THE CrossFit JOURNAL

By the Numbers

Members of Flatirons CrossFit set out to get hard data about the effects of the Paleo Diet and CrossFit workouts. Amy Santamaria and Tim Retzik report their findings.

By Amy Santamaria and Tim Retzik Flatirons CrossFit **September 2010**

Courtesy of Flatirons CrossFit

As more members of the CrossFit community adopt a Paleo Diet, there is a great need for data quantifying the benefits of such a diet. We hear plenty of anecdotal evidence for Paleo-related improvements, including weight loss and leaner body composition, improvements in cholesterol and other blood markers, increased strength and metabolic conditioning, reduced pain and improved immune response, and better energy and mood.

But how reliable are these unsubstantiated claims? Those recommending a switch to Paleo need a foundation of results and critical evaluation.

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The Study

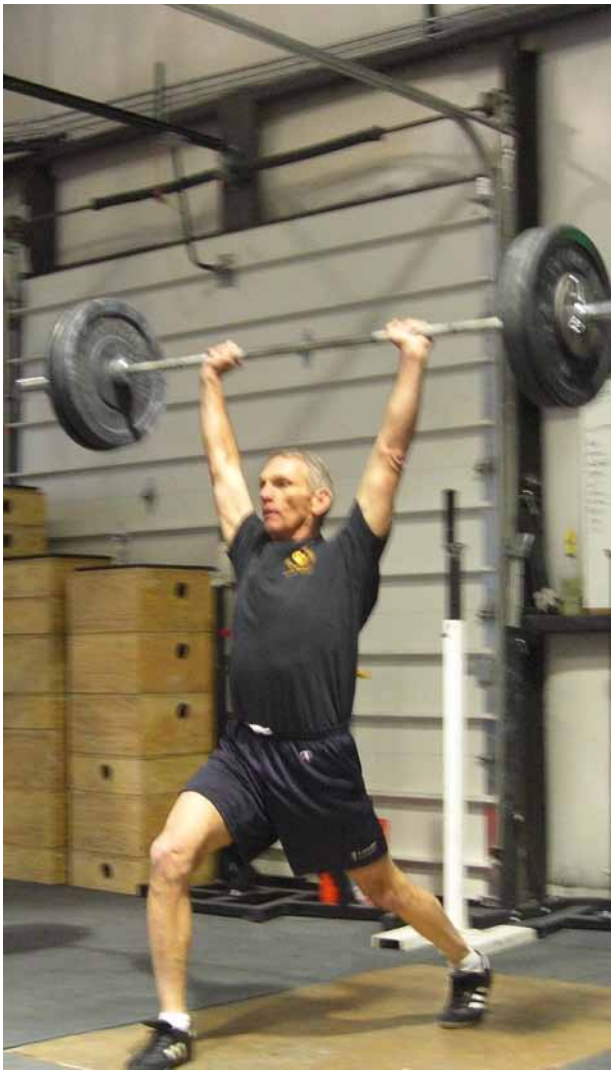
To encourage their members to try out the Paleo Diet, many CrossFit affiliates are embarking on Paleo "challenges," often with a competitive element to help with motivation. At our affiliate, Flatirons CrossFit, we tried that, but only a few people stuck with the diet long-term, so the second time around we tried a different approach. We decided to embark on a Paleo study rather than a challenge. There was no competitive element; rather, affiliate members agreed to participate in a scientific investigation following the standard guidelines for experimentation with human participants. This meant that they committed to participating, filled out consent forms, followed an experimental protocol, provided data at regular intervals, and participated in an interview and debriefing at the end of the study.

We chose to do a study rather than a challenge for several reasons:

1. To add to the body of data evaluating the effects of a Paleo Diet.
2. To provide a template/example for other affiliates wishing to add to the body of data.
3. To encourage our members to try Paleo in a non-competitive, supportive context and judge the results for themselves.

Participants agreed to eat a Paleo-Zone diet for eight weeks. The Paleo Diet is based on the diet of our human ancestors from the Paleolithic era. The modern interpretation of Paleolithic nutrition includes meat, vegetables, fruit, seeds and nuts. It omits all grains, dairy, refined sugar, soy, and starches like potatoes and legumes. The Zone part (see *Enter the Zone* by Dr. Barry Sears) refers to portion sizes and macronutrient ratios. The Zone ratio is 30 percent protein, 40 percent carbohydrates, and 30 percent fat. The Zone Diet uses "blocks," which refer to certain benchmark portion sizes to save you from doing calculations all the time. Paleo-Zone simply refers to a diet based on Paleo foods with Zone portions/ratios.

In addition, participants agreed to track their compliance and several other factors in a daily log, train regularly, get body-composition measures taken every two weeks throughout the study, and get performance measures and blood work (a lipid profile) taken at the beginning and the end of the study.



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Many people think a Paleo Diet improves performance, but the authors wanted to bolster anecdotal claims with hard numbers.

We hypothesized that:

1. Cholesterol and triglyceride measures would improve, particularly for participants outside the normal range.
2. Strength and metabolic-conditioning performance would improve on average.
3. Subjective wellness measures (energy and affect) would improve throughout the study.
4. Body composition would improve (weight loss and lowered body-fat percentage).

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Members of Flatirons CrossFit volunteered for a non-competitive eight-week study in which their athletic performance and their body composition and blood profile would be evaluated.

Participants

All participants were members of our affiliate who volunteered for the study. The sample we chose certainly shows a self-selection bias: motivation, dedication and health, and fitness levels of CrossFitters are likely higher than in the general population. Furthermore, this was a subset of CrossFitters who were motivated and dedicated enough to change up their diet for eight weeks and make a number of study-related commitments.

Recruitment

Participants were recruited with announcements on our affiliate's website. All participants received a thorough written description of the study, attended a lecture on eating Paleo-Zone given by our resident nutrition expert, and gave informed consent to participate. Potential benefits of participating included:

- Participation in a scientific investigation to benefit the CrossFit community and beyond.
- An improved understanding of the real effects of a Paleo-Zone diet on performance and physiological measures of health.
- An individualized data profile of performance and physiological measures, with analyses of sleep, training and eating patterns over two months.
- A chance to experiment with diet and potentially see big gains in health and fitness.

Participant Background Information

A total of 21 participants volunteered for the study, ranging in age from 18 to 59, with an average age of 37.5 (s = 9.8). There were 13 men (average age 40.4) and 8 women (average age 32.8). There were no existing medical conditions other than high cholesterol (5) and exercise-induced asthma (1). At the beginning of the study, participants averaged:

- 11.9 months of CrossFit experience (s = 5.7, range: 5-21 months).
- 3.5 training days per week (s = 1.1, range: 1.5-5 days).
- 7.3 hours of sleep per night (s = 0.8, range: 6-9 hours).

We asked them to rate their current diet on a scale of 1-10, with 1 being unhealthy and 10 being healthy, and ratings averaged 6.9 (s = 1.4, range: 4-9). We also asked them to rate their motivation to change their current diet, and ratings averaged 8.0 (s = 2.0, range: 2-10). Eleven of the 21 participants reported that someone else in their household was also eating Paleo.

A total of 15 participants completed the study, and 6 dropped out. Six of those 15 participants were missing one or more measures: two were missing blood work, three were missing end-of-study performance measures (strength and met-con) due to illness or injury, and one was missing both.

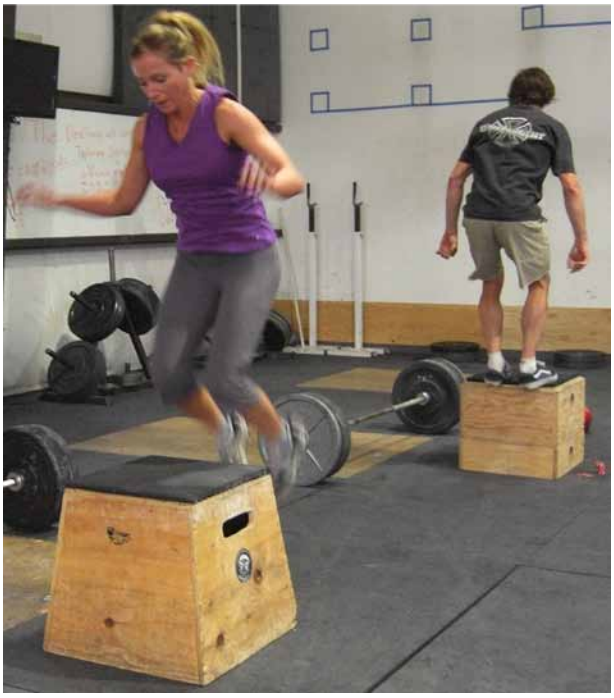
The 15 participants who completed the study ranged in age from 25 to 59, with an average age of 38.7 (s = 10.0). There were 11 men (average age 41.7) and 4 women (average age 30.3). At the beginning of the study, these 15 participants averaged:

- 11.6 months of CrossFit experience (s = 4.8, range: 6-20 months)
- 3.6 training days per week (s = 0.9, range: 1.5-5 days)
- 7.4 hours of sleep per night (s = 0.7, range: 6-8 hours)

Their healthiness-of-diet ratings averaged 6.4 (s = 1.3, range: 4-9). Their motivation-to-change-diet ratings averaged 8.5 (s = 1.1, range: 7-10). Six of these 15 participants reported that someone else in their household was also eating Paleo.

Reasons for Participating

We asked participants why they chose to volunteer for the study, and they gave several reasons. Of the original 21 participants, 11 mentioned performance, nine mentioned health, and three specifically mentioned cholesterol. Seven mentioned body composition—wanting to lean out or lose weight.



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Study participants were all CrossFitters, and 11 of them chose to participate in hopes of improving performance.

Measures

We collected a wide range of measures to investigate the effects of switching to a Paleo Diet. They included body-composition measures, physiological measures (blood work), performance measures (strength and metabolic conditioning), subjective measures, and compliance measures.

Body-composition measures included weight, percent body fat and waist circumference in inches. Percent body fat was measured with a scale that required inputs for height, sex, age and activity level. Scales that measure body composition are not entirely accurate, but because we were interested in before and after differences for individuals and not absolute values of body composition, the scale suited our purpose and was more convenient for multiple measurements than some of the more involved and expensive methods of body-fat measurement.

Physiological measures included total cholesterol, HDL, LDL, VLDL (when available) and triglycerides. These measures are part of a standard lipid profile. Participants went to their usual doctor or ordered a kit from bloodtestsathome.com.

Performance measures included both strength measures and metabolic-conditioning (met-con) measures. For strength we used the CrossFit Total (deadlift, back squat and press), and for met-con we used the CrossFit workout Christine, which is 3 rounds for time of a 500-meter row, 12 body-weight deadlifts and 21 box jumps.

Subjective measures included daily self-ratings of energy and affect ("How did you feel today, overall?"). Participants rated these on a scale of 1 to 10, with 1 being worst and 10 being best.

Compliance measures included daily self-reports of Paleo compliance and training compliance. For the study, participants agreed to consume at least 90 percent of their calories from Paleo foods and to train at least three days a week.

Participants also recorded hours of sleep per night to track overall wellness.

Subjective measures, compliance measures and sleep were recorded in an online log (a Google spreadsheet) that was shared only with the study administrator to protect the participants' privacy.

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Method

Participants were told that the study would require an eight-week commitment. They were told that by agreeing to participate in the study, they agreed to:

1. Eat a Paleo-Zone diet, which means eating no more than 10 percent of your calories each day in non-Paleo foods and trying to stay within approximate Zone portions and ratios (which may be adjusted for individuals; e.g., 2x fat, half carbohydrates, etc.).
2. Get blood work done. They needed to do this two times: once before and once after the eight-week study period, at their regular doctor. If they did not have a regular doctor, we recommended a convenient laboratory alternative, bloodtestsathome.com.
3. Get weight and body composition measured at the beginning of the study and every two weeks throughout the eight weeks of the experiment. These measurements were taken at Flatirons CrossFit and were kept confidential.
4. Perform a collection of benchmark strength and metabolic-conditioning tests, once before and once after the eight-week study period. These tests took place at Flatirons CrossFit.
5. Keep a daily log for eight weeks, answering several questions regarding adherence to diet, hours of sleep per night, whether they trained, whether they visited a Paleo-Zone support site set up for the study. They also self-rated affect and energy levels. They signed off on these logs once a week.
6. Train at least three times a week for the eight-week study period.

Participants were told that all their information would remain confidential and that their data would not be individually identifiable in any public documents.

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Study participants agreed to work out a minimum of three times per week during the study.

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Participants kept daily logs throughout the study to keep track of adherence and any anomalies that might affect the study.

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Before the study, all participants were given a lecture on nutrition to ensure they understood Paleo/Zone protocols.

Results

Reported results exclude two identified outliers. In addition, results for different measures are based on different numbers of participants. This is because some participants provided incomplete information; for example, some were injured during the study and unable to complete a second set of performance measures, but they still provided body composition and physiological measures. A few participants opted not to get blood work completed. Complete descriptive statistics, including measures of central tendency and variability, are available in Tables A-D (see end).

Body-composition measures (13 participants)

On average, participants lost 7.1 lb. over eight weeks, ranging from a minimum of 2.6 to a maximum of 15.8 lb. They also lost up to four inches from waist circumference, with an average of 1.4 inches, and up to 12.8 percent body fat, with an average loss of 3.0 percent and, at worst, a gain of 0.6 percent body fat.

Physiological measures (11 participants)

On average, participants' total cholesterol dropped 17 points, with a maximum drop of 106 points. HDL rose on average 1 point, with a maximum gain of 55; LDL dropped on average 18 points, with a maximum drop of 85; and triglycerides dropped on average by 1, with a maximum drop of 42. We had VLDL measures for four participants; it dropped on average 1 point, with a maximum drop of 9. We would expect the largest changes from participants who started with above-normal cholesterol levels (over 200). There were five participants who fit this description. When we look at only these five, their total cholesterol fell on average 48 points, HDL rose by 1 point, LDL fell by 46 points, and triglycerides fell by 15.

Performance measures (9 participants)

Relative strength measures, which are weights lifted divided by body weight, all improved. On average, relative deadlift improved by 8 percent, relative back squat improved by 9 percent, and relative press improved by 3 percent. Relative CrossFit Total improved by 20 percent, on average, ranging from -1 percent to +38 percent. All participants improved on the met-con workout (Christine), with an average improvement of 69 seconds. Improvements ranged from 29 to 165 seconds.

Subjective measures

Energy and affect ratings were similar for participants and across time. Energy averaged a rating of 6.7 across the study, and affect averaged 6.8. Average ratings stayed within a small window (6-7) throughout the study, rose slightly over the first three weeks and then stayed fairly steady.

Compliance and other measures

Compliance with the eating guidelines was good, with participants averaging 6.1 days per week of staying 90 percent Paleo. Paleo compliance stayed close to 6 days per week throughout the study. Training compliance was also good, with number of training days averaging 3.8 (we set a minimum of 3), and it stayed steady throughout the study, with the exception of participants who experienced an illness or injury during the study period. Hours of sleep per night averaged 7.4. Sleep increased a bit from Week 1 to Week 2 but stayed fairly flat throughout the rest of the study.

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Two Examples

In addition to the group results, we would like to highlight the experience of two of our participants. Both participated in the study because of concerns about health and, in particular, cholesterol levels. Both saw the improvements they were hoping for at the end of just eight weeks. In fact, their improvements exceeded their expectations.

The first participant lost nearly 16 lb. and 2 inches off his waist and also dropped his percent body fat. At just over 6 feet tall, he went from 205 to 189 lb. and from a 37- to a 35-inch waist. His percent body fat went from 17.4 to 15.7. His given reason for participating was to lower his cholesterol based on a recommendation from his doctor, and he did just that. He started with a total cholesterol measure of 240 (over 200 is considered "high") and dropped to 197, his HDL ("good cholesterol") went up from 43 to 55, his LDL ("bad cholesterol") dropped from 173 to 127, his VLDL cholesterol dropped from 24 to 15, and his triglycerides dropped from 118 to 76.

The second participant, at 5 feet 9.5 inches tall, went from 186 to 178 lb., and from a 36-inch waist to a 34-inch waist. He dropped his percent body fat by more than 2. His blood work also revealed big changes. He started the experiment with the highest total cholesterol of all the participants, at 339. By the end of the eight weeks, his total cholesterol had dropped to 233, an improvement of over 100 points, putting him much closer to the 200-point cut-off used by physicians. His LDL cholesterol dropped from 225 to 140, and his triglycerides dropped from 292 to 250.

These were impressive changes over just eight weeks, especially keeping in mind that only the type of food was regulated and the amount was not limited in any way. While there is debate about the value of blood cholesterol levels in predicting health outcomes (see extensive review and discussion in Gary Taubes' *Good Calories, Bad Calories)*, most of us must answer to our family physician's concern about elevated cholesterol. To show that a Paleo Diet not only does not increase cholesterol levels but can actually drastically reduce them provides people with some justification for trying a nutrition plan that is not advocated or even accepted within mainstream medicine. For these two participants, impressive numbers overcame the skepticism of their doctors.

Feedback From Participants

Twelve participants provided written feedback about their participation in the study. We asked them to evaluate their experience and about their perceived improvements, support during the study, and their future diet plans.

Evaluation of the Study

What was your overall experience with the study?—Ten of the 12 responding participants indicated that their experience was only positive. The remaining two had a mixed experience, noting that it was challenging or that they didn't feel "good" during the study but that they felt that it was worth it.

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After the study, both strength and met-con numbers were up on average.

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Did you get what you hoped to get from participating in the study?

Ten of the 12 participants said that they did get what they hoped for from the study. The remaining two had mixed responses.

What did you like about participating in the study?

Seven of the participants indicated that they liked the accountability and structure of the study to keep them on track. Three mentioned health improvements, three mentioned the challenge of experimenting with new foods, and two said they liked the support from the study.

What do you not like/what difficulties did you encounter during the study?

Three participants mentioned difficulty planning meals, and three mentioned cravings or hunger. Problems getting enough energy and enough variety were also mentioned.

Do you feel that your strength and conditioning improved (rate on a scale of 1-10)?

The mean rating was 6.5 (s =2.1), with ratings ranging from a minimum of 3 to a maximum of 9.

Do you feel that your body composition improved (rate on a scale of 1-10)?

The mean rating was 6.8 (s = 2.5), with ratings ranging from a minimum of 1 to a maximum of 10.

Did anyone not officially part of the study eat Paleo with you?

Eight of the 12 responding participants had support from someone not officially part of the study (usually a spouse or partner).

Did you feel you had enough support throughout the study?

All but one of the responding participants indicated that they had enough support. The remaining participant indicated that he or she did not actively seek support.

Do you plan to continue eating a Paleo or primal diet now that the study is over?

All 12 responding participants indicated that they planned to continue to eat Paleo after the study. Five qualified this statement somewhat ("mostly" or "with cheats now and then").

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After the study, most participants reported that they would continue eating Paleo.

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More research is needed to confirm the results of the study, and every CrossFit box is a lab.

If so, do you plan to make any changes to how you eat from how you ate during the study?

Almost all of the proposed changes were to reduce strictness, allowing a cheat meal or food now and then, or allowing them to experiment with occasionally adding back in a specific food, such as oatmeal or beans or dairy. Two indicated that they would adjust macronutrient ratios (carbohydrate/protein/fat).

Discussion

In summary, we saw positive results across the board.

Body-composition improvements were moderate in most participants and large in a few. On average, over the eight-week study, participants lost about 7 lb., 1.5 inches off their waistlines, and 3 percent body fat. The largest losses were 16 lb., 4 inches, and 13 percent body fat. While cholesterol, LDL, and triglycerides all fell on average, the largest drops were for the five participants who started the study with what is considered above-normal cholesterol (over 200). Their total cholesterol fell on average 48 points, LDL fell by 46 points, and triglycerides fell by 15, with maximum drops of 106, 85, and 42, respectively.

Relative strength measures all improved; the relative CrossFit Total improved on average by 20 percent (and up to 38 percent). All participants improved on the met-con workout, with an average improvement of over a minute. Of course, we would expect to see these improvements over time with consistent training, and without a control group, we cannot be certain that the improvements in performance were due to the change in diet. However, it is encouraging to see improvements in these measures over just eight weeks.

Self-reported energy and affect stayed relatively stable across the study, on average. Compliance with the eating guidelines was good throughout the study, with participants staying 90 percent Paleo more than six days a week. Training compliance was excellent; we set a minimum of 3 days per week, and participants averaged 3.8 days per week (not including periods of injury or illness).

In addition, our attrition rate was fairly low. We lost only six of the 21 affiliate members who volunteered for the study. Twelve of the 15 participants who completed the study provided written feedback about the study, and all of them indicated that they planned to continue to eat a Paleo Diet, which is extremely encouraging.

Because we don't have a random or representative sample from the general population, we can't claim that our study results generalize to the population at large. However, we believe they likely do generalize to other CrossFitters, and so we wanted to publish them here to make them available to other CrossFitters. In addition, we hope that this study can lay the foundation for other researchers to conduct more rigorous investigations of the effects of a Paleo Diet in a broader population.

We hope that other CrossFit affiliates can use this study as an example if they wish to embark on in-house Paleo challenges. We found that taking a study approach fostered a supportive and positive atmosphere rather than a competitive one, and this resulted in better commitment and morale among our members. Overall, our participants saw improvements across a variety of measures including body composition, physiological measures, and athletic performance. A large proportion of participants had a positive experience and plan to stick with the new eating habits they learned. The study also piqued interest in members who did not participate in the study.

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To conclude, we would like to share some of our favorite quotes from participants:

- "It was life-changing for me: my cholesterol levels dropped to acceptable levels after years of 'healthy eating' as I saw it."
- "I enjoyed the overall experience and thought it was well worth the dedication."
- "The Paleo approach was challenging because it is such a change from my normal way, but I've become accustomed to it and will continue."
- "It forced me to address my diet in a structured way and provided me an excellent alternative to statins."
- "Commitment to the study made it harder to 'blow off' the diet. Sticking to the diet felt good. No sugar crashes. No bloating."
- "I rarely had an upset stomach while eating Paleo foods. Also, I felt energized when I woke up instead of ill and sluggish."
- "Hard at first to eat a variety of Paleo foods. Practice with new recipes made it easier over time."
- "I think I ate too many fat blocks (curse you, almond butter!)."
- "I improved in all areas that were measurable. I developed new habits for food choices."

✦

	Weight Lost (pounds)	Inches Lost (waist)	% Body Fat Lost
Mean	7.1	1.4	3.0
Median	6.0	1.5	1.8
Min	2.6	0.0	-0.6
Max	15.8	4.0	12.8
Std. Dev.	3.8	1.0	3.7
Count	13	13	13

Table A: Body-Composition Results

	Deadlift Change (% body weight)	Back Squat Change (% body weight)	Press Change (% body weight)	CF Total Change (% body weight)	Met-Con Improvement (seconds)
Mean	8	9	3	20	69
Median	6	12	3	27	41
Min	1	-2	-2	-1	29
Max	22	18	7	38	165
Std. Dev.	7	8	3	15	48
Count	9	9	9	9	9

Table B: Relative Strength Results

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	Total Cholesterol Change	HDL Change	LDL Change	Triglycerides Change	VLDL Change
Mean	-17	1	-18	-1	-1
Median	-6	-7	-15	1	1
Min	-106	-17	-85	-42	-9
Max	41	55	43	55	3
Std. Dev.	43	21	39	27	5
Count	11	11	11	11	5

Table C: Blood Cholesterol and Triglycerides Results

	Total Cholesterol Change	HDL Change	LDL Change	Triglycerides Change
Mean	-48	1	-46	-15
Median	-43	3	-46	1
Min	-106	-13	-85	-42
Max	-6	12	-15	8
Std. Dev.	39	10	27	25
Count	5	5	5	5

Table D: Blood Cholesterol and Triglycerides for Participants With Total Cholesterol >200.

Courtesy of Amy Santamaria

Courtesy of Tim Retzik

About the Authors

Amy Santamaria is a member at Flatirons CrossFit in Boulder, Colo. and has a Ph.D. in psychology and neuroscience. She has been involved in CrossFit for two years and has been strict Paleo for over a year. Her background in research and her improvements in health and fitness after switching to a Paleo Diet came together to inspire this study. Amy blogs about her CrossFit experiences at KnitFit.

Tim Retzik owns and runs Flatirons CrossFit in Boulder, Colo. His motivation for carrying out this study was to encourage more members to try a Paleo Diet and judge for themselves whether it improved their health and fitness.

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