

# Role of Physical Activity for Weight Loss and Weight Maintenance

Carla E. Cox

---

■ **IN BRIEF** This article reviews the impact of exercise on weight loss and weight maintenance and the possible reasons that weight loss outcomes resulting from exercise are not consistently realized.

---

**E**nergy balance is a process through which the body attempts to establish homeostasis. Most individuals spend much of their lives in the same weight range without daily focus on caloric intake and output. The two parts of the equation for weight maintenance are energy intake (eating and drinking) versus energy output (nonexercise thermogenesis + exercise). To achieve weight loss, the American Diabetes Association (ADA) (1), American Academy of Clinical Endocrinologists (AACE) (2), and National Academy of Nutrition and Dietetics (3) all recommend exercise as an integral part of any weight loss program. Physical activity and exercise are often used interchangeably. However, correctly defined, physical activity is all movement that creates energy expenditure, whereas exercise is planned, structured physical activity (1).

Research supports the importance of exercise in relationship to improved cardiovascular fitness, insulin sensitivity, glycemic control of type 2 diabetes, blood pressure, and depression scores (1), but does exercise itself contribute to weight loss and maintenance efforts?

The questions addressed in this article are: Does exercise in and of itself improve weight loss efforts outside of dietary restriction? Is there a

difference between aerobic training and resistance training in achieving weight loss or weight maintenance? What are the potential explanations for less weight loss than predicted with exercise? When weight loss is achieved through any weight loss intervention program, does exercise contribute to the maintenance of that weight loss?

## Does Exercise in and of Itself Improve Weight Loss Efforts?

Many outcomes data have been reported from research studies that have examined exercise alone, exercise plus dietary restriction, or dietary restriction alone to determine strategies for weight loss. The challenge over time is to accurately monitor both sides of the equation as individuals interact in their daily lives.

A systematic review of studies with a minimum of 1-year follow-up (4) suggested that subjects who used exercise alone for weight reduction experienced minimal weight loss. There are two questions that need clarification: 1) Does the drive for homeostasis require greater bouts of exercise than previously recommended to contribute to weight loss? 2) Do individuals compensate for exercise by either eating more or reducing their nonexercise activity thermogenesis?

---

Providence Medical Group/Endocrinology, Diabetes and Nutrition, Missoula, MT

Corresponding author: Carla E. Cox, [carla.cox@providence.org](mailto:carla.cox@providence.org)

<https://doi.org/10.2337/ds17-0013>

©2017 by the American Diabetes Association. Readers may use this article as long as the work is properly cited, the use is educational and not for profit, and the work is not altered. See <http://creativecommons.org/licenses/by-nc-nd/3.0> for details.

Thirty-six overweight participants were assigned to either exercise plus calorie restriction or calorie restriction alone to determine whether exercise enhanced weight loss efforts. The calorie deficit remained constant during the 6-month trial. Ten percent weight loss was achieved over 6 months in both interventions without a statistically significant difference in the percentage loss of body fat. However, the exercise group had the added benefit of improved aerobic fitness (5).

In a randomized, controlled trial of 52 obese men (BMI  $31.3 \pm 2.0$  kg/m<sup>2</sup>), Ross et al. (6) demonstrated a body weight decrease of 7.5 kg over 3 months in the exercise-only group (16 men) that was comparable to that of the calorie-restricted group. Duration of exercise was based on the goal of a daily 700-calorie energy expenditure (~60 min/day), suggesting that performing exercise greater than the minimum national recommendations for health of 150 min/week may be required to achieve clinically meaningful weight loss.

Donnelly et al. (7) demonstrated weight loss with exercise alone in a group of 141 overweight or obese (BMI 31 kg/m<sup>2</sup>) men and women in the Midwest Exercise Trial 2. Exercise was supervised for 10 months with an exercise calorie-equivalent reduction of either 400 or 600 calories 5 days per week and a completion rate of 65%. In the completion group, weight losses were  $3.9 \pm 4.9$  and  $5.2 \pm 5.6$  kg, respectively. This demonstrated a clinically significant weight loss for both men and women. However, the amount of activity to achieve this weight loss was again greater than the general exercise recommendations for health.

Weiss et al. (8) demonstrated not only effective weight loss (7% over 16.8 weeks) with exercise alone, but also preservation of lean body mass (LBM) and improvement of maximal oxygen consumption (VO<sub>2max</sub>) when compared to weight loss with a comparable energy deficit through

calorie restriction alone; the latter resulted in both a loss of LBM and a decrease in VO<sub>2max</sub>. In addition, as with other studies that have demonstrated weight loss with exercise, the amount of exercise was substantial at  $7.4 \pm 0.5$  hours/week.

Longer bouts of exercise have demonstrated a greater contribution to weight loss, both in controlled research trials and through self-reported information collected by the National Weight Control Registry (NWCR) (9–11). The NWCR has reported that 94% of individuals in the registry reported including exercise in their weight loss program (9); weight loss was greater in the group with the greatest physical activity, but this group also reported more dietary restraint (10), and only 1% of participants reported exercise alone for weight loss (11).

Most, but not all, study data indicate that exercise alone plays a very small role in weight loss. A joint position statement of the American College of Sports Medicine and the ADA (12) states that the “recommended levels of PA [physical activity] may help produce weight loss. However, up to 60 min/day may be required when relying on exercise alone for weight loss.”

The 2016 AACE and the American College of Endocrinology comprehensive clinical practice guidelines for medical care of patients with obesity (13) include an evidence recommendation for “aerobic training of  $\geq 150$  min/week of moderate intensity, with better outcomes with increasing amounts and intensity of exercise.”

### Is There a Difference Between Aerobic Training and Resistance Training or the Intensity of Activity in Achieving Weight Loss or Weight Maintenance?

Willis et al. (14) compared aerobic exercise (calorie equivalent to 12 miles/week), resistance exercise (3 days/week), and a combination of the two to determine changes in body mass with a consistent program of exercise

and without alternations in reported energy intake in a group of individuals who were previously sedentary and without diabetes (BMI 25–35 kg/m<sup>2</sup>). Weight loss and fat mass reduction occurred with aerobic training to a more significant degree than with resistance training after the 8-month trial (1.76 vs. 0.83 kg for the aerobic and resistance groups, respectively). Adding resistance training did not enhance the change in total body mass compared to aerobic training alone. Over the 8-month study period, there was minimum weight change, suggesting the need for greater energy expenditure to contribute to major weight loss.

Exercise regimens of varying intensities and durations were added to a calorie- and fat-restricted food plan in a randomized, controlled trial by Jakicic et al. (15). Although not statistically significant, an absolute difference in weight loss of 1.7 kg was achieved with more vigorous and higher-duration exercise at 12 months.

### What Are Potential Explanations for Less Weight Loss Than Predicted From Exercise?

The amount of weight loss predicted based on calculated energy expenditure often does not reflect the actual weight lost during research trials. Possible explanations include physiological compensation (less nonexercise activity) and limited control of food intake day by day for the duration of the trial, with the potential for compensatory food intake.

Thomas et al. (16) suggested in their review of 15 studies that the small amount of weight loss observed is the result of a combination of the low level of prescribed exercise and a subsequent increase in calorie intake.

A recent meta-analysis of 51 trials (17) suggested that in the short term, energy intake does not compensate for energy expenditure. Two to 14 hours after exercise bouts of 30–120 min at 36–81% VO<sub>2max</sub>, the

difference in absolute energy intake between exercise and control groups was small; however, a reduction in relative energy intake of >119 calories was noted in 25 of 29 studies within the 51 trials.

Blundell et al. (18) suggested a considerable individual variability with regard to exercise and appetite/food intake. Influences on intake include fat and fat-free mass, resting metabolic rate, and hormonal responses, which vary from person to person, making the individual response to exercise and weight loss difficult to predict.

The article by Caudwell et al. (19) is in agreement with this assessment. These researchers developed an approach to assessing adaptive regulatory biological systems to determine the impact of physical activity on appetite and its contribution in turn to the impact on weight. There appeared to be a large difference in individual responses to physical activity. Neither nonexercise activity nor resting metabolic rate changed significantly. Nonresponders to weight loss strategies demonstrated a much greater degree of hunger and subsequent food intake, which was sufficient in quantity to explain the weight differences.

Research findings suggest that there are responders and nonresponders to exercise as a weight loss tool. Energy intake compensation over the long term may partly explain this variability.

### **When Weight Loss Is Achieved, Does Exercise Contribute to the Maintenance of That Weight Loss?**

Physical activity may be an important component of weight maintenance after weight loss. An excellent study that measured total energy expenditure with the doubly labeled water method suggested that physical activity in the range of 11–12 kcal/kg/day (900 calories/day for an 81-kg woman) may be important to prevent weight regain (20). In the NWCR, 90%

of participants reported exercise to achieve long-term weight loss maintenance, with an average 383-calorie energy expenditure 7 days/week (21). In addition, a systematic review of the literature by Fogelholm and Kukkonen-Harjula (22) suggested that an increase in energy expenditure of 1,500–2,000 calories/week is associated with weight maintenance. In a 33-year follow-up study, men who maintained activity >150 min/week gained 5.6 kg compared to 9.1 kg in less active men, with an even more significant trend (3.8 vs. 9.5 kg) among women (23).

Tate et al. (24) reported that, in a 30-month study of 202 overweight adults, those whose exercise expenditure was >2,500 calories/week had less than half the weight regain of those whose exercise expenditure was <2,500 calories/week (2.9 vs. >6 kg).

There is also evidence to support the notion that individuals who are less physically active are more likely to gain weight over time than those who exercise between 150 and 300 min/week (25).

Recent research based on the NWCR showed that both high- and low-exercise groups were able to maintain weight loss for 3 years. This suggests that there is a great deal of variability in individual responses to the ability to maintain weight loss over time (10).

### **Strategies to Promote Physical Activity in Practice**

Although exercise contributes to multiple health benefits, and most of the research suggests that it can play a role in both short- and long-term weight loss and weight maintenance, patients often have a difficult time engaging in a regular exercise program and continuing that program as a lifestyle modification. Thirty-six percent of people >18 years of age with diabetes reported no physical activity in the previous 30 days (26). Only 30% of patients are counseled about exercise during an appointment with their primary care physician (27).

Starting with the first encounter, physicians and other health professionals should engage patients in a discussion of the importance of daily exercise, which may promote weight loss in overweight people, but also reduce weight gain over time, contributing to overall health.

A recent article addressing strategies for promoting physical activity in clinical practice (28) provided excellent suggestions for engaging patients in physical activity. These include lifestyle modification suggestions such as getting up out of a chair and walking for 2 min every 30–60 min, connecting patients with physical activity professionals to create individualized programs that work for them, using mobile technology applications, and creating a “Walk with a Doc” program in the local community.

### **Conclusion**

The evidence that exercise contributes significantly to weight loss and weight maintenance is not firmly established. It is important to recognize the challenge of monitoring dietary intake and exercise intensity and duration over the long term. Overreporting of actual exercise and underreporting of food intake by individuals could be a contributing factor to the mixed results found to date. In addition, individual differences may play a role (responders vs. nonresponders). Variability in sex, BMI, exercise intensity and duration, and type of exercise in research studies make conclusive recommendations more difficult. Minimal research has been focused specifically on the weight loss effects of exercise alone in individuals with type 2 diabetes, who may have a different response to exercise than the population without diabetes.

Consistently performing exercise of a duration greater than the basic recommendations for health (150 min/week of moderate-intensity exercise) does appear to be more likely to contribute to weight loss and weight maintenance efforts over the long term.

Physical activity of all types, including aerobic, resistance, flexibility exercises, and reduced sedentary time clearly results in multiple health benefits for individuals with type 2 diabetes and should be included in any lifestyle recommendations for individuals with diabetes (1). Encouraging individuals to exercise for longer periods of time each day may help to enhance weight loss. However, it is challenging for some patients to consistently achieve even small bouts of exercise daily. In counseling patients, it is important not to focus on the potential for weight loss as the sole outcome from exercise, but rather to suggest that exercise may contribute to weight loss efforts and does result in a myriad of other health-related benefits. This focus will reduce the likelihood of patients using the lack of weight loss as a reason to discontinue their exercise program.

### Duality of Interest

No potential conflicts of interest relevant to this article were reported.

### References

1. Colberg SR, Sigal RJ, Yardley JE, et al. Physical activity/exercise and diabetes: a position statement of the American Diabetes Association. *Diabetes Care* 2016;39:2065–2079
2. Handelman Y, Bloomgarden Z, Grunberger G, et al. American Association of Clinical Endocrinologists and American College of Endocrinology clinical practice guidelines for developing a diabetes mellitus comprehensive care plan—2015. *Endocr Pract* 2015;21(Suppl. 1):1–87
3. Seagle HM, Strain GW, Makris A, Reeves RS; American Dietetic Association. Position of the American Dietetic Association: weight management. *J Am Diet Assoc* 2009;109:330–346
4. Franz MJ, VanWormer JJ, Crain L, et al. Weight-loss outcomes: a systematic review and Meta-analysis of weight-loss clinical trials with a minimum 1-year follow-up. *J Am Diet Assoc* 2007;107:1755–1767

5. Redman L, Heilbronn L, Martin C, et al. Effects of calorie restriction with or without exercise on body composition and fat distribution. *J Clin Endocrinol Metab* 2007;92:865–872
6. Ross R, Dagnon D, Jones P, et al. Reduction in obesity and related comorbid conditions after diet-induced weight loss or exercise-induced weight loss in men. *Ann Intern Med* 2000;133:92–103
7. Donnelly JE, Honas JJ, Smith BK, et al. Aerobic exercise alone results in clinically significant weight loss for men and women: Midwest Exercise Trial 2. *Obesity* 2013;21:E219–E228
8. Weiss E, Jordan R, Frese E, et al. Effects of weight loss and lean mass, strength, bone and aerobic capacity. *Med Sci Sports Exerc* 2017;49:206–217
9. National Weight Control Registry. NWCR facts [Internet]. Available from <http://nwcr.ws/research/default.htm>. Accessed 30 December 2016
10. Ogden L, Phelan S, Thomas J, Hill J, Wing R, Wyatt H. Dietary habits and weight maintenance success in high vs low exercisers in the National Weight Control Registry. *J Phys Act Health* 2014;11:1540–1548
11. Wing R, Phelan S. Long-term weight loss maintenance. *Am J Clin Nutr* 2005;82(Suppl.):222S–225S
12. Colberg SR, Sigal RJ, Fernhall B, et al. Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association joint position statement. *Diabetes Care* 2010;33:e147–e167
13. Garvey WT, Mechanick JI, Brett EM, et al. AACE/ACE comprehensive clinical practice guidelines for medical care of patients with obesity. *Endocr Pract* 2016;22(Suppl. 3):1–203
14. Willis L, Slentz C, Bateman L, et al. Effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. *J Appl Physiol* 2012;113:1831–1837
15. Jakicic J, Marcus B, Gallagher K, Napolitano M, Lang W. Effect of exercise duration and intensity on weight loss in overweight sedentary women. *JAMA* 2003;290:1323–1330
16. Thomas DM, Bouchard C, Church T, et al. Why do individuals not lose more weight from an exercise intervention at a defined dose? An energy balance analysis. *Obes Rev* 2012;13:835–847
17. Schubert MM, Desbrow B, Sabapathy S, Leveritt M. Acute exercise and subsequent

energy intake: a meta-analysis. *Appetite* 2013;63:92–104

18. Blundell JE, Gibbons C, Caudwell P, Finlayson G, Hopkins M. Appetite control and energy balance: impact of exercise. *Obes Rev* 2015;16(Suppl. 1):67–76
19. Caudwell P, Gibbons C, Hopkins M, et al. The influence of physical activity on appetite control: an experimental system to understand the relationship between exercise-induced energy expenditure and energy intake. *Proc Nutr Soc* 2011;70:171–180
20. Schoeller D, Shay K, Kushner R. How much physical activity is needed to minimize weight gain in previously obese women? *Am J Clin Nutr* 1997;66:551–556
21. Klem M, Wing R, McGuire M, et al. A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *Am J Clin Nutr* 1997;66:239–246
22. Fogelholm M, Kukkonen-Harjula K. Does physical activity prevent weight gain: a systematic review. *Obes Rev* 2000;1:95–111
23. Moholdt T, Wisloff U, Lydersen S, Nauman J. Current physical activity guidelines for health are insufficient to mitigate long-term weight gain: more data in the fitness versus fatness debate (the HUNT study, Norway). *Br J Sports Med* 2014;48:1489–1496
24. Tate D, Jeffery R, Sherwood N, Wing R. Long-term weight losses associated with prescription of higher physical activity goals: are higher levels of physical activity protective against weight regain? *Am J Clin Nutr* 2007;85:954–959
25. Swift D, Johannsen N, Lavie C, Earnest C, Church T. The role of exercise and physical activity in weight loss and maintenance. *Prog Cardiovasc Dis* 2014;56:441–447
26. Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System. Age-adjusted percentage of adults aged 18 years or older with diagnosed diabetes who were physically inactive, United States, 1994–2010 [Internet]. Available from <https://www.cdc.gov/diabetes/statistics/comp/fig9.htm>. Accessed 30 December 2016
27. Barnes PM, Schoenborn CA. Trends in adults receiving a recommendation or other physical activity from a physician or other health professional (NCHS Data Brief 2012:86) [Internet]. Available from <https://www.cdc.gov/nchs/data/databriefs/db86.pdf>. Accessed 29 December 2016
28. Sallis R, Franklin B, Joy L, Ross R, Sabgir D, Stone J. Strategies for promoting physical activity in clinical practice. *Prog Cardiovasc Dis* 2015;57:375–386