Investigating slow carbs for metabolic rate

Effects of carbohydrate quantity and glycemic index on resting metabolic rate and body composition during weight loss

Introduction

One of the biggest struggles for people who have lost weight is trying to keep it off. Weight regain after an initial period of loss is a highly common occurrence among dieters. While there are different reasons for this weight gain, a potential contributor may be the metabolic adaptation to weight loss itself. As weight loss occurs, a person will be physically moving around less mass, and therefore expending less energy. But these periods of weight loss can induce reductions in metabolic rate above and beyond what can be attributed to the weight loss alone. This is known as adaptive thermogenesis. Resting metabolic rate (RMR) is a component of energy expenditure that plays a role in adaptive thermogenesis. RMR is the amount of energy your body expends during a state of rest to keep all your organs and bodily systems functioning and, in most people, it is the biggest contributor to total daily energy expenditure.

It is plausible that dietary factors could help to prevent these reductions in RMR during weight loss. One area of research has examined carbohydrate quantity and glycemic index (GI) as a potential strategy to prevent RMR decreases. The glycemic index is a measure of how much a food will raise your blood sugar. To date, the research has been somewhat equivocal. Some studies have shown benefits for low-GI diets in terms of preserving RMR, but these studies did not match protein intake between intervention groups, which can confound the results. Other studies have shown no weight loss difference or significant changes in RMR between diets that altered both carbohydrate content and GI level.

This study aims to further examine the effects of dietary carbohydrate content and GI on RMR adaptations and changes in body composition during and following weight loss. By isolating both the carbohydrate content and GI level in a diet, we can better tease out if either of these variables may have an RMR preserving effect. Additionally, it is not known if diets very high in carbohydrate (greater than 65%) could attenuate these outcomes. The researchers conducting this study examined four types of diets to in an effort to determine their ability to attenuate reductions in RMR.

Resting metabolic rate (RMR) can become depressed during and after weight loss. It has been hypothesized that this decrease in RMR could play a role in weight regain. The effects of dietary carbohydrate content and glycemic index to preserve RMR are not well known. This trial examines four diets varying in GI and carbohydrate content to determine their influence on RMR during and after weight loss.

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Who and what was studied?

Researchers recruited 107 men and postmenopausal women (45 to 65 years old) with BMIs ranging from overweight to obese (28 to 38). The study objective was to assess the effects of altering dietary carbohydrate-to-fat ratio and GI on changes in body composition, RMR, and metabolic adaptation during and after weight loss in an overweight and obese adult population. Body composition assessments were performed using air displacement plethysmography (BOD POD), a rigorous method for determining body composition. RMR was measured at the end of the first three phases by indirect calorimetry using a portable metabolic cart.

The trial was broken up into four phases, seen in Figure 1. The first three were controlled-diet phases that lasted 22 weeks in total. All food and drink were provided to the participants during these phases. Dietary supplement use was suspended during this time to limit confounding variables. It's important to note that the protein, fiber, and energy density were matched between all diet groups. Many diet studies do not match protein or fiber content between intervention groups, which can confound weight loss and energy expenditure measurements. The fourth phase was an *ad libitum* diet follow-up period that lasted 12 months.

Phase 1 was a five-week weight maintenance phase during which researchers determined the required energy needs for participants to sustain a stable weight. Diets during this period were 48% carbohydrate, 16% protein, and 36% fat. For phase 2, participants were randomized into one of four weight loss diets for 12 weeks, which differed in carbohydrate content and dietary glycemic index. The groups were:

- Moderate Carb, Low GI – 55% carb, GI <60
- Moderate Carb, High GI – 55% carb, GI ≥80
- High Carb, Low GI – 70% carb, GI <60
- High Carb, High GI – 70% carb, GI ≥80

The initial caloric intake for each participant was 67% of the weight maintenance energy intake determined in phase 1, but they were allowed to increase energy intake during this phase by requesting additional, diet-group appropriate foods from the metabolic kitchen if they felt they were too hungry to adhere to study guidelines. Phase 3 was a five-week weight maintenance period during which participants remained in their respective diet group. Energy intakes were adjusted to support maintenance at the new, lower body weight. For the final phase, participants selected and prepared their own meals but were instructed to follow the diet to which they had been initially randomized.

Figure 1: Study design

Glycemic Index vs. Glycemic Load

The glycemic index was developed back in the 1980s and was used to rank carbohydrates on a scale of 0 to 100 based on their ability to raise blood sugar after consumption. To determine ranking, fasted participants would come in and be fed a serving of food containing 50 grams of carbohydrates. The greater and more prolonged the response, the higher the GI rating. A high GI food is typically characterized by rapid digestion and absorption into the bloodstream. High GI foods are greater than 70, moderate is 56 to 70, and low GI is less than or equal to 55.

However, this model does not take into account the quantity of a food consumed in a real life, free-living setting. The use of the glycemic load (GL) was meant to correct that problem. To calculate the glycemic load of a food, you need both the glycemic index rating of your food and how much you are consuming. So, GL = (Glycemic index rating * grams of food consumed) / 100. High GL foods are greater than 20, moderate is 11 to 19, and low is 1 to 10. Some foods, like watermelon, can have a very high GI (72). Once serving size is taken into account, their GL can be very low, in this case a GL of 4 for watermelon. A table of calculated GIs and GLs can be found here.

One issue with the fourth phase of this trial is that participants food intake and activity levels were not as closely monitored as they were in the first three, but rather self-reported, which can lead to inaccurate data. During the previous three phases, the researchers implemented safeguards when designing their trial to help reduce some of the common limitations that occur in free-living studies. These were intended to help bolster the validity and reliability of their data. For example, participants reported to the study center three to five days a week during phase 1 and three days a week during phase 2 and 3. During these visits, they would be weighed, pick up their food, and eat a meal under research staff supervision. Participants would also return all empty food containers and any uneaten foods for documentation. During the final phase, interactions were limited to quarterly visits and monthly phone calls with a nutritionist. While not as rigorous as observing trial subjects in a metabolic ward 24/7, the trial design helped ensure greater accuracy over a standard free-living study, which usually employs minimal direct observation.

Researchers randomized 107 older men and women with obesity into one of four diets that paired high or moderate dietary carbohydrate with high or low glycemic foods. The study researched the effects of altering dietary carbohydrate and GI on changes in body composition, resting metabolic rate (RMR), and metabolic adaptation during and after weight loss. During the first 22 weeks of the study, all foods were provided to participants in order to control calories, and ensure weight loss then weight stabilization. Detailed records were kept of their weight and food intake. After the first 22 weeks, participants were placed on an ad libitum-diet for a follow-up period that lasted 12 months.

What were the findings?

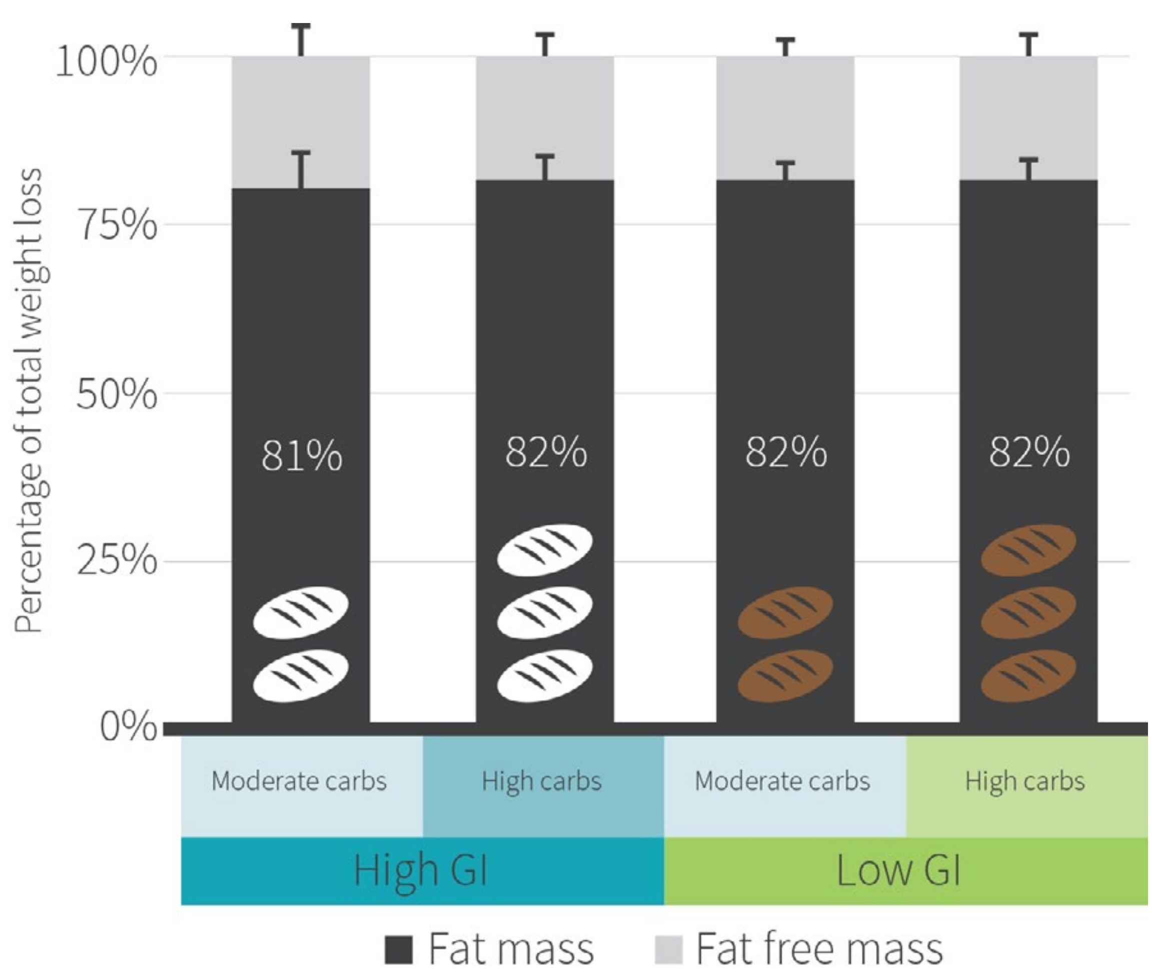
Dietary adherence was fairly strong across all four groups, with more than 77% of participants remaining compliant during phases 2 and 3. The average weight loss was 15.4 pounds (seven kilograms). Weight loss did not differ by carbohydrate content or GI across groups. As shown in Figure 2, there was no difference between the groups in weight loss coming from fat mass or fat-free mass. About 82% of total weight loss (about 12.6 pounds) was from fat mass, while 18% was from fat-free mass (2.7 pounds).

At the end of the phase 2 weight loss period, RMR had dropped by 6.5% from baseline (54 calories per day). Once stabilized at their new weight at the end of phase 3, RMR was measured again and was 6.2% below baseline (41 calories per day). None of the measured changes in RMR at the end of phase 3 differed by carbohydrate content, by GI, or across groups. The researchers even went as far to do an analysis including only those participants who were the most compliant, but the same conclusions still held for this subgroup.

Of the original 107 participants enrolled, only 60 finished the fourth, 12-month phase. The average weight regain for this cohort was 9.5 pounds (4.3 kilograms), 58% of the weight lost at the end of phase 3. Weight regain did not differ among groups. Since researchers did not detect any statistical differences between groups, the full cohort was analyzed to see if there was a relationship between the changes in RMR and weight regain. No correlation was found. These results indicate that neither moderate to high carbohydrate content nor high or low GI were able to preferentially attenuate decreases in RMR, preserve lean mass, or reduce fat mass during periods of weight loss or weight stabilization.

During phase 2 and 3, participants lost an average of 15.4 pounds but regained 9.5 of those pounds during the 12 month fourth phase where participants prepared their own food. At the end of the phase 2—the weight loss period—RMR had dropped by 54 calories per day, but rebounded slightly to 41 calories per day during the weight stabilization third phase. No statistical differences were observed in these areas between any of the groups. These results indicate that neither manipulating carbohydrate intake or GI would diminish drops in RMR, preserve lean mass, or reduce fat mass when undergoing weight loss or weight stabilization.

Figure 2: Percent of fat mass and fat-free mass lost in each group



What does the study really tell us?

While adaptive variations in RMR can be measured, they appear to be unrelated to dietary carbohydrate content and GI when compared among diets that were matched for protein, energy, and fiber content. Ensuring these dietary aspects are equal among comparative diets can help to cut down on confounding factors. The study also demonstrated that neither dietary GI or the percentage of dietary energy from carbohydrate is likely to affect weight loss ability. The idea that carbohydrate content in a diet is not a major factor in weight loss has been echoed in another recent paper that was covered in ERD #11 Volume 2.

The authors of this study were able to increase the validity and reliability of data collected from participants by monitoring them more frequently and blinding them to their diet group assignments. When conducting food intervention trials, participants will clearly know what they are eating and therefore cannot be totally blinded, but in this case the scientists were able to hide the purpose behind the dietary assignments.

Trials of this nature are not without their limitations, though. Participants dropped out at each of the four phases of the trial. Of the 107 initially enrolled, 91 completed phase 2 (15% dropout rate), 79 finished phase 3 (26% dropout rate), and 60 made it through to the end (44% dropout rate). Additionally, participants continued to lose weight during phase 3, when they were supposed to remain weight stable. RMR may have bounced back more significantly during this phase if the participants had been able to remain at a stable weight.

The authors noted that metabolic adaptation to weight loss did tend to lessen, but not disappear, in the weight stable periods following weight loss, but that these numbers were not able to reliably predict who would be most at risk of regaining weight. Essentially, the variability in participant RMR after weight loss relative to baseline RMR did not predict weight changes over the 12-month fourth phase and no difference in metabolic adaptation between weight regainers and those who maintained weight loss was observed. Finally, the results of this study cannot be extrapolated to low-carbohydrate intakes as the trial did not test low-carb diets with high and low GI foods.

The dietary carbohydrate content and GI levels tested in this trial were unable to show an advantage to any of the four combinations examined. It also showed carbohydrate content in the diet is unlikely to affect one's ability to lose weight. Predictions on which participants would regain the most weight based off decreases in RMR proved to be unreliable. A major limitation of this trial was the 44% drop out rate, as only 60 of the initial 107 participants were able to complete all four phases of the study.

The big picture

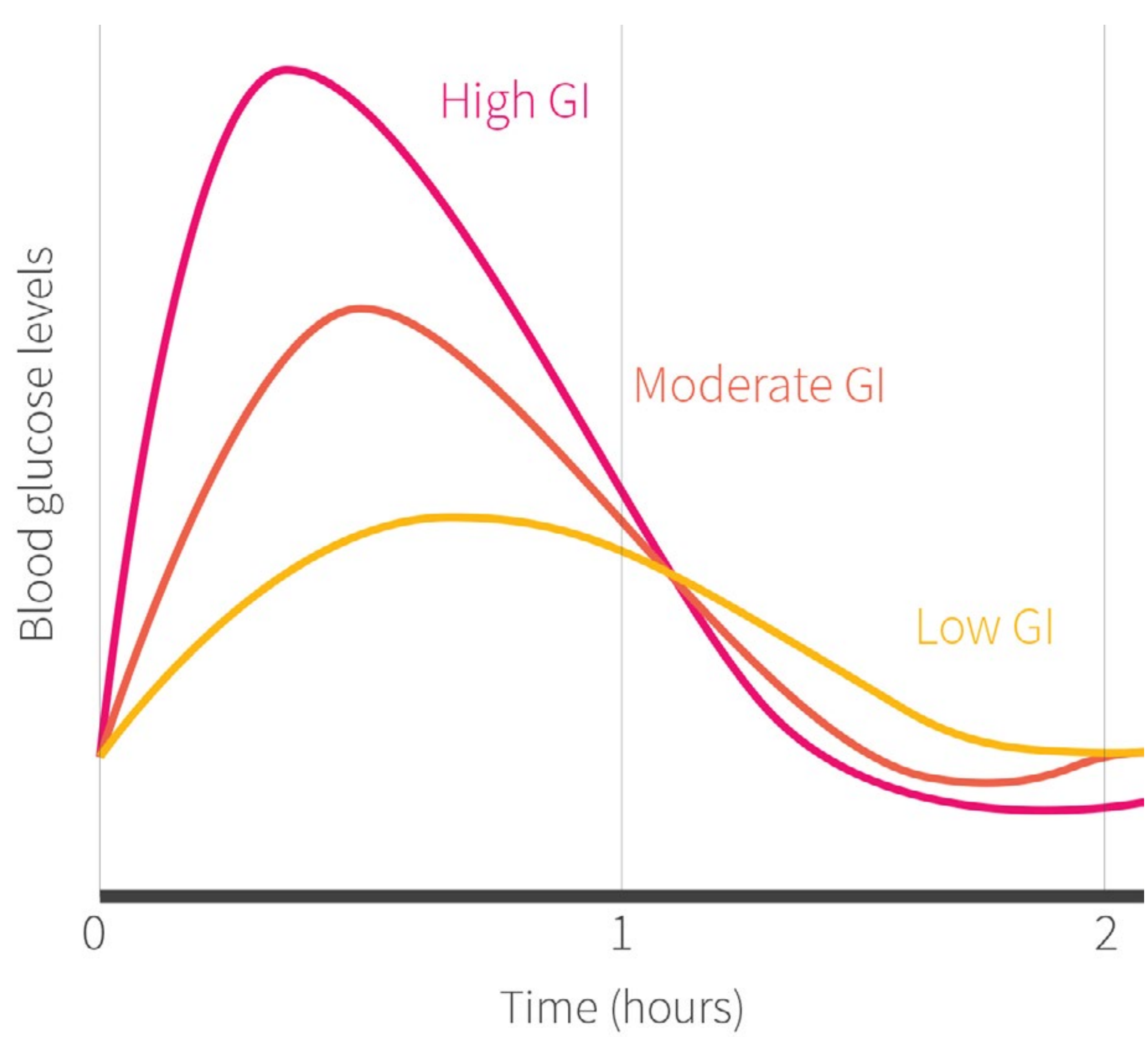
The glycemic index has been proposed as a useful tool in many areas of health. Low-GI foods have been recommended for better weight loss, increased satiety, and increased blood glucose control. The current study examined their ability to preserve RMR. Previous meta-analyses of low-carbohydrate diets (and therefore, low total glycemic load) have suggested that they may help preserve fat-free mass relative to fat mass loss during periods of weight loss. But many of these trials are confounded by the high protein intake commonly seen in low-carb diets. Higher protein intake during weight loss has been associated with preservation of fat-free mass and of energy expenditure.

The results of this study also fit with previous trials that looked at different GI carbohydrates that also matched intervention diets for total energy density and protein content. Results of these past trials found no clinically significant results in weight loss with diets that differed in GI. The main factor that distinguished the diets in these trials is their total glycemic load. In the present study, the high carb+high GI diet had a high GL, while the moderate-carb+low GI diet had a lower GL. If GI, and therefore GL, has benefits to weight management, we should have seen big differences between those two diets. In some cases, the glycemic index may not tell the whole story of a foods health impacts. For example, white potatoes have one of the highest glycemic indexes but have also been shown to be a very satiating food. Higher satiety foods can help to prevent overeating. Fructose has a very low GI but can increase food palatability, particularly in refined foods like soda, which can lead to overconsumption.

The glycemic response to the same food can also vary widely from the typical response (seen in Figure 3) depending on the person. A recent trial looked at post-meal glucose response and found that results had high individual variation. A few servings of ice cream for one person could send their blood sugar through the roof while someone else would barely experience any rise in their glucose levels. The researchers found that a post meal glycemic response can be heavily influenced by dietary habits, physical activity, and your gut microbiota. What this could potentially mean is that even if someone is following a 'low-GI' diet, they could still be experiencing blood sugar spikes, which can be especially problematic to those with diabetes.

Focusing just on GI to improve health or to lose weight may distract from the various aspects of nutrition and physical activity that are important in maintaining health. GI responses from person to person are highly variable and influenced by the dietary habits and the gut microbiome. High GI foods like potatoes are healthy and satiating while low GI ingredients like isolated fructose may increase overeating.

Figure 3: Typical glycemic responses for foods of different GIs



Frequently asked questions

What effect can low glycemic foods have on appetite?

One of the more popular ideas surrounding the glycemic index is that the higher GI foods cause problematic large blood sugar spikes. The hypothesis goes that when these high blood sugars come down, or 'crash,' they cause hypoglycemia (low blood sugar) which makes you feel hungry and drives you to eat. However, trials have demonstrated that factors like protein, energy density, fiber, palatability, and water content of food correlate more positively with satiety, while GI did not. In further rigorously designed trials that controlled for these factors that affect satiety (energy density, macronutrient content, fiber, and palatability) GI did not correlate with feelings of fullness or caloric intake. One meta-analysis found that blood glucose response to food was also not a good predictor of satiety.

Would it be more advantageous to use glycemic load instead of glycemic index?

The glycemic load improves upon some aspects of the glycemic index because GL has been adjusted for serving size. So the short answer is yes, when trying to determine the possible blood sugar response to certain foods using the GL will give you a more accurate answer. However, even using the glycemic load cannot account for the high variability of glycemic responses we see from person to person. There have been many studies to date showing that factors like exercise levels and the makeup of your microbiome can influence blood glucose levels. So while more accurate, GL currently does not consider many other influencing factors.

What should I know?

The authors summed up their findings nicely by stating, "neither low-GI relative to high-GI diets nor moderate-carbohydrate relative to high-carbohydrate diets showed differences with respect to effects on changes in body composition or resting metabolism during weight loss when confounding dietary factors were tightly controlled in a study providing all food for 22 weeks, and individual variability in metabolic adaptation following weight loss did not predict weight regain over 12 months."

An over-reliance on the glycemic index may distract from the other factors that promote health. With weight loss in particular, energy expenditure will adapt to changes in your weight, but the results of this and other studies indicate that once weight has stabilized these metabolic adaptations appear to be sustained, and that GI is unlikely to have any effect on these changes. ◆

The nutritional dogmas of the 1980s continue to fall, one by one. Sorry glycemic index. Talk this over at the ERD private Facebook forum.

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