

Body Composition Analysis

Body composition analysis (BCA) provides clinical benefits that extend well beyond what **BMI alone** can capture, offering actionable data on fat mass, lean/muscle mass, bone mineral content, and regional fat distribution that directly informs **preoperative risk stratification, rehabilitation planning, disease prognostication, and longitudinal monitoring of therapeutic interventions**.

Preoperative Risk Stratification

This is arguably the strongest evidence-based application of BCA. In spine surgery, reliance on BMI alone is insufficient — **central adiposity and sarcopenic obesity** are independent predictors of wound complications, mechanical failure, and delayed recovery. CT-derived radiographic abdominal circumference outperformed BMI for predicting diabetes (Cohen's $d = -0.84$) and hypertension in orthopedic patients, with the highest AUC values for both conditions.

In a multicenter study of 2,100 colorectal cancer patients, CT-defined body composition profiles were independently associated with hospital length of stay and readmission, with the combination of **myosteatorsis + sarcopenia + visceral obesity** producing the highest risk (IRR 1.58 for LOS; OR 2.98 for readmission), independent of major complications. A systematic review of surgical oncology patients found that **psoas muscle mass** was a particularly strong predictor, with a six-fold increased risk of 30-day mortality in sarcopenic patients compared to less than two-fold when using total skeletal muscle mass.

In lumbar spine surgery specifically, sarcopenic patients had significantly **higher perioperative complication rates, delayed mobilization, longer hospital stays, and higher mortality** compared to non-sarcopenic patients across all age groups over 50. Increased percent body fat independently predicted more severe functional disability in lumbar spinal stenosis patients, even when skeletal muscle mass was similar between groups.

Identification of Sarcopenia and Sarcopenic Obesity

BCA enables diagnosis of conditions invisible to BMI:

- **Sarcopenia** (low muscle mass + reduced function) has a prevalence of **24–56% in patients over 60** and is present in 44% of elderly orthopedic

surgery patients. It is associated with increased falls, fractures, disability, and postoperative morbidity and mortality.

- **Sarcopenic obesity** — the coexistence of low muscle mass and excess fat — was found in **15.3%** of overweight/obese orthopedic patients, predominantly in women undergoing knee surgery. This phenotype carries compounded risk beyond either condition alone.
- **Myosteatosis** (fatty infiltration of muscle, reflected by low muscle radiodensity on CT) was the single best independent predictor of major postoperative complications in gastrointestinal cancer surgery (OR for major complications on multivariate analysis).

Cardiovascular and Metabolic Risk Assessment

The AHA 2024 Scientific Statement on cardiac rehabilitation identifies body composition (fat-to-lean mass ratio) as more closely associated with CVD risk than weight or BMI alone. Key findings include:

- "Normal-weight obesity" (normal BMI but high body fat/low lean mass) confers particularly high CVD risk.
- DXA-measured high body fat is associated with increased all-cause mortality independent of BMI, with optimal body fat percentages of **22% for men and 35% for women** on J-shaped mortality curves.
- Visceral adiposity shows a continuous dose-response relationship with postoperative complications (OR 1.70 per SD increase for 30-day complications after gastrectomy).

Guiding Prehabilitation and Rehabilitation

BCA serves as both a baseline assessment tool and an outcome measure for prehabilitation programs. In the F4S PREHAB trial (816 patients), multimodal prehabilitation guided by body composition assessment produced significant improvements in **fat-free mass (+0.5 kg)**, **peak oxygen uptake (+0.6 mL/kg/min)**, and **leg press strength (+18.9 kg)**, though gains were not consistently sustained postoperatively. Nutritional prehabilitation strategies increasingly use radiological body composition assessment for risk stratification, allowing targeted intervention in those most likely to benefit.

BIA Phase Angle deserves special mention — a systematic review of 1,508 surgical cancer patients found that phase angle (reflecting cellular integrity and

hydration) more consistently predicted postoperative complications than derived body composition estimates, suggesting it may serve as a rapid bedside screening tool.

References

Brown, T. M., Pack, Q. R., Aberegg, E., Brewer, L. C., Ford, Y. R., Forman, D. E., Gathright, E. C., Khadanga, S., Ozemek, C., & Thomas, R. J. (2024). *Core components of cardiac rehabilitation programs: 2024 update: A scientific statement from the American Heart Association and the American Association of Cardiovascular and Pulmonary Rehabilitation*. *Circulation*, 150(18), e304–e329.
<https://doi.org/10.1161/CIR.0000000000001272>

Carter, J., Husain, F., Papasavas, P., Blalock, C., Benson-Davies, S., & Clinical Issues Committee of the American Society for Metabolic and Bariatric Surgery. (2024). *American Society for Metabolic and Bariatric Surgery review of body composition. Surgery for Obesity and Related Diseases*, 20(3), 211–224.
<https://doi.org/10.1016/j.soard.2023.12.018>

Carvalho, A. L. M., Gonzalez, M. C., Sousa, I. M., das Virgens, I. P. A., Medeiros, G. O. C., Oliveira, M. N., Dantas, J. C. A. S., & Trussardi Fayh, A. P. (2021). Low skeletal muscle radiodensity is the best predictor for short-term major surgical complications in gastrointestinal surgical cancer: A cohort study. *PloS one*, 16(2), e0247322.
<https://doi.org/10.1371/journal.pone.0247322>

Daniels, A. H., Kim, J., Nassar, J. E., & Diebo, B. G. (2026). Impact of Obesity, Sarcopenia, and Nutritional Status on Spine Surgery Patients. *The Journal of the American Academy of Orthopaedic Surgeons*, 10.5435/JAAOS-D-25-01362. Advance online publication. <https://doi.org/10.5435/JAAOS-D-25-01362>

Drager, L. D., van den Heuvel, B., Strijker, D., van Laarhoven, C. J. H. M., Buffart, L. M., & Verlaan, S. (2026). Changes in Functional Capacity and Body Composition After a Multimodal Prehabilitation Program in Patients with Cancer undergoing Abdominal Surgery. *Annals of surgical oncology*, 33(6), 5714–5725.
<https://doi.org/10.1245/s10434-026-19173-4>

Fradley, W., Abdul-Hamid, S., & Phillips, B. E. (2026). Nutritional prehabilitation strategies in abdominal surgery. *Current opinion in clinical nutrition and metabolic care*, 29(3), 231–237. <https://doi.org/10.1097/MCO.0000000000001215>

Gaddikeri, M. B., Nene, A., Patel, P., Bamb, H., & Bhaladhare, S. (2024). Sarcopenia and its effects on outcome of lumbar spine surgeries. *European spine journal : official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society*, 33(4), 1369–1380.

<https://doi.org/10.1007/s00586-024-08155-3>

Lin, Z., Xia, L. M., Wu, Q., & Xu, X. (2026). Comparative contributions of visceral adiposity and muscle-related parameters to postoperative complications after gastrectomy: a domain-based analysis. *BMC cancer*, 10.1186/s12885-026-16496-z.

Advance online publication. <https://doi.org/10.1186/s12885-026-16496-z>

Manriquez, A. H., Singh, M., Gonzalez, G., Kim, J., Carayannopoulos, N., Chisango, Z. M., Hurley, C., Nassar, J. E., Daniels, A. H., & Diebo, B. G. (2026). Preoperative Risk Stratification Using Radiographic Measures of Central Obesity. *Spine*, 51(8), 577–581.

<https://doi.org/10.1097/BRS.0000000000005513>

Martin, L., Hopkins, J., Malietzis, G., Jenkins, J. T., Sawyer, M. B., Brisebois, R., MacLean, A., Nelson, G., Gramlich, L., & Baracos, V. E. (2018). Assessment of Computed Tomography (CT)-Defined Muscle and Adipose Tissue Features in Relation to Short-Term Outcomes After Elective Surgery for Colorectal Cancer: A Multicenter Approach. *Annals of surgical oncology*, 25(9), 2669–2680.

<https://doi.org/10.1245/s10434-018-6652-x>

Matthews, L., Bates, A., Wootton, S. A., & Levett, D. (2021). The use of bioelectrical impedance analysis to predict post-operative complications in adult patients having surgery for cancer: A systematic review. *Clinical nutrition (Edinburgh, Scotland)*, 40(5), 2914–2922. <https://doi.org/10.1016/j.clnu.2021.03.008>

Prado, C. M., Gonzalez, M. C., Norman, K., Orsso, C. E., Barazzoni, R., Cederholm, T., Compher, C., Jensen, G. L., Abe, T., Barbosa-Silva, T. G., Bennett, J. P., Carmichael, O. T., Earthman, C. P., Evans, W. J., Fields, D. A., Genton, L., Hu, H. H., Kara, M., Miles-Chan, J. L., Mourtzakis, M., ... Heymsfield, S. B. (2026). Methodological standards for body composition assessment-an expert-endorsed guide for research and clinical applications: bioimpedance, dual-energy X-ray absorptiometry, computerized tomography, and ultrasound methods. *The American journal of clinical nutrition*, 123(5), 101283. <https://doi.org/10.1016/j.ajcnut.2026.101283>

Rizzo, S., & Petrella, F. (2026). CT-Assessed Body Composition as Predictor of Post-Operative Complications in Lung Cancer Patients. *Cancers*, 18(3), 431. <https://doi.org/10.3390/cancers18030431>

Tomažič, A., Žvanut, B., Grbac, L. V., & Jurdana, M. (2022). Identification of sarcopenic obesity in adults undergoing orthopaedic surgery: Relationship between "a body shape index" (ABSI) and fat-free mass. A cross -sectional study. *PloS one*, 17(6), e0269956. <https://doi.org/10.1371/journal.pone.0269956>

Weerink L. B. M., van der Hoorn A., van Leeuwen B. L., and de Bock G. H. (2020) *Low skeletal muscle mass and postoperative morbidity in surgical oncology: a systematic review and meta-analysis*, *Journal of Cachexia, Sarcopenia and Muscle*, 11, 636–649. <https://doi.org/10.1002/jcsm.12529>.