

Metabolism: Facts & Fiction

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Whatever you've heard or read about metabolism, odds are it's wrong. Most of the myths out there started out as theories—which have since been discredited. Unfortunately the facts aren't usually as exciting as the theories—so they don't get widely reported which leaves both professionals and laypersons with the wrong ideas.

Overweight and obesity, despite having multiple contributing factors (environmental, behavioral, genetic, etc.), are ultimately caused by a chronic energy imbalance resulting in weight gain. Clearly in order to lose weight (and maintain a lowered body weight) a lower net energy balance must be achieved, by consistently eating fewer (and/or burning off more) calories.

This article covers commonly misunderstood issues, related to energy metabolism, that are barriers to weight loss. By understanding the documented (versus purported) effects of energy restriction, physical activity, hypothyroidism, and changes in skeletal muscle on resting energy expenditure (REE) you can better focus on activities that produce an energy balance deficit and result in weight loss.

Energy Expenditure

Total energy expenditure (TEE), measured over 24 hours, consists of REE, physical activity-induced energy expenditure, thermic effect of food, facultative thermogenesis, and anabolism/growth.¹ REE, the largest component of TEE (~65 - 75%) consists of involuntary activities necessary to sustain life (circulation, respiration, hormone secretion, nerve activity, etc). In research settings REE is measured in the morning (after ≥12-hour fast and ≥12-hour abstinence from exercise) in a thermoneutral room (79 to 84° F) while the subject is reclined and resting.

How Does Energy Restriction Affect REE?

For most people on low-calorie diets (≥1,200 calories per day) the reduction in REE (if any) is modest (<5%). Conversely, a 5% to 15% reduction can be seen with very low calorie diets (VLCDs), which by definition are ≤800 calories.² According to a recently published review paper REE doesn't always drop with energy restriction. However "the trend is that the greater the [magnitude of] energy restriction the greater the potential reduction in REE."³ The so called "starvation response" significantly exaggerates the observed effects of energy restriction on REE. Research attempting to document metabolic adaptation ("starvation response") in chronically underfed populations has lead researchers to conclude that it is of "doubtful existence." It is postulated that any major energy conservation comes from a reduction in TEE, through a reduction in activities of daily living.⁴

How Does "Yo-Yo" Dieting Affect REE?

Several comprehensive reviews of the literature (including one by a National Institutes of Health expert panel), have concluded that the negative metabolic and body composition side-effects frequently attributed to "yo-yo" dieting are not supported by careful review of the data. The conclusions: weight cycling does not have a negative effect on REE, or lean body mass lean body mass, and does not make future attempts at weight loss more difficult (at least from a physiological standpoint).^{5,6} However, if a person's belief (that they have a low metabolism) is not addressed their underlying expectation of failure—may become a self-fulfilling prophesy.

How does physical activity affect REE?

Physical activity does have the ability to offset the potential reduction in REE secondary to energy restriction. However, the effect of physical activity is not consistent; physical activity doesn't increase REE in all subjects. This is likely due to the fact that lower intensity activities have no effect on REE; only activities that are vigorous enough to create post exercise oxygen consumption (PEOC) (which are moderate to high intensity activities) have the potential to offset reductions in REE. The general trend is that the higher the intensity of physical activity the greater the potential increase in REE.⁷

TEE ^a of "Reference Male"	
2,520 calories	Physical Activity 23% (or more)
1,932 calories	Thermic Effect of Food (TEF) 7-10%
1,680 calories	Organs 58%
Total Energy Expenditure (TEE) Basal Metabolic Rate (BMR)	Liver 21%
	Brain 20%
	Heart 9%
	Kidneys 8%
	Skeletal Muscle 22%
Misc. Tissues (bone, skin, etc.) 16%	
Fat Tissue 4%	

LBM^b accounts for 60-70% of BMR, but (skeletal) muscle itself accounts for only 22%

"Muscle tissue" includes organ tissue and skeletal muscle tissue. The metabolic rate of organ tissue accounts for the largest portion of BMR. The liver, brain, heart and kidneys in a 154-pound reference male account for 58% of his total BMR. Miscellaneous tissues (bone, skin, glands, intestines, etc.) account for another 16%, skeletal muscle contributes 22% and adipose (fat) tissue contributes the final 4% (for women, skeletal muscle accounts for a smaller portion of their BMR—16% based on the reference female—because females have less muscle mass).

Reference male:

154-pounds, 5'9", age 30, 21.4% body fat.

Reference female:

127.6-pounds, 5'4", age 30, 32.7% body fat.

a. Total Energy Expenditure

b. Lean Body Mass

Figure 2