A Pound of Muscle Burns 30-50 Kcal/Day, Really…

Two "expert" fitness websites contradict each other – according to one "each additional pound of muscle equates to an increase of 50 kcal of resting metabolism each day" but the other online site suggests "you will burn an additional 30 calories a day by adding a pound of muscle mass." Which is correct? As you may expect from the internet, neither website is correct. Presumably these inflated numbers come from antiquated studies with poor conclusions that looked at the effects of resistance training on muscle mass gains and metabolism. Several early studies demonstrated gains of 1.5-2 kg of lean mass in untrained individuals performing resistance training for 8-12 weeks. The metabolic result was a daily increase of 200-300 calories above previous measured daily expenditure. Doing some simple math, if a person added 3 pounds of muscle and burned 240 calories more per day the net gain would be 80 kcals per pound. But this would not be the doing of lean mass alone.

Working out with weights burns calories, as does any movement. To suggest an increase of one or two pounds of muscle equates to a notable increase in resting metabolic rate would be inaccurate. Muscle has a low metabolic rate compared to other metabolic tissues at rest. It is estimated that sedentary muscle mass burns about 6 kcals per pound/day or 0.25 calories an hour per pound. This number obviously increases with activity relative to the intensity, but looking it at from a metabolic perspective (METS) that number still does not reach 50 kcal per pound. If it did, a 185 lb person would need 3885 calories to sustain their muscle tissue which represents only about 40% of bodyweight. What about the other sixty percent, and the 3885 calories does not take into account the 300 kcal for the brain (109 kcal/lb) or the 400 kcal for the liver (91 kcal/lb) and 125 kcal for kidneys (200 kcal/lb). Add these organs in and this number now is 4710 kcal/day without even counting the highly metabolic heart (200 kcal/lb) or any other tissue including the skin or fat, although the latter provides the lowest metabolic stimulus at about 2 kcals per pound. After it's all said and done this person would require over 5000 kcal from their diet a day to support rest; imagine if he exercised.

Using a simple formula to look at the oxygen demands of tissue exemplifies the limited calories expended per pound of muscle. Working muscles use carbohydrates as a primary fuel for more intense exercise. Therefore, applying the concept that lean tissues burns 5 kcal per liter of oxygen when used with carbohydrates, the metabolic rate of the tissue can be calculated during activity. Consider 60 minutes of exercise at a 10 MET intensity.

1 lb of muscle = 0.45 kg lean mass x .035 L (10 METS) x 60 min x 5 kcal/L = 4.7 kcal/hour per pound

This equates to approximately 350 kcals for total muscle mass if used in a workout. Since we do not use total musculature continuously in a 60 minute workout this number is inflated, but the other tissues make up for the difference. During cross country skiing for example, the muscles can require 60-70% of cardiac output, but at rest only 15%. At rest, the metabolic organs actually contribute heavily to metabolism and use a higher percentage of cardiac output (about 50%). Even bone receives more than 10% cardiac output at rest. It is the workouts and other physical activities engaged in during the day that raise the metabolic rate of muscle to the roughly 11 kcals per pound suggested in exercise physiology textbooks. Part of the reason that muscle only does so much to promote metabolic expenditure in a day is the body is at rest for the

majority of the time. If it burned high levels of calories at rest, early humans would have constantly been searching for food or would have starved to death. Although representing only about 6% of bodyweight, the metabolic organs contribute much more dramatically to resting expenditure than the quantifiably heavier muscle and fat tissue.

The muscles though, do provide a metabolic boost during rest in the recovery of exercise. This "after burn" or more correctly excess post exercise oxygen consumption occurs in response to the physiological disruption in the tissue. Post exercise, muscles and organs are drained of energy and require replenishment, the heart must continue to work to supply oxygen to ischemic tissues and to help promote byproduct removal in the fast component of the process. A slower component that lengthens the durations of recovery is the imposed rate of protein turnover associated with higher intensity training, particularly from high tension anaerobic exercises like squats and deadlifts. Most forms of resistance exercise will increase protein turnover albeit body building, strength training, or conditioning drills such as plyometrics and all will increase calorie expenditure in the hours that follow based on tension and total volume.

Therefore adding muscle is just as important as training the current muscle that exists on the body. This explains why clinically supervised weight loss programs emphasize the maintenance of lean mass. Losses of lean mass during the "dieting" process reduce the caloric contribution of muscle and just 10 kcals/day equates to the metabolic equivalent of one pound of fat in a year. Looking at the numbers from a day to day perspective devalues the tissues impact over time. To defend against this risk many with the goal of weight loss increase protein intake to preserve muscle.

This is where a second fitness fallacy comes into play. Many exercisers increase protein to maintain or add lean mass. But consumed protein does not equate to gained lean mass. Excess protein in the diet follows a preferential path to triglyceride formation. Eating more protein only ensures more nitrogen enters the body which often requires more water to excrete it. The same muscle websites that tell you adding a pound of muscle contributes to 50 kcal of resting metabolism are the ones suggesting a person needs a gram of protein per pound to add muscle mass.

Muscle tissue really only needs a relatively small amount of added protein to promote the process of remodeling. An intake of 1.6 grams per kilogram of body weight easily supports this goal without crossing the tolerable upper limit (UL). Certainly body builders who take steroids can utilize more protein because they have the internal environment to use it, but the need for a personal training client is much reduced in comparison. Consider this, a pound of muscle weighs 454 g and is composed of 22% protein. This equates to about 100 g of protein in a pound of muscle. Therefore to add a pound of muscle in a week (assuming appropriate training and anabolic activity) a person would need only 100 additional grams of protein per week or 14 g per day (56 kcal). To add mass the body actually needs calories, about 400-500 extra a day to add a pound of muscle a week. But that does not mean all the calories should come from protein and the added calories also usually means added fat as well. When put into perspective the same 185 lb person would only need 75 g of protein a day if sedentary, and if he suddenly became an avid weightlifter would require 134 g of protein per day or an increase of 59 g from his sedentary requirement. This jump in protein includes any additional muscle building needs.

Interestingly though, many exercise programs attempt to emphasize adding muscle mass to

help reduce fat mass and use cardiovascular exercise and restricted diet to reduce body fat at the same time. Based on the above this should sound counterintuitive. To add mass you need calories, to lose mass you need to remove calories. Deconditioned people and those who are anabolically enhanced are really the only ones who lose fat while they add muscle and the prior will add a relatively small amount before leveling off quickly. Based on this information weight loss programs may benefit from a periodized approach where at one point they emphasize caloric expenditure with a goal of maintaining mass (which also speaks to improved cardiovascular and anaerobic endurance conditioning) before focusing on adding mass whilst trying to limit fat gain. For the obese the goal should be physical activity in general, to manage the likely inflammatory problems and for those with cardio-metabolic disease an emphasis on health and fitness will complement weight loss. Regardless of the population being addressed, having a better idea of the dynamics that affect metabolism and body mass certainly aid in finding a level of success in managing it.