
Brzozowska (2020)	10	-2.80	3.03
Brzozowska (2020)	21	-5.80	2.44
Brzozowska (2020)	7	-6.00	5.32
Calleja-Fernández (2015)	46	-6.95	1.91
Chen (2021)	49	-12.80	2.12
Ciangura (2010)	42	-9.80	1.58
Cole (2017)	5	-7.50	7.57
Coupaye (2005)	36	-2.90	1.76
Diniz-Sousa (2020)	16	-10.30	0.99
Faucher (2019)	93	-8.40	0.35
Faucher (2019)	186	-9.20	0.66
Favre (2018)	21	-4.97	2.12
Favre (2018)	18	-6.10	2.23
Favre (2018)	5	-6.67	3.23
Fjeldborg (2015)	31	-9.90	3.10
Hayashi (2017)	11	-11.02	1.90
Hayashi (2017)	3	-3.54	1.77
Legro (2012)	17	-11.00	1.50
Lubrano (2004)	45	-4.90	2.31
Maimoun (2019)	30	-10.50	2.05
Marengo (2017)	38	-7.75	1.07
Moizé (2013)	25	-6.20	2.19
Moizé (2013)	25	-9.30	3.18
Olbers (2006)	29	-3.90	2.35
Olbers (2006)	31	-5.60	2.17
Tacchino (2003)	101	-8.70	0.93
Talalaj (2020)	155	-10.50	0.31
Tamboli (2010)	29	-13.02	2.54
Vatier (2012)	86	-9.40	1.94
Vaurs (2015)	92	-9.50	1.39
Vilarrasa (2011)	59	-7.80	0.94

Overall effect

1471

Heterogeneity: $I^2 = 63\%$, $\tau^2 = 2.9140$, $\chi^2_{34} = 91.71$ ($p < 0.01$)





Lean Body Mass loss



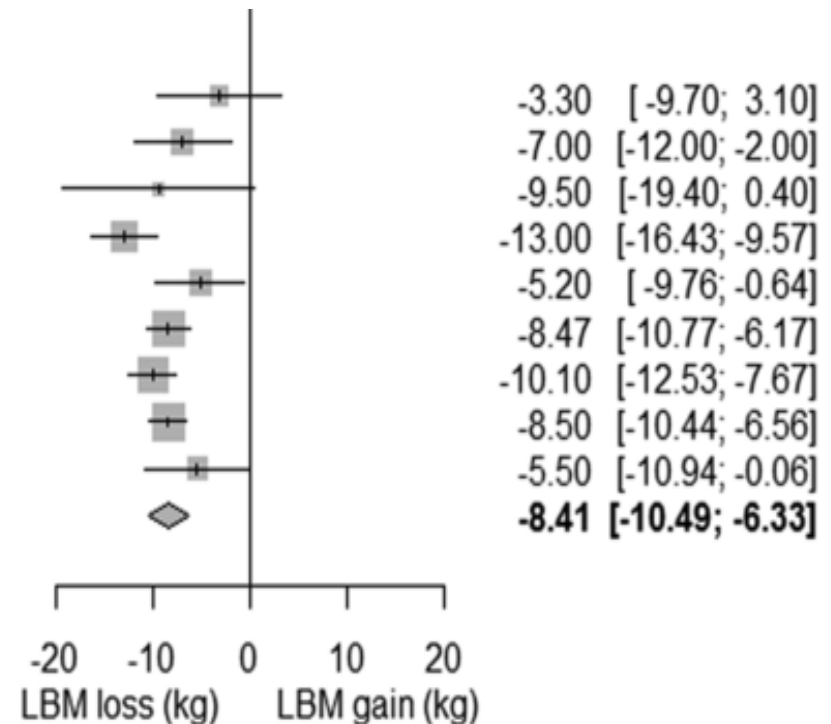
Visit = 18 to 36 months

Brzozowska (2020)	9	-3.30	3.27
Brzozowska (2020)	19	-7.00	2.55
Brzozowska (2020)	7	-9.50	5.05
Legro (2012)	9	-13.00	1.75
Lubrano (2004)	45	-5.20	2.33
Marengo (2017)	38	-8.47	1.18
Tacchino (2003)	101	-10.10	1.24
Vilarrasa (2011)	59	-8.50	0.99
Werling (2015)	6	-5.50	2.77

Overall effect

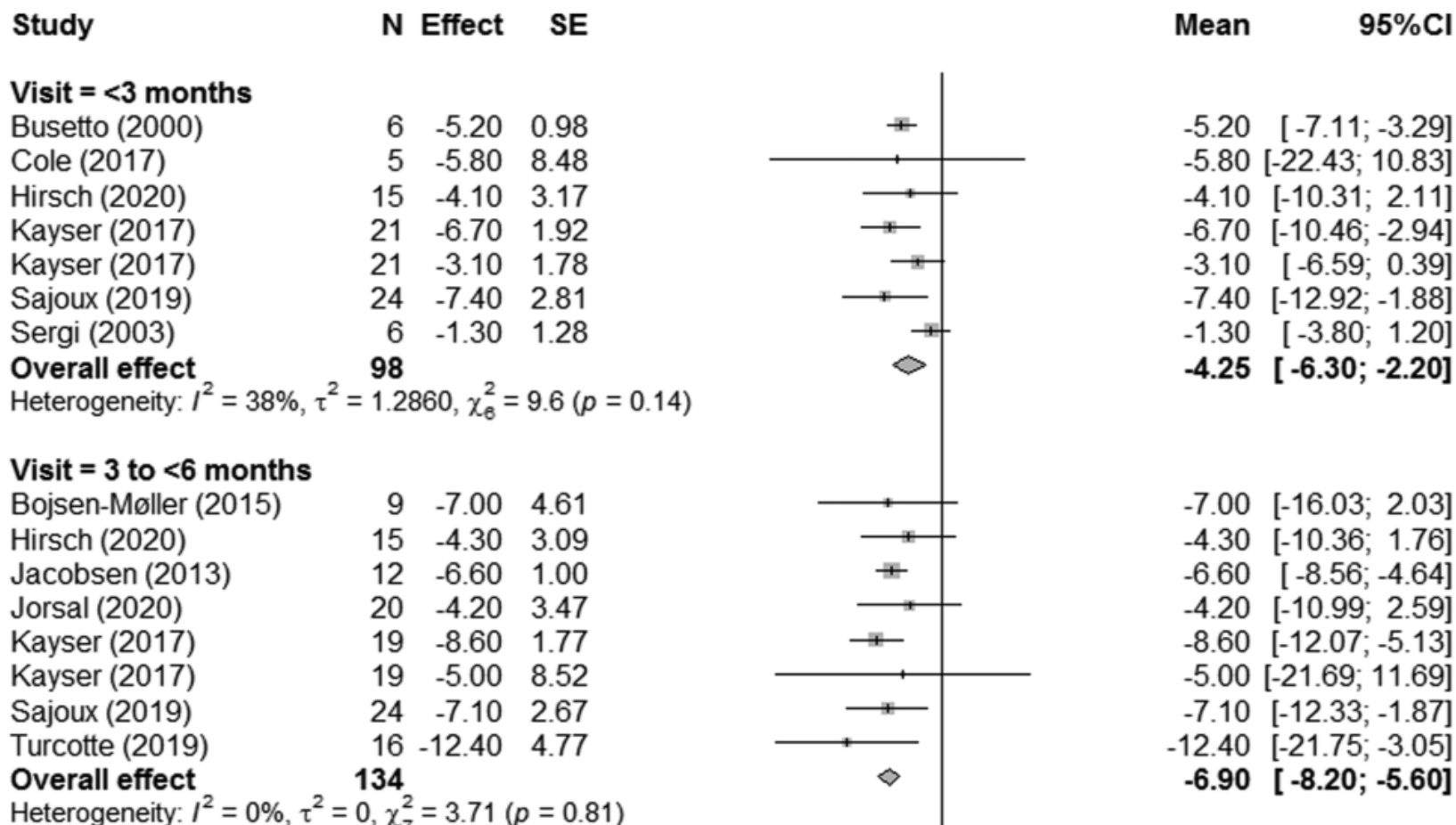
293

Heterogeneity: $I^2 = 44\%$, $\tau^2 = 3.2710$, $\chi^2_8 = 14.18$ ($p = 0.08$)





FFM loss





FFM loss

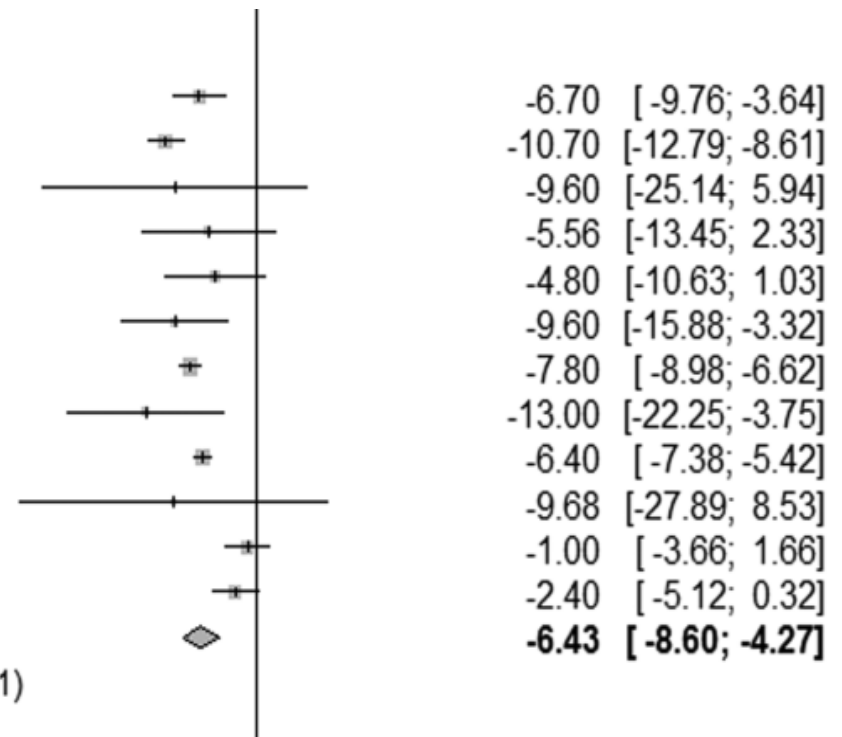


Visit = 6 to 9 months

Busetto (2000)	6	-6.70	1.56
Carrasco (2009)	42	-10.70	1.07
Cole (2017)	5	-9.60	7.93
Garrapa (2005)	15	-5.56	4.02
Hirsch (2020)	15	-4.80	2.97
Johnson (2017)	16	-9.60	3.20
Khoo (2014)	30	-7.80	0.60
Moehlecke (2017)	30	-13.00	4.72
Nielsen (2021)	41	-6.40	0.50
Raffaelli (2015)	8	-9.68	9.29
Savastano (2010)	45	-1.00	1.36
Sergi (2003)	6	-2.40	1.39

Overall effect **259**

Heterogeneity: $I^2 = 77\%$, $\tau^2 = 6.2333$, $\chi^2_{11} = 48.27$ ($p < 0.01$)





FFM loss



Visit = 12 months

Calleja-Fernández (2015)	46	-7.31	1.86
Carrasco (2009)	42	-10.70	1.05
Cole (2017)	5	-7.80	7.93
Johnson (2017)	15	-9.30	3.06
Khoo (2014)	30	-8.20	0.70
Mingrone (2002)	15	-14.50	2.51
Mingrone (2002)	31	-8.80	1.31
Savastano (2010)	45	-0.80	1.25
Tan (2016)	12	-7.44	2.90
Tan (2016)	10	-7.07	5.01
Turcotte (2019)	16	-12.30	4.94

Overall effect **267**

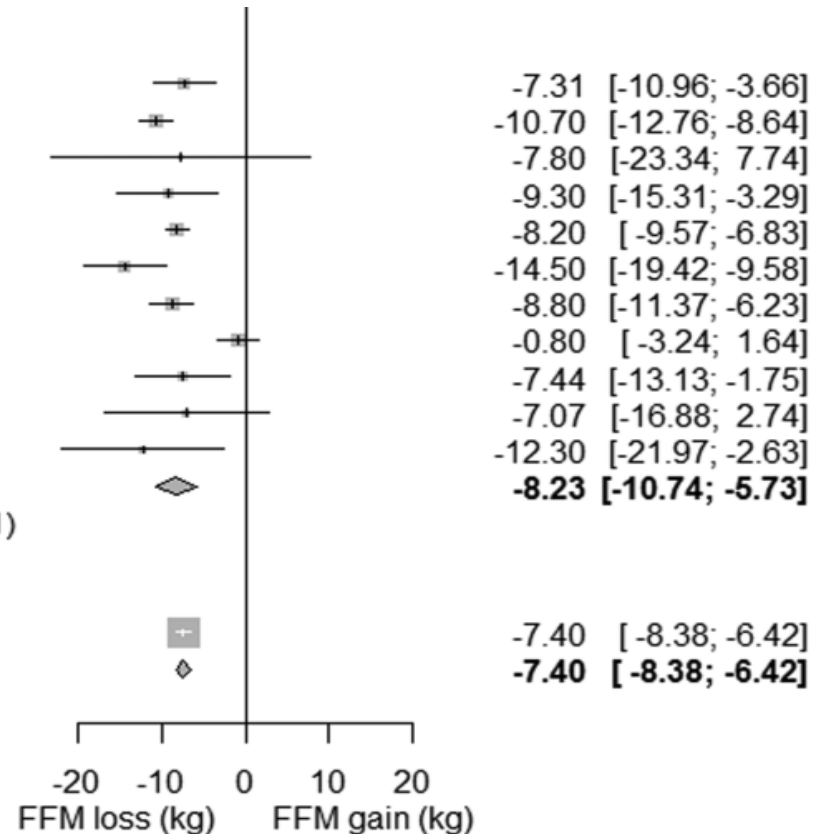
Heterogeneity: $I^2 = 79\%$, $\tau^2 = 7.9622$, $\chi^2_{10} = 48.32$ ($p < 0.01$)

Visit = 18 to 36 months

Nielsen (2021)	39	-7.40	0.50
----------------	----	-------	------

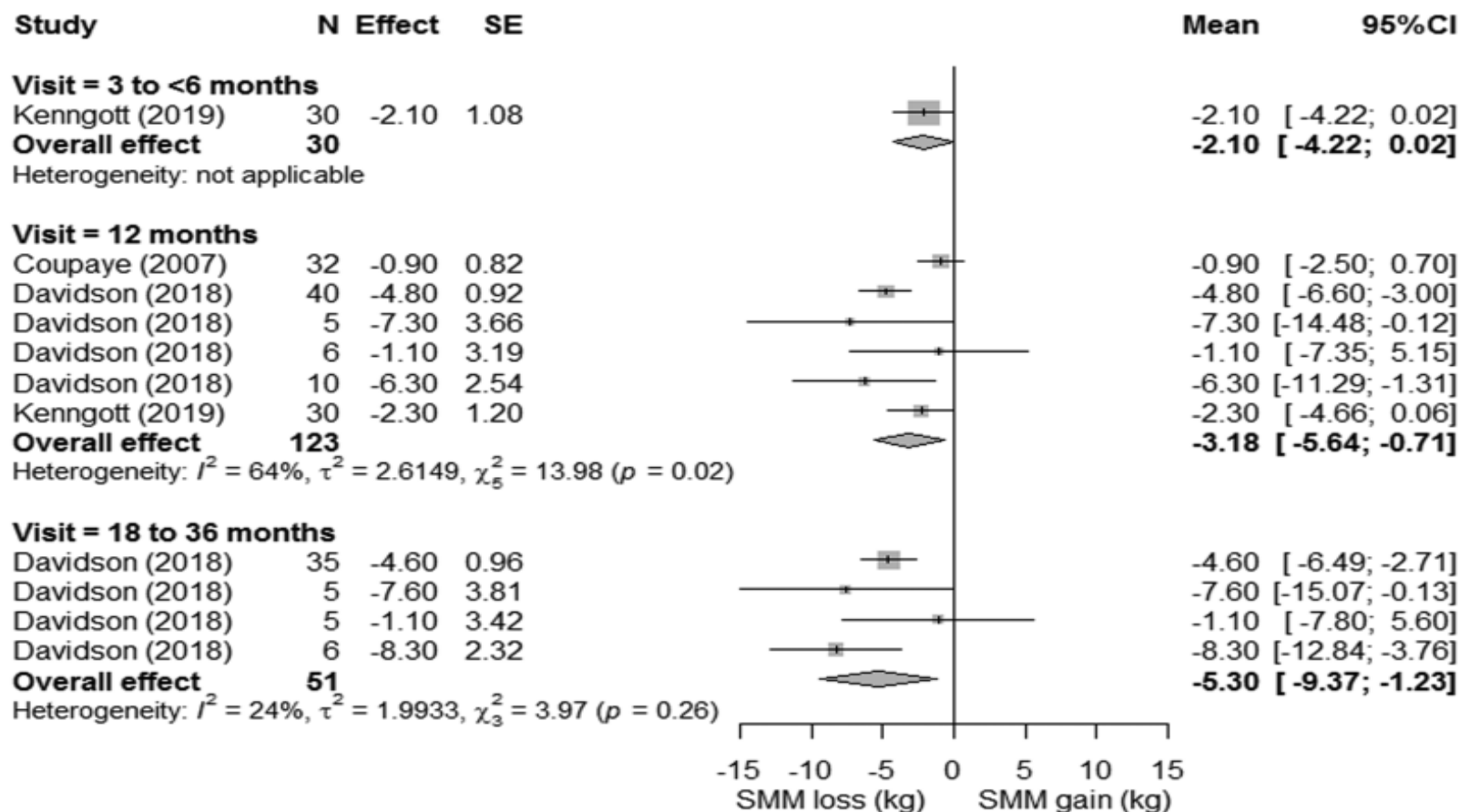
Overall effect **39**

Heterogeneity: not applicable



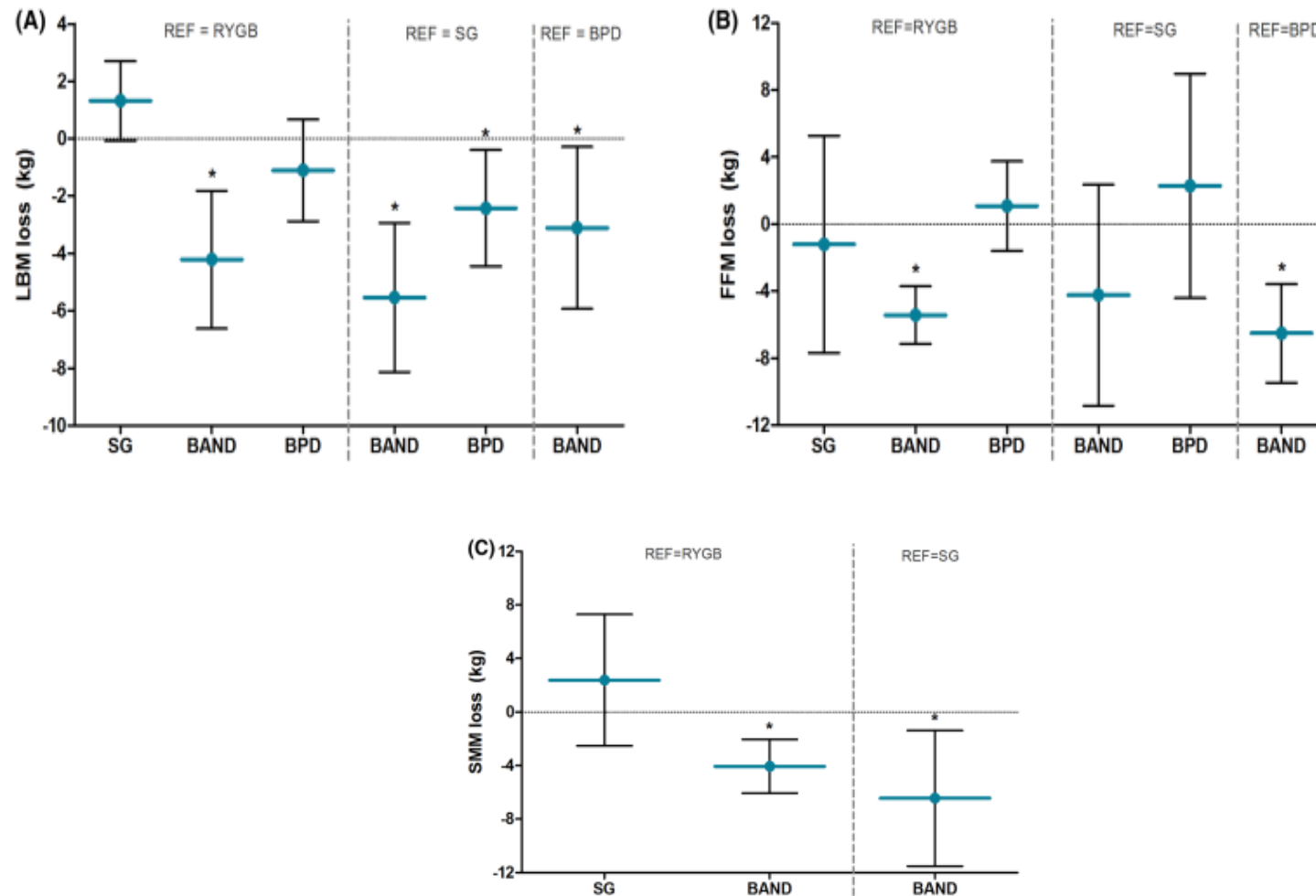


SMM loss





The comparison of LBM, FFM, and SMM loss between different types of surgery





The comparison of LBM, FFM, and SMM loss between different types of surgery



- total body weight loss: BPD (43.5 ± 9.8 kg), RYGB (38.6 ± 5.2 kg), SG (33.2 ± 6.1 kg) and BAND (22.4 ± 6.1 kg)
- Adjustable gastric band procedures showed a lower LBM loss of 3.1 kg, 4.2 kg , and 5.5 kg compared with BPD, RYGB, and SG procedures, respectively.
- Similar effects were for FFM and SMM, in which the adjustable gastric band: smaller decreases in FFM compared with RYGB and BPD.
- adjustable gastric band: smaller decreases in SMM concerning RYGB and SG.



Result



- The studies ($n = 8$) that assessed LBM both at 12 and 18–36 months:
- mean loss of 1.29 ± 1.0 kg LBM

suggesting a more stabilized LBM after 12 months

within 3-month post surgery:

LBM loss 4.45 kg (55% of the 12-month)

FFM loss 4.25 kg (52% of 12-month)

SMM loss 2.10 kg (66% of 12-month)



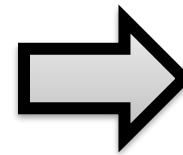
Muscle mass loss per surgery type



a strong relation between weight loss and FFM or LBM loss

The excessive FFM loss predominantly occurs shortly after surgery.

per kg FFM loss after bariatric surgery



1.95 kcal in REE

- ✓ enhance the drive to eat
- ✓ predictive score of sarcopenia
- ✓ increase the risk for frailty
- ✓ functional disability
- ✓ Mortality
- ✓ Cardiometabolic diseases



- The rapid FFM / LBM loss shortly after surgery is probably multifactorial
- Insufficient dietary protein intake
- Muscle protein synthesis (MPS) functions via a dose-response
- The body does not store protein



Future studies



- **Preoperative** factors are known to affect post bariatric muscle mass loss,
body composition
gender, ethnicity, age
thyroid function and prevalence of diabetes
growth hormone deficiency.
- **Postoperative** factors such as,
protein intake
exercise levels



Future studies



- Effect of protein supplementation and exercise
- segmental analyses of post bariatric muscle mass on health risks
- which extent changes in myostatin contribute to muscle mass preservation



- The studies (n = 8) that assessed LBM both at 12 and 18–36 months:
- mean loss of 1.29 ± 1.0 kg LBM

suggesting a more stabilized LBM after 12 months

within 3-month postsurgery:

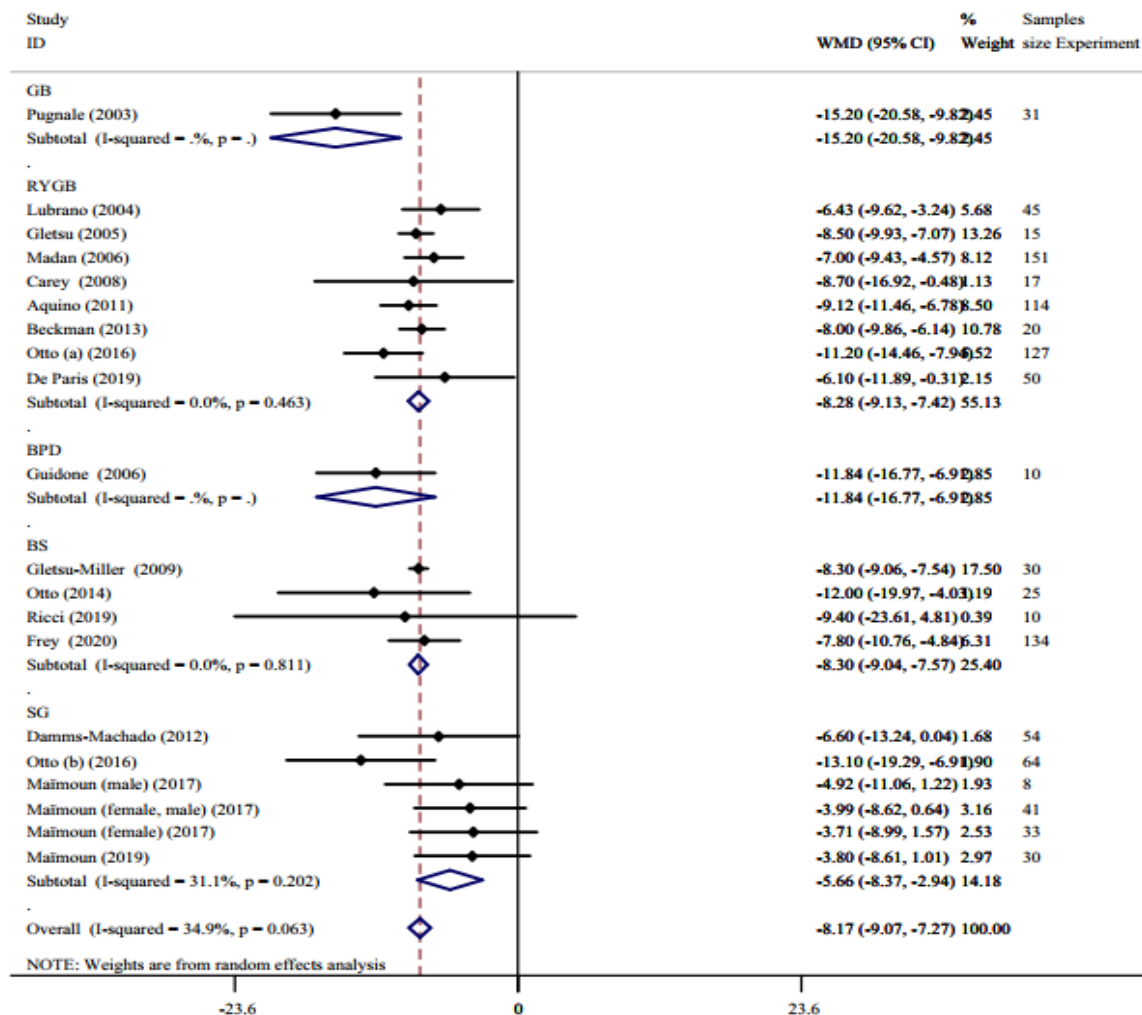
LBM loss 4.45 kg (55% of the 12-month)

FFM loss 4.25 kg (52% of 12-month)

SMM loss 2.10 kg (66% of 12-month)



ONE
BOLLID
WSES
RRFF
FFF
DDD
REEE





NUTRITION



ONE

BOLLID

WSES

RRFF

FFF

DDD

REEE

	<3 (mo)	≥3- to <6 (mo)		12 (mo)	18- to ≤36 (mo)
LBM	-4.45 kg [-6.21; -2.70]			-8.13 kg [-7.26; -9.01]	
FFM	-4.25 kg [-6.30 to -2.20]			-8.23 kg [-5.73; -10.74]	
SMM	-2.10 kg [-4.22 to 0.02]			-3.18 kg [-0.71; -5.64]	
FM	- 15.75 kg [- 17.49, - 14.0]	- 22.51 kg [- 23.93, - 21.09]		- 29.69 kg [- 31.3, - 28.09]	
BFP	- 4.90% [- 5.97, - 3.83]	- 8.56% [- 9.63, - 7.49]		- 13.49% [- 14.52, - 12.40]	