Life after MBS:
What clinicians should know about the consequences of skeletal muscle loss

Dr Lauren Hanna, Monash University

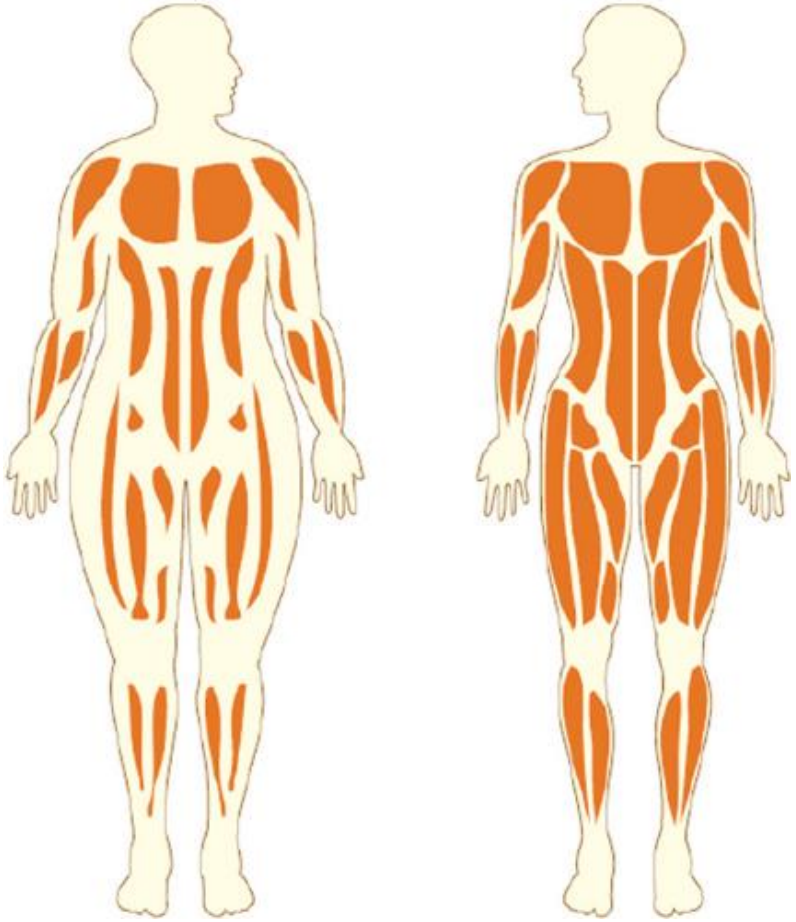

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Image adapted from:
Prado et al. J Cachexia Sarcopenia Muscle 2020
doi.org/10.1002/jcsm.12525

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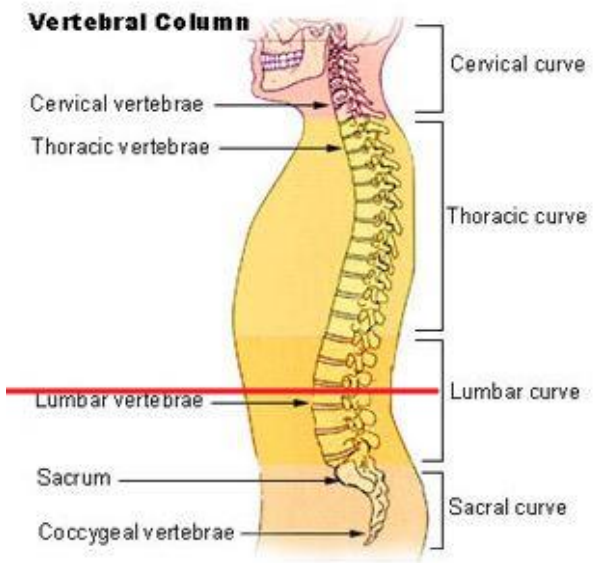
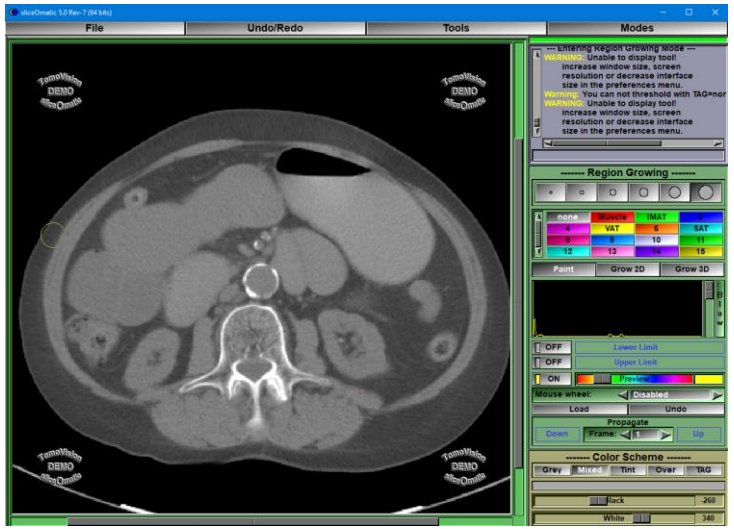
CT imaging analysis for skeletal muscle assessment

Axial plane image at L3 from routine-care CT



Upload to sliceOmatic software and analyse



sliceOmatic 5.0

Determine skeletal muscle index: skeletal muscle cross-sectional area (cm^2) / height (m^2)

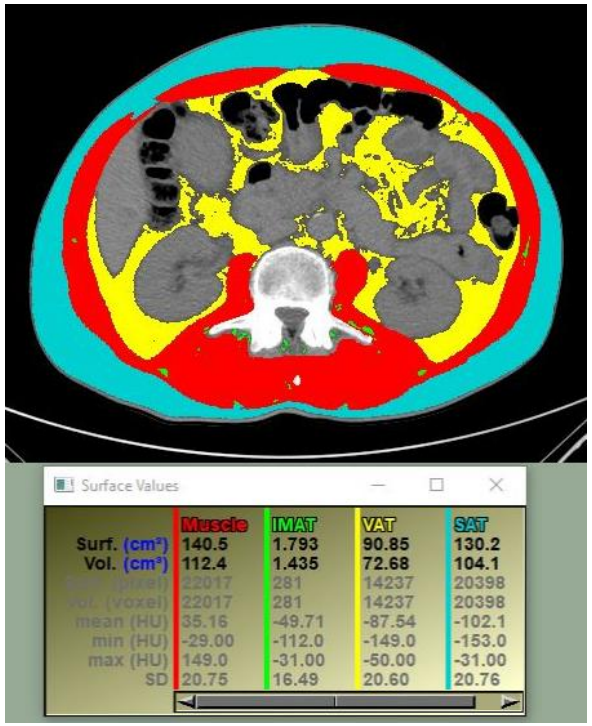
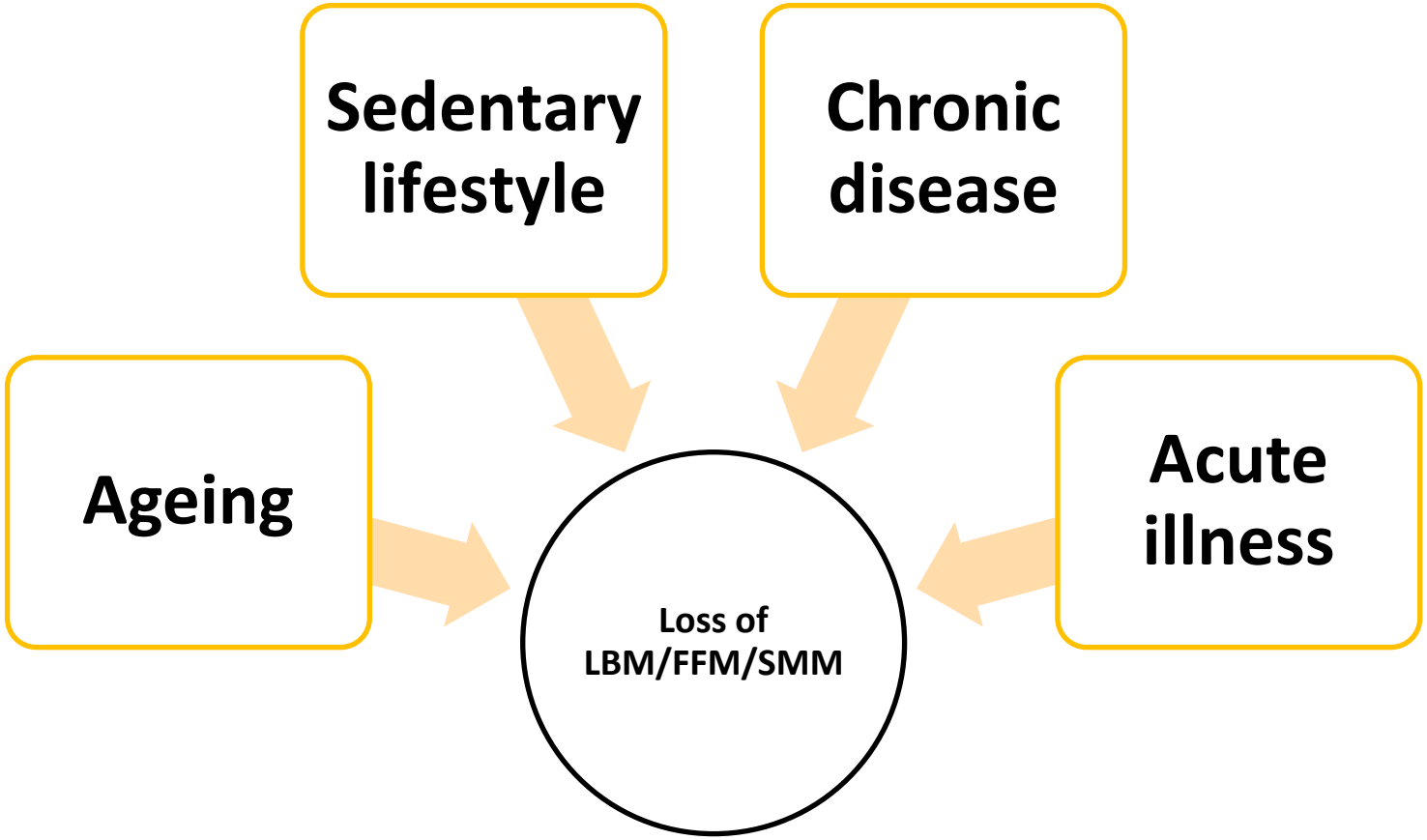


Image adapted from:
National Cancer Institute SEER Training Modules (copyright-free)
Sliceomatic: tomovision.com/products/sliceomatic.html

General causes of lean tissue loss



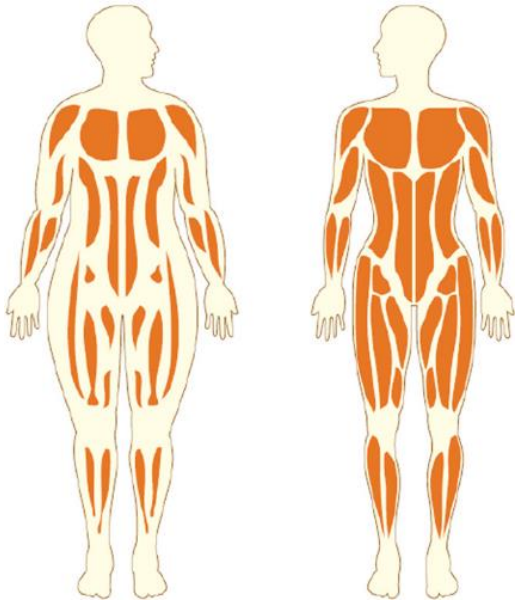
Colloca et al. J Geriatric Oncology 2019
Prado et al. Clinical Nutrition 2022

Consequences of lean tissue (skeletal muscle) loss in cancer

Skeletal muscle index below sex-specific cut points (i.e. low SMM) is associated with poor cancer outcomes:

Example SMI cut point:

41cm^2/m^2 females
43cm^2/m^2 males with BMI <25
53cm^2/m^2 males with BMI ≥25

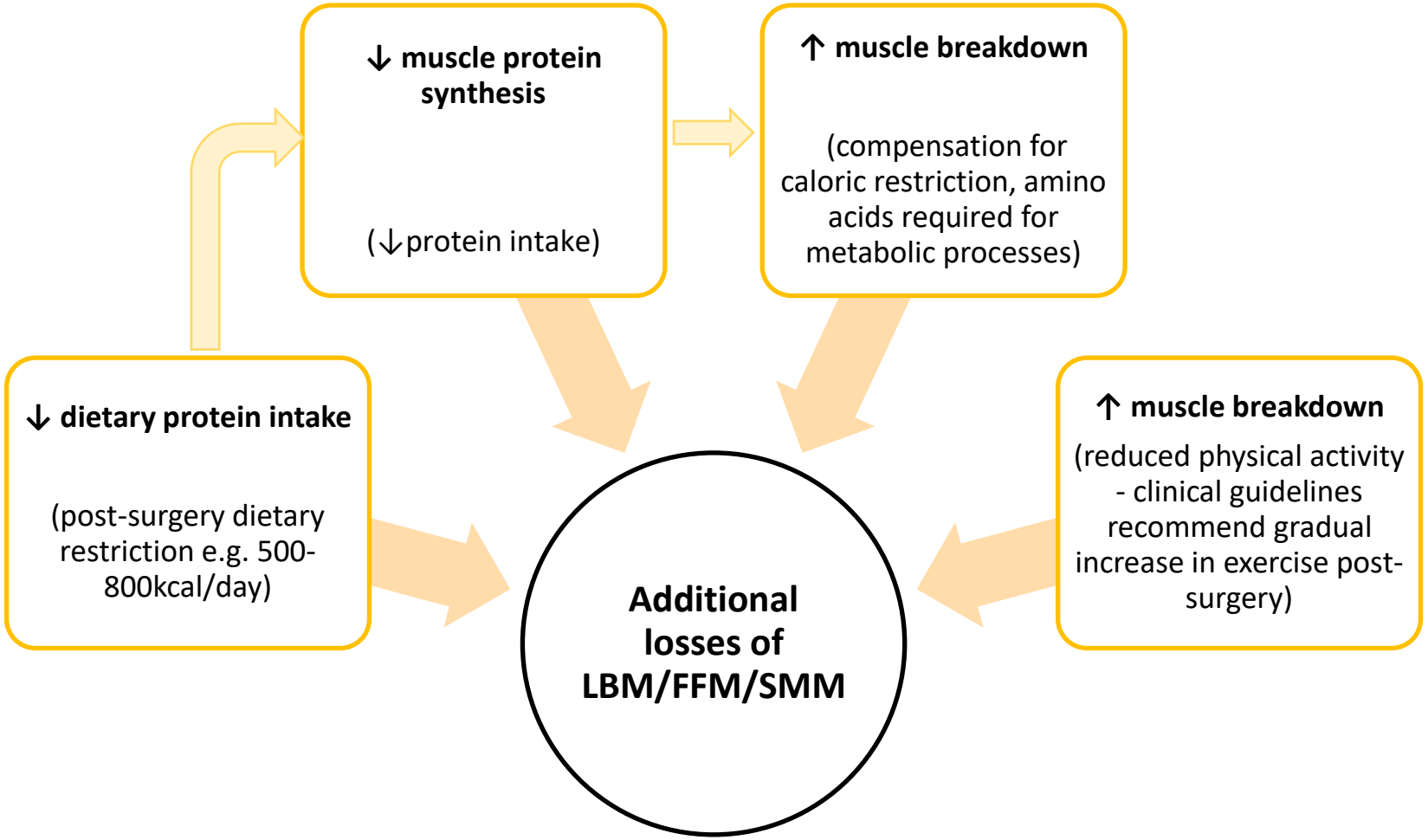


Low SMM occurs independent of BMI

- Shorter overall survival
- More postoperative complications
- Increased chemotherapy toxicity
- Earlier cancer recurrence

Prado et al. J Cachexia Sarcopenia Muscle 2020
Martin et al. J Clinical Oncology 2013

What about bariatric surgery?



Nuijten et al. Obesity Reviews 2021
Tabesh et al. Obesity Surgery 2019

Lean tissue loss after bariatric surgery

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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

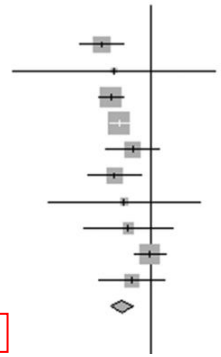
Malou A.H. Nuijten[1] | Thijs M.H. Eijsvogels[1] | Valerie M. Monpellier[2] | Ignace M.C. Janssen[2] | Eric J. Hazebroek[3] | Maria T.E. Hopman[1]

First published meta-analysis, 59 studies:

- 20 studies measured Fat Free Mass (FFM)
- 37 studies measured Lean Body Mass (LBM, i.e. FFM excluding bone)
- 3 studies measured Skeletal Muscle Mass (SMM, i.e. LBM excluding organs, water)

3 months after bariatric surgery

LBM

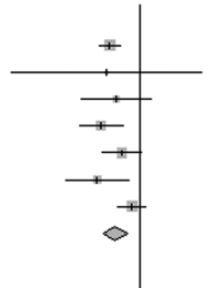


Study	N	Effect	SE	Mean	95%CI
Visit = <3 months					
Clements (2011)	30	-7.70	1.74	-7.70	[-11.12; -4.28]
Cole (2017)	5	-5.80	8.07	-5.80	[-21.61; 10.01]
Diniz-Sousa (2020)	20	-6.30	0.97	-6.30	[-8.21; -4.39]
Legro (2012)	27	-5.00	0.75	-5.00	[-6.47; -3.53]
Lubrano (2004)	45	-2.90	2.09	-2.90	[-6.99; 1.19]
Maïmoun (2019)	30	-5.70	2.17	-5.70	[-9.95; -1.45]
Rabl (2014)	12	-4.20	6.09	-4.20	[-16.14; 7.74]
Rabl (2014)	8	-3.60	3.54	-3.60	[-10.54; 3.34]
Tacchino (2003)	101	-0.20	1.24	-0.20	[-2.63; 2.23]
Werling (2015)	6	-3.00	2.58	-3.00	[-8.05; 2.05]
Overall effect	**284**			**-4.45**	**[-6.21; -2.70]**

Heterogeneity: I^2 = 56%, τ^2 = 2.1783, χ^2_9 = 20.49 (p = 0.02)

- -4.45kg LBM within 3 months

FFM

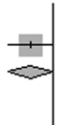


Study	N	Effect	SE	Mean	95%CI
Visit = <3 months					
Busetto (2000)	6	-5.20	0.98	-5.20	[-7.11; -3.29]
Cole (2017)	5	-5.80	8.48	-5.80	[-22.43; 10.83]
Hirsch (2020)	15	-4.10	3.17	-4.10	[-10.31; 2.11]
Kayser (2017)	21	-6.70	1.92	-6.70	[-10.46; -2.94]
Kayser (2017)	21	-3.10	1.78	-3.10	[-6.59; 0.39]
Sajoux (2019)	24	-7.40	2.81	-7.40	[-12.92; -1.88]
Sergi (2003)	6	-1.30	1.28	-1.30	[-3.80; 1.20]
Overall effect	**98**			**-4.25**	**[-6.30; -2.20]**

Heterogeneity: I^2 = 38%, τ^2 = 1.2860, χ^2_6 = 9.6 (p = 0.14)

- -4.25kg FFM within 3 months

SMM



Study	N	Effect	SE	Mean	95%CI
Visit = 3 to <6 months					
Kenngott (2019)	30	-2.10	1.08	-2.10	[-4.22; 0.02]
Overall effect	**30**			**-2.10**	**[-4.22; 0.02]**

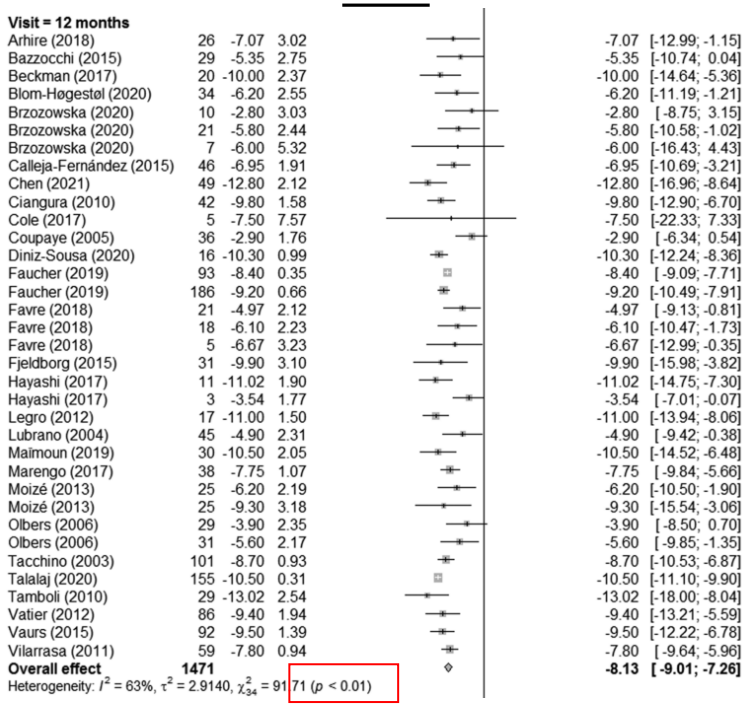
Heterogeneity: not applicable

- -2.10kg SMM within 3-6 months (one study)

Nuijten et al. Obesity Reviews 2021

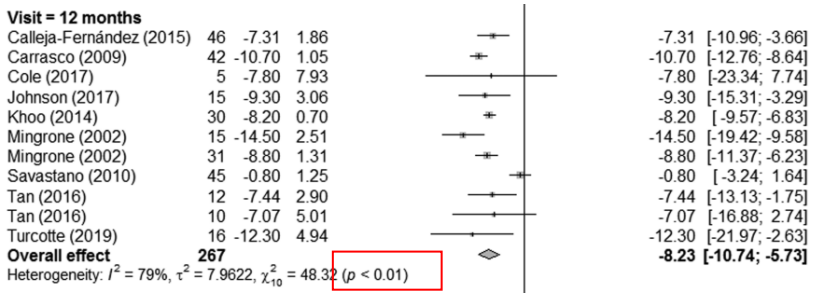
12 months after surgery

LBM



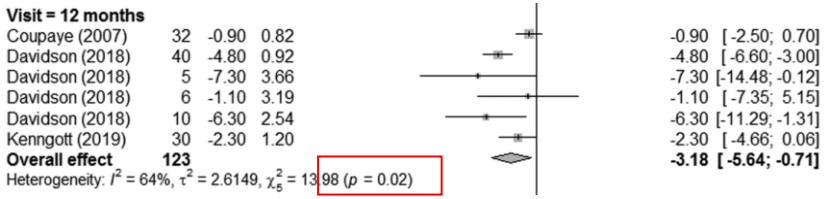
- -8.13kg LBM at 12 months
- 55% of LBM loss occurred within first 3 months
- This was **13% of baseline LBM**, 23.4% of total weight loss

FFM



- -8.23kg FFM at 12 months
- 52% of FFM loss occurred within first 3 months
- This was **13% of baseline FFM**, 20.8% of total weight loss

SMM



- -3.18kg SMM at 12 months
- 66% of SMM loss occurred within first 3-6 months
- This was **13% of baseline SMM**, 8.2% of total weight loss

Nuijten et al. Obesity Reviews 2021

General consequences of lean tissue loss

% loss of LBM	Associated complications
10%	Decreased immunity Increased risk of infection
20%	Decreased wound healing Increased muscle weakness
30%	Pressure ulcers Pneumonia
40%	Increased risk of death

Colloca et al. J Geriatric Oncology 2019

General consequences of low skeletal muscle mass

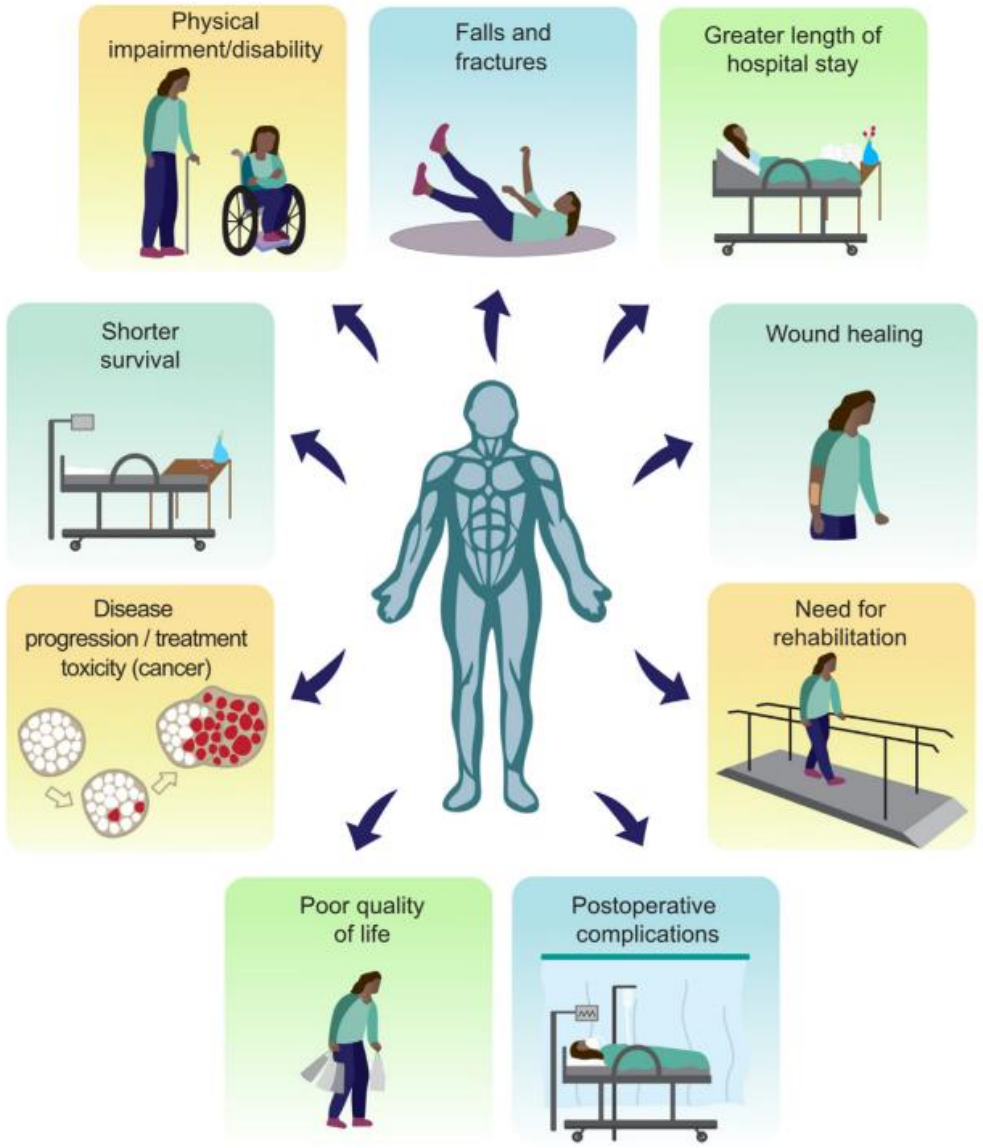
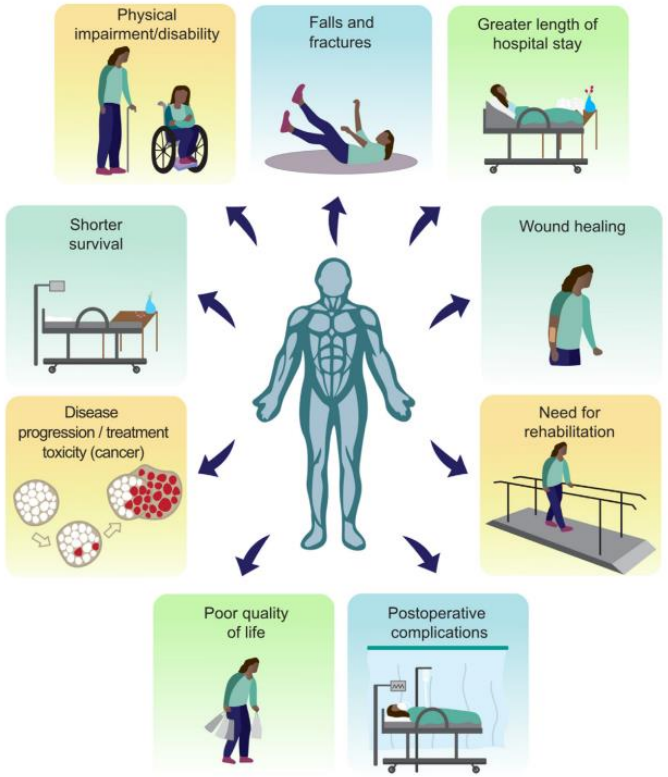


Image: Prado et al. Clinical Nutrition 2022

Consequences of low skeletal muscle mass in obesity – pre and post bariatric surgery



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↑ risk of cardiometabolic abnormalities:

- insulin resistance
- dyslipidemia
- hypertension
- inflammation

Mobility limitations

Depression

Asthma

Hernia

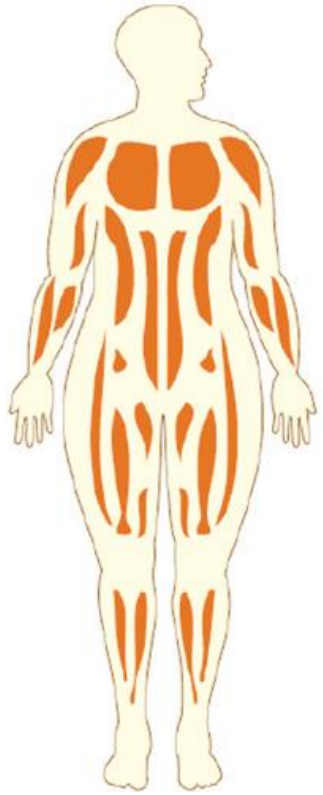


Image: Prado et al. Clinical Nutrition 2022
Koliaki et al. Metabolism 2019
Xiao et al. Clinical Nutrition ESPEN 2018

Image adapted from:
Prado et al. J Cachexia Sarcopenia Muscle 2020
doi.org/10.1002/jcsm.12525

Lean tissue loss after bariatric surgery compounds an existing issue

Lean tissue may already be declining prior to surgery, therefore risk of increasing prevalence of low SMM

ELSEVIER

Clinical Nutrition ESPEN

Volume 49, June 2022, Pages 436-441

Original article

Prevalence of low skeletal muscle mass following bariatric surgery

Judith Molero [a], Romina Olbeyra [b], Lilliam Flores [a b f], Amanda Jiménez [a b c], Ana de Hollanda [a b c], Alba Andreu [a c], Ainitze Ibarzabal [d], Violeta Moizé [a b f], Sílvia Cañizares [e], José María Balibrea [d], Amadeu Obach [e], Josep Vidal [a b f]

PLOS ONE

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

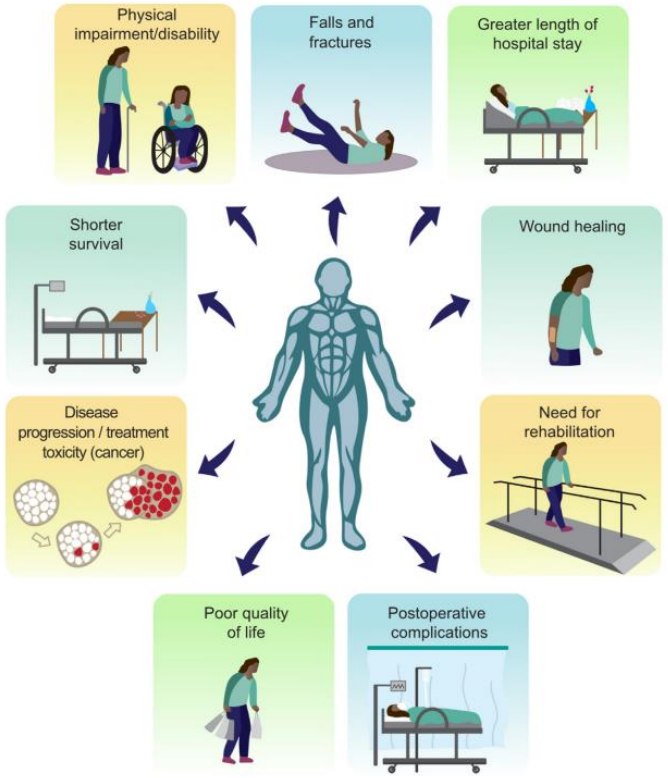
Predictive score of sarcopenia occurrence one year after bariatric surgery in severely obese patients

Cosmin Sebastian Voican, Amandine Lebrun, Sophie Maitre, Panagiotis Lainas, Karima Lamouri, Micheline Njike-Nakseu, Martin Gaillard, Hadrien Tranchart, Axel Balian, Ibrahim Dagher, Gabriel Perlemuter, Sylvie Naveau

Published: May 14, 2018 • https://doi.org/10.1371/journal.pone.0197248

- n=952
- BIA-derived SMM index
- Low SMM classified using standard deviations
  - Pre-surgery: 20.3% had low SMM
  - 5 years post surgery: 22.7% had low SMM

- n=184
- CT-derived skeletal muscle index
- Low SMM classified using published sex-specific mortality-based SMI cut-points
  - Pre-surgery: 8% had low SMM
  - 1 year post surgery: 32% had low SMM



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↑ risk of cardiometabolic abnormalities:

- insulin resistance
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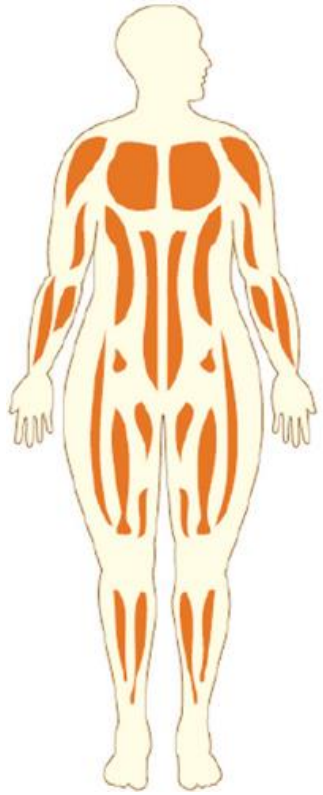
- inflammation

Mobility limitations

Depression

Asthma

Hernia



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Thank you

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