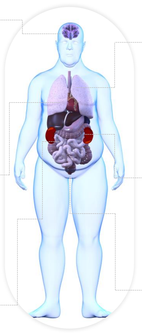
Why is it Essential to Understand and Assess Body Composition Before, During, and After Weight Reduction?

Obesity is abnormal or excessive fat accumulation in different human body parts. In people with obesity, weight reduction leads to clinically meaningful improvements in multiple health outcomes, including physical function and overall quality of life.[1,2]

Obesity is a Multisystem Disease Associated With Multiple Complications and Comorbidities[3,4]



CNS
Migraine, stroke, pseudotumor cerebri, depression, anxiety

Cardiovascular
Hypertension, CAD, stroke, congestive HF, atrial fibrillation, venous stasis, pulmonary embolism

Gastrointestinal
Gastroesophageal reflux, cholelithiasis, MAFLD, MASH, hepatic steatosis

Pulmonary
Obstructive sleep apnea, OHS, pulmonary hypertension, restrictive lung disease, respiratory failure

Renal
Nephrolithiasis, proteinuria, CKD

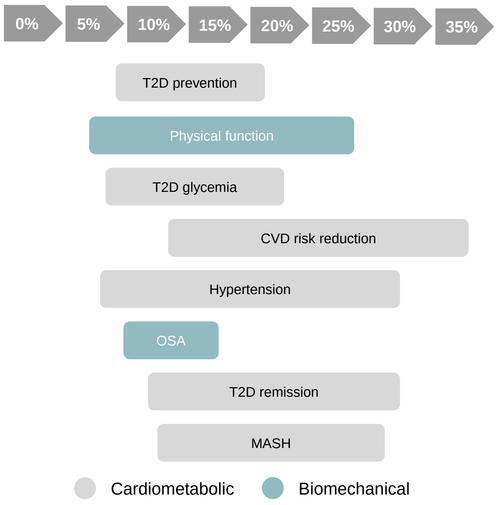
Genitourinary
Women: urinary stress incontinence, PCOS, infertility, pregnancy complications
Men: benign prostatic hypertrophy, hypogonadism

Endocrine: prediabetes, T2D, dyslipidemia

Cancer: colorectal, postmenopausal breast, endometrial, gastrointestinal, liver

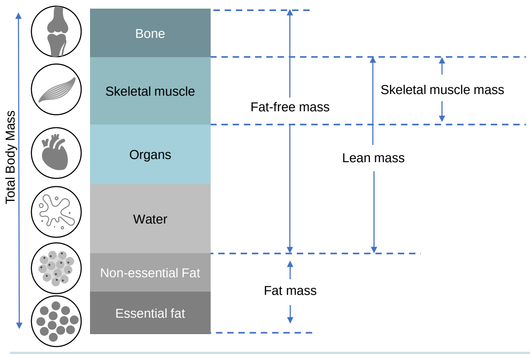
Infections: sensitivity to influenza, skin, and soft tissue infections

The association between the degree of weight reduction and its associated improvement in obesity-related complications and health outcomes[5]



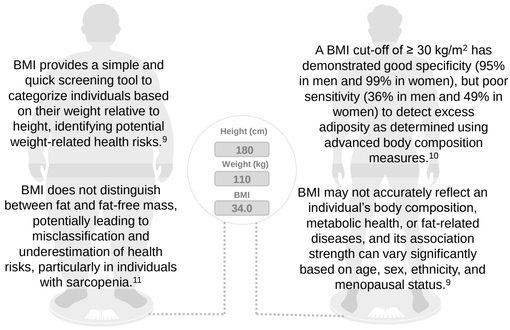
Body Mass Index vs. Body Composition: Screening Limitations and Applications

Body Composition[6-8]



Body composition refers to the proportion of fat mass and fat-free mass in the body. Monitoring changes in these proportions during weight reduction can provide insights into disease status and risk profile. A healthy weight reduction plan should focus on improving body composition, as it can lead to better health outcomes and help prevent obesity-related complications.[6] Additionally, body composition analysis can identify risk factors and help customize training and nutrition plans.[6-8]

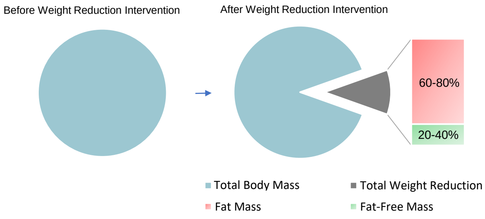
Body Mass Index



BMI is a reasonable initial screening tool for most individuals and a useful indicator of weight-related health risk at a population level. However, because of its limitations, it is not precise enough to diagnose obesity or fully assess an individual's health risk.[9-10]

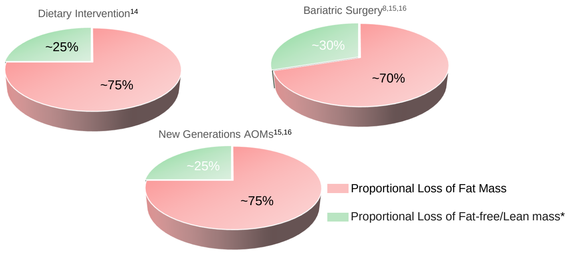
Weight reduction is accompanied by the loss of both fat mass and fat-free mass[12]

Weight Reduction With Most Obesity Interventions[12,13]



The image above illustrates the contribution of fat mass and fat-free mass to total weight reduction

Weight Reduction With Different Interventions



*Lean mass, a component of fat-free mass excluding bone mass, is typically assessed using Dual-Energy X-Ray Absorptiometry (DXA).[6]

Studies on lifestyle, AOMs, and bariatric surgery have shown that weight reduction interventions can result in a reduction of both fat mass and fat-free mass.[16,17] For most interventions, fat mass accounts for 60-80% of total weight reduction, while approximately 20-40% represents loss of fat-free mass.[12] Despite the reduction in fat-free mass, improvement in physical function has been described with a weight reduction of 5% or greater.[5,15,16,17]

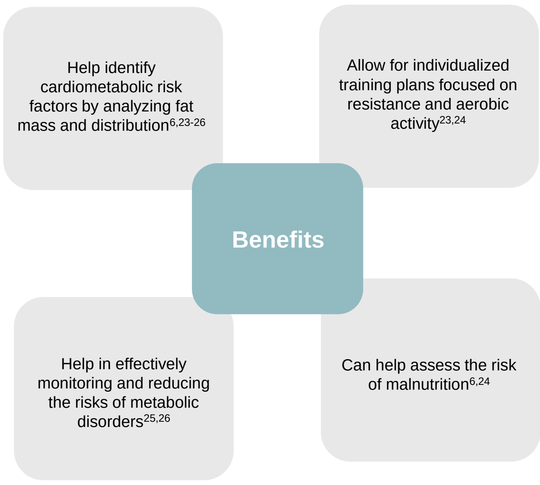
Methods of Evaluating Body Composition

Assessment Method	Overview of Methodology	Speed <10 min	Cost	No Radiation Exposure	Portable	Validated in Obesity and Weight Loss	Minimal Technical Expertise Required
Bioelectrical Impedance Analysis (BIA)[6,7,18]	Low-level electrical current passes through body to measure impedance, enabling estimation of total body water, fat mass, and fat free mass.	●	$	●	●	●	●
Dual-Energy X-Ray Absorptiometry (DXA)[6,7,18,19]	DXA machine, a multi-compartment assessment, provides quantification for whole-body fat, bone, and bone-free lean mass.	⊖	$$$	⊖	⊖	●	⊖
Computed Tomography (CT)[6,7,18]	It can be used for volumetric measurement of lean mass, adipose tissue, and ectopic fat.	⊖	$$$	⊖	⊖	●	⊖
Magnetic Resonance Imaging (MRI)[6,7,18]	Considered the gold standard for assessing regional body composition, including measurement of VAT and ectopic fat.	⊖	$$$	●	⊖	●	⊖
Air Displacement Plethysmography (ADP)[6,7]	BOD POD measures body volume by air displacement. This can be used to estimate fat mass and fat-free mass.	●	$$	●	⊖	●	●
3D Optical Imaging[6,20]	The technology captures a 3D mesh representing a person's entire shape, which is then used to predict body composition.	●	$	●	●	⊖	●
Visual Body Composition (VBC)[21,22]	Commercially available smartphone-based applications used to estimate percent fat, fat mass, and fat-free mass.	●	$	●	●	⊖	●

$$$=Expensive; $$=Moderate; $=Comparatively Cheaper; ● =Presence of the Mentioned Trait; ⊖ =Absence of the Mentioned Trait.

Additional methods include skin folds (calipers), waist and hip circumferences, and hydrostatic weighing.

Benefits of Assessing Body Composition



AOMs=Anti-Obesity Medications; BMI=Body Mass Index; CAD=Coronary Artery Disease; CKD=Chronic Kidney Disease; CNS=Central Nervous System; FM=Fat Mass; FFM=Fat-Free Mass; HF=Heart Failure; MAFLD=Metabolic Dysfunction-Associated Fatty Liver Disease; MASH=Metabolic Dysfunction-associated Steatohepatitis; OHS=Obesity Hypoventilation Syndrome; OSA=Obstructive Sleep Apnea; PCOS=Polycystic Ovary Syndrome; RF=Radio Frequency; T2D=Type 2 Diabetes; VAT=Visceral Adipose Tissue.
1. Tadayon Najafabadi B, et al. *Cochrane Database Syst Rev*. 2023;5(5):CD015201. 2. Fruh SM. *J Am Assoc Nurse Pract*. 2017;29(S1):S3-S14. 3. Tsai AG, Bessesen DH. *Ann Intern Med*. 2019;170(5):ITC33-ITC48. 4. Sarma S, et al. *Diabetes Obes Metab*. 2021;23(1):3-16. 5. Garvey WT. *J Clin Endocrinol Metab*. 2022;107(4):e1339-e1347. 6. Holmes CJ, Racette SB. *Nutrients*. 2021;13(8):2493. 7. Burridge K, et al. *Obes Pillars*. 2022;1:100007. 8. Nuijten MAH, et al. *Obes Rev*. 2022;23(1):e13370. 9. National Academies of Sciences, Engineering, and Medicine. Translating Knowledge of Foundational Drivers of Obesity into Practice: Proceedings of a Workshop Series. Washington (DC): National Academies Press; 2023. 10. Romero-Corral A, et al. *Int J Obes (Lond)*. 2008;32(6):959-966. 11. https://obesitymedicine.org/resources/obesity-algorithm/ (Accessed September 09, 2024). 12. McCarthy D, Berg A. *Nutrients*. 2021;13(7):2473. 13. Heymsfield, S. *Obesity Reviews*. 2014;15(4):310-321. 14. Willoughby, D. *Nutrients*. 2018;10(12):1876. 15. Wadden TA, et al. *Curr Obes Rep*. 2023;12(4):453-473. 16. Chaston, T. *Int J Obes (Lond)*. 2007;31(5):743-750. 17. Alba, D. *The Journal of Clinical Endocrinology & Metabolism*. 2019;104(3):711-720. 18. Cenicola GD, et al. *Nutrition*. 2019;62:25-31. 19. Lemos T, Gallagher D. *Curr Opin Endocrinol Diabetes Obes*. 2017;24(5):310-314. 20. Garber AK, et al. *Am J Clin Nutr*. 2023;118(4):812-821. 21. Graybeal AJ, et al. *Clin Nutr*. 2022;41(11):2464-2472. 22. Medina Inojosa BJ, et al. Prediction of presence and severity of metabolic syndrome using regional body volumes measured by a multisensor white-light 3D scanner and validation using a mobile technology. *Eur Heart J Digit Health*. Published online 2024. 23. Lopez P, et al. *Obes Rev*. 2022;23(5):e13428. 24. Almandoz JP, et al. *Obesity (Silver Spring)*. 2024;1–19. 25. Kelley DE, et al. *Am J Physiol Endocrinol Metab*. 2000;278(5):E941-E948. 26. Salmón-Gómez L, et al. *Rev Endocr Metab Disord*. 2023;24(5):809-823.

Importance of Incorporating Lifestyle Recommendations

People living with obesity are at high risk for malnutrition and nutritional deficiencies, and this risk increases with higher BMI[1,3,4]

Lifestyle modifications can help individuals with overweight and obesity in reducing and maintaining weight, ultimately improving health outcomes[2]

Diets rich in high-quality protein sources can support muscle maintenance and overall metabolic health during weight reduction efforts[1]

It is important to incorporate resistance training and adequate protein intake to reduce the risk of sarcopenia[1,3,4]

Lifestyle Recommendations to Optimize Obesity Treatment

When managing weight reduction for patients with obesity, it is recommended to focus on lifestyle modifications that maximize fat loss while minimizing muscle loss. These modifications enhance physical function and overall health and well-being[1,2]

Fluid[1]: >2-3L/day

- Fluid intakes should be met with water, low-calorie beverages (such as unsweetened coffee or tea), or nutrient-dense beverages (such as low-fat dairy or dairy alternatives)
- Limit or avoid consuming caffeine, carbonated beverages, sugar-sweetened beverages, and alcohol

Energy[1,2]: 1200-1500 kcal/day for most women and 1500-1800 kcal/day for most men have been recommended as safe during weight reduction

- Individuals with low energy intakes (<1200 kcal/day) may have difficulty meeting nutritional needs by diet alone
- Energy intake may need to be adjusted throughout weight reduction, and when the target weight is achieved
- Recommended sources: vegetables, fruits, whole grains, lean protein foods, low-fat dairy or dairy alternatives, and healthy fats

Protein[1]: at least 60-75 g/day, and up to 1.5 g/kg body weight per day

- Higher protein intake may be considered for selected individuals
- For individuals treated with AOMs, protein shakes, protein bars, and other formulated foods may supplement dietary intake to meet protein needs, especially early in treatment if appetite is significantly reduced
- Recommended sources: egg, poultry, lean meat, fish, low-fat yogurt, cottage cheese, lentils, peas, soy

Dietary Fat[1]:

25-60 g/day for a 1200-1500 kcal/day diet or 35-70 g/day for a 1500- 1800 kcal/day diet

- Severe restrictions are not necessary. Consume healthy fats moderately and limit saturated fat sources like animal fats and tropical oils
- Limiting fried, greasy, and high-fat food may help with GI discomfort associated with AOMs
- Recommended sources: flaxseed, avocado, tahini, olive oil, walnuts, pumpkin seeds

Dietary Carbohydrates[1]:

135-245 g/day for a 1200-1500 kcal/day diet or

170-290 g/day for a 1500- 1800-kcal/day diet

- When following a low-carbohydrate dietary pattern, pay attention to hydration (with fluid intake of >2 L/day), along with consumption of micronutrient-rich, high-fiber vegetables and fruits
- Severe restrictions are not necessary
- Recommended sources: lentils, brown rice, whole wheat bread, sweet potatoes

Dietary Fiber[1]: Adequate intake is between 21-25 g/day for women and between 30-38 g/day for men, depending on age

- Consume at least 14g of fiber for every 1000 calories eaten Adequate intake might alleviate gastrointestinal discomfort[5]
- Fiber supplements may be considered when individuals are unable to meet the recommended dietary intake with food alone
- Recommended sources: broccoli, carrots, peas, beans, brown rice, oats, pear, almonds, and avocado

Micronutrients[1]:

- Treat preexisting deficiencies and counsel on adequate micronutrient intake
- Micronutrient deficiencies can affect multiple organ systems, leading to fatigue, reduced physical function, impaired mood and cognition, immune dysfunction, and other complications
- Consider supplementation with Vitamin D, calcium, and a complete multivitamin for patients receiving AOMs

Physical Activity :

- 150 to 300 min/week of moderate-intensity physical activity (i.e. walking, cycling, swimming) [6]
- 2 to 3 times a week resistance training[6]
- 5000 to 10,000 or more steps per day[7,8]

- Amongst those living with obesity, there is a subset of individuals that have sarcopenic obesity[3,6,9], which is the coexistence of obesity (excess of fat mass) and sarcopenia (low skeletal muscle mass) accompanied by low muscle function[3,10,11]
- Approximately 11% of individuals aged 60 years and above worldwide experience sarcopenic obesity[12]
- This condition is linked to functional decline, reduced mobility, frailty, falls, fractures, cardiovascular disease, and hospitalization, all of which contribute to an increased risk of mortality[11,12]
- The diagnostic process includes assessing skeletal muscle function and evaluating body composition, where excess adiposity and low skeletal muscle mass confirm the diagnosis of sarcopenic obesity[13]
- Individuals with obesity and sarcopenia require special consideration, particularly those aged 60 years or above[11,14]

AOMs=Anti-obesity Medications; BMI=Body Mass Index.

1. Almandoz JP, et al. *Obesity (Silver Spring).* 2024;32(9):1613-1631. 2. Wadden TA, et al. *Am Psychol.* 2020;75(2):235-251. 3. Batsis JA, Villareal DT. *Nat Rev Endocrinol.* 2018;14:513-537. 4. Aasheim ET, et al. *Am J Clin Nutr.* 2008;87(2):362-369. 5. https://www.dietaryguidelines.gov/resources/2020-2025-dietary-guidelines-online-materials (Accessed September 10, 2024). 6. Yang YJ. *Korean J Fam Med.* 2019;40(3):135-142. 7. Rooney D, et al. *Ulster Med J.* 2023;92(1):9-15. 8. Bays HE, et al. *Obes Pillars.* 2023;5:100056. 9. Prado, C. *Nature Reviews Endocrinology.* 2024;20(5):261-277. 10. McCarthy D, Berg A. *Nutrients.* 2021;13(7):2473. 11. Kim D, et al. *J Cachexia Sarcopenia Muscle.* 2024;15(1):240-254. 12. Wei S, et al. *Front Endocrinol (Lausanne).* 2023;14:1185221. 13. Donini LM, et al. *Obes Facts.* 2022;15(3):321-335. 14. Mirzai S, et al. *Curr Obes Rep.* 2024;13(3):532-544.