Age>65 and Adolescents: New ASMBS/IFSO Guidelines

Older population. Management of Sarcopenia in Bariatric Patients

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Scientific Commitee The Upper Gastrointestinal Surgeons (TUGS)

30th of August, 2023

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IFSO NAPOLI 2023

Symposium: Sarcopenia: Diagnosis and Mechanisms

Sarcopenia: Origins and Clinical Relevance[1]

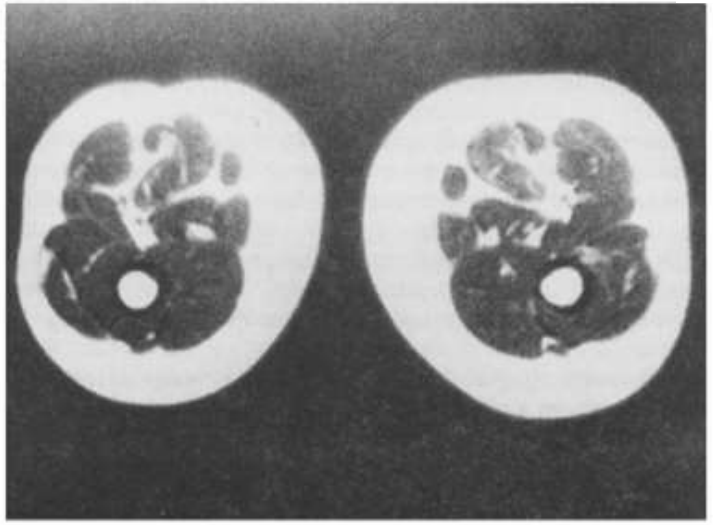
1997

Irwin H. Rosenberg

Jean Mayer Human Nutrition Research Center on Aging at Tufts University, Boston, MA 02111

ABSTRACT This presentation reflects on the origins of the term sarcopenia. The Greek roots of the word are *sarx* for flesh and *penia* for loss. The term actually describes important changes in body composition and related functions. Clearly defining sarcopenia will allow investigators to appropriately classify patients and examine underlying pathogenic mechanisms and will allow funding agencies to appropriately target research funds to a taxonomically distinct syndrome. J. Nutr. 127: 990S–991S, 1997.

KEY WORDS: • *sarcopenia* • *lean body mass* • *aging*



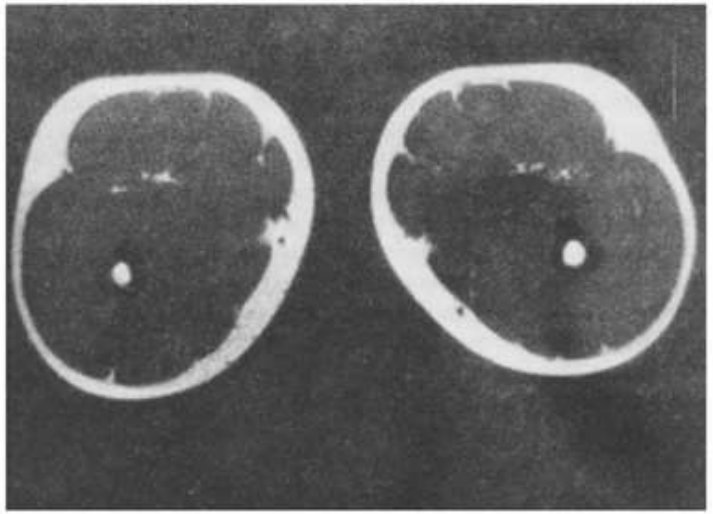


FIGURE 2 Proportion of lean-body mass vs. fat in the thighs of a young vs. old woman. See text for detail. Reproduced with permission from Evans and Rosenberg (1991).

- ✓ The term "Sarcopenia", coined by Rosenberg, is derived from the Greek word sarx (flesh) and penia (loss) which refers to the age-related loss of skeletal muscle mass.
- ✓ The term actually describes important changes in body composition and related functions.
- ✓ The term classifies patients and examine underlying pathogenetic mechanisms which generate this syndrome.

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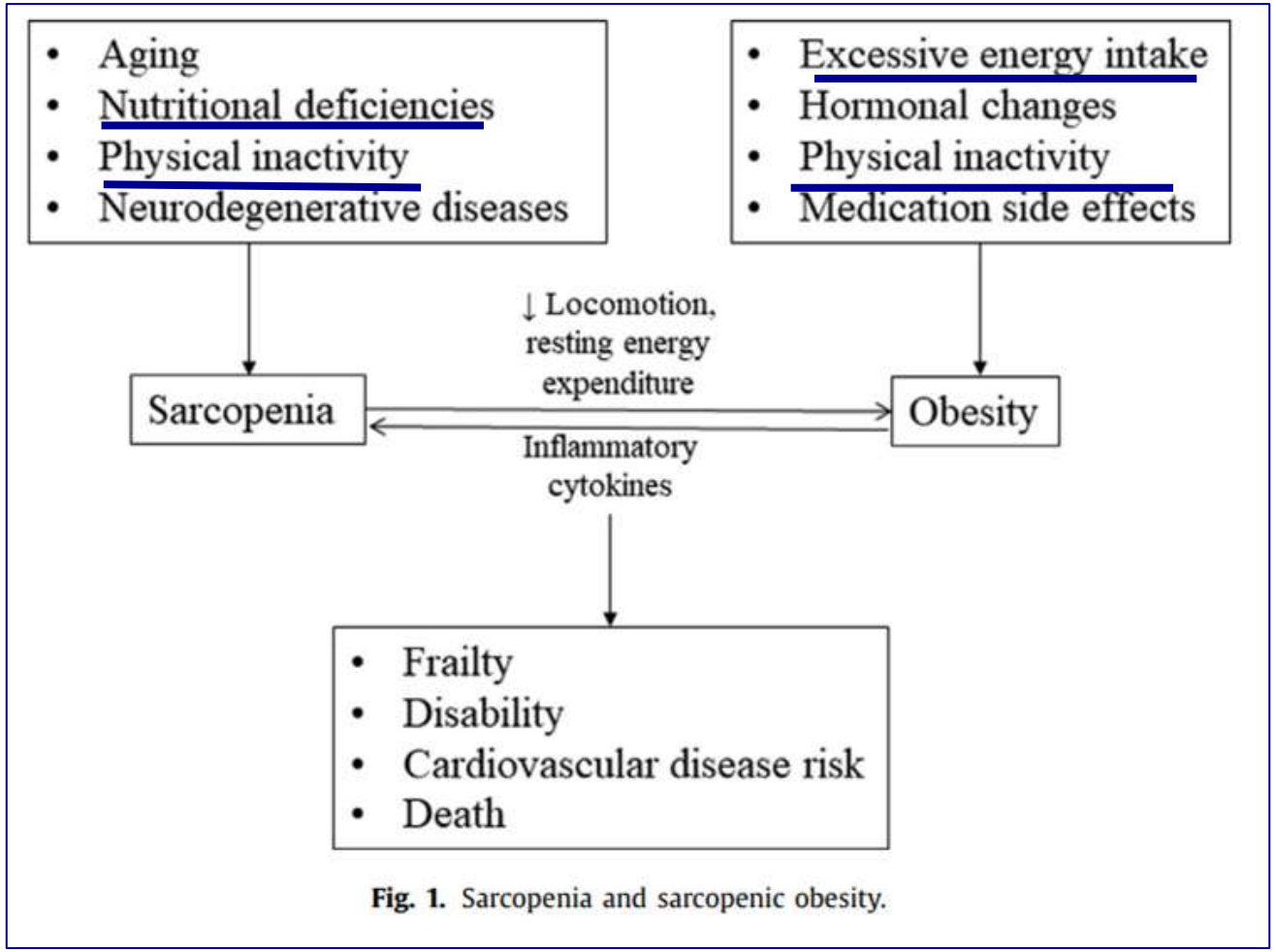

Fig. 1. Sarcopenia and sarcopenic obesity.

Mohapatra S, Gangadharan K, Pitchumoni CS. **Malnutrition in obesity before and after bariatric surgery**. Dis Mon. 2020 Feb;66(2):100866. doi: 10.1016/j.disamonth.2019.06.008. Epub **2019** Jul 10. PMID: 31301800.

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Obesity Facts

Consensus Statement

Obes Facts
DOI: 10.1159/000521241

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Published online: February 23, 2022

Definition and Diagnostic Criteria for Sarcopenic Obesity: ESPEN and EASO Consensus Statement

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2022

- Sarcopenic obesity is a clinical and functional condition consisting in:
  - a) obesity, characterized by excess Fat Mass (FM)
  - b) sarcopenia
- Sarcopenia, defined as low Fatty Free Mass (FFM) and function, has been identified and described as a geriatric syndrome with multifactorial aetiology whose prevalence increases with age

ESPEN: European Society of Parenteral and Enteral Nutrition
EASO: European Association for the Study of Obesity

Older population. Management of Sarcopenia in Bariatric Patients

Definition and Diagnostic Criteria for Sarcopenic Obesity: ESPEN and EASO Consensus Statement

2022

Sarcopenic obesity is defined as the co-existence of obesity and sarcopenia

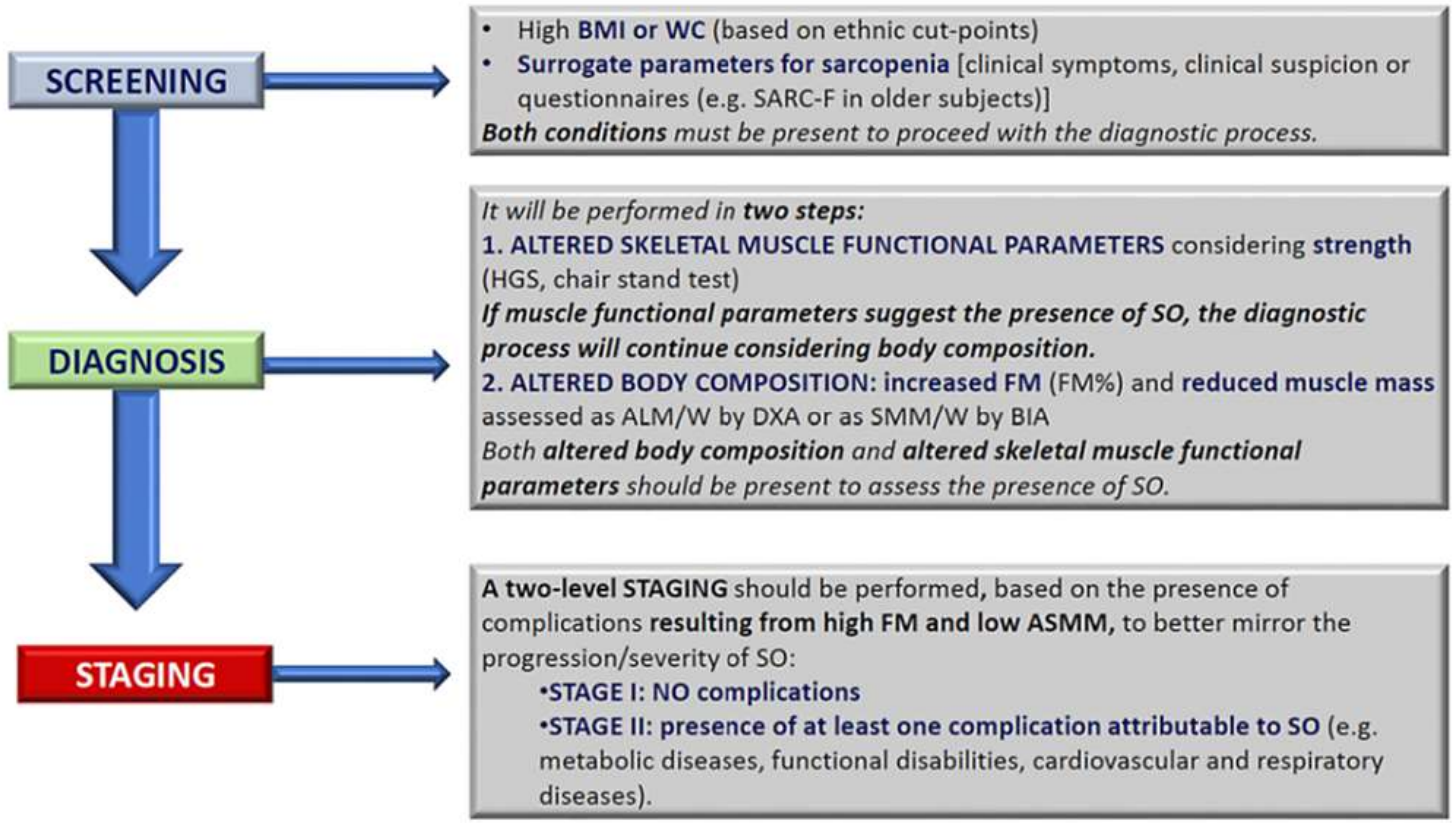
Table 1. Clinical symptoms or suspicion factors for the screening of sarcopenic obesity

- Age >70 years
- Chronic disease diagnosis (e.g., inflammatory diseases and organ failure or chronic disease) including but not limited to:
  - Chronic heart failure
  - Chronic kidney disease (particularly renal replacement therapy)
  - Chronic bowel failure or dysfunction
  - Chronic liver disease (particularly NASH and liver cirrhosis)
  - Chronic respiratory disease
  - Chronic neurologic and neurodegenerative diseases
  - Chronic cognitive impairment
  - Depression
  - Organ transplantation
  - Endocrine diseases (e.g., metabolic syndrome, diabetes mellitus, hypercortisolism, hypogonadism and corticoid treatment)
  - Osteoarthritis
  - Cancer (especially but not limited to chemotherapy of breast or prostate cancer)
- Recent acute disease/nutritional events:
  - Recent hospitalization (particularly but not limited to COVID-19, ICU stay, surgery)
  - Recent major surgery or trauma with/without complications
  - Recent sustained immobilization or reduced mobility (e.g., trauma, fracture, orthopaedic disease)
  - Recent history of reduced food intake (e.g., <50% for >2 weeks)
  - Recent weight loss (including diet-induced voluntary weight loss and weight cycling syndrome)
  - Recent rapid increase in weight
  - Long-standing restrictive diets and bariatric surgery
- History – complaint of:
  - Repeated falls
  - Weakness, exhaustion
  - Fatigability
  - Perceived progressive movement limitations

Definition and Diagnostic Criteria for Sarcopenic Obesity: ESPEN and EASO Consensus Statement

2022

Sarcopenic obesity is defined as the co-existence of obesity and sarcopenia



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Obesity Surgery (2020) 30:2015–2020
https://doi.org/10.1007/s11695-020-04516-1

REVIEW

2020

Sarcopenia: What a Surgeon Should Know

Enrico Pinotti[1,2] · Mauro Montuori[1,2] · Vincenzo Borrelli[2] · Monica Giuffrè[2] · Luigi Angrisani[3]

Published online: 2 March 2020

Techniques for Assessing Sarcopenia

Muscle Mass

Anthropometric measurements, such as BMI, mid-upper arm circumference, calf circumference, and skinfold thickness, are relatively easy to perform in a normal clinical setting; however, they are not recommended for diagnosing sarcopenia since they are prone to error [4]. CT scan and magnetic resonance imaging can distinguish fat from muscles and provide anatomical details and, in particular, can be used to assess skeletal muscle volume. They allow calculation of segmental and total muscle mass, and assessment of fat infiltration in the muscle, which impacts on muscle quality and force development. For these reasons, CT scan and MRI have considered the gold standard techniques for evaluating muscle mass. Dual-energy X-ray absorptiometry (DXA) can correctly evaluate body composition with good precision and low radiation exposure [13]. Bioimpedance analysis (BIA) is an inexpensive, easy to use, and reproducible method considered a portable alternative to DXA. CT scan and MRI are often available for the surgeon that needs preoperative imaging to plan oncological or non-oncological surgical treatment. The surgeon together with the radiologist can use imaging to assess the area and density of the muscles (usually psoas muscle at the level of L2 or L3). However, the radiological diagnosis of sarcopenia is not simple, and there are risks of mistakes.

Muscle Strength

Muscle strength is commonly evaluated using handgrip strength, which is an easy, reliable, and inexpensive method [14]. Cutoffs for grip strength are less than 20 kg for women and 30 kg for men [4]. Knee flexion techniques are suitable for research studies, but their use in clinical practice is limited by the need for special equipment and training. Peak expiratory flow (PEF) is determined by the strength of respiratory muscles and can be used to assess the strength of respiratory muscles.

Physical Performance

Gait speed is the most widely used technique to assess physical performance [15]. A walking speed slower than 0.8 m/s is being considered a poor performance and it is associated with disability and frailty. The short physical performance battery is a composite of some separate tests that evaluates balance, gait, strength, and endurance. The short physical performance battery can be used as a standard measure of physical performance both for research and in clinical practice. In most of the surgical researches, only the quantitative component of sarcopenia is assessed; muscle mass is a quantitative domain. It is the fastest parameter to perform and is associated with the least risk of error. However, sarcopenia is a multifactorial

Gait Speed: Time a patient takes to walk a specific distance on level surface over a short distance

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Obesity Surgery (2020) 30:2158–2164
https://doi.org/10.1007/s11695-019-04198-4

IFSO

ORIGINAL CONTRIBUTIONS

2020

Check for updates

The Impact of Age on the Prevalence of Sarcopenic Obesity in Bariatric Surgery Candidates

Judit Molero[1] · Violeta Moizé[1] · Lilliam Flores[1,2,3] · Ana De Hollanda[1,2] · Amanda Jiménez[1,2,4] · Josep Vidal[1,2,3]

Table 2 Prevalence of sarcopenia in the study participants

		Total ($n = 1370$)	18–39 years (n = 465)	40–49 years (n = 412)	50–59 years (n = 358)	≥ 60 years (n = 135)
According to SMMI						
No sarcopenia (%)	Male	83.8	84.6	83.8	82.8	83.3
	Female	77.1	85.4	82.0	69.4	58.1
Class I sarcopenia (%)	Male	14.8	15.4	15.4	12.9	16.7
	Female	17.3	12.0	13.9	22.6	29.1
Class II sarcopenia (%)	Male	1.4	0.0	0.9	4.3	0.0
	Female	5.6	2.6	4.1	7.9	12.8
According to %SMM						
No sarcopenia (%)	Male	84.9	85.5	83.9	83.3	84.9
	Female	78.7	87.1	83.7	70.9	59.0
Class I sarcopenia (%)	Male	13.4	14.6	12.0	12.9	16.7
	Female	15.6	10.5	12.2	20.8	27.4
Class II sarcopenia (%)	Male	1.7	0.0	2.6	3.2	0.0
	Female	5.7	2.3	4.1	8.3	13.7

Data are presented as percent. SMMI, skeletal muscle mass index; %SMM, percent skeletal muscle mass. a: p value<0.05 for the paired comparison between the reference group and other age groups

Sarcopenic Obesity is fairly common in caucasian patients with obesity, mainly females, aged >60 years, that are candidates to MBS

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Obesity Surgery (2021) 31:4485–4491
https://doi.org/10.1007/s11695-021-05634-0

ORIGINAL CONTRIBUTIONS

2021

Improvement in Muscle Strength and Metabolic Parameters Despite Muscle Mass Loss in the Initial Six Months After Bariatric Surgery

Roberto Viña Coral[1] · André Vicente Bigolin[1] · Mayara Christ Machry[1] · Rodrigo Koprovski Menguer[1] · Júlio Carlos Pereira-Lima[2] · Isabela Contin[2] · Paula Veigas Stock[2]

Table 2 Comparison of BIA results before surgery and 6 months after surgery

Variable	Before surgery Mean ± SE	6 months Mean ± SE	Difference (95%CI)	P
Total body weight (kg)	113.5 ± 2.2	82.5 ± 1.6	−31.0 (−33.2 to −28.9)	<0.001
BMI (kg/m^2)	42.2 ± 0.7	30.7 ± 0.5	−11.5 (−12.2 to −10.8)	<0.001
Lean body mass (kg)	32.5 ± 0.8	28.5 ± 0.6	−4.1 (−4.6 to −3.5)	<0.001
Fat mass (kg)	55.8 ± 1.3	30.8 ± 1.2	−25.0 (−26.8 to −23.2)	<0.001
Appendicular lean mass (kg)	24.4 ± 0.6	20.9 ± 0.5	−3.4 (−3.8 to −3.1)	<0.001
Appendicular lean mass/height^2 (kg/m^2)	9.0 ± 0.1	7.7 ± 0.1	−1.3 (−1.4 to −1.2)	<0.001
Appendicular lean mass/BMI (m^2)	0.58 ± 0.01	0.69 ± 0.02	0.11 (0.56 to 0.12)	<0.001
Fat mass/Lean mass ratio	1.74 ± 0.03	1.11 ± 0.05	−0.63 (−0.69 to −0.57)	<0.001
Body fat percentage, %	49.1 ± 0.5	36.9 ± 1.0	−12.2 (−13.5 to −10.9)	<0.001
Basal metabolic rate	1617 ± 27.0	1486 ± 22.0	−131 (−150.6 to −111.5)	<0.001
Waist-to-hip ratio	1.02 ± 0.0	0.95 ± 0.01	−0.07 (−0.08 to −0.06)	<0.001
Obesity grade (%)	195.8 ± 3.2	142.4 ± 2.5	−53.4 (−56.5 to −50.2)	<0.001
Visceral fat (m^2)	19.9 ± 0.1	14.0 ± 0.5	−5.9 (−6.9 to −4.9)	<0.001

- **Functional evaluation methods (Handgrip strenght test, Timed Up and Go test and Gait Speed test) did not reflect** the reduction in skeletal muscle mass demonstrated 6 months after bariatric surgery in comparison to the preoperative baseline
- **Improvement in muscle strength was followed by improvement in metabolic parameters**

Table 3 Comparison of muscle parameters before surgery and 6 months after surgery

Variable	Before surgery Mean ± SE	6 months Mean ± SE	Difference (95%CI)	P
Handgrip strength (kg)	25.7 ± 1.2	25.4 ± 1.0	−0.3 (−0.7 to 0.9)	0.647
Timed Up and Go (s)	9.9 ± 0.2	8.9 ± 0.2	−1.0 (−1.4 to −0.6)	<0.001
Gait speed (m/s)	0.62 ± 0.01	0.69 ± 0.01	0.07 (0.04 to 0.09)	<0.001

Older population. Management of Sarcopenia in Bariatric Patients

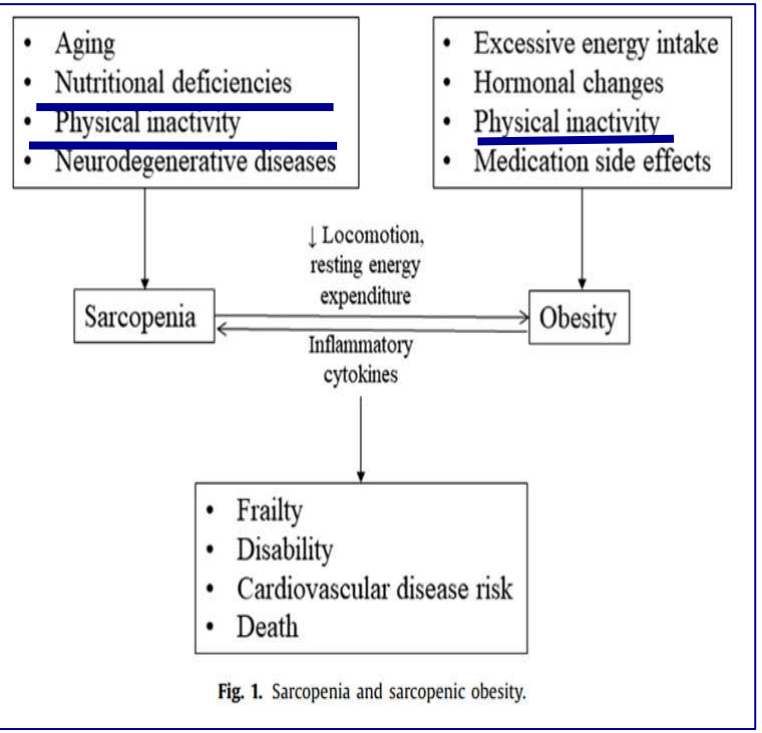

Fig. 1. Sarcopenia and sarcopenic obesity.

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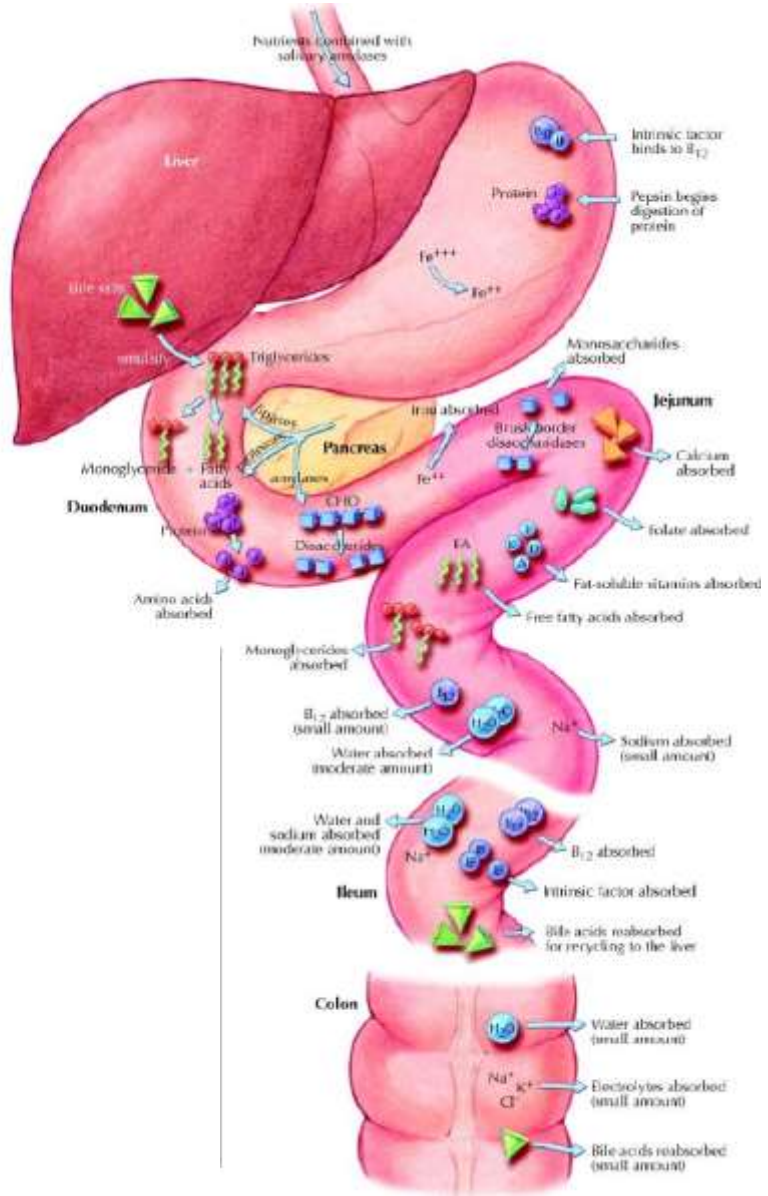

Practical Recommendations of the Obesity Management Task Force of the European Association for the Study of Obesity for the Post-Bariatric Surgery Medical Management

Luca Busetto[a] Dror Dicker[b] Carmil Azran[c] Rachel L. Batterham[d, e, f] Nathalie Farpour-Lambert[g] Martin Fried[h] Jøran Hjelmesæth[i] Johann Kinzl[j] Deborah R. Leitner[k] Janine M. Makaronidis[d, f] Karin Schindler[l] Hermann Toplak[k] Volkan Yumuk[m]

Obesity Facts

2017

LSG

RYGB

OAGB

BPD/DS

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ELSEVIER

Surgery for Obesity and Related Diseases ▮ (2015) 00–00

SURGERY FOR OBESITY AND RELATED DISEASES

Original article

Preoperative micronutrient status in morbidly obese patients before undergoing bariatric surgery: results of a cross-sectional study

Eva Wolf, M.Sc.[a,b], Markus Utech, M.D.[a], Peter Stehle, Ph.D.[b], Martin Büsing, M.D.[c], Birgit Stoffel-Wagner, M.D.[c], Sabine Ellinger, Ph.D.[b,d,*]

[a]Department of General and Visceral Surgery, Klinikum Vest, Knappschaftskrankenhaus Recklinghausen, Recklinghausen, Germany
[b]Department of Nutrition and Food Sciences, Nutritional Physiology, University of Bonn, Bonn, Germany
[c]Department of Clinical Chemistry and Clinical Pharmacology, University Hospital Bonn, Bonn, Germany
[d]Faculty of Food, Nutrition and Hospitality Sciences, Hochschule Niederrhein, University of Applied Sciences, Mönchengladbach, Germany

Received September 5, 2014; accepted March 27, 2015

2015

Methods: The cross-sectional study investigated retinol, ascorbic acid, tocopherol, and β-carotene (high-pressure liquid chromatography), 25-hydroxycholecalciferol (enzyme-linked immunosorbent assay), and calcium, phosphate, and magnesium (photometry) in serum/plasma in 43 patients (body mass index: 52.6 ± 10.5 kg/m^2) before sleeve gastrectomy. Albumin, parathyroid hormone, and alkaline phosphatase were analyzed. Data were compared with accepted cutoff values. Dietary intake was estimated by 3-day food records, and nutrient intake was compared with recommended values.

Conclusions

Many morbidly obese patients in Germany suffer from multiple micronutrient deficiencies, especially vitamin D, ascorbic acid, and β-carotene, before bariatric surgery that may further worsen after surgery. Nutritional therapies

Table 2
Serum/plasma concentrations of micronutrients

	Patients*	Reference range†
25-Hydroxycholecalciferol (nmol/L)	35 ± 17	50–175‡
Retinol (μmol/L)	1.2 ± .4	.7–1.75
Ascorbic acid (μmol/L)	32 ± 15	28–85
Toc/chol ratio (μmol/mmol)	5.5 ± 1.0	>2.8
β-Carotene (μmol/L)	.3 ± .1	.9–4.6
Calcium (mmol/L)§	2.43 ± .10	2.25–2.5¶
Magnesium (mmol/L)	.77 ± .06	.65–1.05
Phosphate (mmol/L)	1.08 ± .18	.77–1.45

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OBES SURG (2016) 26:833–838
DOI 10.1007/s11695-015-1844-y

ORIGINAL CONTRIBUTIONS

2016

Malnutrition in Bariatric Surgery Candidates: Multiple Micronutrient Deficiencies Prior to Surgery

Leigh A. Peterson[1] · Lawrence J. Cheskin[2,3,4] · Margaret Furtado[5] · Konstantinos Papas[6] · Michael A. Schweitzer[1] · Thomas H. Magnuson[1] · Kimberley E. Steele[1]

Table 3 Frequency of clinical deficiency prior to bariatric surgery by sex and race

		Cut-point	Total	Female	Male	White	Black	Hispanic	
Vitamin A		<20 ug/dL	1.7 %	2.2 %	0 %	0 %	5.6 %	0 %	
Vitamin B_{12}		<180 ng/L	3.5 %	2.2 %	7.7 %	2.7 %	5.6 %	0 %	
Vitamin D		<30 ng/mL	92.9 %	90.9 %	100 %	91.9 %	93.8 %	100 %	
Vitamin E-α		<5.5 mg/L	5.2 %	6.7 %	0 %	0 %	16.7 %	0 %	*
Thiamine		<78 nmol/L	1.8 %	2.3 %	0 %	0 %	0 %	33.3 %	*
Folate		<7.2 ug/L	5.3 %	6.7 %	0 %	2.7 %	11.8 %	0 %	
Iron	Female	<50 ug/dL	36.2 %	35.4 %	38.5 %	37.8 %	38.9 %	0 %	
	Male	<65 ug/dL							
TIBC		>400 ug/dL	22.4 %	26.6 %	7.7 %	24.3 %	22.2 %	0 %	
Iron saturation		<20 %	56.9 %	62.2 %	38.5 %	51.4 %	66.7 %	66.7 %	
Multiple micronutrient deficiencies		≥3	39.7 %	40.0 %	38.5 %	35.1 %	50.0 %	33.3 %	

*$p<0.05$

Conclusions

Malnutrition in one or multiple micronutrients is pervasive in this pre-operative bariatric cohort, chiefly in vitamin D and iron. Minorities tended to have greater malnutrition. Further studies should be carried out to determine whether these deficiencies increase the risk of adverse surgical outcomes. Furthermore, the effect of pre-operative supplementation, especially vitamin D and iron, should be explored.

Older population. Management of Sarcopenia in Bariatric Patients

Obesity Surgery (2023) 33:212–218
https://doi.org/10.1007/s11695-022-06355-8

ORIGINAL CONTRIBUTIONS

2023

Micronutrients Deficiencies in Candidates of Bariatric Surgery: Results from a Single Institution over a 1-Year Period

Giovanna Berardi[1] · Antonio Vitiello[1] · Adam Abu-Abeid[2] · Vincenzo Schiavone[1] · Antonio Franzese[1] · Nunzio Velotti[1] · Mario Musella[1]

Key Points

- Approximately 90% of patients had deficient or insufficient serum levels of vitamin D preoperatively.
- Almost half of the patients had a preoperative deficit of folate.
- Vitamin B12 deficiency was significantly more frequent in the female population.
- Age and obesity-related disease did not significantly influence the serum level of the studied nutrients.
- It is mandatory to screen all BS candidates and treat them accordingly before surgery.

			Sex		Total	*P*-value
			Female	Male		
Vit. B12 deficiency	No	*N*	117	47	164	**0.03***
		%	92.1%	100.0%	94.3%	
	Yes	*N*	10	0	10	
		%	7.9%	0.0%	5.7%	
Total			127	47	174	
Folate deficiency	No	*N*	74	24	98	0.25
		%	58.3%	51.1%	56.3%	
	Yes	*N*	53	23	76	
		%	41.7%	48.9%	43.7%	
Total			127	47	174	
Vit. D deficiency	No	*N*	42	16	58	0.52
		%	33.1%	34.0%	33.3%	
	Yes	*N*	85	31	116	
		%	66.9%	66.0%	66.7%	
Total			127	47	174	

boldface means $^{*}p < 0.05$

139 patients (79.9%) had at least one preoperative micronutrient disorder

Older population. Management of Sarcopenia in Bariatric Patients

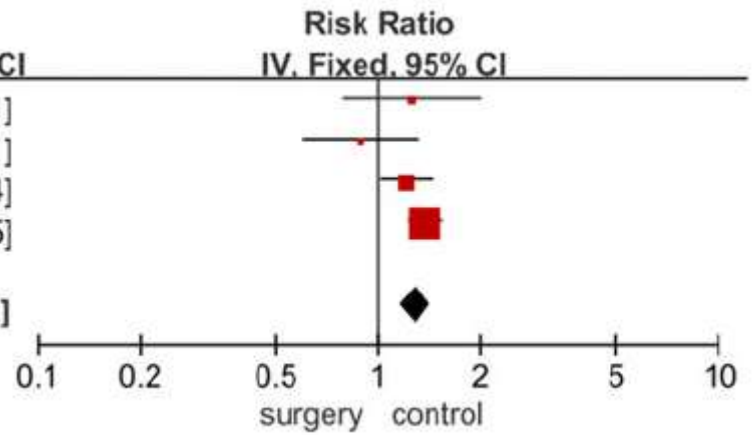
Obesity Surgery/Outcomes

A meta-analysis of the effects of bariatric surgery on fracture risk

Study or Subgroup	log[Risk Ratio]	SE	Weight	Risk Ratio IV, Fixed, 95% CI
Douglas IJ 2015	0.23	0.24	3.9%	1.26 [0.79, 2.01]
Lalmohamed A 2012	-0.12	0.2	5.6%	0.89 [0.60, 1.31]
Lu CW 2015	0.19	0.09	27.8%	1.21 [1.01, 1.44]
Rousseau C 2016	0.32	0.06	62.6%	1.38 [1.22, 1.55]
Total (95% CI)			**100.0%**	**1.29 [1.18, 1.42]**

Heterogeneity: $Chi^2 = 5.22$, df = 3 (P = 0.16); $I^2 = 43\%$

Test for overall effect: Z = 5.38 (P < 0.00001)



1003 studies analysed

MBS is associated with an increased risk of total and non vertebral fractures, expecially in the upper limbs

Zhang Q et al. Obes Rev 2018;19:728

Post-bariatric surgery follow-up

Table 5. Major vitamins and minerals deficiencies after bariatric surgery: clinical manifestations and estimated frequency according to the bariatric procedure

Deficiency	Key clinical manifestations	Procedure-related frequency
Iron	microcytic anaemia	AGB + SG ++ RYGB, BPD, BPD/DS +++
Vitamin B12	megaloblastic anaemia neurologic abnormalities	SG, RYGB, BPD, BPD/DS ++
Vitamin D (and calcium)	bone demineralization increased risk of fractures	RYGB ++ BPD, BPD/DS +++
Vitamin A	ocular xerosis night blindness symptoms	BPD, BPD/DS +++
Vitamin E	anaemia ophthalmoplegia peripheral neuropathy	BPD, BPD/DS +++
Vitamin K	easy bleeding	BPD, BPD/DS +

AGB = Adjustable gastric banding; SG = sleeve gastrectomy; RYGB = gastric bypass; BPD = biliopancreatic diversion; BPD/DS = biliopancreatic diversion with duodenal switch.

Obesity Facts
Obes Facts 2017;10:597–632

Older population. Management of Sarcopenia in Bariatric Patients

Malnutrition in obesity before and after bariatric surgery

Sonmoon Mohapatra, MD[a], Keerthana Gangadharan, MBBS[b], Capecomorin S. Pitchumoni, MD, MACG, MACP, MPH, FRCP (C), FRCP (Edin)[c,*]

[a] *Department of Gastroenterology and Hepatology, Saint Peter's University Hospital – Rutgers Robert Wood Johnson School of Medicine, New Brunswick, NJ, United States*
[b] *Department of Internal Medicine, Saint Peter's University Hospital – Rutgers Robert Wood, Johnson School of Medicine, New Brunswick, NJ, United States*
[c] *Department of Gastroenterology, Hepatology and Clinical Nutrition, Saint Peter's University Hospital – Rutgers Robert Wood Johnson School of Medicine, New Brunswick, NJ, United States*

2020

- The most severe macronutrient complication associated with bariatric surgical procedures is **protein malnutrition**
- Evaluate strictly patients with Albumin < 3 g/dL
- It has been reported most frequently after BPD-DS where it occurs in an estimated 3–21% of patients
- Following RYGB an incidence of up to 13% has been estimated depending on the length of the Roux-limb

Older population. Management of Sarcopenia in Bariatric Patients

ELSEVIER

Surgery for Obesity and Related Diseases 15 (2019) 441–446

SURGERY FOR OBESITY AND RELATED DISEASES

Original articles

Protein deficiency after gastric bypass: The role of common limb length in revision surgery

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Table 1
Clinical characteristics of patients with morbidly obesity before and 1 year after surgery.

	All ($n=2397$)	RYGB ($n=377$)	OAGB ($n=1022$)	AGB ($n=169$)	SG ($n=649$)	SG-DJB ($n=92$)	VBG ($n=88$)
Age, yr	34.8 (10.7)	35.9 (10.6)	34.4 (10.9)	32.1 (9.7)	35.1 (10.1)	42.0 (10.7)	30.2 (10.3)
Female (%)	1612 (67)	268 (71)	696 (68)	96 (56)	436 (67)	58 (63)	58 (65)
BMI, kg/m^2 preop	39.9 (7.5)	38.6 (6.7)	41.2 (7.7)	39.3 (7.1)	39.3 (7.1)	34.2 (6.1)	42.1 (7.8)
1-yr after op	27.7 (5.0)*	29.2 (4.7)*	27.3 (4.7)*	32.8 (6.1)*	27.4 (4.9)*	25.0 (3.7)*	29.0 (5.8)*
Total weight loss %	30.1 (9.5)	28.5 (9.2)	33.1 (8.5)	16.6 (9.4)	25.1 (7.1)	25.9 (9.0)	29.0 (5.8)
Albumin, mg/dL preop	4.4 (.3)	4.4 (.3)	4.4 (.3)	4.4 (.3)	4.4 (.3)	4.4 (.3)	4.5 (.3)
1 yr after op	4.3 (.4)	4.2 (.4)*	4.2 (.4)*	4.4 (.3)	4.3 (.3)	4.2 (.3)*	4.5 (.3)
Total protein, mg/dL preop	7.5 (.5)	7.5 (.5)	7.5 (.5)	7.4 (.8)	7.5 (.5)	7.6 (.5)	7.5 (.5)
1 yr after op	7.2 (.5)	7.1 (.5)*	7.1 (.5)*	7.4 (.5)	7.2 (.5)*	7.1 (.5)*	7.5 (.5)
Protein deficiency† n (%) preop	13 (.5)	1 (.3)	6 (.6)	3 (1.8)	3 (.5)	0 (0)	0 (0)
1 yr after op	46 (2.0%)*	7 (1.8%)*	29 (2.8%)*	1 (.6%)	8 (1.2%)	1 (1.1%)	0 (0%)

RYGB = Roux-en-Y gastric bypass; OAGB = one-anastomosis gastric bypass; AGB = adjustable gastric band; SG = sleeve gastrectomy; DJB = duodeno-jejunal bypass; VBG = vertical gastric banding; BMI = body mass index; Preop = preoperation; Op: operation.

Data are presented as the mean (standard deviation).

* Significantly different from preoperative data ($P<.05$).

† Protein deficiency: albumin <3.5 gm/dL.

Patients can develop Protein Deficiency after gastric bypass surgery when the common limb length is <400 cm

Older population. Management of Sarcopenia in Bariatric Patients

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2020

The incidence of iron deficiency anemia post-Roux-en-Y gastric bypass and sleeve gastrectomy: a systematic review

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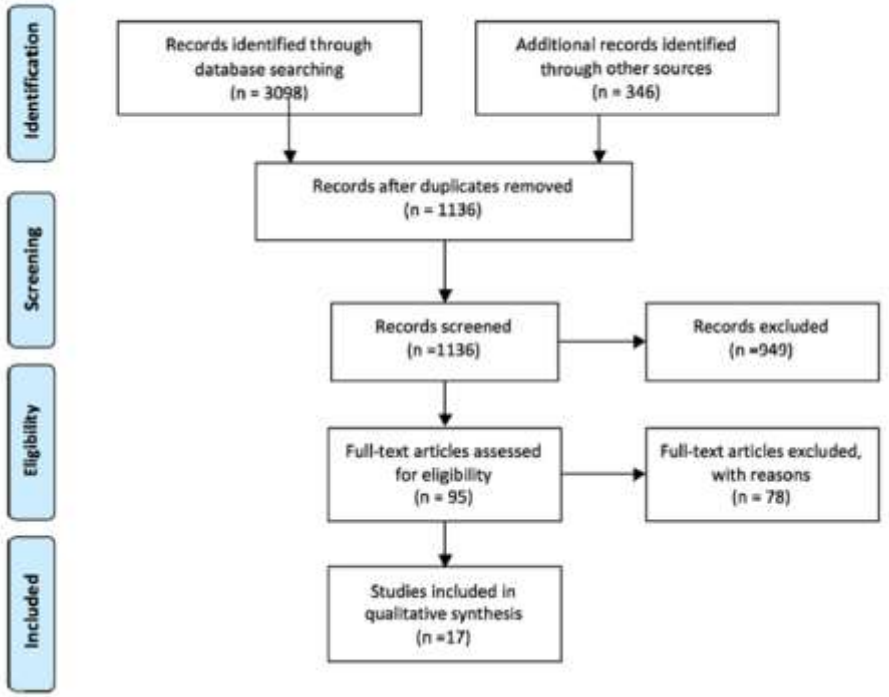

Table 2 Iron deficiency, iron deficiency anemia, and unclassified anemia by bariatric surgery type

	RYGB %	SG %
Iron deficiency		
Pre-operative	14.7	36.6
Post-operative	22.5	12.4
Iron deficiency anemia		
Pre-operative	NR	NR
Post-operative	14.8	1.6
Unclassified anemia		
Pre-operative	11.2	19.1
Post-operative	22.9	19.6

NR not reported, *RYGB* Roux-en-Y gastric bypass, *SG* sleeve gastrectomy

The incidence of iron deficiency-related anemia was 16.7% post-RYGB and 1.6% post-SG

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2014

SURGERY FOR OBESITY AND RELATED DISEASES

Surgery for Obesity and Related Diseases ▮ (2014) 00–00

Original article

Anemia, iron and vitamin B_{12} deficiencies after sleeve gastrectomy compared to Roux-en-Y gastric bypass: a meta-analysis

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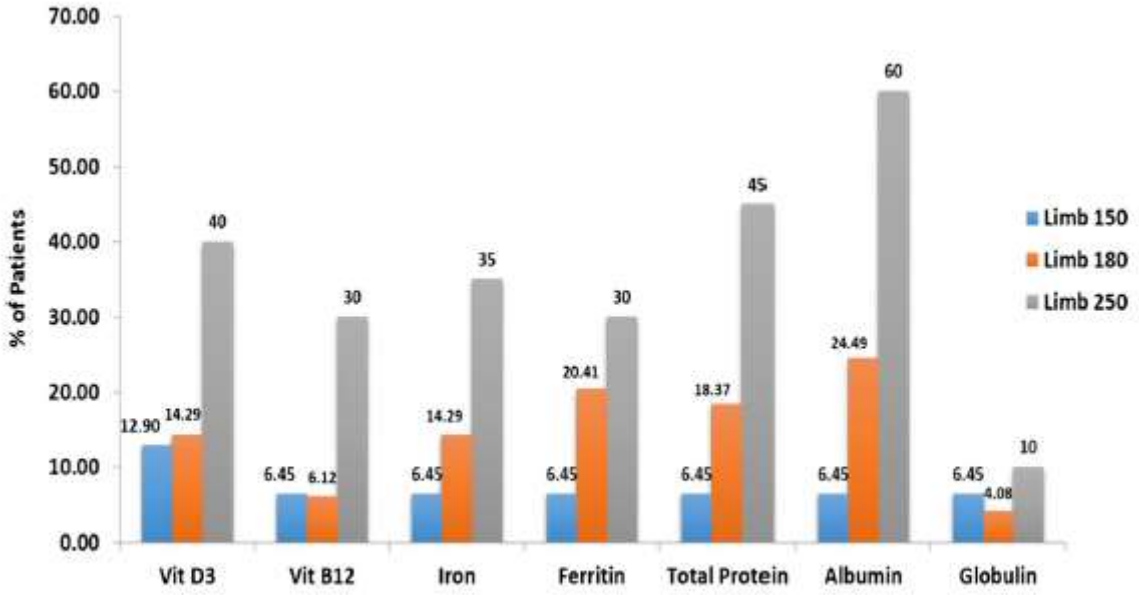
In summary, the authors' findings suggest that SG is more beneficial than RYGB with regard to postoperative vitamin B_{12} deficiency risk in the analysis of RCTs, although the 2 methods are comparable in postoperative anemia and iron deficiency risk. Postoperative prophylactic iron and B_{12} supplementation, in addition to general multivitamin and mineral supplementation, is recommended based on subgroup analysis results, which showed comparable risks of nutritional deficiency associated with the 2 surgical methods.

MGB-OAGB: Effect of Biliopancreatic Limb Length on Nutritional Deficiency, Weight Loss, and Comorbidity Resolution

Fig. 2 Percentage of patients with nutritional deficiencies in 150-cm, 180-cm, and 250-cm groups



Percentage of patients with nutritional deficiencies in 150 cm, 180 cm & 250 cm groups.

Ahuja A et al. Obes Surg 2018;28:3439

Post-bariatric surgery follow-up

Table 6. Minimal periodic surveillance for nutritional deficiencies after bariatric surgery

	AGB	SG	RYGB	BPD – BPD/DS
Timing	every 6 months in the first year every 12 months thereafter	every 3–6 months in the first year every 12 months thereafter	every 3–6 months in the first year every 12 months thereafter	every 3 months in the first year every 6–12 months thereafter
Assessment	CBC, platelets electrolytes iron, ferritine vitamin B12 folate vitamin D PTH	CBC, platelets electrolytes iron, ferritine vitamin B12 folate vitamin D PTH	CBC, platelets Electrolytes iron, ferritine vitamin B12 folate vitamin D PTH 24-H U-calcium osteocalcin	CBC, platelets electrolytes iron, ferritine vitamin B12 folate vitamin D PTH 24-H U-calcium osteocalcin vitamin A vitamin E INR albumin prealbumin

AGB = Adjustable gastric banding; SG = sleeve gastrectomy; RYGB = gastric bypass; BPD = biliopancreatic diversion; BPD/DS = biliopancreatic diversion with duodenal switch. CBC = complete blood count; PTH = intact parathyroid hormone; 24-H U-calcium = 24-hour urinary calcium (modified [39]).

Obesity Facts
Obes Facts 2017;10:507–632

Protein intake and lean tissue mass retention following bariatric surgery

Table 3
Multilinear regression analysis of the determinants of lean tissue mass loss relative to weight loss (as a percent), at 4- and 12-months after surgery.

	OR	95% CI	*p*
4 months after surgery			
Protein intake (g/kg IBW/d)	−0.376	(−20.071), (−2.113)	0.017
Gender (Male = 1, Female = 2)	0.120	(−6.234), (11.163)	0.570
Age (years)	−0.071	(−1.245), (0.154)	0.645
Lean tissue mass at baseline (kg)	0.068	(−0.298), (0.405)	0.798
Type of surgery (GBP = 0, SG = 1)	0.197	(−1.823), (8.011)	0.211
12 months after surgery			
Protein intake (g/kg IBW/d)	−0.468	(−16.764), (−4.753)	0.001
Gender (Male = 1, Female = 2)	0.221	(−2.791), (9.953)	0.263
Age (years)	0.148	(−0.067), (0.217)	0.290
Lean tissue mass at baseline (kg)	0.215	(−0.124), (0.389)	0.303
Type of surgery (GBP = 0, SG = 1)	0.399	(1.538), (8.382)	0.006

OR: odds ratio. CI: confidence interval. IBW: ideal body weight. GBP: gastric bypass. SG: sleeve gastrectomy.

Moizé V et al. Clin Nutr. 2013;32:550

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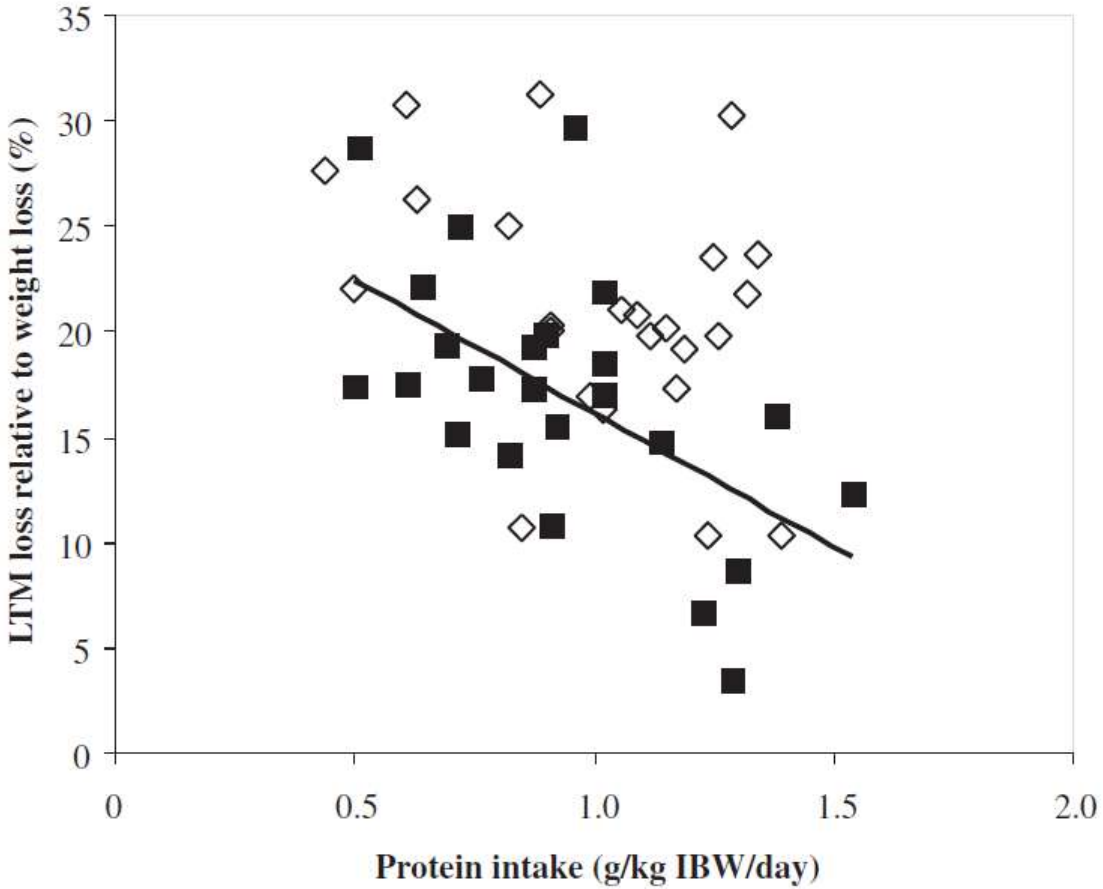
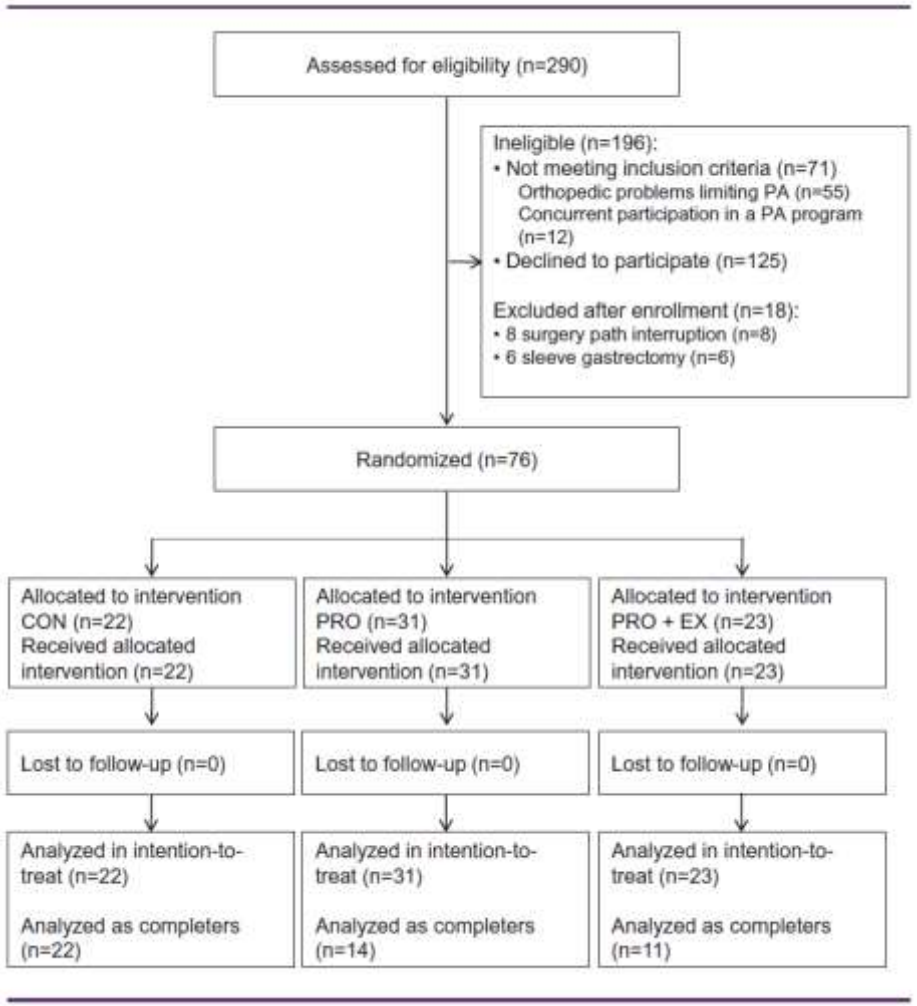
Protein intake and Lean Tissue Mass (LTM) loss following metabolic bariatric surgery



Moizé V et al. Clin Nutr. 2013; 32:550

Resistance Training and Protein Supplementation Increase Strength After Bariatric Surgery: A Randomized Controlled Trial



Oppert JM et al. Obesity 2018;26:1709

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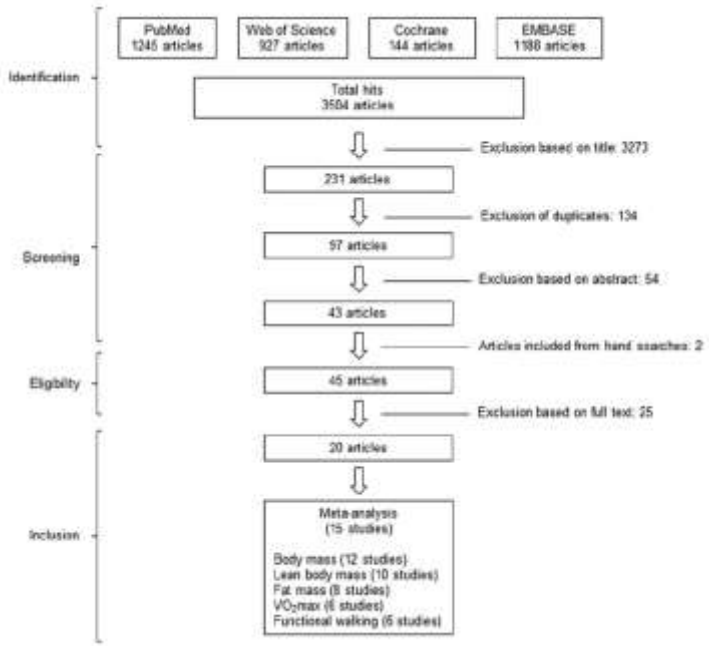
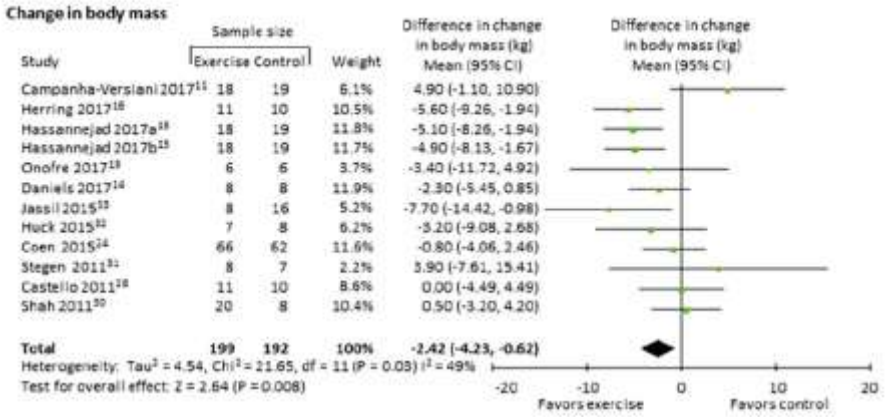
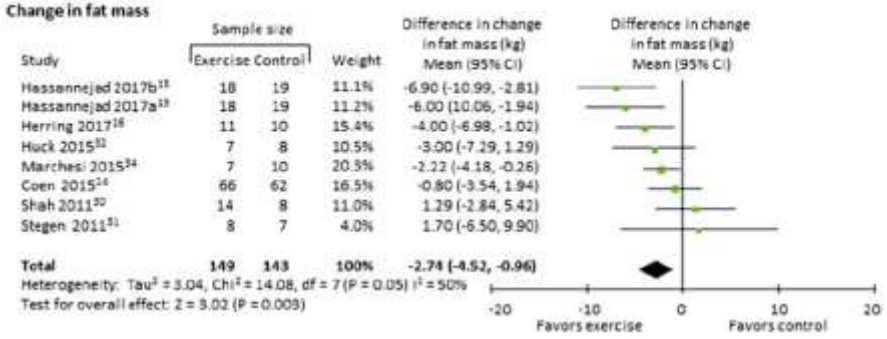
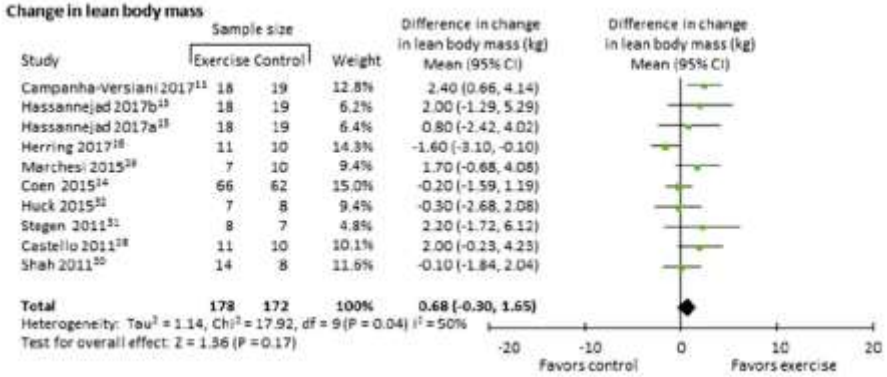
Effectiveness of exercise training after bariatric surgery —a systematic literature review and meta-analysis









Bellicha A et al. Obes Rev 2018;19:1544

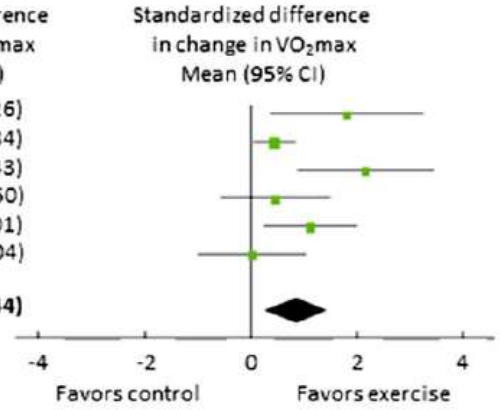
Older population. Management of Sarcopenia in Bariatric Patients

Effectiveness of exercise training after bariatric surgery —a systematic literature review and meta-analysis

Change in VO_2max

Study	Sample size Exercise	Sample size Control	Weight	Standardized difference in change in VO_2max Mean (95% CI)
Onofre 2017[19]	6	6	10.6%	1.82 (0.38, 3.26)
Coen 2015[26]	50	51	27.5%	0.44(0.05, 0.84)
Marchesi 2015[34]	7	10	12.3%	2.16 (0.89, 3.43)
Huck 2015[32]	7	8	15.6%	0.47 (-0.56, 1.50)
Shah 2011[30]	20	8	18.1%	1.13 (0.25, 2.01)
Stegen 2011[31]	8	7	15.9%	0.02 (-0.99, 1.04)
Total	**98**	**90**	**100%**	**0.86 (0.29, 1.44)**

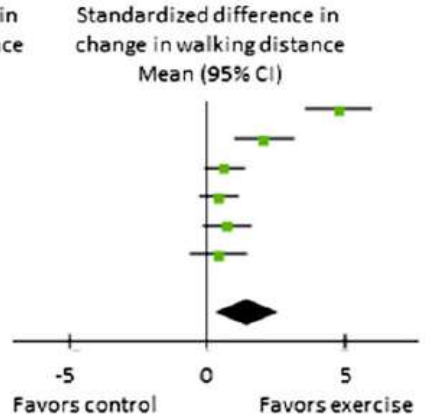
Heterogeneity: $Tau^2 = 0.27$, $Chi^2 = 11.71$, df = 5 (P = 0.04) $I^2 = 57\%$
Test for overall effect: Z = 2.95 (P = 0.003)



Change in functional walking

Study	Sample size Exercise	Sample size Control	Weight	Standardized difference in change in walking distance Mean (95% CI)
Coleman 2017[13]	21	23	15.6%	4.79 (3.58, 5.99)
Herring 2017[16]	11	10	16.0%	2.07 (0.96, 3.17)
Hassannejad 2017b[15]	16	15	17.5%	0.61 (-0.11, 1.34)
Hassannejad 2017a[15]	18	15	17.6%	0.44 (-0.26, 1.13)
Castello 2011[28]	11	10	16.9%	0.72 (-0.17, 1.62)
Stegen 2011[31]	8	7	16.3%	0.40 (-0.62, 1.43)
Total	**85**	**80**	**100%**	**1.45 (0.32, 2.58)**

Heterogeneity: $Tau^2 = 1.75$, $Chi^2 = 46.64$, df = 5 (P < 0.001) $I^2 = 89\%$
Test for overall effect: Z = 2.52 (P = 0.01)



Bellicha A et al. Obes Rev 2018;19:1544

Post-bariatric surgery follow-up

Table 2. List of graded clinical practical recommendations for post-bariatric nutritional management

Recommendations	Level of evidence	Grade of recommendation*
Bariatric patients should receive periodic counselling by a registered dietician about long-term dietary modifications. The focus of dietary counselling should be the adaptation of patients eating behaviour to the surgical procedure and the general qualitative aspects of a healthy nutrient-dense diet.	1	A
Regular physical activity should be encouraged after bariatric surgery, starting since after the recovery from surgery. Patients should be advised to incorporate moderate aerobic physical activity to include a minimum of 150 min/week and goal of 300 min/week, including strength training 2–3 times per week.	1	A
Nutritional counselling should address the problem of protein intake, particularly in the first months after surgery. A minimal protein intake of 60 g/day and up to 1.5 g/kg ideal body weight per day should be targeted. The use of liquid protein supplements (30 g/day) can facilitate adequate protein intake in the first period after surgery.	4	D
Nutritional manipulation should be the first line treatment for the control of dumping syndrome. Medical therapy with octreotide should be considered in patients who fail to be controlled with dietary modifications.	1	A

Obesity Facts
Obes Facts 2017;10:507–632

Take Home Messages

- Sarcopenia is defined as low Fatty Free Mass (FFM) and function

- Sarcopenia is a geriatric syndrome with multifactorial aetiology (comprehensive of *nutritional deficiences* and *physical inactivity*) whose prevalence increases with *age*

- Sarcopenic obesity is a clinical and functional condition consisting in:
  a) obesity, characterized by Excess Fat Mass (EFM)
  b) low Fatty Free Mass (FFM) and function

- Patients candidate to MBS can report malnutrition in micronutrients (mainly iron and Vitamine D)

- MBS could be related to macronutrients (mainly protein) and micronutrient deficiences

- Protein intake, micronutrients supplementation and exercise training have a main role in the management of sarcopenia in bariatric patients

Age>65 and Adolescents: New ASMBS/IFSO Guidelines

Older population. Management of Sarcopenia in Bariatric Patients

Thanks!

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