

In last week's issue of Weightology Weekly, [I told you how energy expenditure decreases with weight loss](#). I also told you how the decrease is greater than what you would expect based on the weight loss alone. In other words, the decrease in energy expenditure is not just due to the fact you have less weight to move around. It's also due to an overall decrease in activity, as well as an increase in efficiency (you burn less calories for the same movement). There is also a decrease in your metabolic rate, but it's not nearly as impactful on your energy expenditure as the decrease in activity.

In that article, I also mentioned how previous research has shown that the decrease in energy expenditure is related to the amount of weight that is subsequently regained. [Another study out of Wake Forest University supports these findings](#).

The Study

In this study, 41 women were randomly assigned to one of three groups:

- Diet Only
- Diet + Low Intensity Exercise
- Diet + High Intensity Exercise

Each intervention was designed to produce a 400 calorie per day energy deficit. In the diet group, this deficit came purely from a decrease in food intake. In the other groups, the deficit came from a combination of a decrease in food intake and exercise. Most of the food was provided for the subjects, and the subjects met weekly with a dietitian to verify compliance with the diet. The exercise involved 55-minute treadmill sessions for the low-intensity group and 30 minute treadmill sessions for the high-intensity group; exercise was performed 3 days per week. The intervention lasted 20 weeks. Body composition, resting metabolic rate (RMR), and self-reported physical activity were recorded before and after the intervention. Also, energy expenditure from physical activity was estimated before the intervention, as well as during the final week of the intervention, using a *triaxial accelerometer* (a device that measures up-and-down, forward-and-backward, and side-to-side movement). The accelerometer was about the size of a pager and was worn by clipping to the waist. Subjects were instructed to maintain their regular physical activity and to wear the monitor at all times for 5-7 days, except for while bathing or sleeping. They wore the monitor an average of 6.5 days during the baseline measurement, and 5.6 days at the end of the intervention. During the last week, the exercising women did 3 exercise sessions; the energy expenditure from these sessions was estimated from readings provided by the treadmill, and were subtracted from each woman's individual physical activity energy expenditure as determined by the accelerometer. Thus, physical activity energy expenditure in this study

represented only calories burned outside of the scheduled exercise sessions.

Of the 41 women, 34 returned for follow-up visits at 6 and 12 months. Weight was determined at these follow-up visits. The researchers then looked to see if there were any relationships between changes in physical activity energy expenditure and RMR during the 20-week intervention, and subsequent weight regain at 6 and 12 months.

Regain Results

Decreases in body weight, and improvements in body composition, were similar among all the groups during the 20-week intervention. RMR and physical activity energy expenditure also decreased in all the groups over the 20 weeks. RMR decreased on average by 7% or 108 calories per day. 27 of the 34 women experienced a decrease in RMR; the changes were quite variable, ranging from a decrease of 346 calories to an increase of 180 calories per day. However, RMR relative to lean mass remained unchanged, indicating that the drop in RMR was mostly due to a drop in body weight.

Physical activity energy expenditure decreased by an average of 26% or 162 calories per day. The change was quite variable, ranging from a decrease of 553 calories to an increase of 117 calories per day. 31 of the 34 women experienced a decrease in physical activity energy expenditure. Physical activity relative to body weight also decreased, indicating that the decrease in energy expenditure was not just due to weight loss; it was due to a decrease in overall movement.

Among all the women, the average weight regain at 6 months was 6.4 pounds. Again, regain was variable, ranging from a loss of 6.8 pounds to a gain of 20 pounds. 26 of the 34 women regained at least some weight. A total of 31.5% of the weight lost during the intervention was regained by 6 months. At 12 months, the average weight regain was 11.4 pounds, ranging from a loss of 5 pounds to a regain of nearly 48 pounds. 28 of the 34 women regained some weight at 12 months. On average, 51.4% of the weight was regained. The amount of weight regained at 6 and 12 months was not related to the amount of weight lost.

Weight regain at the end of 6 months was inversely related to changes in physical activity energy expenditure, with a correlation of -0.52 (where 1 is a perfect correlation and 0 means no correlation). Weight regain at the end of 12 months was also related to changes in physical activity energy expenditure, although less so (a correlation of -0.40). These results indicated that women who had the greatest decreases in physical activity after 20 weeks of weight loss tended to have the greatest amount of weight regained at 6 and 12 months after the weight loss program. Similar results were observed when physical activity was corrected

for body weight. Weight regain was not related to decreases in RMR or self-reported changes in self-reported physical activity.

Activity Throughout the Day Keeps the Regain Away

This study showed two things. First, it showed that physical activity, outside of a structured exercise program, decreases with weight loss, and this decrease is greater than what can be explained by the weight loss alone. This is in agreement with [the study I talked about last week](#). Second, it showed that the decrease in physical activity predicted the amount of weight regained over 6 and 12 months. This is also in agreement with [previous research](#).

One particular strength of this study is that the researchers measured physical activity before the weight was regained. They also showed that physical activity predicted weight regain, even when corrected for body weight. Thus, one cannot claim that people were less active simply because they weighed more. Another strength is that the researchers measured physical activity outside of the structured exercise program. Thus, the decrease in activity came from a decrease in non-exercise activity thermogenesis (NEAT, which includes all your non-exercise activity throughout the day). This is in agreement with [the study I discussed last week](#). This study also demonstrates that decreases in RMR play very little role in the tendency to regain weight, which is in agreement with [previous research](#).

One limitation of this study is that accelerometers were used to determine activity energy expenditure, rather than doubly labeled water. Thus, the energy expenditure estimates should be considered very rough estimates. Nevertheless, the study is in agreement with other studies that have used other methods for determining energy expenditure, and it is clear that there is a decrease in overall movement that cannot be explained by weight loss alone.

Another limitation is that this study cannot show cause and effect. Just because the decreased activity predicted weight regain, doesn't mean it caused the weight regain. However, randomized controlled trials have demonstrated that [when you prescribe higher levels of physical activity to people, they are much more successful at maintaining weight loss](#). What most likely happens is that, after people have lost weight, they start to experience "creep" in their overall caloric intake. Because physical activity decreases with weight loss, this creep can lead to weight regain as activity is abnormally low. Higher physical activity levels provide a buffer for this creep in caloric intake. Remember, we're talking about overall physical activity here...not just structured exercise.

Pedometer Plug

Studies such as this one are a big reason why I am a fan of simple pedometers for helping maintain long-term weight loss. Because [walking at only 1 mph will double your energy expenditure over sitting](#), accumulating walking activity throughout the day can go a long way into helping you keep your NEAT levels elevated after weight loss. It will give you the feedback you need to know if you're having a tendency to move around less during the day. However, not all pedometers are created equal, and some can be very inaccurate. [Click here to learn about the accuracy of a couple models of Omron pedometers.](#)

REFERENCE: [Wang, X., et al. Weight regain is related to decreases in physical activity during weight loss. *Med. Sci. Sports Exerc.* 40\(10\):1781-1788, 2008.](#)

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