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# Body composition and metabolism in anorexia nervosa: assessment of changes and regulation during nutritional recovery

**Background:** Depletion of body protein and fat leads to increased morbidity in malnourished patients with Anorexia Nervosa (AN). However commonly available, indirect techniques to assess body composition (BC) might not provide accurate information for this specific population. At the same time, it is of particular interest to monitor the process and degree of protein and fat accretion as well as the regional fat distribution patterning of AN patients during nutritional recovery. Finally, identifying key players and their role in the complex system regulating metabolic adaptation to starvation as well as energy partitioning during subsequent recuperation is an issue of central importance in the understanding and treatment of malnutrition.

**Methods**: BC was measured using a reference 4-compartment (4C) model (in-vivo neutron activation analysis for total body protein, isotope dilution for total body water, and Dual-Energy X-Ray Absorptiometry for bone mineral content), as well as with simpler methods (Bioimpedance analysis and Skinfold anthropometry) in 81 adolescent AN (mean age 15 years) on admission to hospital. Metabolism (Resting Energy Expenditure) and hormones associated with energy homeostasis (thyroid hormones, leptin, adiponectin, ghrelin, cortisol, sex hormones) were also assessed. 37 AN were followed longitudinally after 7 months of weight gain. All measurements were performed once in a sex and age-matched healthy control group.

**Results and conclusions**:
*Methodology*. Severe protein depletion (seen in 40% of the patients) and the amount of the remaining body fat could not be detected accurately with common methods (Skinfold anthropometry, Bioimpedance analysis or Dual-Energy X-Ray Absorptiometry). This bias was found to be at least partly due to a change in the composition of FFM, which can not be detected with 2-compartment models. Correction factors for simpler measures to assess body fat as assessed by Bland & Altman analysis of agreement in comparison with the 4C model are provided.

*Metabolism*. In AN, metabolic adaptation during starvation was related to decreases in fat free mass. Furthermore, evidence is provided that (i) Resting Energy Expenditure was independently mediated by thyroid hormones and that (ii) leptin was involved in the regulation of body weight, via the thyroid axis, during the transition between the starved and fed state.

*Reconstitution of Body Composition*. After 7 months of weight recuperation, protein repletion was adequate but showed a marked inter-individual variance, which could be partly explained by differences in initial testosterone levels as well as baseline amount of body protein and fat. In the course of nutritional recovery there was evidence of catch-up fat and central fat accumulation, which was mediated by cortisol and estradiol concentrations. With full nutritional recovery, ‘post-starvation obesity’ might occur in these patients. There is the need for future studies to assess if the way in which fat is recovered in AN in the short term might involve adverse health effects, such as an increased risk for metabolic or cardio-vascular disease, in the long term.