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Fitness Myths, Misconceptions, & Misinformation

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Myth: Strength training increases resting metabolic rate.

Proposed Argument:

- Weight training ↑ muscle mass
- ↑ muscle mass ↑ RMR
- ↑ RMR burns more calories all day
- Burning more calories all day helps ↓ weight

Truth:

- Weight loss occurs only when caloric expenditure > caloric intake (negative caloric balance).
- As people lose weight, RMR *decreases* (even when muscle mass is maintained by weight training) or stays the same (when exercise, rather than caloric restriction, is reason for weight loss).
- Since no research shows that RMR increases when people are in negative caloric balance, how can exercise increase RMR, resulting in weight loss?

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Resting Metabolic Rate

- RMR ranges from ~1,200 to ~2,000 kcal/day (1,400-1,600 kcal/day in most people).
- RMR is not significantly different between people of different aerobic fitness levels & is independent of training status.
- *Heavier* people have slightly higher RMR because they have more mass to support.
- Each pound of muscle burns about 6-7 kcal/day.

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Resting Metabolic Rate

Avg. RMR = 3.5 ml O_2/kg/min, commonly referred to in clinical practice as one MET (metabolic equivalent).

$$\frac{3.5 \text{ ml } O_2}{\text{kg x min}} \times \frac{1{,}440 \text{ min}}{1 \text{ day}} \times \frac{91 \text{ kg}}{1} \times \frac{5 \text{ kcal}}{1 \text{ L } O_2} \times \frac{1 \text{ L}}{1{,}000 \text{ ml}} = 2{,}293 \text{ kcal/day} = 1{,}713 \text{ kcal/day}$$

Assuming 25% body fat, fat mass = 0.25 x 91 kg = 17 kg

Fat-free mass = 68 - 17 = 51 kg

91 - 23 = 68 kg

$$\frac{2{,}293 \text{ kcal}}{1 \text{ day}} \times \frac{1}{68 \text{ kg}} \times \frac{1 \text{ kg}}{2.2 \text{ lbs}} = 15.3 \text{ kcal/lb/day} = 15.3 \text{ kcal/lb/day}$$

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Research on RMR and Exercise

Study	Exercise Intervention	Change in RMR
Byrne & Wilmore (2001)	weight training	+44 kcal/day*
	weight training + walking (20 weeks)	−53 kcal/day*
Potteiger et al. (2008)	20-45 min @ 60-75% HRR (3-5 days/week for 9 months)	men: +30 kcal/day*
		women: +109 kcal/day*
Dolezal & Potteiger (1998)	endurance training: run 25-40 min @ 65-85% max HR	−48 kcal/day*
	weight training: 3 sets of 10-15 reps, progressing to 3 sets of 10-12 RM/8-10 RM/4-8 RM)	+114 kcal/day*
	combined endurance + weight training (3 x week for 10 weeks)	+83 kcal/day*
Lemmer et al. (2001)	weight training (24 weeks)	young: +100 kcal/day*
		seniors: +92 kcal/day*
		men: +142 kcal/day*
		women: +47 kcal/day

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Study	Exercise Intervention	Change in RMR
Pratley et al. (1994)	strength training w/ heavy weights (16 weeks)	+131 kcal/day*
Poehlman & Danforth (1991)	endurance training (cycling) (8 weeks)	+10%*
Broeder et al. (1992b)	weight training: 3 sets of 10-12 reps, progressing to 3 sets of 10-12 RM/8-10 RM/6-8 RM)	No change
	endurance training: walk/run 40-50 min @ 70-90% VO_2max	No change
Frey-Hewitt et al. (1990)	energy restriction only	Decreased*
	exercise only: run 10 miles/week (1 year)	No change
Poehlman et al. (2002)	endurance training: run 25-40 min @ 60-95% max HR	−26 kcal/day
	resistance training: 3 sets of 10 reps @ 80% 1 RM (3 x week for 6 months)	+60 kcal/day*

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Study	Exercise Intervention	Change in RMR
Taafe et al. (1995)	high-intensity exercise: 3 sets of 7 reps of 10 exercises @ 80% 1 RM)	No change
	low-intensity exercise: 3 sets of 14 reps @ 40% 1 RM) (3 x week for 15 weeks)	No change
Wilmore et al. (1998)	endurance training: cycling 30-50 min @ 55-75% VO_2max (3 x week for 20 weeks)	No change
Kraemer et al. (1997)	diet + aerobic exercise: 30-50 min @ 70-80% max HR	−30 kcal/day
	diet + aerobic exercise + strength training: 1-3 sets @ 5-7 RM & 8-10 RM on alternating days (3 x week for 12 weeks)	−143 kcal/day

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Research Conclusions

- Majority of research shows that, while post-exercise metabolic rate (EPOC) is acutely elevated, RMR does not increase following an exercise program (i.e., an increased RMR is not a chronic adaptation to exercise training).
- While some research has shown a significant increase in RMR following training, the magnitude of change is relatively small (30-142 kcal/day) compared to what is needed for weight loss.
- Older adults are more likely to show increases in RMR due to attenuating effect of exercise on age-associated losses in muscle mass.
- When weight loss is achieved by exercise rather than by caloric restriction (diet), exercise may prevent decline in RMR.

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Myth: Lactic acid causes fatigue, muscle burning, and muscle soreness.

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Lactic Acid

- First discovered in 1780 in sour milk.
- Produced in a metabolic pathway called glycolysis.
- In the 1920s, Nobel Prize winners A.V. Hill and Otto Meyerhof discovered that lactic acid is produced during fatiguing muscle contractions in the absence of oxygen.

At physiological pH, lactic acid exists as lactate.

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Lactate DOES NOT Cause Fatigue!

There has never been any experimental evidence proving a cause-and-effect relationship between lactate and fatigue. While lactate increases during intense exercise, so do other metabolites, including K^+, H^+, ADP, & P_i, all of which have been implicated in fatigue. Because of lactate's concomitant increase with these other metabolites and the simple method of measuring its concentration, blood lactate is used by scientists only as an indirect measure of acidosis.

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Lactate DOES NOT Cause Muscle Burning!

No physiologist has ever burnt himself when taking a blood sample containing a high blood lactate concentration. The exact cause of the sensation of muscle burning is unknown, but it may be related to acidosis and increase in muscle temperature that accompanies intense exercise.

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Lactate DOES NOT Cause Muscle Soreness!

Muscle and blood lactate return to pre-exercise levels within 30 to 60 minutes after exercise, so lactate is long gone by the time soreness develops. Muscle soreness is the result of microscopic tears in the muscle fibers, causing an initial mechanical injury (likely related to the contractile proteins—actin and myosin—pulling apart), and a delayed biochemical injury, which usually brings about the perception of soreness.

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Lactate is Your Friend

- Lactate production supports continued production of energy (ATP) from glycolysis
- Used as fuel by heart
- Used by liver to make new glucose (gluconeogenesis)
- Converted back into glycogen by a reversal of glycolysis
  - new glucose & glycogen used as fuels by muscles so high-intensity exercise can continue
- Lactic acid & ↓ pH have been shown to ↑ in vitro muscle force production

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Misconception: You have to exercise in your fat-burning zone.

- As exercise intensity increases, rely less on fat & more on carbohydrates.
- Carbohydrates are muscles' preferred fuel during exercise.
- When exercising at higher intensity, number of calories used per min & total number of calories expended are much greater than when exercising at lower intensity, so amount of fat used is also greater.
- What matters is *rate* of energy expenditure, rather than % of energy expenditure derived from fat.
- You don't have to use fat during exercise to lose fat from your waistline.

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Fat Use During Exercise

- At low exercise intensities, greater reliance on fat.
- As exercise intensity increases, rely less on fat & more on carbohydrates.
- Carbohydrates are muscles' preferred fuel during exercise.
- You don't have to use fat during exercise to lose fat from your waistline.
- When exercising at higher intensity, number of calories used per min & total number of calories expended are much greater than when exercising at lower intensity, so amount of fat used is also greater.
- What matters is *rate* of energy expenditure, rather than % of energy expenditure derived from fat.

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Fat Use During Exercise

Aerobic exercise makes you a better fat-burning machine by increasing skeletal muscle mitochondrial content & cellular respiratory capacity, allowing for sparing of muscle carbohydrate (glycogen).

This steering in fuel use to a greater reliance on fat at same exercise intensity is one of the hallmark adaptations of aerobic exercise training.

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Myth: People get fat because they eat too much.

Carbs
Protein
Fat

muscle & liver glycogen/blood glucose
tissue repair/structure building
cell membranes/stored energy
insulation/organ protection

fat

Metabolic priority of recovering muscle is replenishment of glycogen stores/reparation of damaged tissue. With no exercise, there is never a drain on muscle glycogen nor any tissue to repair or build, so any calories consumed that are not used to meet metabolic needs or repair/build tissue are stored as fat.

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Why Is It So Hard To Lose Weight?

1 pound = 3,500 Calories

If someone walks/runs 3 miles/day (~45 min walk; ~30 min run) for 5 days/week, he/she expends 1,650 kcal/week (~110 kcal/mile).

Therefore, it will take 2.1 weeks to lose 1 pound, assuming none of the expended calories are replaced.

1 8-oz glass of apple juice = 110 Calories

1 8-oz glass of 1% milk = 120 Calories

1 slice of wheat bread = 70 Calories

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Weight Loss Research

- 150-250 min of moderate-intensity exercise is needed per week to prevent weight gain & provides only modest weight loss (ACSM Position Statement, 2009).
- Exercising >250 min/week is needed for significant weight loss & for maintenance of weight after weight loss (ACSM Position Statement, 2009).
  - people who averaged ≥200 min/week of physical activity lost significantly more weight than those who averaged <150 min/week (Chambliss, 2005).
- Energy expenditure >1,500 kcal/week results in more successful maintenance of weight after weight loss (Zachwieja, 1996).
- Weight regain is related to decreases in physical activity during weight loss (Wang et al., 2008).
  - amount of weight regained after 6 & 12 months was inversely associated with decreases in physical activity during weight loss intervention.

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Weight Loss Research

Williams & Satariano (2005):

- 41,582 female runners stratified into groups based on age & weekly running distance: 0-4, 5-9, 10-14, 15-19, 20-24, 25-29, 30-39, & 40+ mi/week.
- Compared with those who ran <10 mi/week, those who averaged over 40 mi/week had 18% smaller bra cups, 10% lower BMI, 8% lower waist circumferences, 7% lower hip circumferences, & 4% lower chest circumferences.
- In all age groups, the greater the number of miles run/week, the lower the BMI, chest, waist, & hip circumferences.

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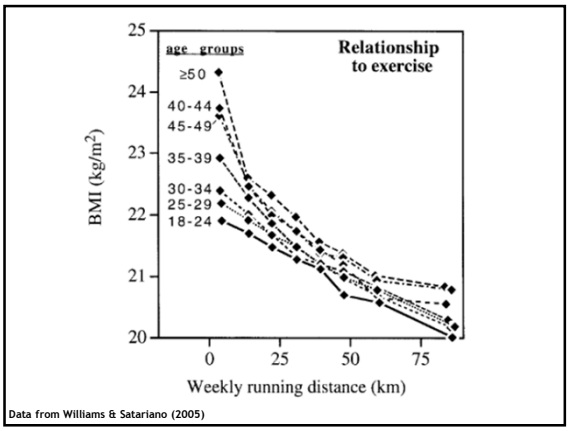

Data from Williams & Satariano (2005)

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Weight Loss Research

Williams & Thompson (2006):

- 3,973 men & 1,444 women who quit running, 270 men & 146 women who started running, & 420 men & 153 women who remained sedentary during 7.4 years.
- Initiation of vigorous exercise & its cessation decrease & increase, respectively, body weight & intra-abdominal fat, with changes proportional to change in exercise dose.

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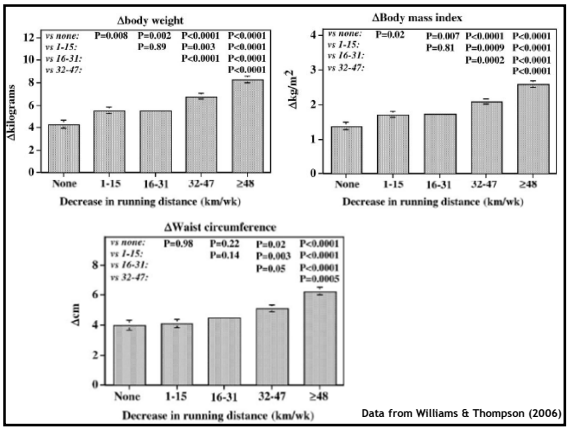

Data from Williams & Thompson (2006)

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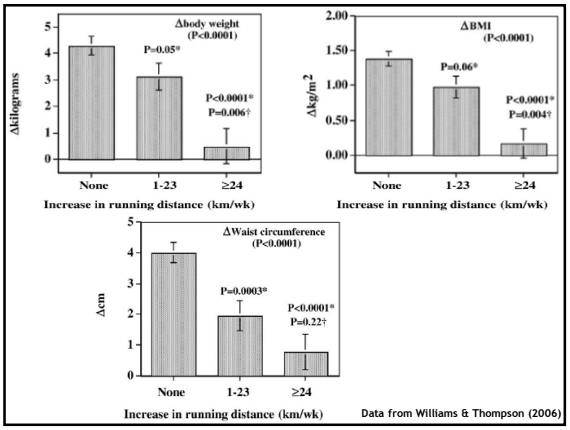

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Myth: Strength training before cardio burns more fat during cardio.

- You have enough glycogen to last about 2 hours of sustained moderate-intensity activity.
- Strength training workout is not likely to deplete muscle glycogen because it's not long enough and most of the workout time is spent resting between sets & exercises.
- Even if workout were long & intense enough to cause glycogen depletion, exercising in a glycogen-depleted state has many negative consequences:
  - ketosis
  - low blood insulin
  - hypoglycemia
  - increased amino acid metabolism
  - increased blood and muscle ammonia

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Cardio/Weight Training Order

- There is no research showing that strength training immediately before cardio increases amount of fat used during cardio workout.
- Exercise intensity determines which substrate is used.
- It's possible that muscle fatigue incurred from strength training may cause clients to decrease their subsequent cardio intensity, thus expending fewer calories over whole workout.
- If client's primary goal is to increase aerobic endurance or lose weight, then cardiovascular exercise should be performed first.
- If client's primary goal is to increase muscular strength, local muscular endurance, or sculpt his/her body, then strength training should be performed first.

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Misinformation: Stretching prevents injuries, improves performance, and reduces soreness.

- Type of activity & type of injury need to be considered when determining whether stretching has anti-injury effect.
- If activity includes explosive or ballistic movements (e.g., volleyball, basketball, & plyometric exercises), stretching can reduce injuries by increasing compliance of tendons & improve their ability to absorb energy.
- For low-intensity activities that don't include ballistic movements (e.g., running, cycling, & swimming), stretching has no beneficial effect on injury prevention since there is no need for compliant tendons.
- Stretching seems to have beneficial effect for preventing muscle injuries (sprains & strains), but not bone or joint injuries.

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Stretching (cont.)

- Research shows that stretching does not improve exercise performance. Muscle strength performance has been shown to decrease 4½-28% when preceded by stretching.
- Stretching before or after exercising has minimal or no effect on post-workout muscle soreness.

Major benefit to stretching is to increase functional range of motion (flexibility). When stretching to increase flexibility, doing it apart from workout seems to have greatest benefit.

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Some More Myths, Misconceptions, & Misinformation…

MMM: Lifting weights will cause you to get bigger muscles.

Truth: Whether or not you get bigger muscles (hypertrophy) depends on 3 factors—genetics, gender, & training intensity. Males acquire larger muscles than do females due to greater amount of testosterone which influences protein metabolism.

MMM: Exercising first thing in the morning burns more fat.

Truth: While muscles are forced to rely on fat when glucose in unavailable, exercising when blood glucose is low will decrease exercise intensity, resulting in less calories burned.

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Some More Myths, Misconceptions, & Misinformation…

MMM: Eating right before going to bed will make you fat.

Truth: Enzymes don't wear watches. It makes no difference what time you eat; weight loss/weight gain is about how many calories you consume vs. how many calories you expend.

MMM: Low carb diets are good for weight loss.

Truth: While some research shows that low-carb diets can result in initial weight loss, they are not good for the long term. Exercise, not diets, leads to sustained weight loss. Fat burns in the flame of carbohydrate!

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Some More Myths, Misconceptions, & Misinformation…

MMM: Muscle weighs more than fat.

Truth: Muscle and fat weigh the same — a pound of muscle is equal to a pound of fat. The difference is the densities of the two — muscle is more dense because it has less volume for its mass (D = m/v).

MMM: Doing crunches will shrink your waistline.

Truth: Crunches will not shrink your waistline. It would take a billion crunches to add up to enough calories to make a difference in your waistline. Crunches can strengthen and hypertrophy the abdominal muscles, but not make you lose fat.

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