

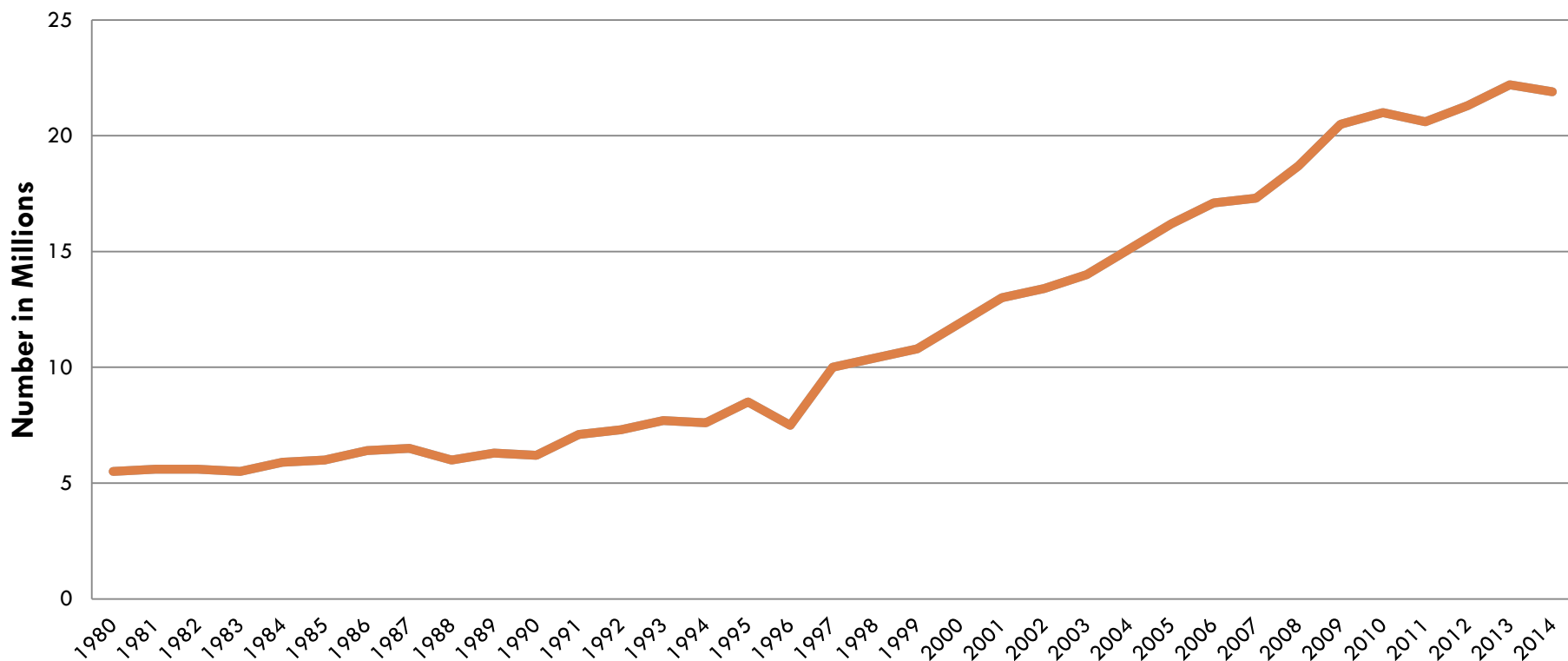
A multicomponent  
very low-carbohydrate diet  
and lifestyle program  
for adults with type 2  
diabetes

Laura Saslow, University of Michigan  
Assistant Professor



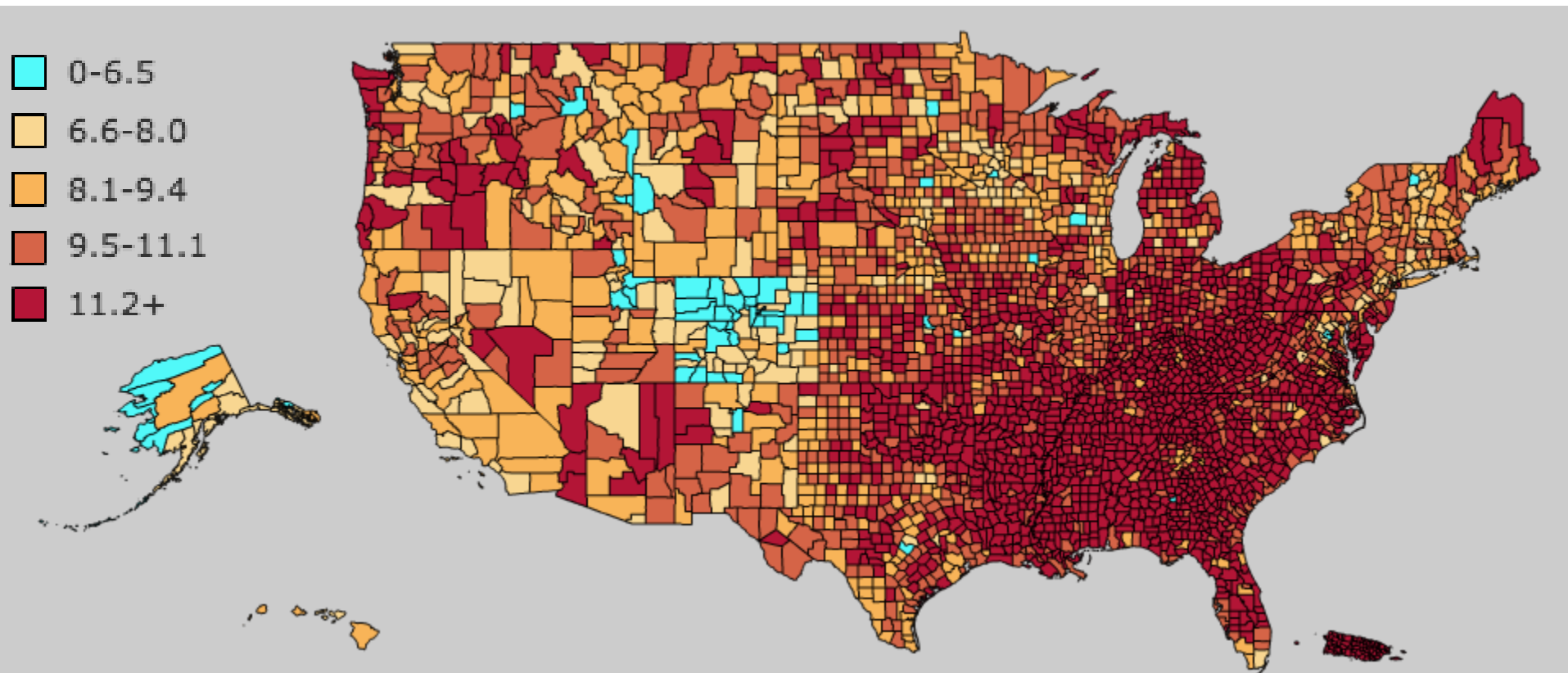
Type 2 Diabetes:  
Prevalent &  
dangerous

# From 1980-2014 the number of adults in the US with diabetes has quadrupled



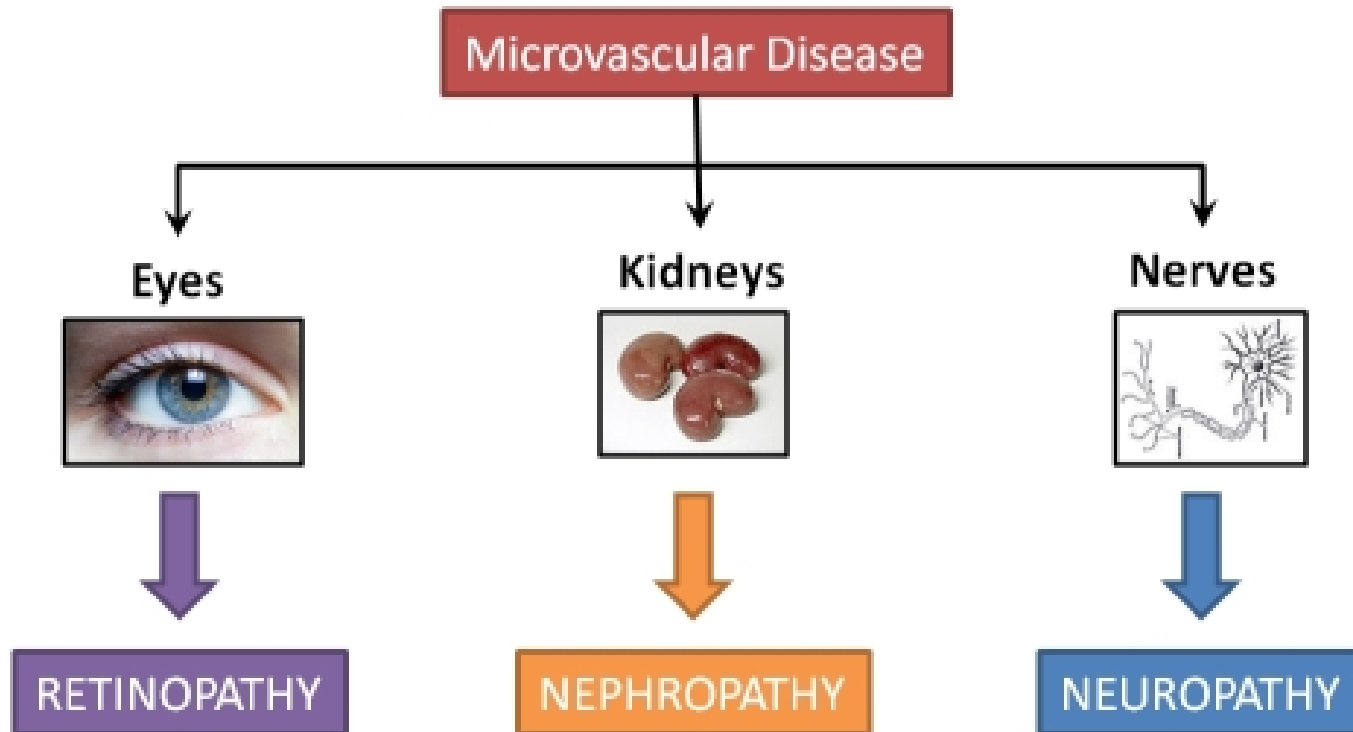
US adults have a 40% risk of being diagnosed with type 2 diabetes in their lifetime.

# Diagnosed diabetes percentage 2013



Red counties have more than 11.2% of adults with diagnosed type 2 diabetes

# Type 2 Diabetes Complications



About half have these complications  
1/10 health care dollars spent on it

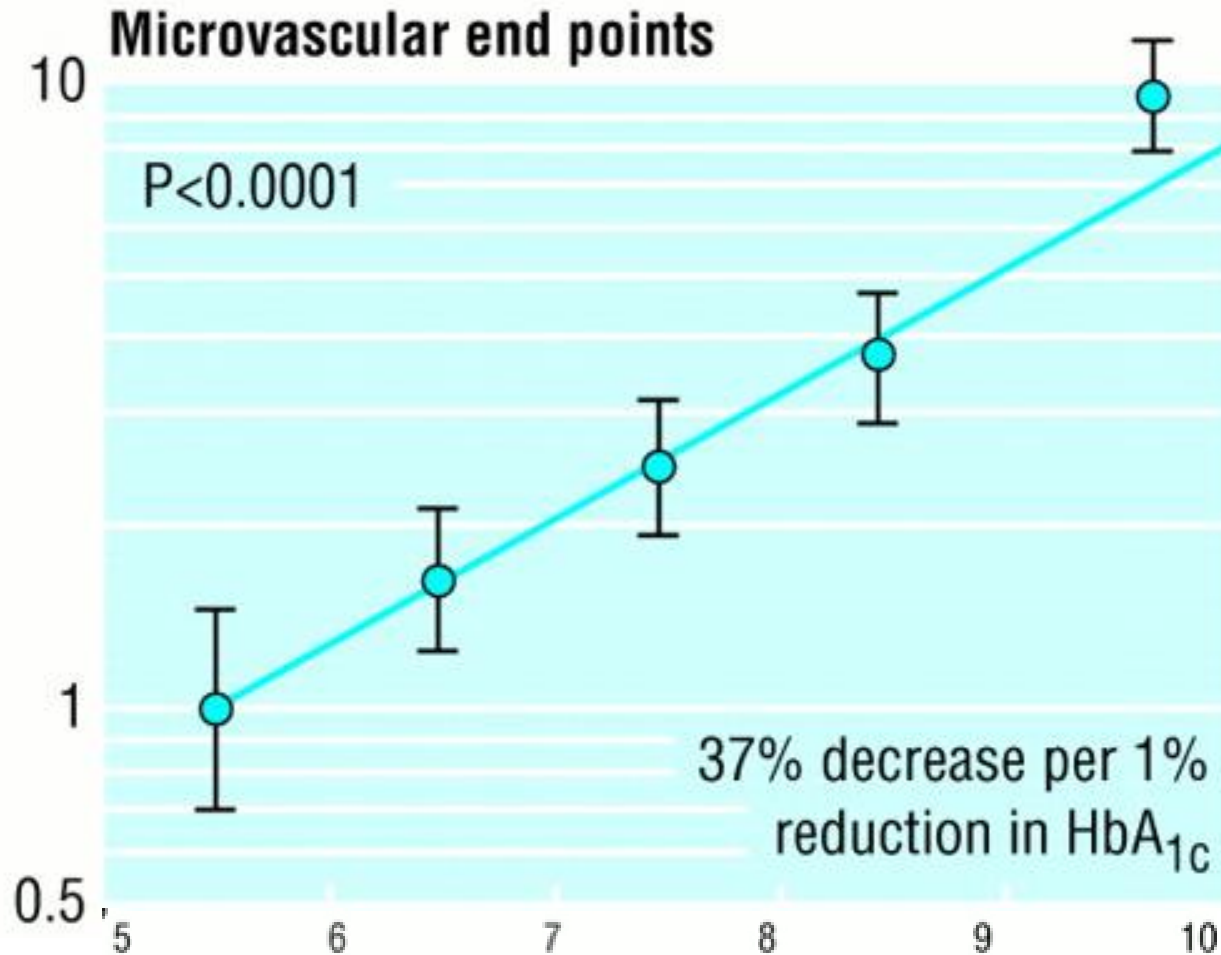
# Diagnosing type 2 diabetes

**HbA1c** (glycated hemoglobin): As blood sugar increases, a protein in the blood, hemoglobin, binds to sugar, or is glycated.

Type 2 Diabetes  
6.5% or higher

# Solution: Lower Blood Sugar (HbA1c)

Hazard ratio



Each 1% reduction in HbA1c was associated with a 37% decrease in risk for microvascular complications

(UK Prospective Diabetes Study Group, 2000)

# Historic treatment of type 2 diabetes

## FOODS STRICTLY FORBIDDEN

- |                                       |                                |
|---------------------------------------|--------------------------------|
| 1. Sugars                             | 15. Beets (on doctor's order)  |
| 2. All Farinaceous Foods and Starches | 16. Large Onions               |
| 3. Pies                               | 17. All Sweet and Dried Fruits |
| 4. Puddings                           | 18. Honey                      |
| 5. Flour                              | 19. Levulose                   |
| 6. Bread                              | 20. All Sweet Wines            |
| 7. Biscuits                           | 21. Liqueurs                   |
| 8. Rice (by permission only)          | 22. Cordials                   |
| 9. Sago                               | 23. Syrups                     |
| 10. Arrowroot                         | 24. Beer                       |
| 11. Barley                            | 25. Ale                        |
| 12. Oatmeal (by permission only)      | 26. Stout                      |
| 13. Tapioca                           | 27. Porter                     |
| 14. Macaroni                          | 28. Chocolate                  |
| 29. Condensed Milk                    |                                |

(Diabetic Cookery, 1917)



# Joslin Diabetes Diet, 1915

**QUANTITY OF FOOD** Required by a Severe Diabetic Patient Weighing 60 kilograms:  
(Joslin.)

Food	Quantity Grams	Calories per Gram	Total Calories
Carbohydrate.....	10	4	40
Protein.....	75	4	300
Fat.....	150	9	1,350
Alcohol.....	15	7	105
			<hr/> 1,795

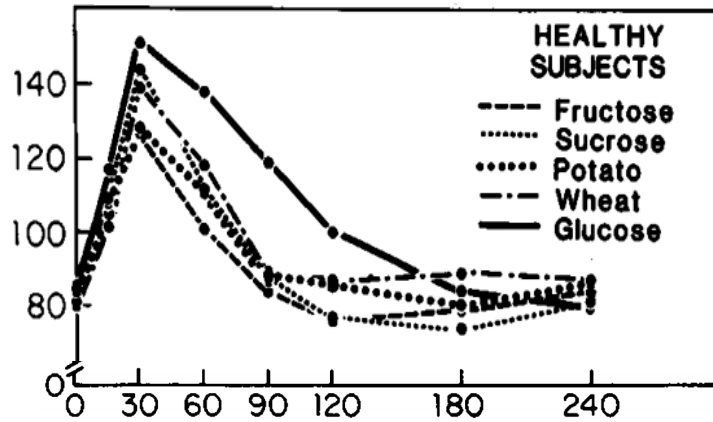
**STRICT DIET.** (Foods without sugar.) Meats, Poultry, Game, Fish, Clear Soups,  
Gelatine, Eggs, Butter, Olive Oil, Coffee, Tea and Cracked Cocoa.

This is a very low-carbohydrate diet

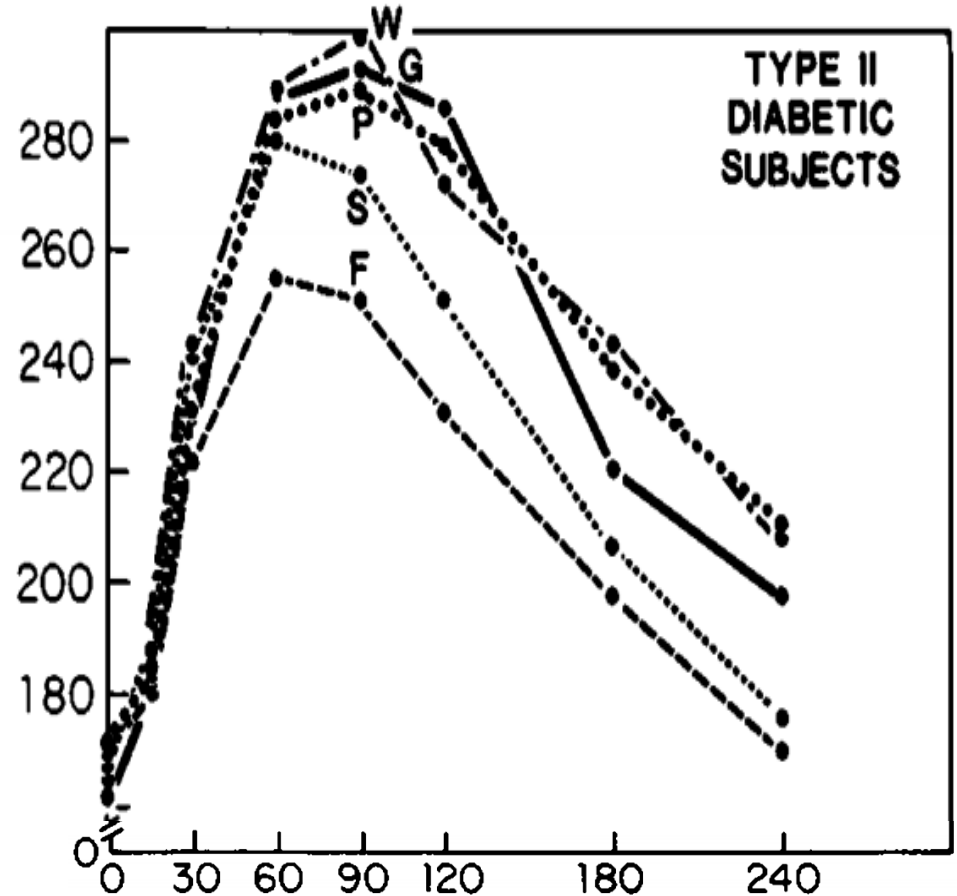
# Carbohydrates increase blood sugar especially in people with type 2 diabetes

Plasma Glucose (mg/dl)

--- Fructose  
..... Sucrose  
..... Potato  
-.- Wheat  
— Glucose



Time (minutes)




Time (minutes)


(Bantle, Laine, Castle, Thomas, Hoogwerf, & Goetz, 1983)

# Prior research (my informal meta-analysis)

In 17 previous trials of very low-carbohydrate diet programs in adults with type 2 diabetes, (average length was 12 months):



HbA1c  
dropped a  
unit of 1%



Body  
weight lost  
was 8%

(Review Feinman et al., 2014)

## Goal: Create an effective program

---

EAT  
SLEEP  
BE HAPPY  
REPEAT

- Great dietary adherence
- High program satisfaction
- Few dropouts

What does the ADA recommend?



“Diet, physical activity, and behavioral therapy designed to achieve  $>5\%$  weight loss should be **prescribed** for overweight and obese patients with type 2 diabetes ready to achieve weight loss.”

(Diabetes Care, 2017)

# Intervention Development!

# Novel intervention for type 2 diabetes



# Very low-carbohydrate, ketogenic diet



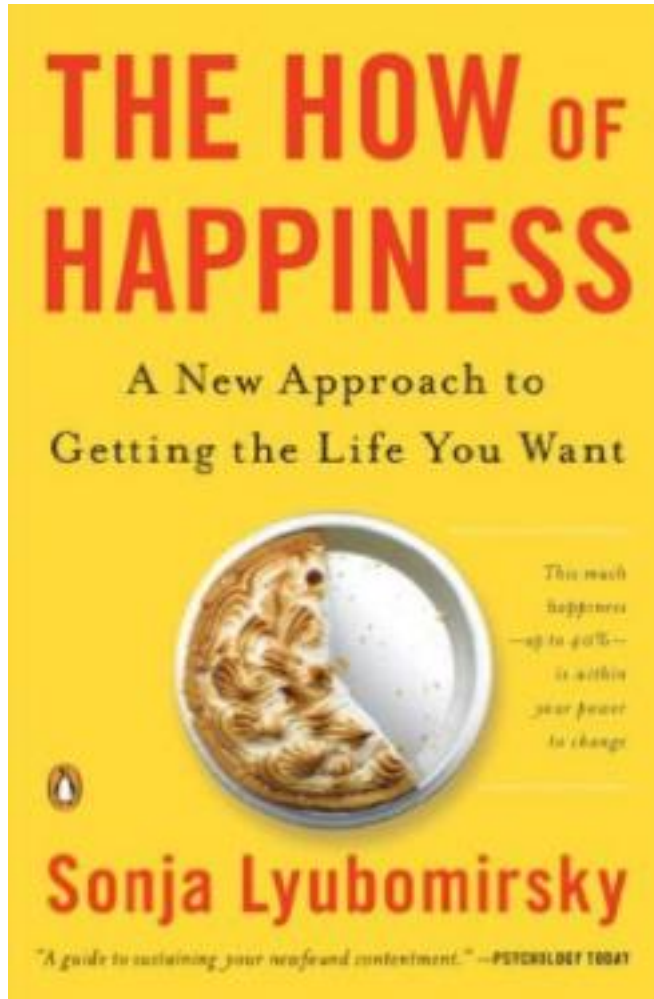
Encouraged to eat

- 20-35 non-fiber grams of carbohydrates a day
- Protein same (80-120 g a day, no more than 25-50 g of protein at a time)
- Rest of calories from fat

Asked to eat when hungry,  
stop when full



# Positive Affect Regulation Strategies



- Gratitude
- Savoring
- Personal strengths
- Positive reappraisal
- Positive activities

Saslow & Moskowitz, 2013

Saslow, Cohn, & Moskowitz, 2013

Cohn, Pietrucha, Saslow, Hult, & Moskowitz, 2014

# Positive Affect Regulation Strategies



## How does it help?

- broaden perspective, build resources (Fredrickson & Joiner, 2002)
- “time-out” from stress (Folkman, 2008)
- hedonic theory: doing more of what you like (Williams, 2008)

# Mindfulness and Mindful Eating



Awareness and acceptance of:

- Hunger & fullness
- Cravings & triggers
- Flavor, texture, aroma
- Thoughts & feelings

Daubenmier, Kristeller, Hecht, et al., 2011

Daubenmier, Moran, Kristeller, et al., 2016

# Mindfulness and Mindful Eating

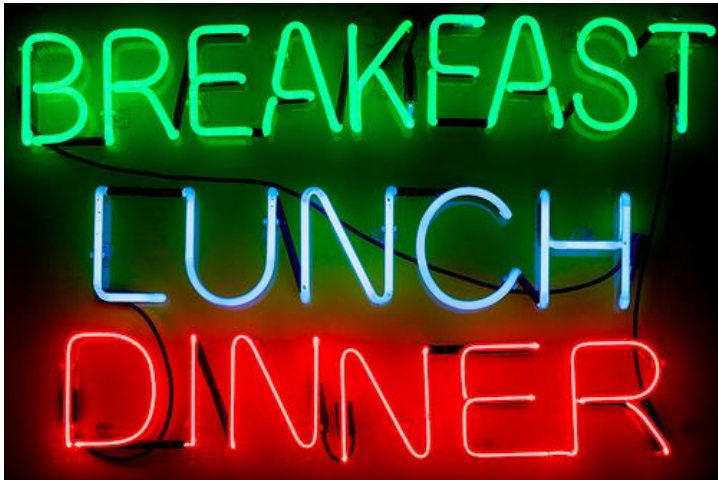


How does it help?

**Learn to acknowledge but not act on impulses**

- Reduce emotional eating
- Reduce eating due to external cues
- (O'Reilly, Cook, Spruijt-Metz, & Black, 2014)

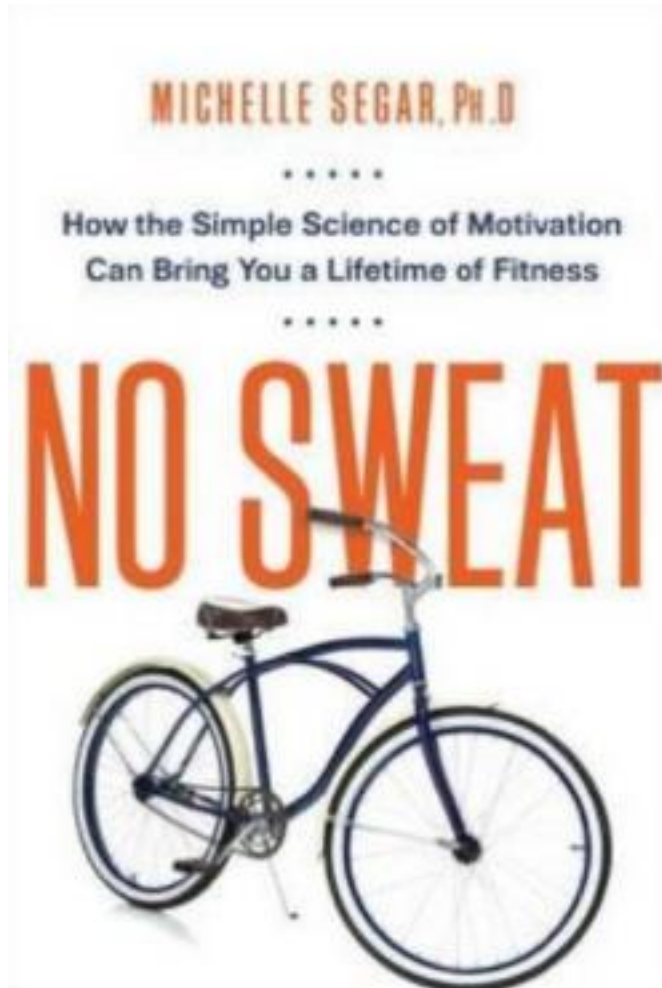
# Behavioral Support



Based on Bandura's Social Cognitive Theory of Self-Regulation

- **self-monitoring diet, exercise, & sleep** for self-diagnosis and self-motivation
- **vicarious experiences** (such as quotes from successful others) to improve self-efficacy and develop new norms
- **slow skill transitions** to improve self-efficacy

# Physical Activity Guidelines



Encouraged to engage in moderately intense physical activity, such as brisk walking, for at least 150 min/week.

Find activities they enjoy! (Michelle Segar)

Physical activity is related to better physical health & blood sugar control, reduced inflammation, depression, and anxiety (Warburton, Nicol, & Bredin, 2006)

# Sleep Guidelines



Encouraged to sleep 7-9 hours a night, enough to feel well rested

Sleep is related to better physical health & blood sugar control, reduced inflammation, and depression (Alvarez & Ayas, 2007; Tsuno et al, 2005)



Treating Type 2

Diabetes:

In-Person Program



# A Randomized Pilot Trial of a Moderate Carbohydrate Diet Compared to a Very Low Carbohydrate Diet in Overweight or Obese Individuals with Type 2 Diabetes Mellitus or Prediabetes

Laura R. Saslow<sup>1\*</sup>, Sarah Kim<sup>1</sup>, Jennifer J. Daubenmier<sup>1</sup>, Judith T. Moskowitz<sup>1</sup>, Stephen D. Phinney<sup>2</sup>, Veronica Goldman<sup>1</sup>, Elizabeth J. Murphy<sup>1</sup>, Rachel M. Cox<sup>3</sup>, Patricia Moran<sup>1</sup>, Fredrick M. Hecht<sup>1</sup>

34 overweight individuals with type 2 diabetes or prediabetes, not on insulin.

Baseline HbA1c about 7%.

12-month program:

- weekly, catered, 2-hour classes for about 4 months
- meetings every 2 months for the remaining time

# Compare two diets, both supported with extras

ADA carbohydrate-counting diet

Multi-component program

Very low-carbohydrate diet

Multi-component program

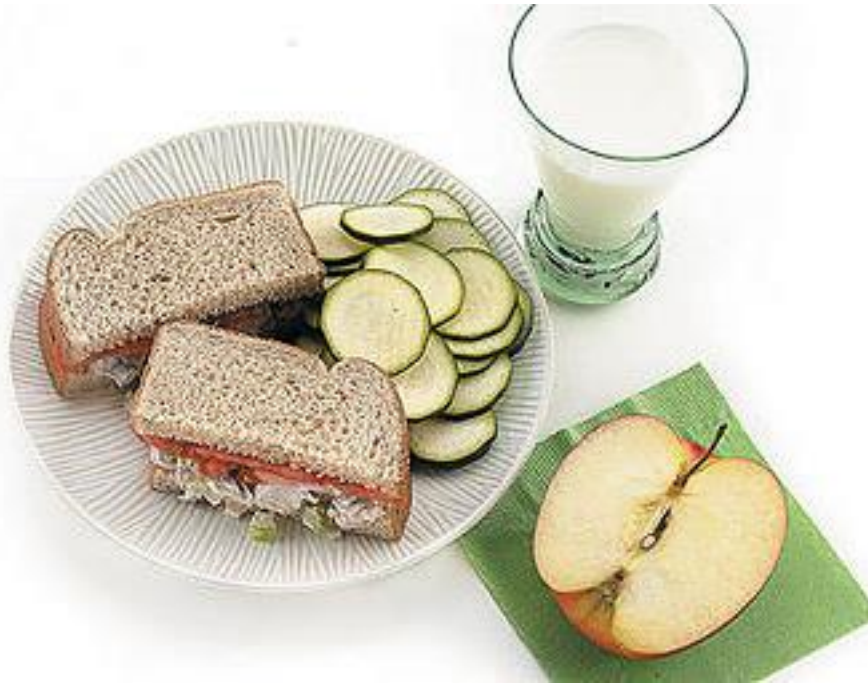
Positive Affect Training

Mindfulness Instruction

Behavioral Support

Exercise & Sleep Guidelines

# Compare two diets



ADA carbohydrate counting:  
goal of about 150 grams  
of carbs/day (n = 18)



Very low carbohydrate:  
goal of about 20-35 net  
grams of carbs/day (n = 16)

# Measurements



Quest  
Diagnostics



ASA24™

ASA24 Automated Self-administered 24-hour Recall



# Example handout:



## Mindfulness of Cravings and Triggers

Sometimes, we can let our food cravings and environmental triggers decide when and what we should eat. By doing so, we are giving up control over our eating.

We can eat for several reasons such as to satisfy the needs of the body, to satisfy the needs of the mind, and out of habit. We crave foods we don't need and are triggered to eat foods from external cues. *To eat mindfully, is to eat to satisfy the needs of our bodies and to enjoy our food, but not to eat of habit or overeat because of cravings or triggers.*

## Eating from Biological Need, Not Cravings or Triggers

In German, they describe the weight we gain from emotional overeating as “kummerspeck.” It literally translates to “grief bacon.” Food cravings may become more intense when we are in emotional distress. Food is soothing, particularly sugary foods, and it can actually dampen the stress response and calm our nerves in the short term. Over time, some people may develop the habit of over-relying on food for comfort or as a way to cope with stress. Rather than judge ourselves for this, we can become aware of this tendency, get curious about it.

By being more mindful, we can see that a craving or trigger for food is just a momentary state of mind. We can then slow down and practice the habit of making a more reasoned choice of whether to eat or not to eat.

**Track your cravings and triggers** to identify your patterns. To make sense of these, ask yourself, when, where, and under what circumstances do you have these feelings?

To help yourself track your cravings and triggers, before, during, or after you eat, you could ask yourself: **“Why am I eating? Am I hungry, have I been prompted by something in my environment, or am I eating to cope, to address my emotional needs?”**

**Stop mentally pushing your cravings away and beating yourself up for using food as a tranquilizer. Instead, embrace your yearning for food. Get to know it. Investigate it in a curious but uncritical way.**  
~ Susan Albers

# Dropout, medication changes

## ADA carb-counting diet & extras

Dropout: 17%

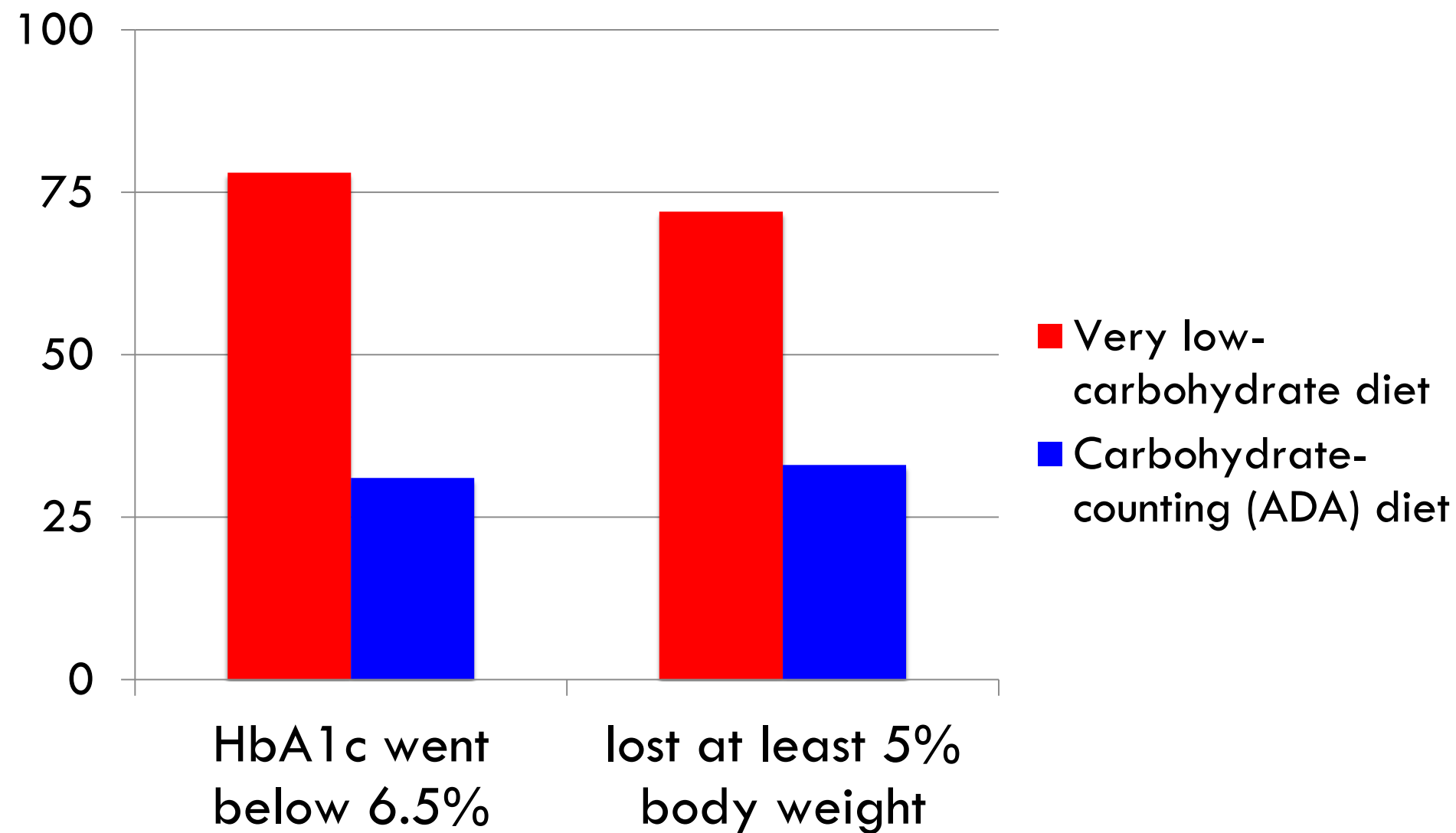
**11% discontinued** one or more diabetes medications

## Very low-carbohydrate diet & extras

Dropout: 12%

**44% discontinued** one or more diabetes medications

# Results: at 12 months, percentage of participants reaching thresholds



# Treating Type 2 Diabetes: Online Program



Original Paper

# An Online Intervention Comparing a Very Low-Carbohydrate Ketogenic Diet and Lifestyle Recommendations Versus a Plate Method Diet in Overweight Individuals With Type 2 Diabetes: A Randomized Controlled Trial

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Laura R Saslow<sup>1</sup>, PhD; Ashley E Mason<sup>2</sup>, PhD; Sarah Kim<sup>3</sup>, MD; Veronica Goldman<sup>2</sup>; Robert Ploutz-Snyder<sup>4</sup>, PhD; Hovig Bayandorian<sup>5</sup>; Jennifer Daubenmier<sup>6</sup>, PhD; Frederick M Hecht<sup>2\*</sup>, MD; Judith T Moskowitz<sup>7\*</sup>, PhD

25 overweight adults (BMI  $\geq 25$ ) with type 2 diabetes (elevated HbA1c of 6.5%-9%) on no diabetes medications other than metformin.

Baseline HbA1c about 7%.

32-week (8-month) program:

- automatic e-mails with symptom check-in, online videos, & downloadable handouts; e-mail and phone support

# Randomize Participants to 1 of 2 Groups

ADA plate  
method diet (n=13)



Very low-  
carbohydrate diet  
(n=12)

Multi-  
component  
program

Positive  
Affect  
Training

Mindfulness  
Instruction

Behavioral  
Support

Exercise &  
Sleep  
Guidelines

# Remote measurements



# Example video slide:

**\*increase your food variety!**



**SNACKS**



**SOUPS**



**SALADS**



**MAIN DISHES**



**SIDE DISHES**



**BREADS**



**DESSERTS**



**MISCELLANEOUS**

online low carb recipe collections like  
<http://www.genaw.com/lowcarb>

# Dropout, diet ratings

## ADA plate method diet

Dropout: 46%

**Lower** rating for how much they like how they feel on their assigned diet

**More** likely to self-report cheating on the diet

## Very low-carbohydrate diet & extras

Dropout: 8%

**Higher** rating for how much they like how they feel on their assigned diet

**Less** likely to self-report cheating on the diet

# Self-reported diet

## ADA plate method diet

**Non-fiber g of carbs:**  
**144.8** (SD 33.7)  
(152 g at baseline)

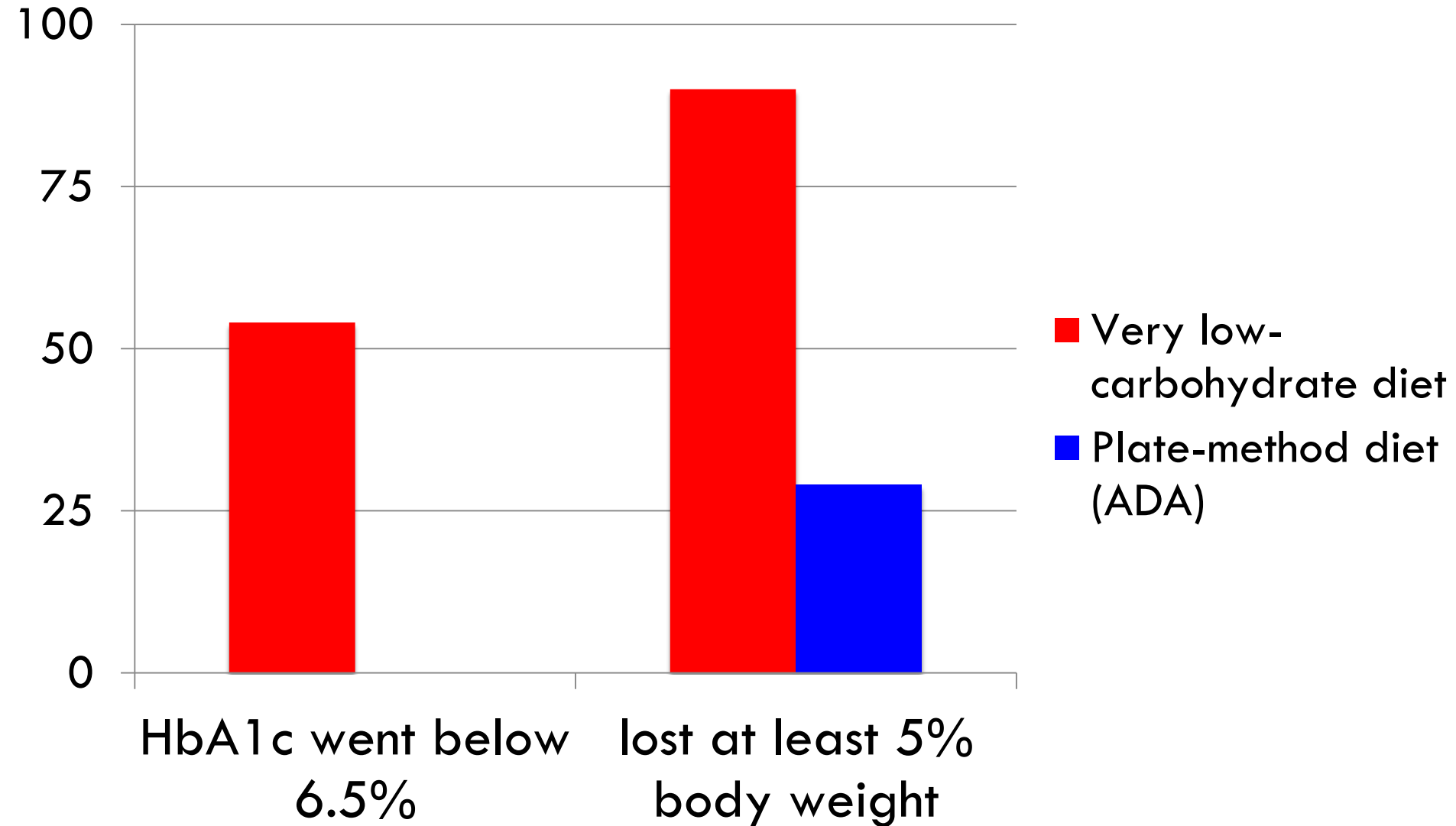
**Percentage of calories from total carbs:**  
**43.0%** (SD 9.1%)  
(38% at baseline)

## Very low-carbohydrate diet & extras

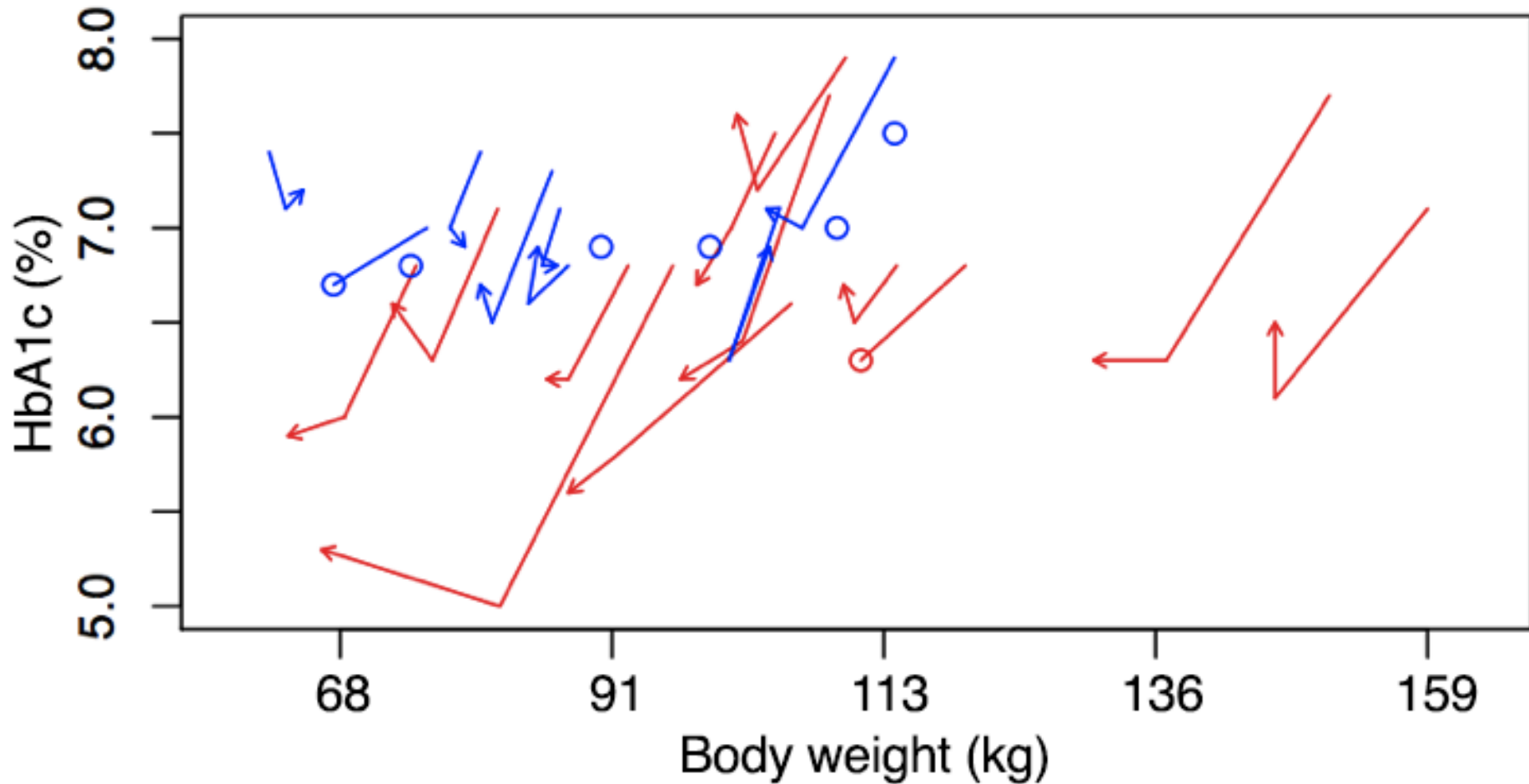
**Non-fiber g of carbs:**  
**43.5** (SD 33.9)  
(164 g at baseline)

**Percentage of calories from total carbs:**  
**18.5%** (SD 12.8%)  
(40% at baseline)

# Results: at 8 months, percentage of participants reaching thresholds



**Body weight and HbA1c** plotted for each participant separately for each of the three time periods (0, 4, and 8 months).





## Participant comments

*“Things are going very well. Still excited by the weight loss and the blood glucose levels. Thanks for being there. Look forward to the messages each week.”*

*“Very happy with the diet, lack of hunger, weight loss (down 28lbs in 6 weeks or so). Had a diabetes checkup with my doctor. My A1c was 5.8. So all good!”*

# Optimizing the Online Program:

Texts, Meter, Gifts

# Optimizing the online program



**44** overweight individuals with type 2 diabetes, on no diabetes medications other than metformin.

Baseline HbA1c 8.4%.

12-month program:

- similar to the previous program

# Compare 3 Factors

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Very low-carbohydrate diet  
& multicomponent program

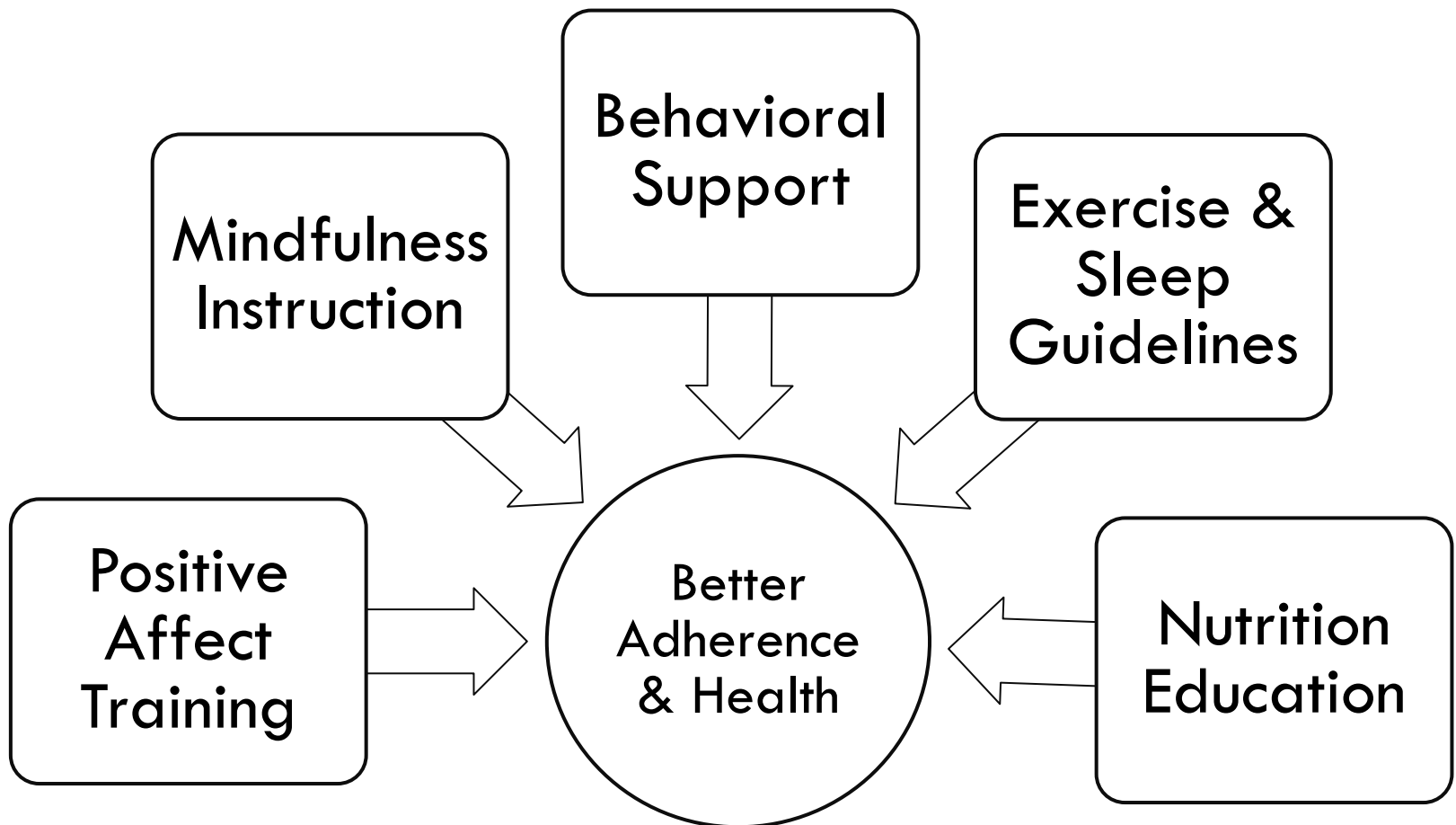
Text  
Messages  
(Yes or No)

Breath Meter  
(Yes or No)

Food & Book  
Gifts  
(Yes or No)

Full factorial (2x2x2)

# Text Messages (Yes or No)



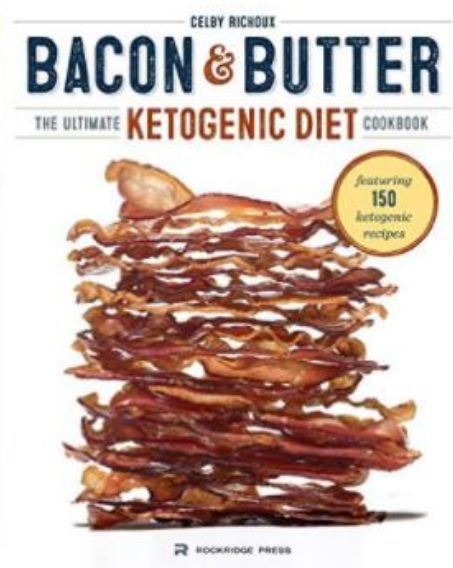
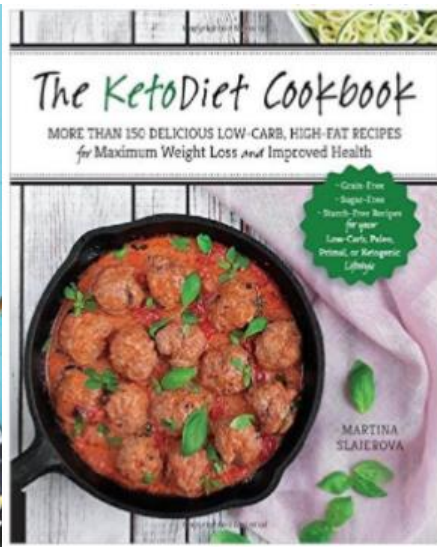
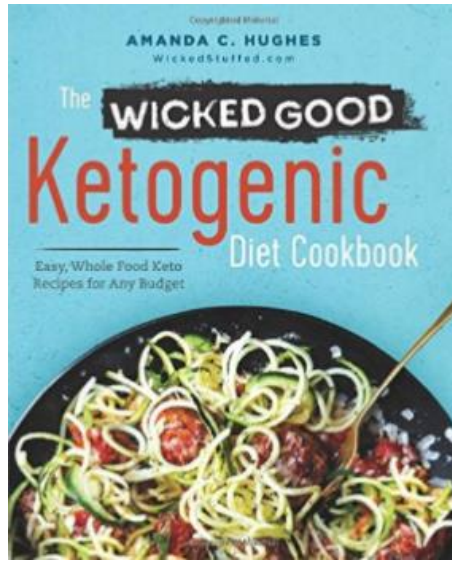
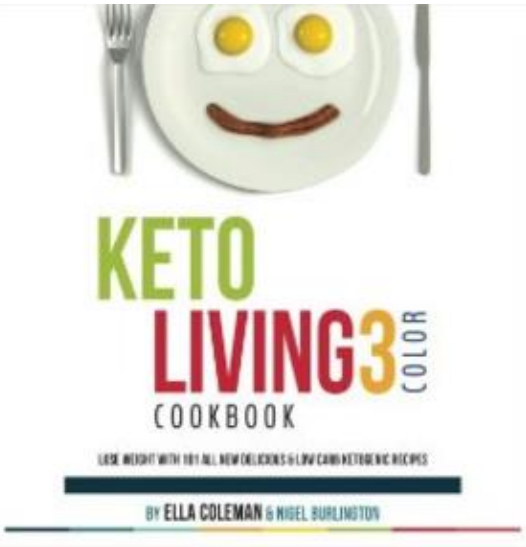
# Breath Meter (Yes or No)



*Breath Ketone Analyzer*  
**KETONIX®**



# Food & Book Gifts (Yes or No)



## Participant comments



A1c reduced from 8.2% to 6.3% after 5 months: *“I am very happy with my new state of health! My Doctor reduced my Metformin in half... I want to thank you for giving me control of my sugar cravings, and my blood glucose levels! I now I have the tools to completely control my own Type 2 Diabetes. Food no longer dominates my thoughts.”*



# Participant comments

A1c reduced from 11.4% to 5.9% after 7 months: *“I can't really think of any improvements to be honest, think you do a good job of providing useful information to stay low carb! Thanks! Last blood test low triglycerides, all good readings. Dr. is cutting meds. Thank You.”*

A1c reduced from 8.3% to 6.9% after 6 months: *“I'm so excited!... My doctor LOVES this plan to promote a healthier me! Thanks forever!”*

# Optimizing the Online Program:

Positive Affect,

Mindfulness, Tracking

# K01 from the National Institute of Diabetes and Digestive and Kidney Diseases



## **NOW RECRUITING at [SUCCEEDStudy.org](http://SUCCEEDStudy.org)**

**144** overweight individuals with type 2 diabetes, on no diabetes medications other than metformin

**12-month** program:

- similar to previous trials with optional texts, some gifts, urine test strips
- measurements at 0, 4, 8, and 12 months

# Compare 3 Factors

Very low-carbohydrate diet  
& multicomponent program

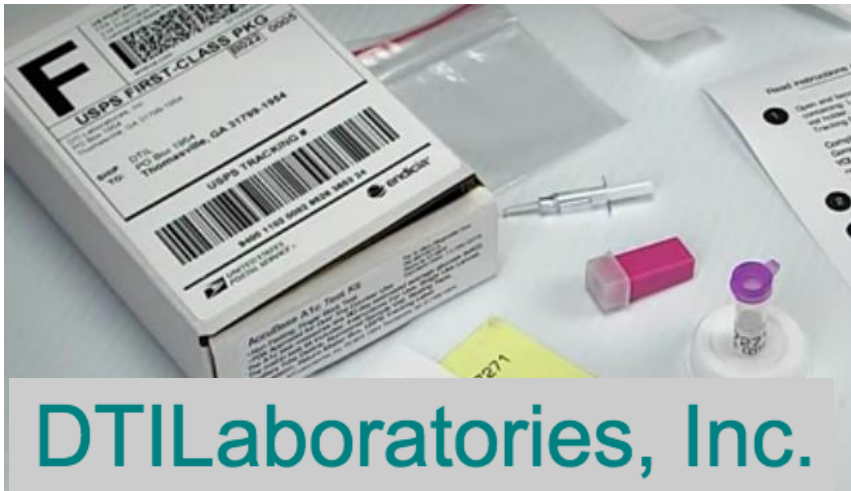
Positive  
Affect  
(Yes or No)

Mindfulness  
(Yes or No)

Dietary  
Tracking  
(High or Low)

Full factorial (2x2x2)

# Remote measurements



 BodyTrace



myfitnesspal



## Results



**We'll see!**

**NOW RECRUITING at  
SUCCEEDStudy.org**

# SUCCEEDStudy.org

## Help me recruit! Take some brochures!

The National Institute of Diabetes and Digestive and Kidney Diseases, part of the National Institutes of Health, is supporting the SUCCEED study, a research study to improve an already successful online self-management weight-loss program for adults with type 2 diabetes.

We are seeking people with type 2 diabetes who are interested in participating. We pay up to \$100.

Participants will receive, for free:

- More than 15 video-based lessons
- Coaching, helpful texts (if you'd like them)
- Gifts of food and cookbooks
- Your HbA1c results and a digital scale

...Enjoy your life, spend it in happiness...  
Savor your food, [and] make each of your days a delight...  
- Gilgamesh (an ancient Sumerian text)

**M HEALTH SYSTEM**  
UNIVERSITY OF MICHIGAN

FOR MORE INFORMATION OR TO SEE IF YOU QUALIFY FOR THE STUDY PLEASE VISIT:  
[www.SUCCEEDstudy.org](http://www.SUCCEEDstudy.org)

**M**  
UNIVERSITY OF MICHIGAN

Laura Saslow, PhD  
[info@succeedstudy.org](mailto:info@succeedstudy.org)  
734-764-7836  
UM IRBMED # HUM00115537

**Want to lose weight & control your diabetes?**

- BLOOD SUGAR CONTROL
- WEIGHT LOSS
- TOOLS TO HELP YOU

The SUCCEED study may be right for you  
[www.SUCCEEDstudy.org](http://www.SUCCEEDstudy.org)

**SUCCEED**

The goal of the SUCCEED study is to improve our already successful online program to help adults with type 2 diabetes improve their health, lose weight, reduce their blood sugar levels, feel less hungry, and be better able to control their food cravings.

**ABOUT THE SUCCEED STUDY**  
Researchers at the University of Michigan have developed an online program for adults with type 2 diabetes. The program teaches a diet and lifestyle plan to help you improve your health. As part of your participation you will also receive cookbooks, a bodyweight scale, and your HbA1c results at no cost. **No in-person sessions are required.**

**AM I ELIGIBLE?**  
You may be eligible if you:

- Are between 21 and 70 years old
- Are overweight
- Only take metformin (Glucophage™) for your diabetes (or no medications)
- Have type 2 diabetes (current HbA1c of 6.5% or higher)
- Are ready to make changes!

**COMMENTS FROM PARTICIPANTS!**  
66-year old woman: "At my visit with my endocrinologist my A1c was 6.3. About 5 months ago it was 8.2. I am very happy with my new state of health! My Doctor reduced my Metformin in half... I want to thank you for giving me control of my sugar cravings, and my blood glucose levels! I now I have the tools to completely control my own Type 2 Diabetes. Food no longer dominates my thoughts."  
57-year old man who started with an A1c of 11.4% after 7 months: "I can't really think of any improvements to be honest, think you do a good job of providing useful information to stay low carb! Thanks! Last blood test 5.9 A1c, low triglycerides. Dr. is cutting meds. Thank You."  
52-year old woman who started with an A1c of 8.3% after 6 months: "Last visit to doctor and my HbA1c level was down to 6.9!!!!!! I'm so excited... My doctor LOVES this plan to promote a healthier me!"

**MAKE LASTING CHANGES**  
The online SUCCEED program teaches you how to follow a lower carbohydrate diet, enjoy more physical activity, and get adequate sleep.  
Our goal is to help adults with type 2 diabetes make LASTING diet and lifestyle changes for better long-term health.  
After 8 months, more than 90% of our past participants lost at least 5% of their body weight.

Go to [www.SUCCEEDstudy.org](http://www.SUCCEEDstudy.org) to get started!

Overweight adults (BMI 25-45), 21-70 years old, A1c 6.5%+, on metformin or no glucose-lowering medications for their type 2 diabetes, Paid \$100

# Future Research



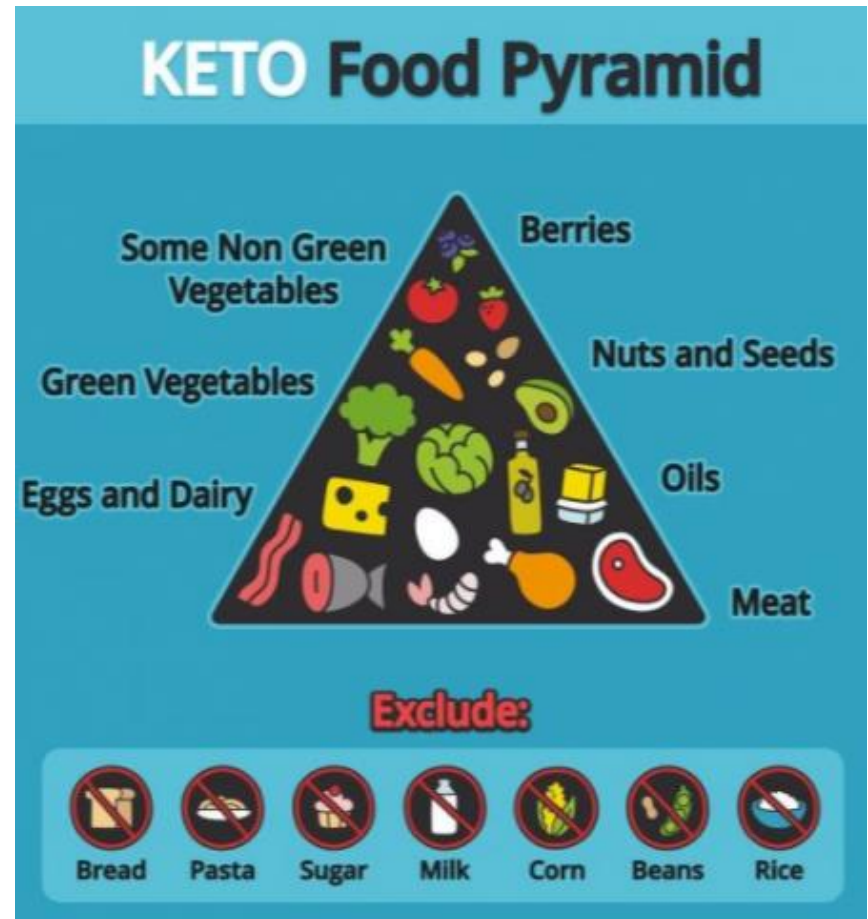
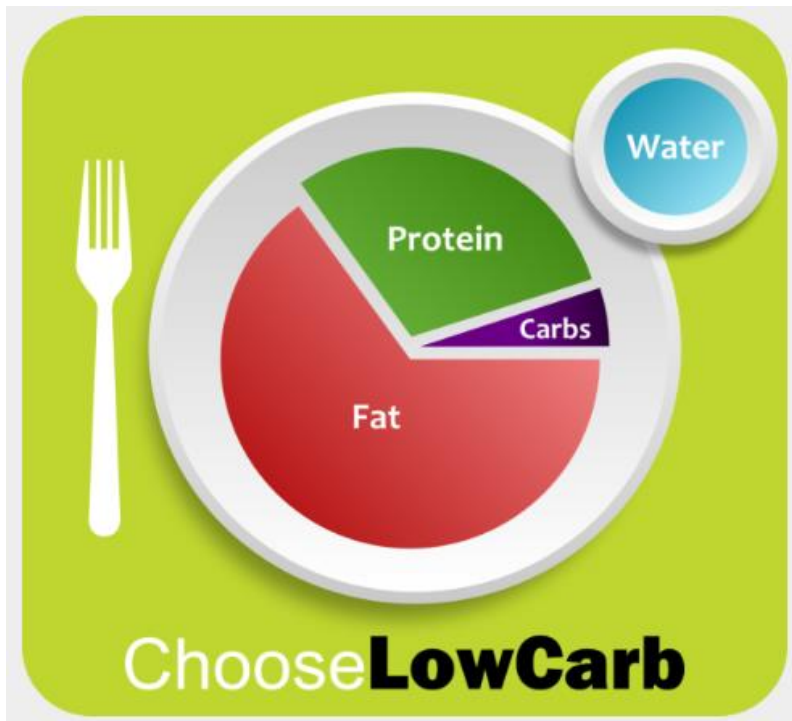
# Future: Long-term adherence



“The **after treatment** of diabetic patients is quite as important as the initial treatment. Patients must learn to **keep sugar-free** and maintain weight, and when difficulties occur **report for advice.**”

Elliott Joslin, 1915

# Future: Simplified rules?



# Future: Keto vs. Low-Carb



For more information, visit [reddit.com/r/keto](https://reddit.com/r/keto)  
 For delicious keto recipes, visit [reddit.com/r/ketorecipes](https://reddit.com/r/ketorecipes)

# NOW RECRUITING at SUCCEEDStudy.org

## Thank you:

Our participants!

Ashley Mason

Carley Hauck

Elizabeth J. Murphy

Eric Westman

Gary Taubes

Gina Dahlem

Hovig Bayandorian

James Aikens

Jennifer J. Daubenmier

Judith T. Moskowitz

Marlene Otto

Michele Heisler

Michael Hall

Mike Acree

Martha Pietrucha

Patricia Moran

Rachel M. Cox

[reddit.com/r/keto](https://www.reddit.com/r/keto)

Rick Hecht

Robert Ploutz-Snyder

Sarah Kim

Stephen D. Phinney

Veronica Goldman

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- Center for Complexity and Self-Management of Chronic Disease
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- Mount Zion Health Fund
- Bowes Fund for Innovative Research in Integrative Medicine



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