Does Cardio After an Overnight Fast Maximize Fat Loss?

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A common fat burning strategy employed by bodybuilders, athletes, and fitness enthusiasts is to perform cardiovascular exercise first thing in the morning on an empty stomach. This strategy was popularized by Bill Phillips in his book, "Body for Life" (23). According to Phillips, performing 20 minutes of intense aerobic exercise after an overnight fast has greater effects on fat loss than performing an entire hour of cardio in the post-prandial state. The rationale for the theory is that low glycogen levels cause your body to shift energy utilization away from carbohydrates, thereby allowing greater mobilization of stored fat for fuel. However, although the prospect of reducing body fat by training in a fasted state may sound enticing, science does not support its efficacy.

First and foremost, it is short-sighted to look solely at how much fat is burned during an exercise session. The human body is a very dynamic organism and continually adjusts its use of fat for fuel. Substrate utilization is governed by a host of factors (i.e. hormonal secretions, enzyme activity, transcription factors, etc) and these factors can change by the moment (27). Thus, fat burning must be considered over the course of days — not on an hour to hour basis — to get a meaningful perspective on its impact on body composition (13). As a general rule, if you burn more carbohydrate during a workout, you inevitably burn more fat in the post-exercise period and vice versa (34).

It should be noted that high-intensity interval training (HIIT) has proven to be a superior method for maximizing fat loss compared to moderate-intensity, steady-state training (2610, 26, 29). Interestingly, studies show that blood flow to adipose tissue diminishes at higher levels of intensity (24). This is believed to entrap free fatty acids within fat cells, impeding their ability to be oxidized while training. Yet despite lower fat oxidation rates during exercise, fat loss is nevertheless greater over time in those who engage in HIIT versus training in the in the "fat burning zone" (29), providing further evidence that 24-hour energy balance is the most important determinant in reducing body fat.

The concept of performing cardiovascular exercise on an empty stomach to enhance fat loss is flawed even when examining its impact on the amount of fat burned in the exercise session alone. True, multiple studies show that consumption of carbohydrate prior to low intensity aerobic exercise (up to approximately 60% $\dot{V}O_{2\ max}$) in untrained subjects reduces the entry of long-chain fatty acids in the mitochondria, thereby blunting fat oxidation (18, 14,18 1, 28). This is attributed to an insulin-mediated attenuation of adipose tissue lipolysis, an increased glycolytic flux, and a decreased expression of genes involved in fatty acid transport and oxidation (15, 3, 6). However, both training status and aerobic exercise intensity have been shown to mitigate the effects of a pre-exercise meal on fat oxidation (24, 4, 5). Recent research has shed light on the complexities of the subject.

Horowitz, et al. (14) studied the fat burning response of six moderately trained individuals in a fed versus fasted state to different training intensities. Subjects cycled for two hours at varying intensities on four separate occasions. During two of the trials, they consumed a high-glycemic carbohydrate meal at 30 minutes, 60 minutes, and 90 minutes of training, once at a low intensity (25% peak oxygen consumption) and once at a moderate intensity (68% peak oxygen consumption). During the other two trials, subjects were kept fasted for 12 to 14 hours prior to exercise and for the duration of training. Results in the low intensity trials showed that although lipolysis was suppressed by 22% in the fed state compared to the fasted state, fat oxidation remained similar between groups until 80 to 90 minutes of cycling. Only after this point was a greater fat oxidation rate observed in fasted subjects. Conversely, during moderate intensity cycling, fat oxidation was not different between trials at any time — this despite a 20-25% reduction in lipolysis and plasma FFA concentration.

More recently, Febbraio et al. (9) evaluated the effect of pre- and during-exercise carbohydrate consumption on fat oxidation. Using a cross-over design, seven endurance-trained subjects cycled for 120 minutes at approximately 63% of peak power output, followed by a "performance cycle" where subjects expended 7 kJ/kg body weight by pedaling as fast as possible. Trials were conducted on four separate occasions, with subjects given either: 1) a placebo before and during training; 2) a placebo 30 minutes before training and then a carbohydrate beverage every 15 minutes throughout exercise; 3) a carbohydrate beverage 30 minutes prior to training and then a placebo during exercise; or 4) a carbohydrate beverage both before and every 15 minutes during exercise. The study was carried out in double-blind fashion with trials performed in random order. Consistent with previous research, results showed no evidence of impaired fat oxidation associated with consumption of carbohydrate either before or during exercise.

Taken together, these studies show that during moderate- to high-intensity cardiovascular exercise in a fasted state — and for endurance-trained individuals regardless of training intensity — significantly more fat is broken down than the body can use for fuel. Free fatty acids that are not oxidized ultimately become reesterified in adipose tissue, nullifying any lipolytic benefits afforded by pre-exercise fasting.

It should also be noted that consumption of food before training increases the thermic effect of exercise. Lee et al. (20) compared the lipolytic effects of an exercise bout in either a fasted state or after consumption of a glucose/milk (GM) beverage. In a cross-over design, four experimental conditions were studied: low intensity, long duration exercise with GM; low intensity, long duration exercise without GM; high intensity, short duration exercise with GM, and; high intensity, short duration exercise without GM. Subjects were ten male college students who performed all four exercise bouts in random order on the same day. Results showed that ingestion of the GM beverage resulted in a significantly greater excess post-exercise oxygen consumption compared to exercise performed in a fasted state in both high and low intensity bouts. Other studies have produced similar findings, indicating a clear thermogenic advantage associated with pre-exercise food intake (7, 11).

The location of adipose tissue mobilized during training must also be taken into account here. During low- to moderate-intensity training performed at a steady state, the contribution of fat as a fuel source equates to approximately 40 to 60% of total energy expenditure (31). However, in untrained subjects only about 50 to 70% of this fat is derived from plasma FFAs; the balance comes from intramuscular triglycerides (IMTG) (31).

IMTG are stored as lipid droplets in the sarcoplasm near the mitochondria (2), with the potential to provide approximately two-thirds the available energy of muscle glycogen (32). Similar to muscle glycogen, IMTG can only be oxidized locally within the muscle. It is estimated that IMTG stores are approximately three times greater in type I versus type II muscle fibers (8, 21, 30), and lipolysis of these stores are maximally stimulated when exercising at 65% $\dot{V}O_{2\,max}$ (24)

The body increases IMTG stores with consistent endurance training, which results in a greater IMTG utilization for more experienced trainees (12, 16, 22, 30). It is estimated that nonplasma fatty acid utilization during endurance exercise is approximately twice that for trained versus untrained individuals (32, 24). Hurley, et al. (17) reported that the contribution of IMTG stores in trained individuals equated to approximately 80% of total body fat utilization during 120 minutes of moderate intensity endurance training.

The important point here is that IMTG stores have no bearing on health and/or appearance; it is the subcutaneous fat stored in adipose tissue that influences body composition. Consequently, the actual fat-burning effects of any fitness strategy intended to increase fat oxidation must be taken in the context of the specific adipose depots providing energy during exercise.

Another factor that must be considered when training in a fasted state is its impact on proteolysis. Lemon and Mullin (19) found that nitrogen losses were more than doubled when training while glycogen depleted compared to glycogen loaded. This resulted in a protein loss estimated at 10.4% of the total caloric cost of exercise after 1 hour of cycling at 61% VO2max,. This would suggest that performing cardiovascular exercise while fasting may not be advisable for those seeking to maximize muscle mass.

Finally, the effect of fasting on energy levels during exercise ultimately have an effect on fat burning. Training first thing in the morning on an empty stomach makes it very difficult for an individual to train at even a moderate level of intensity. Attempting to engage in a HIIT-style routine in a hypoglycemic state almost certainly will impair performance (33). Studies show that a pre-exercise meal allows an individual to train more intensely compared to exercise while fasting (25). The net result is that a greater number of calories are burned both during and after physical activity, heightening fat loss.

In conclusion, the literature does not support the efficacy of training first thing in the morning on an empty stomach as a tactic to reduce body fat. At best, the net effect on fat loss associated with such an approach will be no better than training after meal consumption, and quite possibly it would produce inferior results. Moreover, given that training with depleted glycogen levels has been shown to increase proteolysis, the strategy has potential detrimental effects for those concerned with muscle strength and hypertrophy.

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