Metabolism Makeover: Fact or Fiction
Len Kravitz, Ph.D.

A major goal of weight management strategies and programs is to create some type of imbalance with energy intake (decreasing) and energy expenditure (increasing) in order to facilitate weight loss. Daily or total 24-hour energy expenditure (TEE, see Figure 1 for its constituents) is a multifaceted physiological phenomenon that is influenced by a complex interaction of genes (which favor energy conservation and storage for survival) and an environment (which enables a sedentary lifestyle and promotes ready access to food) (Rosenbaum and Liebel, 2010). The authors continue that TEE can be separated into resting metabolic rate (RMR, which is ~60% of TEE), the thermic (i.e., heat and energy releasing reactions) of exercise and spontaneous physical activity (comprising ~30 of TEE), and the thermic effect of food (digestion, absorption, and metabolism of nutrients which accounts for 5-10% of TEE). Because of its robust role in TEE, RMR has become the target of many substantiated and unsubstantiated weight loss propositions. This column will provide an evidence-based review of several of these popular questions on metabolism.

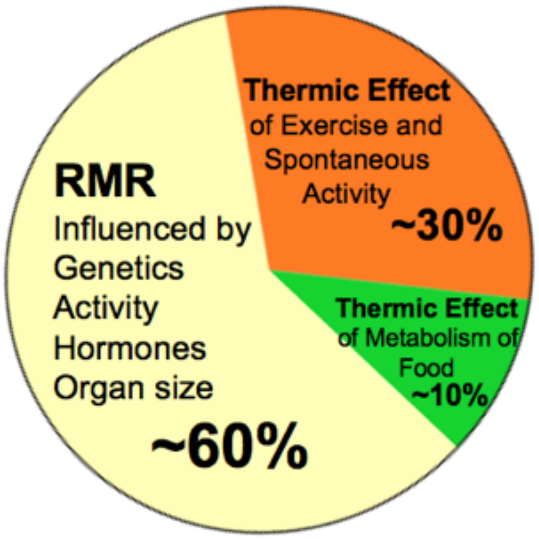

Figure 1. Components of Total 24-hour Daily Energy Expenditure (TEE)

1) How much does RMR lower from diet-only interventions? Hill (2004) states that basal metabolic rate (which is very similar to RMR, only it is measured using slightly stricter criteria) can be suppressed up to 20%. For example, a person who's BMR is 1500 calories a day might have an approximate decrease of 300 calories per day in a diet-only program. However, Hill continues that physical exercise (aerobic training and resistance exercise) provides a protective effect to this lowering from energy restriction. This can be primarily explained by the fact that people tend to lose a considerable portion of muscle mass in diet-only programs, where as one of the key contributions from exercise in weight loss programs is the preservation of muscle and RMR.

2) How much does RMR change from continuous long-term participation in aerobic exercise? Potteiger and colleagues (2008) completed a 16-month study on the effect of RMR in adult female (exercise group=25, control group=18) and male (exercise group=16, control group=15) subjects who did aerobic exercise 3-5 days/week for 30-45 minutes/session at a moderate intensity (60-75% of their heart rate reserve). There were no RMR changes in the control group, who just maintained their normal exercise and diet patterns for the 16 months. However, on average the females in the exercise group had a mean increase of 129 calories/day while the males in the exercise group experienced an average increase in 174 kilocalories/day in this 16-month investigation.

3) How much does RMR change from continuous long-term participation in resistance exercise? Hunter et al (2000) conducted a 26-week resistance training study with beginning, sedentary and older (61-77 yrs old) males (n=7) and females (n=8). Subjects completed supervised workouts consisting of 2 sets of 10 repetitions (with 2

minutes of rest between each set). The resistance exercises were elbow flexion, elbow extension, lateral pulldown, seated row, chest press, leg extension, leg curl, seated press, back extensions, bent-leg sit-ups (15–25 repetitions) and squats or leg presses (as determined by the supervising exercise physiologist). The subjects trained at intensity within 65–80% of their 1 repetition maximum (1-RM). Progressive overload was carefully integrated in the program after reviewing daily training logs and re-testing of the 1-RM every 3 weeks. At the end of this 6-month investigation male and female subjects increased their RMR by 7%, which was approximately an additional 100 calories per day.

4) What is the best equation to estimate resting metabolic rate?

Frankenfield and colleagues conducted a review of four population RMR estimation equations. The Mifflin-St Jeor (1990) equation was found to be most accurate. The Miflin-St Jeor RMR equation was derived from data collected on males (n=251) and females (n=247) aged 19-78 years of age. The RMR equations for men and women are as follows:

Males: RMR=10x(wt in kg) + 6.25x(ht in cm) – 5x(age in years) + 5

Females: RMR=10x(wt in kg) +6.25x(ht in cm) – 5x(age in years) – 161

To determine body weight in kg from lbs simply divide weight in lbs by 2.205. For instance, a 140 lb woman would calculate body weight in kg as follows: 140 lbs/2.205=63.5 kg. Height in centimeters is easily determined by multiplying a person's height (in inches) by 2.54. So, for a female who is 5 feet 6 inches (or 66 inches), height in centimeters is 66 inchesx2.54=167.64 cm. Continuing with this RMR estimation, if a

female client is 30 years old, 140 lbs and 5 feet 6 inches the estimate for her RMR would be calculated as follows:

RMR=10(63.5) + 6.25(167.64) – 5(30) – 161
=635 + 1048 – 150 – 161
= 1372 calories per day
Now it's YOUR turn: Calculate your estimated RMR!

5) How much does RMR vary between persons?

Lazer and colleagues (2010) studied the relationship of RMR, gender, age and body composition in 8,780 obese subjects, whose ages ranged from 7 to 74 years. The data shows quite a bit of variability between subjects in RMR, which the authors note can be explained by genetic factors, physical activity, organ mass and hormonal factors. In fact, because of this variability in persons the Mifflin-St Jeor RMR equation highlighted above has a plus or minus 10% accuracy prediction of RMR. In addition, some people have what Rosebaum and Leibel (2010) refer to as an increased 'genetic risk' towards obesity. These persons have metabolisms that are appreciably more depressed by their 'thrifty genes' in the body that strive to maintain body fat levels.

6) Does eating more frequently during the day elevate resting metabolic rate?

As noted early in the article, the thermic effect of food is up to 10% of TEE. Eating more frequently during the day may actually help to maintain this thermic effect effectively (Rosenbaum and Leibel, 2010). A worrisome concern to the exercise professional is when a client chooses to skip meals. Besides creating potential inadequate nutrient intake and low blood glucose concerns, this unwise strategy may be interpreted as a 'threat' by the mind, resulting in a series of physiological reactions to conserve fat reserves on the body.

7) Are any of these proposed 'thermogenic ingredients' such as teas (green, white and oolong, although green tea has been the primary tea studied), caffeine and capsaicins (the major component in red hot peppers and some spices) successful in elevating resting metabolic rate?

Hursel and Westerterp-Plantenga (2010) conducted an extensive review of these proposed thermogenic (process of calorie burning via heat production in the body) ingredients. From this extensive scientific review the authors concluded that these ingredients might briefly increase RMR (4-5%) as well as mildly improve fat oxidation (i.e., fat burning) by the body. The investigators explain that through different physiological pathways these thermogenic ingredients slightly elevate the sympathetic nervous system, which is very involved in the regulation of RMR. The researchers suggest that more research is needed to determine the optimal doses and best combinations of these bioactive ingredients to increase RMR. As an important caution to exercise professionals, the authors state that some people may experience increased systolic and diastolic blood pressure (up to 6 mmHG) with the intake of green tea and caffeine and/or possible side effects including heart palpitations, anxiety, headache, restlessness, and dizziness. However, for most individuals the research indicates very little health risk with the intake of teas and caffeine (and none with capsaicins).

Metabolism Makeover Conclusion

Well-controlled, long-term studies on aerobic exercise and weight lifting show that both approaches independently increase a person's resting metabolic rate, thus contributing to the desired energy balance goals of weight management programs. In addition, optimal doses and combinations of some thermogenic agents (teas, caffeine and capsaicins) that

mildly elevate RMR are on the horizon. These too may ultimately help compliment a client's serious weight loss efforts.

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