

Literatur

1. Hu X, Zhang L, Wang H et al. (2017) Malnutrition-sarcopenia syndrome predicts mortality in hospitalized older patients. *Sci Rep* 7: 3171
2. Vandewoude MF, Alish CJ, Sauer AC et al. (2012) Malnutrition-sarcopenia syndrome: is this the future of nutrition screening and assessment for older adults? *J Aging Res* 2012: 651570
3. Linge J, Borga M, West J et al. (2018) Body composition profiling in the UK biobank imaging study. *Obesity* 26: 1785–1795
4. Selberg O, Buchert W, Graubner G et al. (1993) Determination of anatomical skeletal muscle mass by whole body nuclear magnetic resonance. *Basic Life Sci* 60: 95–97
5. Sjostrom L (1991) A computer based multicompartiment body composition technique and anthropometric predictors of lean body mass, total and subcutaneous adipose tissue. *Int J Obes* 15: 19–30
6. Flindt R. *Biologie in Zahlen. Eine Datensammlung in Tabellen mit über 10 000 Einzelwerten.* Gustav Fischer Verlag, Stuttgart (1995)
7. Nuttal FQ (2015) Body mass index, Obesity, BMI, and health: a critical review. *Nutr Today* 50: 117–128
8. Behnke AR (1942) Physiologic studies pertaining to deep sea diving and aviation, especially in relation to the fat content and composition of the body: The Harvey Lecture, March 19, 1942. *Bull N Y Acad Med* 18: 561–585
9. Brozek J (1966) Body composition models and estimation equations. *Am J Phys Anthropol* 24: 239–244
10. Siri WA (1956) The gross composition of the body. *Adv Biol Med Phys* 4: 239–280
11. Fuller NJ, Jebb SA, Laskey MA et al. (1992) Four component model for the assessment of body composition in humans: comparison with alternative methods, and evaluation of the density and hydration of fat-free mass. *Clin Sci* 82: 687–693
12. Fields DA, Goran MI, McCrory MA (2002) Body-composition assessment via air-displacement plethysmography in adults and children: a review. *Am J Clin Nutr* 75: 453–467
13. Wang J, Thornton JC, Kolesnik S et al. (2000) Anthropometry in body composition. An overview. *Ann N Y Acad Sci* 904: 317–326
14. Lohman TG (1981) Skinfolds and body density and their relation to body fatness: a review. *Hum Biol* 53: 181–255
15. Heyward VH. *Applied body composition assessment.* Human Kinetics, Champaign/IL (USA) (2002)
16. Orphanidou C, McCargar L, Birmingham CL et al. (1994) Accuracy of subcutaneous fat measurement: comparison of skinfold calipers, ultrasound, and computed tomography. *J Am Diet Assoc* 94: 855–858
17. Duren DL, Sherwood RJ, Czerwinski SA et al. (2008) Body composition methods: comparisons and interpretation. *J Diabetes Sci Technol* 2: 1139–1146
18. Gray DS, Bray GA, Bauer M et al. (1990) Skinfold thickness measurements in obese subjects. *Am J Clin Nutr* 51: 571–577
19. Pietrobelli A, Heymsfield SB, Wang ZM et al. (2001) Multi-component body composition models: recent advances and future directions. *Eur J Clin Nutr* 55: 69–75
20. Albanese CV, Diessel E, Genant HK (2003) Clinical applications of body composition measurements using DXA. *J Clin Densitom* 6: 75–85
21. Choi YJ (2010) Dual-energy X-ray absorptiometry: beyond bone mineral density determination. *J Nutr Health Aging* 14: 418–426
22. Lee SY, Gallagher D (2008) Assessment methods in human body composition. *Curr Opin Clin Nutr Metab Care* 11: 566–572
23. Garg MK, Kharb S (2013) Dual energy X-ray absorptiometry: pitfalls in measurement and interpretation of bone mineral density. *Indian J Endocrinol Metab* 17: 203–210
24. Toomey CM, McCormack WG, Jakeman P (2017) The effect of hydration status on the measurement of lean tissue mass by dual-energy X-ray absorptiometry. *Eur J Appl Physiol* 117: 567–574
25. Müller MJ, Braun W, Pourhassan M et al. (2016) Application of standards and models in body composition analysis. *Proc Nutr Soc* 75: 181–187
26. Prior BM, Cureton KJ, Modlesky CM et al (1997) In vivo validation of whole body composition estimates from dual-energy X-ray absorptiometry. *J Appl Physiol* 83: 623–630
27. Thibault R, Pichard C (2012) The evaluation of body composition: a useful tool for clinical practice. *Ann Nutr Metab* 60: 6–16
28. National Institutes of Health Technology Assessment Conference Statement (1996) Bioelectrical impedance analysis in body composition measurement. *Am J Clin Nutr* 64: 524S–532S
29. Kyle UG, Bosaeus I, De Lorenzo AD et al. (2004) Bioelectrical impedance analysis—part I: review of principles and methods. *Clin Nutr* 23: 1226–1243
30. Sun SS, Chumlea WC, Heymsfield SB et al. (2003) Development of bioelectrical impedance analysis prediction equations for body composition with the use of a multi-component model for use in epidemiologic surveys. *Am J Clin Nutr* 77: 331–340
31. Bosy-Westphal A, Danielzik S, Dörhöfer RP et al. (2006) Phase angle from bioelectrical impedance analysis: population reference values by age, sex, and body mass index. *JPEN J Parenter Enteral Nutr* 30: 309–316
32. Barbosa-Silva MC, Barros AJ, Wang J et al. (2005) Bioelectrical impedance analysis: population reference values for phase angle by age and sex. *Am J Clin Nutr* 82: 49–52
33. Siddiqui NI, Khan SA, Shoeb M et al. (2016) Anthropometric predictors of bio-impedance analysis (BIA) phase angle in healthy adults. *J Clin Diagn Res* 10: CC01–CC04
34. Thews G, Mutschler E, Vaupel P. *Anatomie, Physiologie, Pathophysiologie des Menschen.* 5. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart (1999)
35. Wang Z, Heshka S, Wang J et al. (2007) Metabolically active portion of fat-free mass: a cellular body composition level modeling analysis. *Am J Physiol Endocrinol Metab* 292: E49–E53
36. Fragala MS, Kenny AM, Kuchel GA (2015) Muscle quality in aging: a multi-dimensional approach to muscle functioning with applications for treatment. *Sports Med* 45: 641–658
37. Jurca R, Lamonte MJ, Barlow CE et al. (2005) Association of muscular strength with incidence of metabolic syndrome in men. *Med Sci Sports Exerc* 37: 1849–1855
38. Janssen I, Heymsfield SB, Wang Z et al. (2000) Skeletal muscle mass and distribution in 468 men and women aged 18–88 yr. *J Appl Physiol* 89: 81–88
39. Kyle UG, Bosaeus I, De Lorenzo AD et al. (2004) Bioelectrical impedance analysis—part II: utilization in clinical practice. *Clin Nutr* 23: 1430–1453
40. Monteiro R, Azevedo I (2010) Chronic inflammation in obesity and the metabolic syndrome. *Mediators Inflamm* 2010: 289645

41. Gallagher D, Heymsfield SB, Heo M et al. (2000) Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. *Am J Clin Nutr* 72: 694–701
42. Fagerberg P (2018) Negative consequences of low energy availability in natural male bodybuilding: a review. *Int J Sport Nutr Exerc Metab* 28: 385–402
43. Hulmi JJ, Isola V, Suonpää M et al. (2017) The effects of intensive weight reduction on body composition and serum hormones in female fitness competitors. *Front Physiol* 10: 689
44. Bernhard AB, Santo MA, Scabim VM et al. (2016) Body composition evaluation in severe obesity: a critical review. *Adv Obes Weight Manag Control* 4: 159–164
45. Horie LM, Barbosa-Silva MC, Torrinhas RS et al. (2008) New body fat prediction equations for severely obese patients. *Clin Nutr* 27: 350–356
46. Jiménez A, Omaña W, Flores L et al. (2012) Prediction of whole-body and segmental body composition by bioelectrical impedance in morbidly obese subjects. *Obes Surg* 22: 587–593
47. Kushner RF, Schoeller DA (1986) Estimation of total body water by bioelectrical impedance analysis. *Am J Clin Nutr* 44: 417–424
48. Kushner RF, Schoeller DA, Fjeld CR et al. (1992) Is the impedance index (ht^2/R) significant in predicting total body water? *Am J Clin Nutr* 56: 835–839
49. Lukaski HC, Bolonchuk WW, Hall CB et al. (1986) Validation of tetrapolar bioelectrical impedance method to assess human body composition. *J Appl Physiol* 60: 1327–1332
50. O'Brien C, Young AJ, Sawka MN (2002) Bioelectrical impedance to estimate changes in hydration status. *Int J Sports Med* 23: 361–366
51. Patel RV, Matthie JR, Withers PO (1994) Estimation of total body and extracellular water using single- and multiple-frequency bioimpedance. *Ann Pharmacother* 28: 565–569
52. Patel RV, Peterson EL, Silverman N (1996) Estimation of total body and extracellular water in post-coronary artery bypass graft surgical patients using single and multiple frequency bioimpedance. *Crit Care Med* 24: 1824–1828
53. Piccoli A, Pastori G, Guizzo M et al. (2005) Equivalence of information from single versus multiple frequency bioimpedance vector analysis in hemodialysis. *Kidney Int* 67: 301–313
54. Olde Rikkert MG, Deurenberg P, Jansen RW (1997) Validation of multifrequency bioelectrical impedance analysis in monitoring fluid balance in healthy elderly subjects. *J Gerontol A Biol Sci Med Sci* 52: M137–141
55. Cornish BH, Ward LC, Thomas BJ (1996) Evaluation of multiple frequency bioelectrical impedance and Cole-Cole analysis for the assessment of body water volumes in healthy humans. *Eur J Clin Nutr* 50: 159–164
56. Jaffrin MY, Morel H (2008) Body fluid volumes measurements by impedance: a review of bioimpedance spectroscopy (BIS) and bioimpedance analysis (BIA) methods. *Med Eng Phys* 30: 1257–1269
57. Earthman C, Traugher D, Dobratz J et al. (2007) Bioimpedance spectroscopy for clinical assessment of fluid distribution and body cell mass. *Nutr Clin Pract* 22: 389–405
58. Mager JR, Sibley SD, Beckman TR et al. (2008) Multifrequency bioelectrical impedance analysis and bioimpedance spectroscopy for monitoring fluid and body cell mass changes after gastric bypass surgery. *Clin Nutr* 27: 832–841
59. Ward LC (2012) Segmental bioelectrical impedance analysis: an update. *Curr Opin Clin Nutr Metab Care* 15: 424–429
60. Anderson LJ, Erceg DN, Schroeder ET (2012) Utility of multifrequency bioelectrical impedance compared with dual-energy x-ray absorptiometry for assessment of total and regional body composition varies between men and women. *Nutr Res* 32: 479–485
61. Ling CH, de Craen AJ, Slagboom PE et al. (2011) Accuracy of direct segmental multi-frequency bioimpedance analysis in the assessment of total body and segmental body composition in middle-aged adult population. *Clin Nutr* 30: 610–615
62. Bony-Westphal A, Jensen B, Braun W et al. (2017) Quantification of whole-body and segmental skeletal muscle mass using phase-sensitive 8-electrode medical bioelectrical impedance devices. *Eur J Clin Nutr* 71: 1061–1067
63. Thomas B, Cornish B, Pattermore M et al. (2003) A comparison of the whole-body and segmental methodologies of bioimpedance analysis. *Acta Diabetol* 40: s236–s237
64. Thomas B, Cornish B, Ward L et al. (1998) A comparison of segmental and wrist-to-ankle methodologies of bioimpedance analysis. *Appl Radiat Isot* 49: 477–478
65. Tanaka NI, Miyatani M, Masuo Y (2007) Applicability of a segmental bio-electrical impedance analysis for predicting the whole body skeletal muscle volume. *J Appl Physiol* 103: 1688–1695
66. Piccoli A, Rossi B, Pillon L et al. (1994) A new method for monitoring body fluid variation by bioimpedance analysis: the RXc graph. *Kidney Int* 46: 534–539
67. Schell B, Gross R (1987) The reliability of bioelectrical impedance measurements in the assessment of body composition in healthy adults. *Nutr Rep Int* 36: 449–459
68. Heitmann BL (1994) Impedance: a valid method in assessment of body composition? *Eur J Clin Nutr* 48: 228–240
69. Pinto LW, Veloso Gandra S, de Carvalho Alves M et al. (2017) Bioelectrical impedance analysis of body composition: influence of a newly implanted cardiac device. *J Electr Bioimp* 8: 60–65
70. Zhu F, Schneditz D, Wang E et al. (1998) Dynamics of segmental extracellular volumes during changes in body position by bioimpedance analysis. *J Appl Physiol* 85: 497–504
71. Heyward VH (1998) Practical body composition assessment for children, adults, and older adults. *Int J Sport Nutr* 8: 285–307
72. Deurenberg P, Deurenberg-Yap M (2003) Validity of body composition methods across ethnic population groups. *Acta Diabetol* 40: s246–s249
73. Buono MJ, Burke S, Endemann S et al. (2004) The effect of ambient air temperature on whole-body bioelectrical impedance. *Physiol Meas* 25: 119–123

DOI: 10.4455/eu.2019.039