Exercise for weight loss: What are the facts?

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ABSTRACT

When combined with other lifestyle changes, exercise is important for the overall reduction of body weight and subsequent maintenance of weight loss. The perception about the role that exercise can play in energy expenditure has become exaggerated over time. This article focuses on three commonly held perceptions about exercise and weight loss: that exercise consumes a lot of energy, that "fat-burning" exercise is the most effective way to consume fat as a fuel, and that exercise will stimulate energy expenditure for hours after completing exercise. The pertinent literature is reviewed to illustrate that although exercise does increase energy output during and after exercise and can expend energy from fat for many overweight persons, excessive caloric expenditure has limited implications for substantially reducing body weight independent of nutritional modifications. This article includes recommendations for practicing dietitians and nutritionists to assist clients in initiating and maintaining an exercise program by considering clients' emotional and physical states regarding their excess weight when prescribing exercise, and by using intermittent exercise in an exercise prescription for very deconditioned clients.
J Am Diet Assoc. 1995; 95:1414-1417.

Dietitians and nutritionists recommend exercise, in addition to nutrition changes, to help overweight patients lose weight. This advice is consistent with recent recommendations by the National Institutes of Health (1) and the National Academy of Sciences (2). Over the years, recommendations regarding the intensity and duration of exercise needed to gain health benefits, including weight loss, have shifted from high-intensity, short-duration exercise to moderate-intensity exercise of longer duration. Recent joint recommendations by the American College of Sports Medicine and the Centers for Disease Control and Prevention recognize and support this shift to moderate-intensity exercise (3). Many health and fitness professionals have the perception that increasing caloric expenditure by 200 to 300 kcal/day, especially if it is from fat, is a desirable outcome from exercise and will result in substantial weight loss (4).

Through the media and infomercials, people are constantly bombarded with new ideas and products that are supposed to help them lose weight. How many times has a dietitian or nutritionist heard one of the following from a client: "Exercise will help burn off a lot of fat, right?"; "What kind of exercise will help burn only fat?"; or "Is it true that you keep burning calories for hours after you stop exercising?" These questions are common in fitness classes, weight-control programs, and even in the classes I teach for health and wellness majors. Where did these ideas about exercise originate?

At some time in our lives, most of us have probably played a game called "Telephone" in which a number of people are lined up and a short statement is whispered to the first person. The first person repeats it to the second person who repeats it to the third person and so on. By the time the message reaches the last person, it is often very different from the original. Something similar can happen to health and fitness information. For example, a study on excess caloric expenditure published in a journal states that "Groucho" running (ie, running while hold-

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ing one's body lower to the ground similar to the way the comedian Groucho Marx used to walk) will use more energy than running with a normal gait (5). A story about Groucho running is then published in the popular press. The report of this new style of running then proves interesting enough to warrant examination by a television news magazine such as *20/20* or *Dateline*. Capitalizing on the original idea, entrepreneurs sell a new product, the "Groucho Running Video," to the public. The original research that started the process has been used in unintended ways. This might actually have happened with Groucho running if the researchers had not reported that this type of running places unnecessary strain on the knees, making this form of exercise contraindicated. However, other misconceptions have developed over the role exercise can play in the energy expenditure of overweight persons.

The purpose of this article is to examine three questions about exercise and weight loss that are vulnerable to misconceptions: Can exercise effectively use a substantial amount of energy? Is "fat-burning" exercise more effective in using energy from fat? and Is a substantial amount of energy expended for hours after exercise? The answers to each of these questions will be reviewed using evidence from the literature. Finally, recommendations for practitioners regarding exercise and weight control will be presented.

HOW MUCH ENERGY DOES EXERCISE BURN?

The idea of examining the energy cost of various forms of human activity can be traced to Atwater's classic experiments with a human calorimeter about 100 years ago (6). Research on measurement of energy output has continued throughout this century. Tables and charts that give the oxygen consumption and caloric cost of many different activities from archery to writing have been developed from these experiments (6,7). The validity of using oxygen consumption as the basis of measuring energy expenditure is firmly established. Therefore, calculating the energy cost of an activity becomes a matter of keeping track of the time spent in the activity throughout the day, and then looking it up on a table. The largest errors in using this method are likely to arise from a failure to correctly determine the length of time spent in the activity or to correctly gauge the intensity of the activity. Generally, the calculated energy cost of any activity that takes less than an hour will be within 10% to 15% of the actual energy expended by the person (6).

The use of energy charts and tables to determine energy cost can increase the precision of estimating energy output. The common perception is that an average-weight person burns about 62 kcal/km (100 kcal/mile) whether he or she walks or runs. Actually, if a man weighing 81.8 kg (180 lb) walks at 4.83 km/hour (3 mph), he uses 60 kcal/km (96 kcal/mile); whereas if he jogs at 9.7 km/hour (6 mph), he uses 81 kcal/km (130 kcal/mile) (7). The estimated caloric expenditure is close to 100 kcal/mile, but the difference between walking and running can become meaningful over time if the person engages in the higher-intensity exercise consistently. The actual measurement of the energy cost of activities is possible but is impractical for the average person because of the expense of the equipment and staff involved. Energy expenditure tables provide a reasonable alternative to actual measurement.

Two assumptions are important in assessing whether exercise expends a substantial amount of energy. The first is the intensity and duration of exercise that an overweight person can actually perform. If the aforementioned 81.8 kg man walks at a rate of 4.83 km/hr for 45 minutes per day, he will expend about 220 kcal per session. However, that is a substantial quantity of work for an overweight person, especially if he or she has been sedentary. It also represents a considerable investment of time. If we consider that only 22% of all adults currently exercise at a level that will benefit their cardiovascular system, it is a leap of faith to believe the average person will *consistently* invest the time in moderate exercise (8). But for the sake of argument, let's assume that the person will invest that time in exercise.

- Walking at 4.83 kg/hr (3 mph) for 45 minutes:
  4.8 kcal/min expended × 45 min exercise duration= 216 kcal
  total caloric expenditure for the session
- Lying quietly in a recliner:
  1.8 kcal/min expended × 45 min exercise duration= 81 kcal
  The net is 135 kcal extra expended for 45 min of exercise.
- Sitting in a chair writing:
  2.4 kcal/min expended × 45 min exercise duration= 108 kcal
  The net is 108 kcal extra expended for 45 min of exercise.
- Cooking:
  3.7 kcal/min expended × 45 min exercise duration= 167 kcal
  The net is 49 kcal extra expended for 45 min of exercise.

FIG 1. Comparison of activities for net caloric expenditure. The following example was calculated from energy expenditure tables found in reference 7. The kilocalories expended were derived by multiplying the kilocalories per kilogram by the person's weight — in this case, an 81.8-kg (180-lb) woman — to arrive at the kilocalories per minute. The net is calculated by subtracting the total kilocalories expended in the activity from the kilocalories expended from exercise.

The second assumption — that the total energy expended during exercise can be added to the absolute daily energy output — is even more important. The error is in not recognizing that even if a person rests quietly, he or she will be using some energy. And chances are that he or she will be doing something other than resting, which further increases energy output but reduces the "net" used during exercise. Figure 1 gives the caloric cost of walking for 45 minutes at 4.83 km/hr (3 mph) for a woman who weighs 81.8 kg (180 lb). The energy cost of various activities is presented in such a way as to reveal the net kilocalories expended. As the Figure shows, the net kilocalories used, after considering other common activities this woman might be doing, is modest unless she were absolutely sedentary. Even if she were to walk at a faster pace for 45 minutes, at 5.63 km/hr (3.5 mph) she would use 243 kcal, and at 6.44 km/hr (4 mph) she would use 288 kcal.

IS FAT-BURNING EXERCISE THE BEST WAY TO BURN ENERGY FROM FAT?

The idea of fat-burning exercise developed from research into the differences in the relative contribution of fat and carbohydrate metabolism at exercise of varying intensities as determined using the respiratory exchange ratio. Exercise at the low range of moderate intensity, 50% Vo_2max (65% maximal heart rate), can yield a ratio of 0.85, at which equal amounts of carbohydrates and fats are used as fuel. If the intensity is raised to the high end of moderate intensity, 60% Vo_2max (75% maximal heart rate), the ratio will approximate 0.88, which yields about 60% carbohydrate and 40% fat use (7).

Scene 1
Low range of moderate-intensity exercise: 50% of maximal aerobic capacity (or about 65% maximal heart rate); the respiratory exchange ratio is about 0.85 and indicates that 50% carbohydrate and 50% fat is being used as fuel.

For an 81.8-kg (180-lb) woman, 45 min of walking at 20 min/mile (4.83 km/hr or 3 mph) expends 216 kcal=108 kcal carbohydrate+18 kcal fat

Scene 2
High range of moderate-intensity exercise: 60% of maximal aerobic capacity (or about 75% maximal heart rate); the respiratory exchange ratio is 0.88 and indicates 61% carbohydrate and 39% fat is being used as fuel.

For an 81.8-kg (180-lb) woman, 45 minutes of walking at 15 min/mile (6.45 km/hr or 4 mph) expends 288 kcal=176 kcal carbohydrate+112 kcal fat

FIG 2. Impact of intensity on fat-burning exercise (6,7). In scene 2, the woman uses more fat as a fuel by exercising a little more strenuously and her total energy expenditure is higher for the same investment of time.

Figure 2 provides an example of the difference in the total energy expenditure and the kilocalories used from fat and carbohydrates during 45 minutes of two levels of moderate-intensity exercise. The total number of kilocalories expended as well as the total number of kilocalories from fat is greater in the high end of moderate-intensity exercise. Additionally, total energy expenditure is greater in the high range of moderate-intensity exercise for the given time frame. To expend the equivalent number of total kilocalories, the low range of moderate exercise would have to continue for an additional 15 minutes. Although Figure 2 is generated from hypothetical data, numerous testing sessions comparing varying degrees of moderate-intensity exercise with overweight subjects in our Human Performance Laboratory confirm that the respiratory exchange ratio and energy expenditure presented are reasonable approximations of actual energy expenditure.

The high range of moderate-intensity exercise may not be possible for the typical sedentary overweight person until a baseline fitness level is established. When fitness levels are low, reduced intensity may be necessary. However, as fitness levels improve, the person can exercise at a slightly higher intensity and expend more overall energy.

The big factor in the fat-burning phenomenon is time. If total energy expenditure is the focus of exercise (and I am not suggesting it should be), then higher-intensity exercise is better, because even though it uses a lower percentage of fat, it expends more fat energy and more total energy. To my knowledge, no study has demonstrated that burning energy from fat is better than burning energy from glycogen to promote weight loss. As long as the person does not change his or her energy input, the fat will be used at some point in the day and it makes no difference whether it is during exercise or at 3 AM while the person is sleeping.

DOES A PERSON CONTINUE TO EXPEND MORE ENERGY AFTER EXERCISE?

The idea that we continue to expend energy hours after finishing exercise has been accepted for years because researchers have demonstrated that athletes who participate in prolonged, exhaustive exercise have elevated metabolic rates for more than 24 hours after completing the exercise. Over the past 10 years, excess postexercise oxygen consumption (EPOC) has been studied frequently using various intensities and modes of exercise.

Researchers have examined walking (9-11), running (11-14), cycling (15,16), and weight training (17,18) as modes of exercise at low (9,19), moderate (10,14), and high intensity levels (12,20). Some studies have used continuous exercise whereas others have used interval (10) or intermittent (12) exercise. To my knowledge, all studies to date have confirmed the existence of EPOC. The studies have demonstrated that the degree of EPOC is linearly related to exercise intensity up to about 80% Vo_2max and then it rises faster as exercise intensity increases.

In a recent review, Bahr (13) showed that the average energy cost of EPOC is 5 to 10 kcal after light exercise, 12.5 to 35 kcal after moderate exercise, and as high as 180 kcal after strenuous exhaustive exercise. Bahr concluded that the energy expended from EPOC as a result of light and moderate exercise is unlikely to have any real effect on energy balance or weight loss.

When considering the results for high-intensity exercise, the strenuous nature of the exercise necessary to stimulate excess energy consumption has to be considered. It is unlikely that overweight persons, especially if they have been sedentary, will be able to tolerate the intensity and duration of exercise necessary to achieve EPOC high enough to influence weight loss.

PRACTICE RECOMMENDATIONS

Dietitians and nutritionists can use the following recommendations to help their clients initiate and maintain an exercise program.

- Emphasize consistency first, then duration, intensity, and frequency. A person must exercise consistently to achieve a beneficial result, perhaps even before he or she attempts to lose weight (21). Before recommending an in-depth progressive exercise prescription, develop a minimal-level workout and recommend that the person develop a consistent pattern of exercise before attempting more intense exercise or increasing the duration. Ten minutes of exercise performed 4 days per week for 6 weeks may be more important than 6 weeks of 30 minutes sessions that vary between one to five times per week because the person is developing a consistent pattern of exercise. Several participants in programs I direct began by exercising just once a week for a few months. They developed a consistent pattern of activity and are now following more conventional exercising strategies. Although the physiologic benefits of this approach are limited initially, the goal is to maintain a lifetime of increased physical activity. A person who participates in a low-intensity, short-duration program does not incur the fatigue and soreness generally associated with initiating an exercise program. More importantly, it begins the exercise habit.
- Stress that intermittent exercise is acceptable if a person cannot perform 20 or even 10 minutes of continuous exercise; work intervals should be alternated with rest intervals. One approach is to prescribe 60 seconds of moderate-intensity aerobic work followed by 60 seconds of low-intensity aerobic work (not complete rest) until the person can exercise continuously. Breaking sessions into segments with easier work can double the total exercise time. This approach is based on the interval training techniques athletes have used for decades.
- Practice what you preach. I recently asked a group of dietitians and nutritionists how many exercise regularly according to the latest recommendations from the American

College of Sports Medicine and the Centers for Disease Control and Prevention (ie, 30 minutes or more of moderate-intensity exercise most days of the week) (3). Barely 25% did, which is about the national average (8). Dietitians will be able to speak more effectively and more convincingly about regular exercise if they perform it.

- Respect the overweight client because people become overweight for a variety of genetic, behavioral, psychological, and environmental reasons. Every person deserves our respect no matter what his or her body weight. The nurture dietitians provide is very likely what will help overweight clients overcome the nature of their condition. Maybe they will lose weight, maybe they will not. But they can be healthier if they eat a low-fat diet that follows the recommendations of the Food Guide Pyramid (22) and exercise regularly.
- Understand the clients' physicality. People who have been sedentary, especially if they are overweight, have to gain confidence in their ability to move their bodies. I have used the word "physicality" to describe this expression of physical being. As the clients become successful in their ability to move and exercise, their physicality improves and they are more likely to maintain the exercise program. Therefore, it is important that dietitians and nutritionists recommend fitness professionals and facilities that try to understand the emotional and physical needs of overweight people.

Respect the overweight client because people become overweight for a variety of genetic, behavioral, psychological, and environmental reasons; every person deserves our respect no matter what his or her body weight

SUMMARY

This article has demonstrated that exercise does indeed expend energy, does use fat as a fuel, and can continue to expend energy after a person stops exercising. Although each concept is undeniably true, the magnitude of the body's response, in terms of the total number of kilocalories expended, may have limited value in stimulating weight loss *independent* of nutritional and behavioral modifications. This is not to suggest that health professionals should recommend that overweight people need not exercise unless they make all lifestyle changes simultaneously. They absolutely should exercise, but the intent should not be just to "burn as much energy as possible to lose weight."

All people should exercise, but for the right reasons: to improve the cardiovascular system; to improve the strength, endurance, and flexibility of the muscular system; and to effect positive changes on other body systems such as the skeletal, digestive, and immune systems, and for other manifestations of improved health such as lower serum lipids and lower blood pressure (2). Although not as exciting as the fat-burning approach, the objective is to get people exercising and keep people exercising — not just to stimulate weight loss, but for the health of it!

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