CEC ARTICLE 2, 2010: After Workout Metabolisms and Exercise Differences for Women.

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Recent studies and information have come forth on how long and how much the metabolism is raised after an intense workout. The information is helping people understand that calories burned from exercise do not occur just during an exercise session, but can continue anywhere from hours to days after the session. The calories burned after an exercise session is based on what your body must do to replenish its exercise stores and repair and return the body to its pre-exercise state.

The calories are needed to:

1. Replenish the glycogen stores in the muscles and liver.
2. Replenish the oxygen stores.
3. Replenish the ATP and CP stores.
4. Remove lactate and lactic acid.
5. Repair muscle tissue.
6. Return your oxygen uptake to normal.
7. Return your blood circulation to normal.
8. Return your body temperature to normal.
9. Produce the exercise-induced hormones.

The muscle repair can have the greatest impact because the proteins the body must synthesize to repair and rebuild require significant energy. This is another reason that muscle has 30x the metabolic rate as fat. To build the muscle and maintain it with the increase workload requires a significant amount of energy. This is another reason strength training must be included with cardiovascular workouts for effective weight loss.

The fact is that the amount of calories burned after a workout is directly related to the intensity, duration and type of workout performed. This is another reason to dismiss the “fat-burning” myth of staying at a low intensity to burn more fat. It burns less calories and less fat both during the exercise session and far less after the exercise session because very little repair needs to be done.

The body will continue to burn calories at a higher rate after the exercise bout even if you are not moving. Your internal chemical and enzymatic processes work to return your body glycogen, ATP, CP and oxygen stores and muscle tissue state to its pre-exercise state. There is now a significant amount of research on incorporating and utilizing post-exercise calorie burn for weight loss goal.

Aerobic exercise has two components to consider to maximize the after burn calories, intensity and duration. If the intensity level is the same than the longer one exercises, the higher calorie consumption after exercise.

For a test group where the intensity was set:

20 min Aerobic workout After workout 55.5 calories extra

40 min Aerobic workout	After workout 73.5 calories extra
60 min Aerobic workout	After workout 159.5 calories extra

Notice the non-linear result of this test. The initial start-up has a cost because the body is not at a steady state and the Krebs cycle must become activated, blood flow must increase, heart rate increases, oxygen consumption and uptake must increase. Remember is takes the body 15-20 min to reach steady state. Then as the body continues and depletes its stores and tears down the muscle, the after workout calorie expenditure increases faster than the amount of time spent exercising.

Also if you workout at a higher intensity the amount of after workout calorie expenditure increases and the time spent at the higher level increases. For high intensity aerobic workouts the duration the body may be using after workout calories could be 10 hours. Moderate intensity workouts may be using after workout calories for only 3 hours. Low intensity workouts may be using after workout calories for only 20 minutes.

The following test was done where the duration was varied so the same number of calories were burned, but at different intensity levels.

Intensity level	**Total exercise calories**	**After workout calories**
Low	500	24
High	500	45

The next component examined involved interval versus continuous training.

-Continuous aerobics at 70% VO2 max for 30 min. required 34.5 calories after the workout.
-20 1 min intervals at 105% VO2 max required 75 calories (more then double the calories) after the workout.

Also in another study the intensity (% VO2 max) was held the same, but 1 group did 50 min straight and the other did two 25 min session. Again the amount of post exercise calories was double for the group doing 2 25 min session. Remember what we said about the warm-up or phase to bring the body to steady state. It takes 15-20 min. For the intermittent group of intervals less where the intervals are less than 30 min., subjects are just reaching their steady state when then stop and return to rest. For calorie consumption the levels are higher, but for blood sugar, cholesterol, blood pressure gains, but body needs the extended steady state.

As mentioned earlier, resistance or strength training will have the greatest effect on the after exercise calorie expenditure. Heavy resistance training can keep the body using after exercise calories for up to 72 hours. Three different activities where tested to examine the after exercise calories.

Cycling	after exercise calories 33.5
Circuit Training	after exercise calorie 51

Heavy Resistance Training after exercise calories 53

So, heavy resistance with muscular endurance intervals for an hour or more should probably produce the greatest during and after exercise calorie expenditure. For weight loss, this is what the general trends would show. Not long durations in the "fat burning zone". Also remember that other benefits come from the long duration sustained aerobic activities that are not related to weight loss. Blood pressure decreases, aerobic capacity increases, blood sugar utilization, resting heart rate decreases, and improvement of the Krebs cycle function must be done with sustained intensity aerobic workouts. Also interval training needs to be done after an aerobic base building period so the heart can handle it. These studies are all performed on athletes.

There also seems to be a difference between women and men. For the same 30-minute high intensity bout the men in the study burned 140.5 after exercise calories and the women 121.5 after exercise calories. Unfortunately, this study as well as the others did not look at calories burned per lb of body weight, but only averages for the test subjects. Women in general weight less than men and since metabolism is based on weight and size, the studies did not look at all of the relevant data to provide concrete numbers. Then could only show trends.

This incomplete look as exercise science has plagued the biology world forever. The same standards for tests for examining trends in engineering have rarely been applied to medical, biological fields. The biggest area of neglect has been in comparing data on male and female test subjects and athlete versus sedentary subjects. Athletic male test subjects are more readily available for exercise testing, but then differences due to body weight, body composition, Krebs cycle efficiency, pre-test fitness level, and hormones cannot be evaluated correctly.

Recently, some alarming results came out when athletic female test subjects were included in exercise science testing. The first test was done with male cyclists only. The subjects performed intense intervals until all of the glycogen stores in their legs was depleted. ½ the group was feed carbohydrates only and ½ a combination of carbohydrates and protein. The next morning the test was repeated. No significant difference was seen in the two groups. After two days the subjects were tested again to depletion of glycogen stores. Those who had the protein with the carbohydrates performed an average of 4% better than those who had carbohydrates only. Similar results had been found in other research tests.

The results of the research were to state that protein seemed to aid in the uptake of the carbohydrates from the blood therefore helping the muscles restore more fuel. The protein also aids in the repair of the damaged muscle tissue helping return to its pre-exercise state but it can take 48 hours. For performance athletes, this was in-line with the protein carbohydrate performance combinations and well as the rest and repair theories.

Then by request of the female athletes, the test was repeated with female cyclists.

The results were very different. The protein showed no affect on the test group and those that had the protein said their legs felt more tired and sore.

In a subsequent test, the women were tested for creatine kinase in their blood during the intense intervals. Less of the creatine kinase was found in the female athletes. This implied that the women had less damage to the muscle tissue during the intervals. Therefore the women did not need as much protein to repair the tissue as the men so the protein had less of an effect.

These two studies combined with another study on carbohydrate loading with men and women show that science does not understand how hormones can affect metabolism. That studied showed that women did not store as much carbohydrates (glycogen) in their muscle tissues as men even if then increased calories and the percent of carbohydrates, they only loaded ½ the amount of extra glycogen as their male counter parts.

New studies are finally revealing that estrogen can strongly affect metabolism and muscle health. Some studies with postmenopausal women show that those on estrogen replacement have healthier muscles. This was supported by a study where male athletes were given estrogen and their metabolism during exercise examined.

The male athletes metabolism during exercise changed and became more like a females. Under strenuous exercise the men burned more fat and a smaller amount of protein and glycogen, which mimicked the results found in female athletes.

As an aside, research in polycystic ovarian syndrome shows results supporting the lack of knowledge. These women have cysts in their ovaries, thyroid, pituitary and possible other gland regulating hormone levels. Some of the side affects are hair loss like men, facial/body hair like men, inability to have children, and obesity. What they are also finding out is that they have trouble metabolizing and using carbohydrates so they treat it with thyroid and diabetic medicine to control the blood sugar and weight gain. There is no cure for this disease and little is know on its full affect on metabolism, muscle health, and ability to exercise.

In conclusion, we can learn to look at research with a critical eye and be aware of jumping to conclusions. Also, we need to keep up on the new studies that replace old information, or add to it and clarify the boundaries of the information.

The example shows here is that the following time line of knowledge:

- Research showed that at lower intensities the body burns a higher percentage of fat for the total calories for fuel. People jumped on staying at a low intensity to burn fat and lose weight.

- Research showed that at higher levels of intensity people burned more total calories and more fat calories in the same time period than working at a

lower intensity. People needed to work out longer and harder to lose weight.

- Research showed that at lower intensities the body burns a higher percentage of fat for the total calories for fuel. Problem, people jumped on staying at a low intensity to burn fat.

- Research showed that interval training burned more calories than sustained aerobic. People did intervals without building up their aerobic capacity and ability to perform intervals and more injuries occurred and people did not see reductions in blood pressure, heart rate, sugar utilization…

- Research showed that muscle building increases your metabolism and that muscle has 30x the metabolic rate as fat. People thought that you can lose weight with weight training only and people did not see increase endurance, aerobic capacity reductions in blood pressure, heart rate, sugar utilization…

- Research showed that after exercise calories expended to repair the body can be significant and cardio intervals of 20 min, anaerobic 1 min. intervals done successively for 30 or more min., aerobics endurance of greater than 1 hour, or heavy resistance training gave the greatest after exercise calorie consumption. Finally, we need to do it all in a balance way to get the benefits for not only weight loss. (Isn't that actually where we started out. 3-5 day aerobics, 2 days strength training a week with cross-training and periodization to keep from plateauing and get the other health benefits.)

- Research shows that women's metabolism is not the same as men both during exercise and after exercise and more research is needed. (Obviously)

Logic, common sense, and balance always win. Nothing is ever simple and their isn't one "fix" that works for everyone.

CEC ARTICLE QUESTIONS VOL 2, 2010 (3 CEC's)

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1. What constitutes the calories burned from an exercise session?

2. What are the calories burned after exercise needed for? List 9

3. What post exercise need for calories has the greatest impact on calories burned after exercise and why?

4. What are the 3 components of an exercise session that affect the amount of calories required in post exercise recovery?

5. What are the 4 stores the body must recovery with calories after exercise?

6. What are the 2 components of aerobic activity that affect after exercise calorie utilization?

7. How does the initial exercise phase differ from the steady state phase as far as after exercise calorie utilization?

8. How do intermittent interval less than 30 min. in duration affect after exercise calorie utilization compared to steady-state for greater than 30 min.?

9. How does intensity level even though the same number of calories during exercise were burned affect after exercise calorie utilization?

10. How does strength training versus aerobic training affect after exercise calorie utilization?

11. How does strength training or intervals versus aerobic training affect blood pressure, resting heart rate, blood sugar utilization, aerobic capacity and cholesterol?

12. What were the initial conclusions about being male versus female on after exercise calorie utilization and what were they missing in their conclusion?

13. What difference was found between men and women on the effect of protein in recovery between exercise sessions?

14. What difference was found between men and women on the effect of carbohydrate loading?

15. What difference was found between men and women on muscle tissue breakdown during exercise?

16. What difference was found between men and women on metabolism during exercise and its relationship to estrogen?

17. What disease in women could be related to hormone relationship to metabolism and what are its difficulties for those who have it?

18. Why is the “fat burning zone” correct and not correct and how has it been misused for weight loss?

19. What would be the proper programming for weight loss and health benefits looking at physical fitness, metabolism, health, weight loss, and safety? Ie aerobic versus strength training combination?

20. What did we learn about research and how to use it for our patrons?