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Metabolic adaptations to weight loss

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Does losing weight slow down metabolism? Absolutely. Does metabolism decrease more than expected? It depends on how you set your expectations.

Larger people typically burn more calories, therefore energy expenditure (EE) declines as people lose weight. Quantifying the expected decline in EE with weight loss requires a mathematical model relating EE to changes in body composition. Deviations between the expected and observed decreases in EE defines the degree of metabolic adaptation.

Linear regression is often used to model how resting metabolic rate (RMR) relates to fat-free mass (FFM) and fat mass (FM) in people maintaining their habitual weight. The resulting equations vary depending on the cohort, measurement methods, and the variables included in the model. As an indication of the validity of the regression model, the best-fit coefficients for FFM and FM should be similar to the values calculated by a physiologically based model that accounts for how different organs varying in size and metabolic rate (1) are related to FFM (19 kcal/kg/d) and FM (4.5 kcal/kg/d) (2). Furthermore, the regression model should explain much of the EE variance between people prior to weight loss since large residuals limit the power to detect metabolic adaptation.

In the current issue of Obesity, Wolfe et al. addressed the question of metabolic adaptation by developing regression equations relating RMR and total EE to FFM in patients prior to various bariatric surgeries to predict RMR and total EE after six and 24 months (TK). Metabolic adaptation was present at six months while patients were still losing weight, but RMR and total EE normalized two years after the surgery after accounting for the observed FFM changes.

These results support a growing consensus that metabolic adaptation occurs during periods of negative energy balance. However, much debate surrounds whether metabolic adaptation persists after body weight stabilizes at a lower level. A previous study was similar to Wolfe et al. in that a significant metabolic adaptation six months after Roux-en Y gastric bypass (RYGB) dissipated after one year (3). Interestingly, similar weight losses induced by seven months of caloric restriction and exercise during the Biggest Loser competition resulted in comparable metabolic adaptation as six months after RYGB (3). However, unlike the matched RYGB group, metabolic adaptation persisted six years after the Biggest Loser competition despite regaining two-thirds of the lost weight (4), possibly due to increases in physical activity (5).

Previous studies have found persistent metabolic adaptation 1 year or more after bariatric surgery (6, 7, 8, 9, 10) or diet-induced weight loss (11, 12) after body weight had stabilized. Others failed to detect significant metabolic adaptation after achieving a stable lower weight (13, 14, 15) and a large recent study suggested that RMR adjusted for body composition was slightly higher 1 year after RYGB (16).

While the results of Wolfe et al. add to the literature on metabolic adaptation, we still need to explain how much of the variability in long-term metabolic adaptation is due to differences between cohorts, interventions, or the mathematical models predicting expected EE.

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