HUNGER ★ FREE OKLAHOMA

Food is Medicine Part 1: Nutrition Prescriptions and Implementation Networks

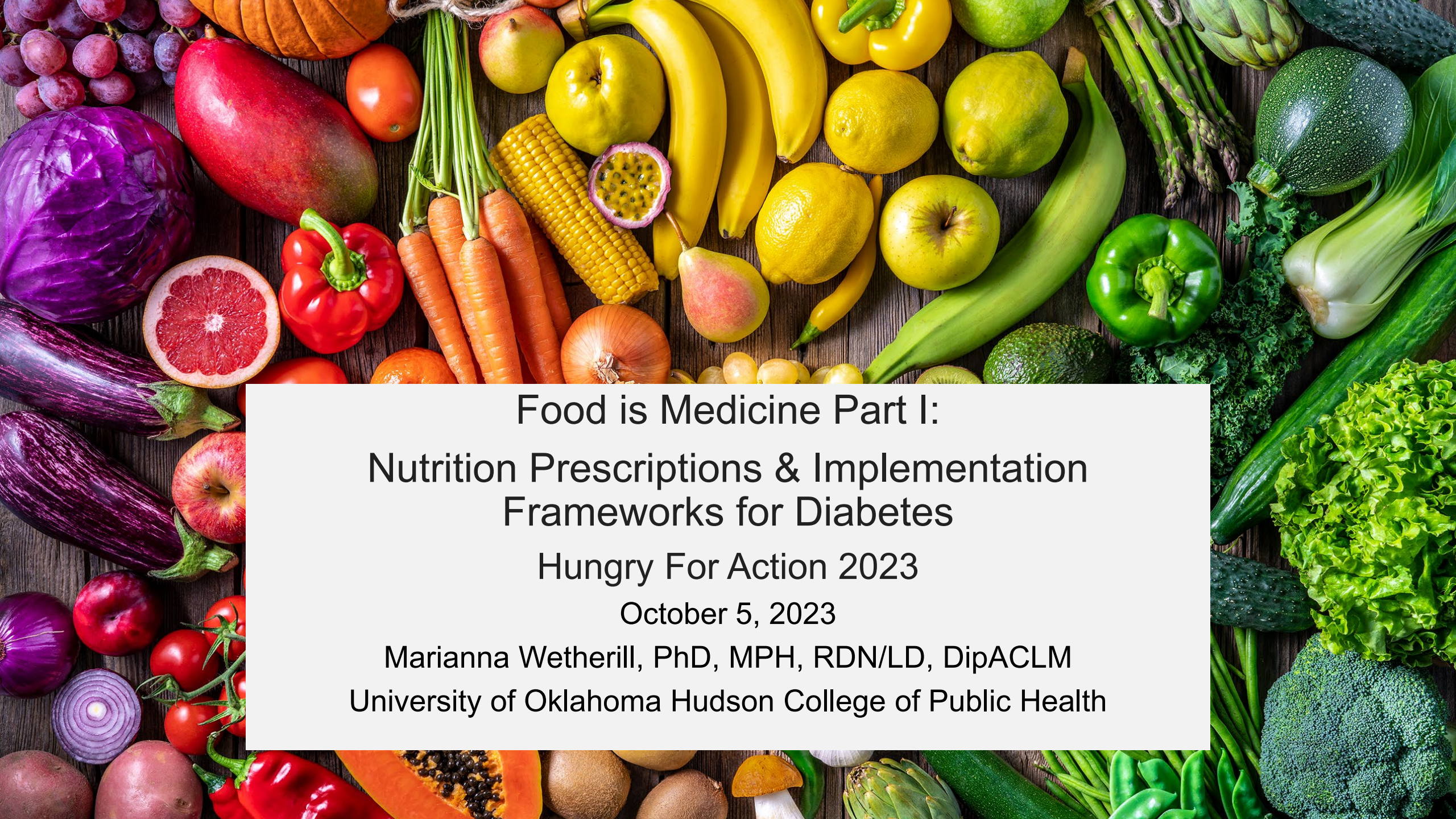
Dr. Marianna Wetherill

AN INITIATIVE OF HUNGER FREE OKLAHOMA

HUNGRY FOR ACTION

OKLAHOMA'S ANTI-HUNGER CONFERENCE 2023

#HungryForActionOK



Food is Medicine Part I:

Nutrition Prescriptions & Implementation Frameworks for Diabetes

Hungry For Action 2023

October 5, 2023

Marianna Wetherill, PhD, MPH, RDN/LD, DipACLM

University of Oklahoma Hudson College of Public Health

Disclosures

Presenter Conflicts of Interest/Financial Relationships Disclosures:
Dr. Marianna Wetherill, PhD, MPH, RDN/LD – Serves as an evaluation consultant for the Double Up Oklahoma Program and for the Sunflower Foundation Food is Medicine Initiative

Funding Acknowledgment:
Development of a portion of the slides used in this presentation was supported by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS) as part of an award (#T99HP33558) totaling $12,616,506 with 10% financed with nongovernmental sources. The contents are those of the authors and do not necessarily represent the official views of, nor an endorsement, by HRSA, HHS or the U.S. Government.

Learning Objectives/Program Overview

- This workshop will review nutrition prescriptions for diabetes and how they can be promoted within healthcare settings through 3 different food is medicine models. Specifically, we will:
  - ✓ Define nutrition insecurity and describe implications for glycemic control.
  - ✓ Define "Food is Medicine" in the healthcare-community context.
  - ✓ Describe opportunities for "food is medicine" in diabetes care, including 4 example nutrition prescriptions that reinforce healthier eating patterns for glycemic control.
  - ✓ Name 3 "food is medicine" implementation frameworks (models) that can be used in healthcare settings, including medically-tailored meals, medically-tailored groceries, and produce prescriptions

Hello!

Marianna Wetherill, PhD, MPH, RDN/LD

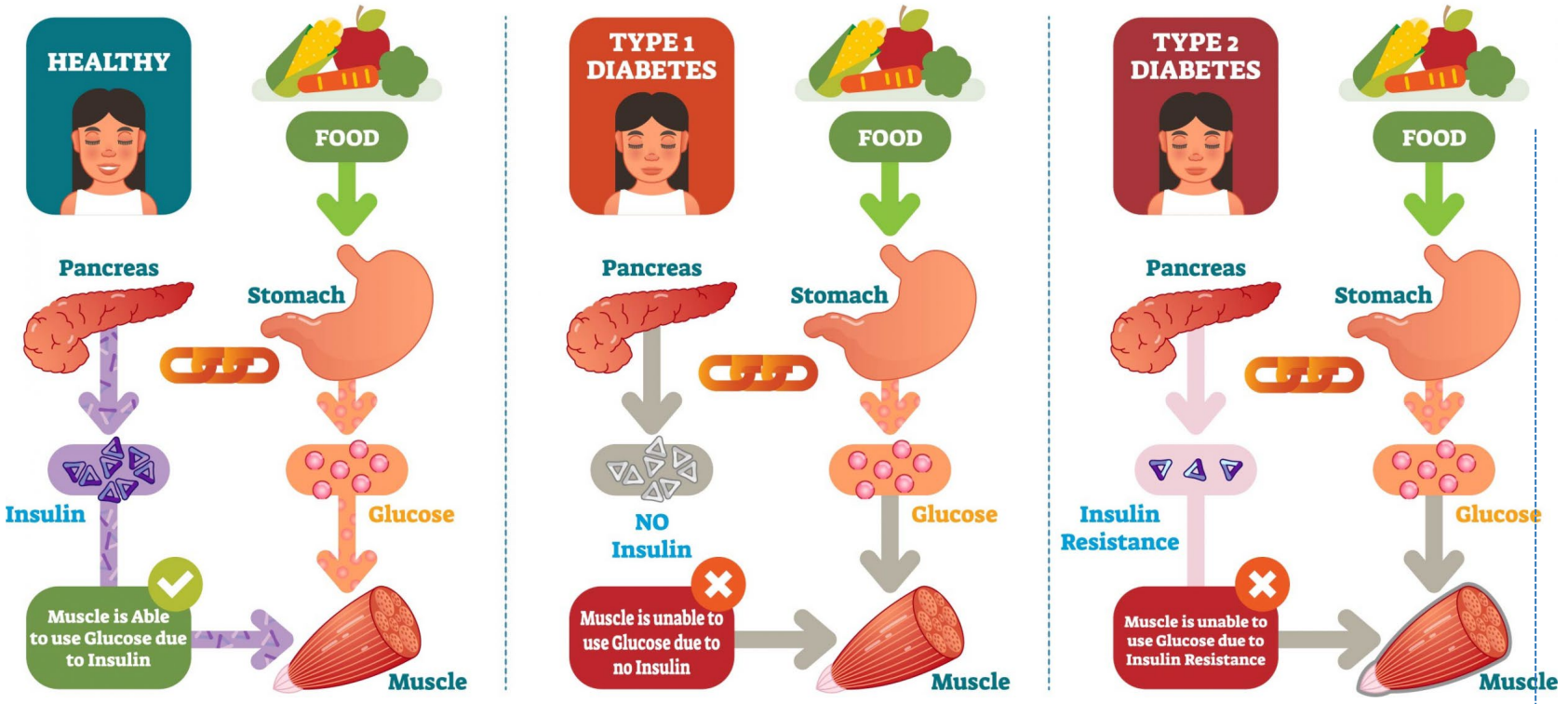
Henry Zarrow Presidential Professor
George Kaiser Family Foundation Chair, Population Healthcare
Associate Professor
Health Promotion Sciences, Hudson College of Public Health
Family & Community Medicine, OU-TU School of Community Medicine

Director, Root Cause Food Equity Lab

Research Director, OU Culinary Medicine Program
University of Oklahoma Tulsa Schusterman Center

DIABETES & NUTRITION INSECURITY IN THE U.S.

Types of diabetes



<5% cases

~90-95% cases

Gestational Diabetes

- Affects 2-10% of all pregnant women in the US
- ~50% of women with gestational diabetes go on to develop type 2 diabetes

root cause FOOD equity LAB | OU-TULSA

https://www.hhs.nd.gov/public-health-information/diseases-conditions-and-immunization/north-dakota-diabetes-prevention-2-1

How long does it take to develop Type 2 diabetes and how is it diagnosed?

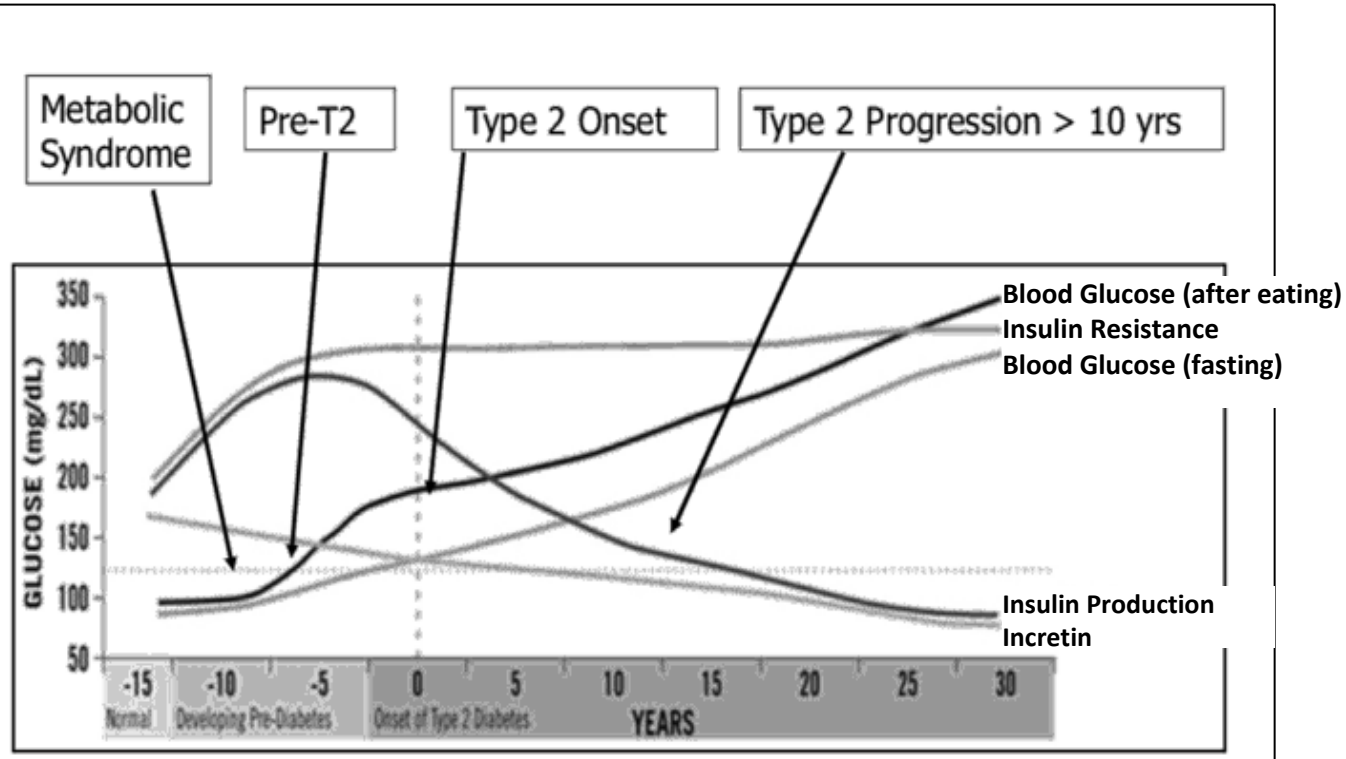
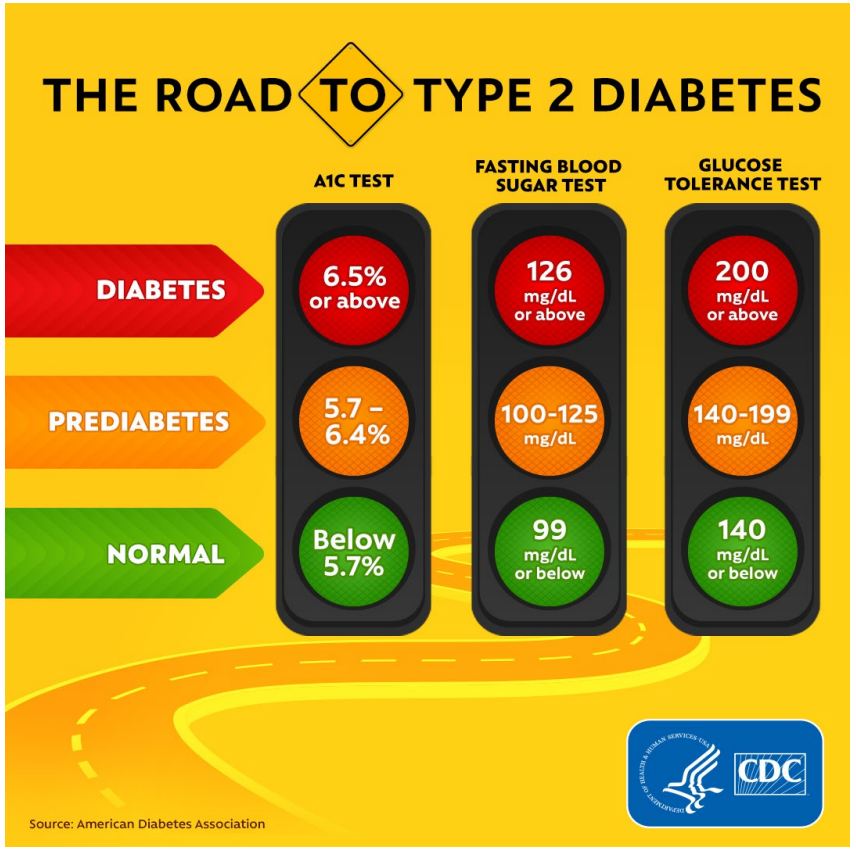
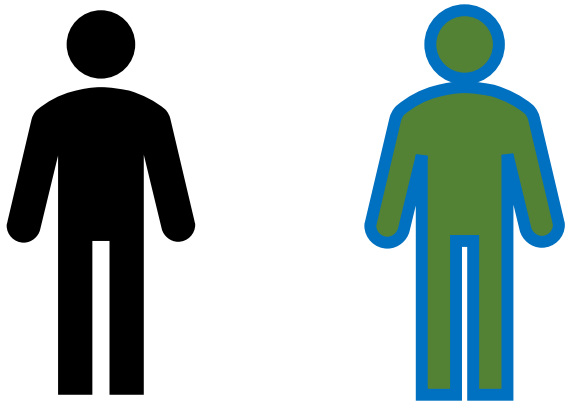


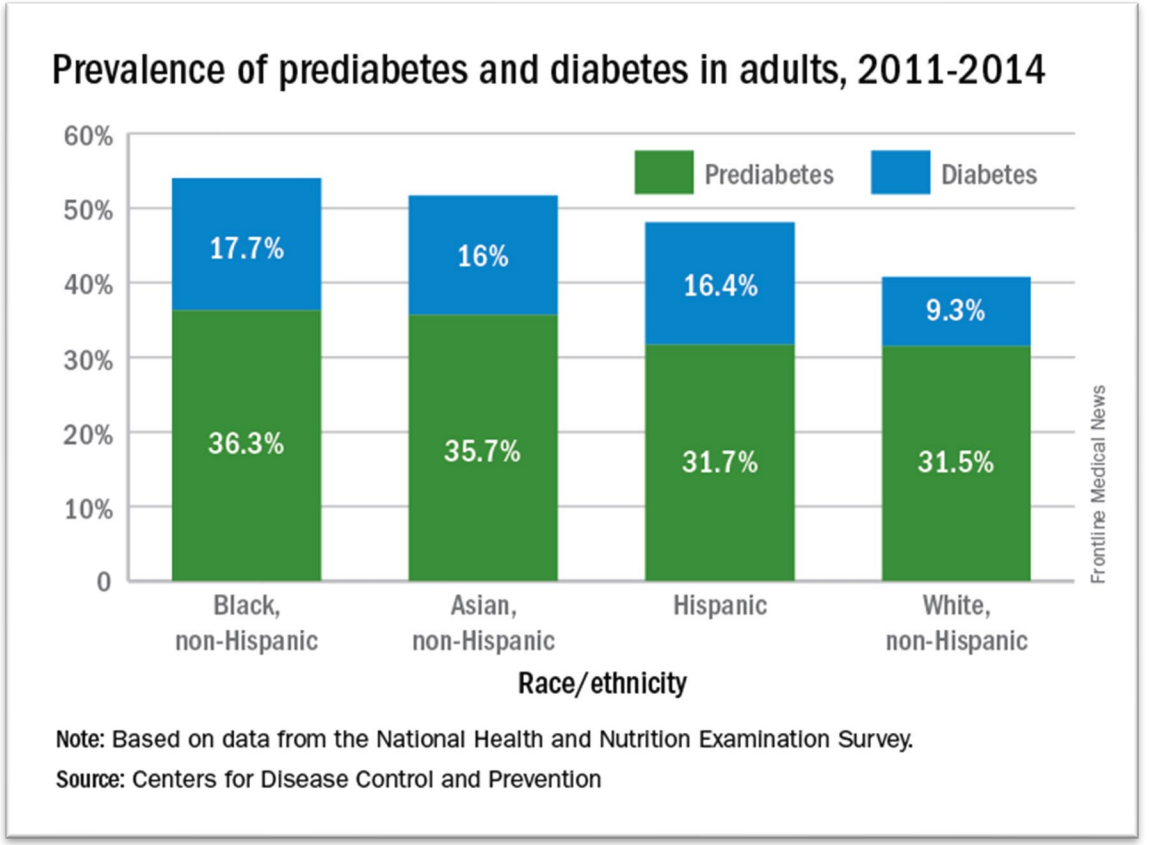
Figure 1. Natural history of IR and diabetes progression from Warshaw,[3] adapted from multiple sources.[2,4]



How many adults in the US have diabetes or prediabetes?



~ 1 in 2 US adults have diabetes or prediabetes



~~FOOD~~ NUTRITION SECURITY DEFINED

Consistent and equitable access to healthy, safe, and affordable foods that promote optimal health and well-being.

Nutrition security builds on food security by focusing on how the quality of our diets can help reduce diet-related diseases.

It also emphasizes equity and tackling long-standing health disparities.

https://www.usda.gov/nutrition-security

Meet Betty

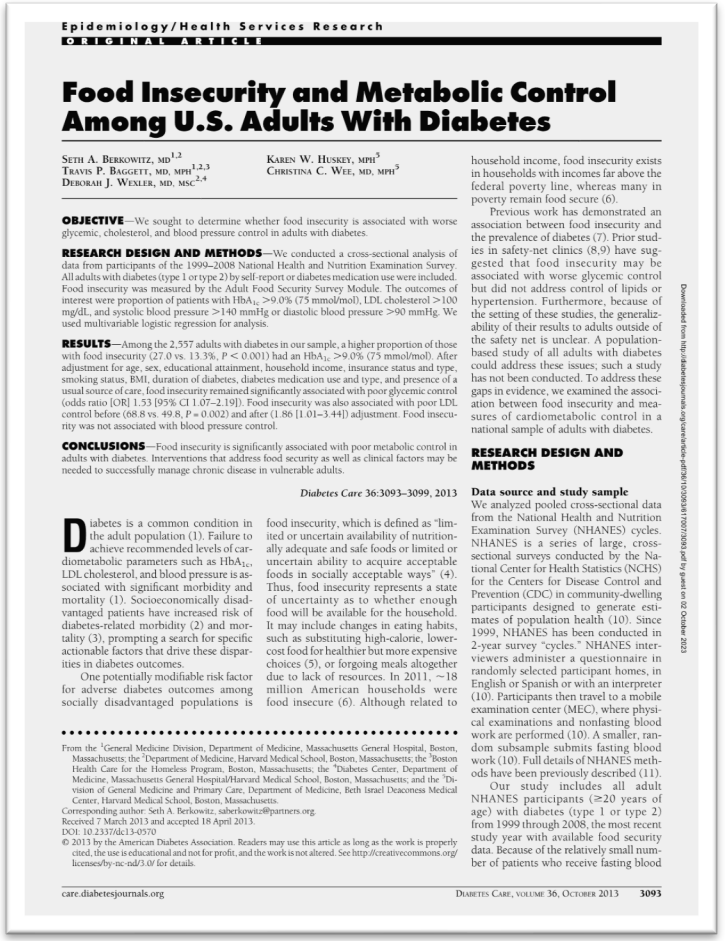
- Betty is a widow with history of diabetes with recent stroke that limits use of dominant hand
- Recently awarded guardianship of 5 grandchildren (ranging ages 3-12)
- POC Hgb A1c is 9.5% in office today
- Reports limiting insulin or oral meds to ½ dose (medication scrimping) due to lack of resources

How common is food insecurity among those with diabetes?

Food Insecurity Prevalence

- Diabetes, overall (12%) [Other studies have found closer to 20%]
- Among those with HbA1c >9.0% (22%)
  - aOR=1.53 (1.07–2.19)
- Among those with LDL >100 mg/dL (15.4%)
  - aOR= 1.86 (1.01–3.44)
- Food insecurity more common among adults with diabetes who were:
  - 20-40 years
  - Non-Hispanic Black and Hispanic
  - Lacked insurance or publicly-insured

"Food insecurity indicates a group at high risk for poor disease control."



Epidemiology/Health Services Research

ORIGINAL ARTICLE

Food Insecurity and Metabolic Control Among U.S. Adults With Diabetes

SETH A. BERKOWITZ, MD[1,2]
TRAVIS P. BAGGETT, MD, MPH[1,2,3]
DEBORAH J. WEXLER, MD, MSC[2,4]
KAREN W. HUSKEY, MPH[5]
CHRISTINA C. WEE, MD, MPH[5]

OBJECTIVE—We sought to determine whether food insecurity is associated with worse glycemic, cholesterol, and blood pressure control in adults with diabetes.

RESEARCH DESIGN AND METHODS—We conducted a cross-sectional analysis of data from participants of the 1999–2008 National Health and Nutrition Examination Survey. All adults with diabetes (type 1 or type 2) by self-report or diabetes medication use were included. Food insecurity was measured by the Adult Food Security Survey Module. The outcomes of interest were proportion of patients with HbA_{1c} >9.0% (75 mmol/mol), LDL cholesterol >100 mg/dL, and systolic blood pressure >140 mmHg or diastolic blood pressure >90 mmHg. We used multivariable logistic regression for analysis.

RESULTS—Among the 2,557 adults with diabetes in our sample, a higher proportion of those with food insecurity (27.0 vs. 13.3%, $P < 0.001$) had an HbA_{1c} >9.0% (75 mmol/mol). After adjustment for age, sex, educational attainment, household income, insurance status and type, smoking status, BMI, duration of diabetes, diabetes medication use and type, and presence of a usual source of care, food insecurity remained significantly associated with poor glycemic control (odds ratio [OR] 1.53 [95% CI 1.07–2.19]). Food insecurity was also associated with poor LDL control before (68.8 vs. 49.8, $P = 0.002$) and after (1.86 [1.01–3.44]) adjustment. Food insecurity was not associated with blood pressure control.

CONCLUSIONS—Food insecurity is significantly associated with poor metabolic control in adults with diabetes. Interventions that address food security as well as clinical factors may be needed to successfully manage chronic disease in vulnerable adults.

Diabetes Care 36:3093–3099, 2013

Diabetes is a common condition in the adult population (1). Failure to achieve recommended levels of cardiometabolic parameters such as HbA_{1c}, LDL cholesterol, and blood pressure is associated with significant morbidity and mortality (1). Socioeconomically disadvantaged patients have increased risk of diabetes-related morbidity (2) and mortality (3), prompting a search for specific actionable factors that drive these disparities in diabetes outcomes.

One potentially modifiable risk factor for adverse diabetes outcomes among socially disadvantaged populations is food insecurity, which is defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (4). Thus, food insecurity represents a state of uncertainty as to whether enough food will be available for the household. It may include changes in eating habits, such as substituting high-calorie, lower-cost food for healthier but more expensive choices (5), or forgoing meals altogether due to lack of resources. In 2011, ~18 million American households were food insecure (6). Although related to household income, food insecurity exists in households with incomes far above the federal poverty line, whereas many in poverty remain food secure (6).

Previous work has demonstrated an association between food insecurity and the prevalence of diabetes (7). Prior studies in safety-net clinics (8,9) have suggested that food insecurity may be associated with worse glycemic control but did not address control of lipids or hypertension. Furthermore, because of the setting of these studies, the generalizability of their results to adults outside of the safety net is unclear. A population-based study of all adults with diabetes could address these issues; such a study has not been conducted. To address these gaps in evidence, we examined the association between food insecurity and measures of cardiometabolic control in a national sample of adults with diabetes.

RESEARCH DESIGN AND METHODS

Data source and study sample

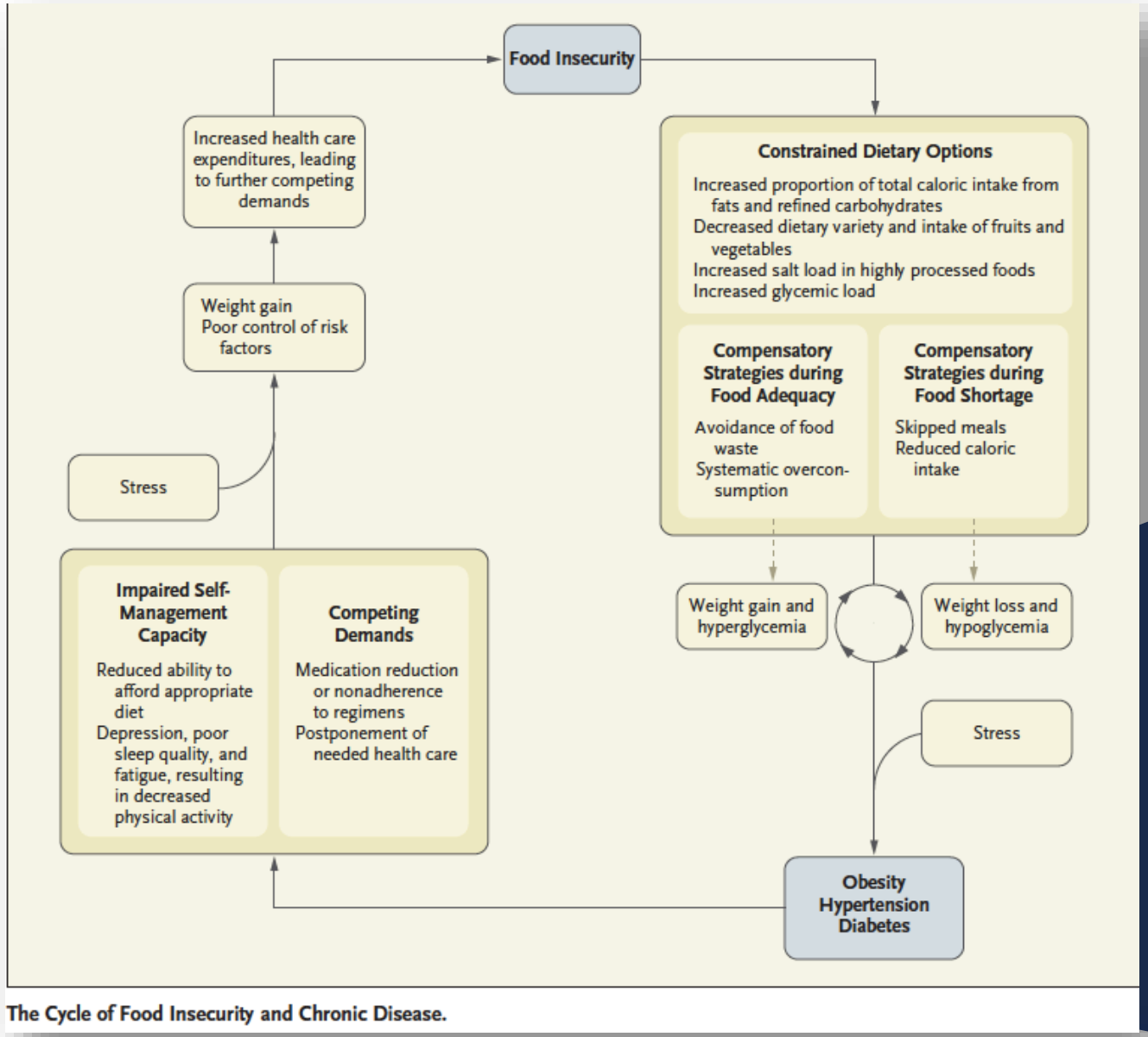
We analyzed pooled cross-sectional data from the National Health and Nutrition Examination Survey (NHANES) cycles. NHANES is a series of large, cross-sectional surveys conducted by the National Center for Health Statistics (NCHS) for the Centers for Disease Control and Prevention (CDC) in community-dwelling participants designed to generate estimates of population health (10). Since 1999, NHANES has been conducted in 2-year survey "cycles." NHANES interviewers administer a questionnaire in randomly selected participant homes, in English or Spanish or with an interpreter (10). Participants then travel to a mobile examination center (MEC), where physical examinations and nonfasting blood work are performed (10). A smaller, random subsample submits fasting blood work (10). Full details of NHANES methods have been previously described (11).

Our study includes all adult NHANES participants (≥20 years of age) with diabetes (type 1 or type 2) from 1999 through 2008, the most recent study year with available food security data. Because of the relatively small number of patients who receive fasting blood

From the [1]General Medicine Division, Department of Medicine, Massachusetts General Hospital, Boston, Massachusetts; the [2]Department of Medicine, Harvard Medical School, Boston, Massachusetts; the [3]Boston Health Care for the Homeless Program, Boston, Massachusetts; the [4]Diabetes Center, Department of Medicine, Massachusetts General Hospital/Harvard Medical School, Boston, Massachusetts; and the [5]Division of General Medicine and Primary Care, Department of Medicine, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts.
Corresponding author: Seth A. Berkowitz, saberkowitz@partners.org.
Received 7 March 2013 and accepted 18 April 2013.
DOI: 10.2337/dc13-0570

root cause FOOD equity LAB | OU-TULSA

Seth A. Berkowitz, Travis P. Baggett, Deborah J. Wexler, Karen W. Huskey, Christina C. Wee; Food Insecurity and Metabolic Control Among U.S. Adults With Diabetes. *Diabetes Care* 1 October 2013; 36 (10): 3093–3099. https://doi.org/10.2337/dc13-0570



The Cycle of Food Insecurity and Chronic Disease.

Food insecurity can be both a *cause* and a *consequence* of poor health.

root cause FOOD equity LAB | OU-TULSA

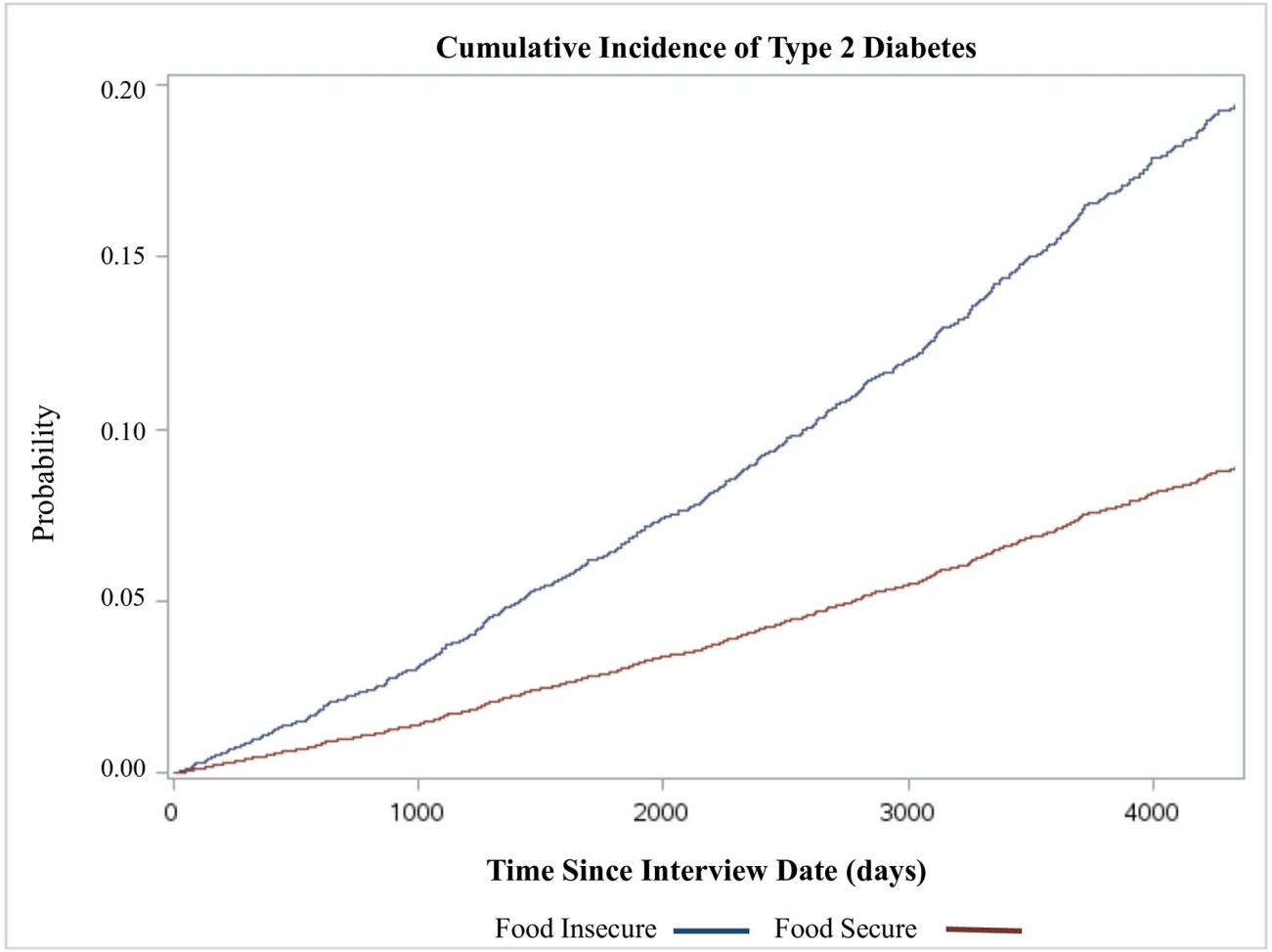
Seligman, H. K., & Schillinger, D. (2010). Hunger and Socioeconomic Disparities in Chronic Disease. *New England Journal of Medicine, 363*(1), 6-9. doi:doi:10.1056/NEJMp1000072

How can food insecurity and obesity co-exist?

Food Research and Action Center. (2015, October). Understanding the Connections: Food Insecurity and Obesity. Retrieved November 17, 2021, from https://frac.org/wp-content/uploads/frac_brief_understanding_the_connections.pdf.
Ding, M., Keiley, M. K., Garza, K. B., Duffy, P. A., & Zizza, C. A. (2015). Food insecurity is associated with poor sleep outcomes among US adults. The Journal of Nutrition, 145(3), 615-621.
Gowda, C., Hadley, C., & Aiello, A. E. (2012). The association between food insecurity and inflammation in the US adult population. American Journal of Public Health, 102(8), 1579-1586.

"Canadians in food insecure households had more than **2 times the risk of developing type 2 diabetes** compared to those in food secure households."

"Additional adjustment for **BMI** attenuated the association between food insecurity and type 2 diabetes."



Cumulative incidence of type 2 diabetes by food security status, household population aged 18 or older, Ontario (n = 4,739), CCHS 2004 (Cycle 2.2).

root cause FOOD equity LAB | OU-TULSA

Tait CA, L'Abbé MR, Smith PM, Rosella LC (2018) The association between food insecurity and incident type 2 diabetes in Canada: A population-based cohort study. PLoS ONE 13(5): e0195962. https://doi.org/10.1371/journal.pone.0195962

Food insecurity increases risk for poor glycemic control. Why?

Food Insecurity Can Cause Hyperglycemia in 6 Possible Ways:

1. Higher intake of processed foods relative to unprocessed foods
2. Binge-fast cycles
3. Medication and food scrimping
4. Chronic stress (direct and indirect effects)
5. Reduced sleep quality (increases insulin resistance)
6. Lower rates of physical activity (increases insulin resistance)

Food Insecurity Can Cause Hypoglycemia in 2 Possible Ways:

1. Skipped meals or not eating for a full day
2. Inadequate carbohydrate intake relative to medication dose, esp. sulfonylureas or insulin

Mayer, V. L., McDonough, K., Seligman, H., Mitra, N., & Long, J. A. (2016). Food insecurity, coping strategies and glucose control in low-income patients with diabetes. Public health nutrition, 19(6), 1103-1111.

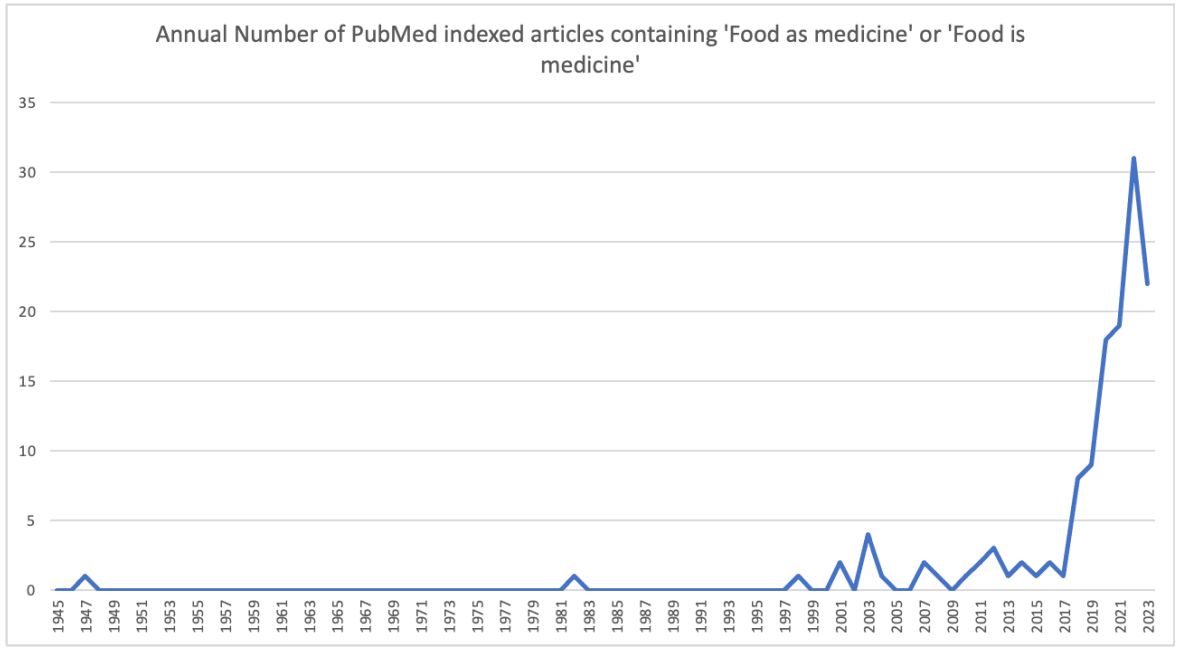
López, A., & Seligman, H. K. (2012). Clinical management of food-insecure individuals with diabetes. Diabetes Spectrum, 25(1), 14-18.

Berkowitz, S.A., X. Gao, and K.L. Tucker, Food-insecure dietary patterns are associated with poor longitudinal glycemic control in diabetes: results from the Boston Puerto Rican Health study. Diabetes Care, 2014. 37(9): p. 2587-92.

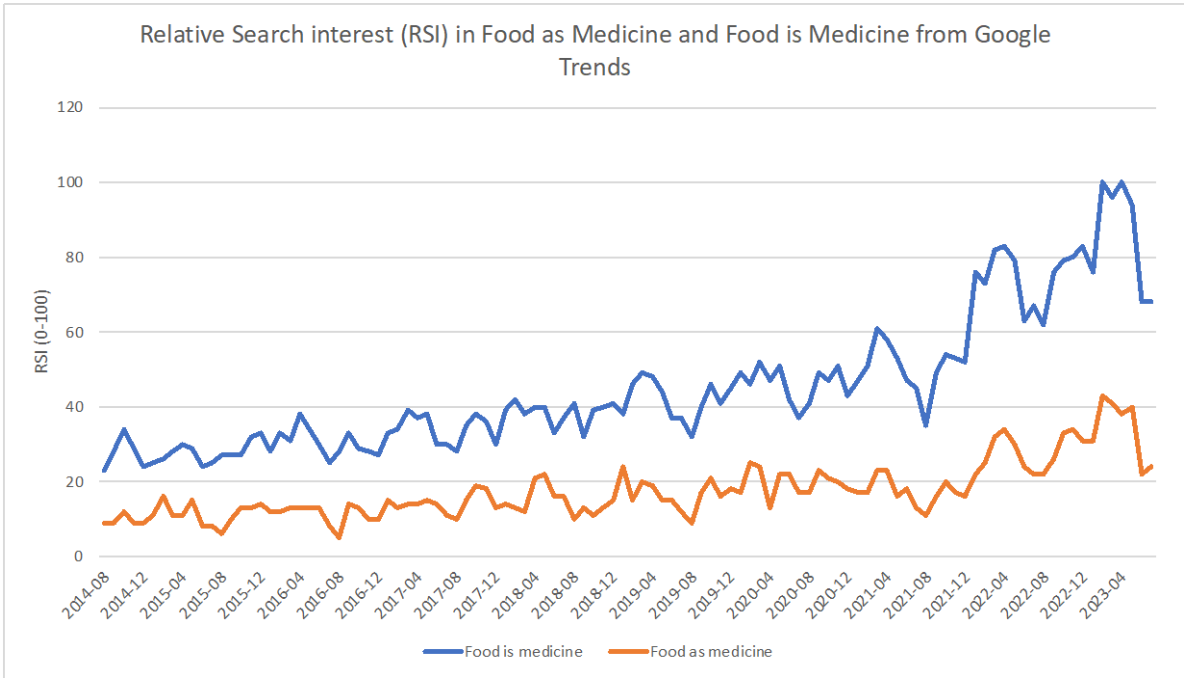
Berkowitz, S. A., Karter, A. J., Corbie-Smith, G., Seligman, H. K., Ackroyd, S. A., Barnard, L. S., ... & Wexler, D. J. (2018). Food insecurity, food "deserts," and glycemic control in patients with diabetes: a longitudinal analysis. Diabetes care, 41(6), 1188-1195.

DEFINING FOOD IS MEDICINE

Snapshot:
Scientific and Public Interest in Food is Medicine



PubMed Indexed Articles



Google Searches

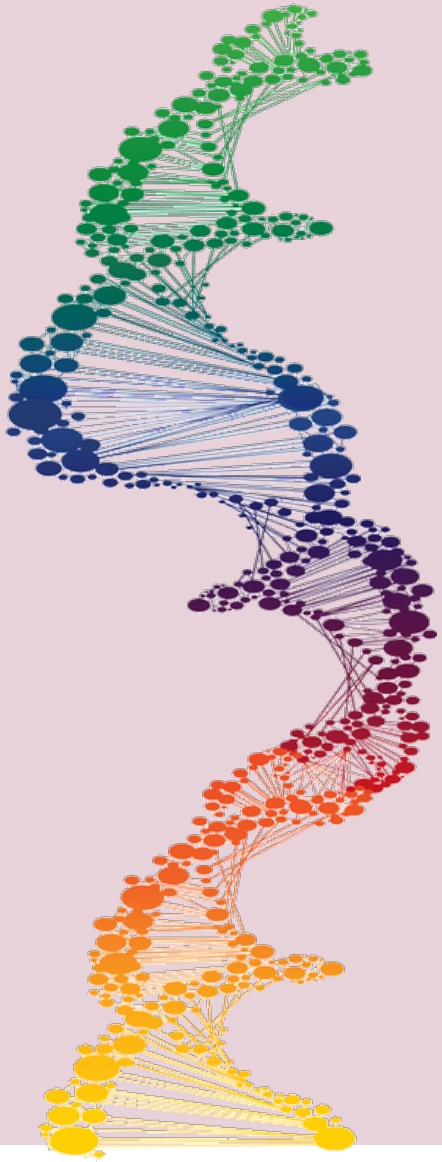
Food Is Medicine

"Food as medicine, is the prioritization of diet and nutrition (what we eat) as an important part of treating and preventing some chronic diseases."
–American College of Lifestyle Medicine

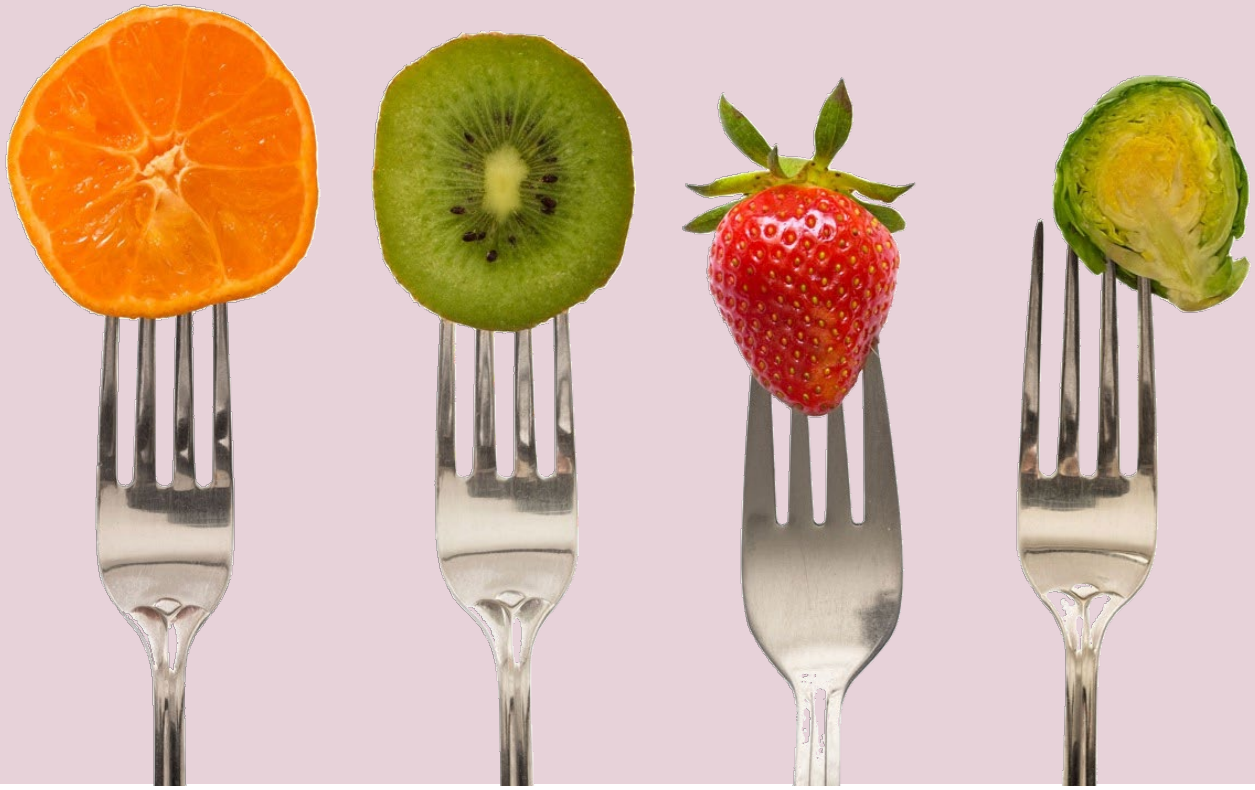
- **Food is Medicine interventions** – a spectrum of programs and services that respond to the critical link between nutrition and health.
- Two components:
  - Provision of food that supports health, such as medically tailored meals or groceries, or food assistance, such as vouchers for produce
  - A nexus to the healthcare system

root cause FOOD equity LAB | OU-TULSA

Downer, S., Clippinger, E. and Kummer, C. *Food is medicine research action plan*. 2022, Food & Society at the Aspen Institute.



Food sends messages to our genes



What diet is best for health?

- Dietary patterns, not specific individual foods, as better predictor of health
- Medically-tailored diets often have more similarities than differences across disease states
- Chronic inflammation is a primary pathway linking Western dietary patterns to elevated chronic disease risk and management
- Several dietary patterns can help to reduce chronic inflammation
  - Mediterranean diet, “New American Plate” diet, whole food, plant-based diets, DASH diet are a few examples
- For most patients, this requires an “eat more” and an “eat less” combined approach to behavior change

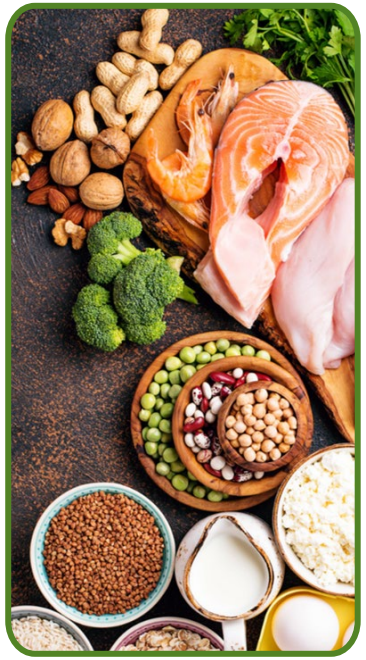
Eat MORE

COLOR

Dark green, yellow, orange, red, purple, blue vegetables and fruits (1/2 your plate)

WHOLE (INTACT) GRAINS

Oats, barley, and other 100% whole grain foods

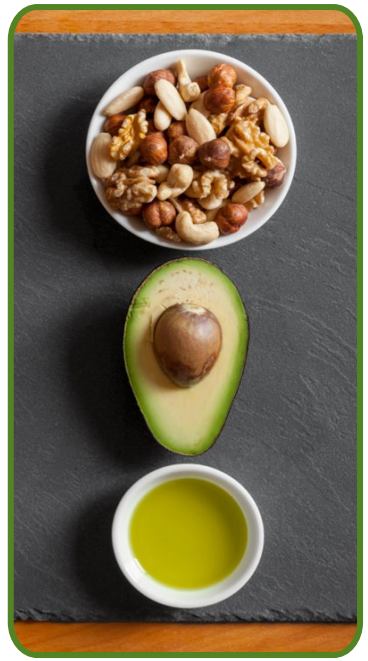


LEAN PROTEINS

Beans, lentils, fish, lean poultry, eggs, nuts, seeds

WATER, BLACK COFFEE, TEA

With no added sugars



HEALTHY FATS

Cold pressed plant oils, avocado, olives, nuts

Eat LESS

SUGAR SWEETENED BEVERAGES

Sodas, sweet tea, sports and energy drinks, fruit drinks

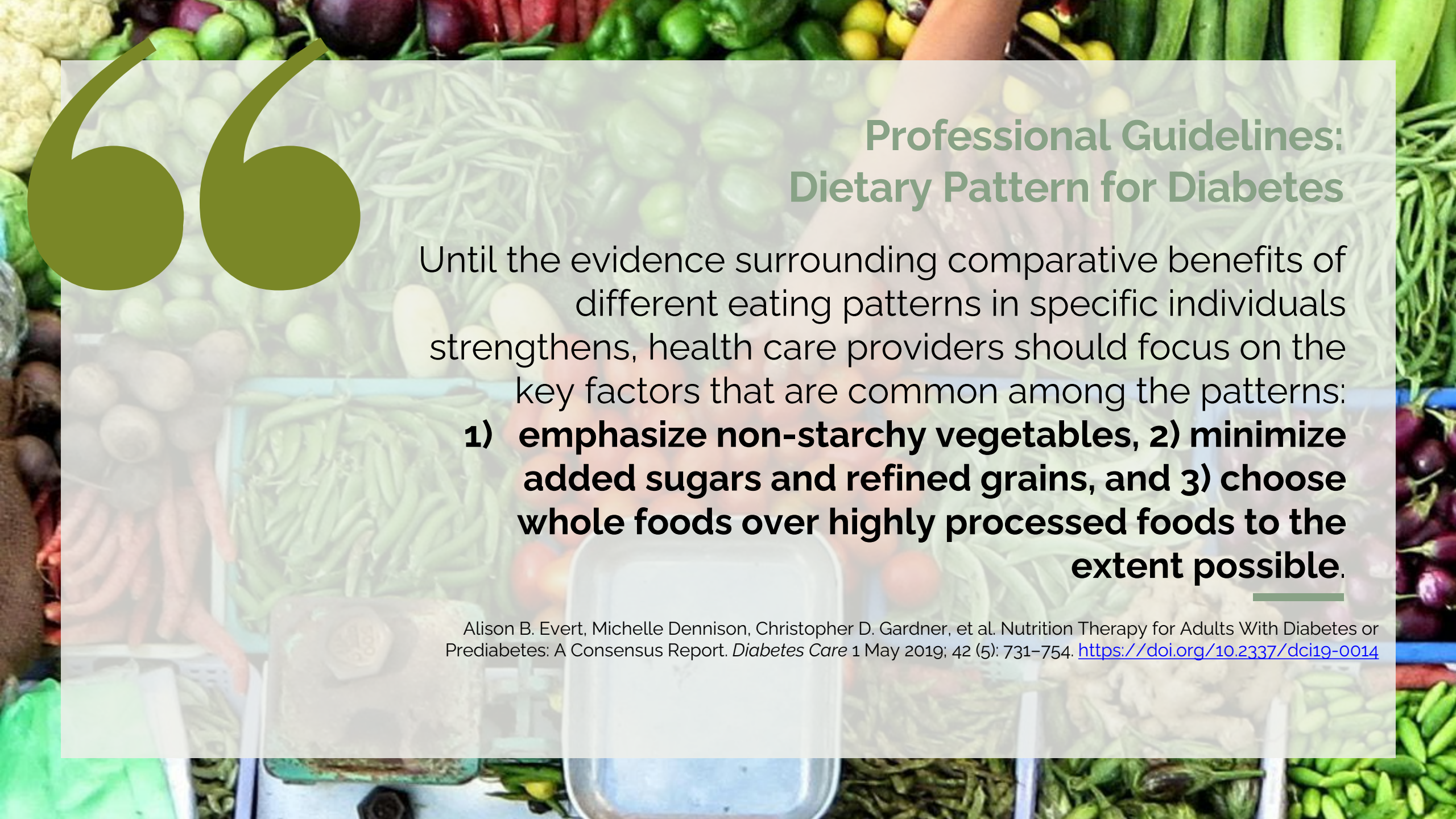
FRIED POTATOES AND OTHER DEEP-FRIED FOODS

ULTRA PROCESSED FOODS

Chips, chocolate, candy, ice-cream, sweetened cereals, packaged soups, etc.

HIGH-FAT ANIMAL PROTEINS & PROCESSED MEATS

Bacon, sausage, lunch meats, etc.



Professional Guidelines: Dietary Pattern for Diabetes

Until the evidence surrounding comparative benefits of different eating patterns in specific individuals strengthens, health care providers should focus on the key factors that are common among the patterns:

1) **emphasize non-starchy vegetables, 2) minimize added sugars and refined grains, and 3) choose whole foods over highly processed foods to the extent possible**.

Alison B. Evert, Michelle Dennison, Christopher D. Gardner, et al. Nutrition Therapy for Adults With Diabetes or Prediabetes: A Consensus Report. *Diabetes Care* 1 May 2019; 42 (5): 731–754. https://doi.org/10.2337/dci19-0014

Components of a

Nutrition Prescription

TYPE

Specify the food
(not the nutrient)

AMOUNT

Specify serving size using visual estimations when possible

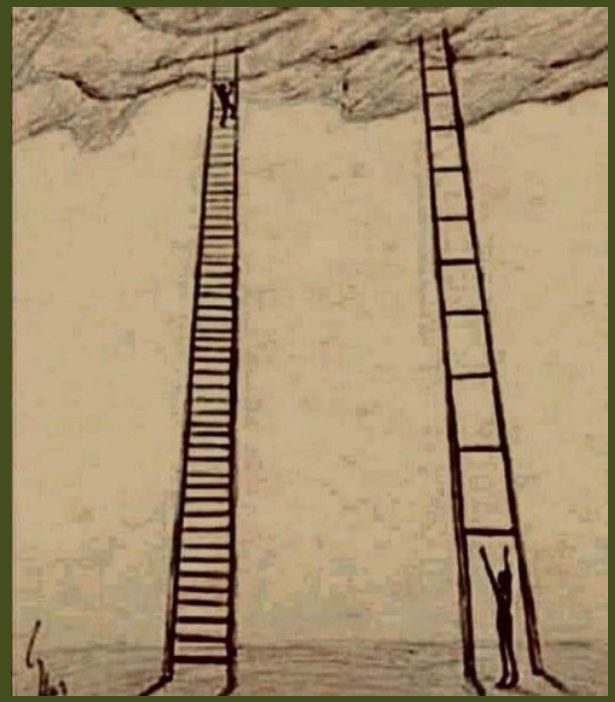
FREQUENCY

Specify how many times per day or per week

Continued...

Nutrition Rx

- The American College of Lifestyle Medicine recommends TAF format for nutrition prescriptions when delivered as part of routine medical care visit by a healthcare provider
- Can be positive (eat more) or negative (eat less)
- Designed to be concrete, easy to understand dietary changes with potential to be highly-therapeutic.
- These prescriptions are different from nutrition prescription written by an RD, which is the product of a comprehensive nutrition assessment as part of a medical nutrition therapy visit and is directly tied to a specific nutrition diagnosis.



Nutrition Rx:

Nuts & Seeds

TYPE

Almonds, walnuts, pecans, cashews, or sunflower, ground flax, or pumpkin seeds

AMOUNT

1-2 oz.

(1-2 small handfuls)

FREQUENCY

5-7 times a week

Nuts & Seeds

Key Intake Gaps

- Only 60.9% men and 53.8% women meet (≥30 g/d) guidelines for nuts, *peanuts*, and seeds (NHANES 2005-2018)
- Because they are micronutrient rich, nuts can help to fill multiple nutrient gaps, such as magnesium and fiber

1 oz.

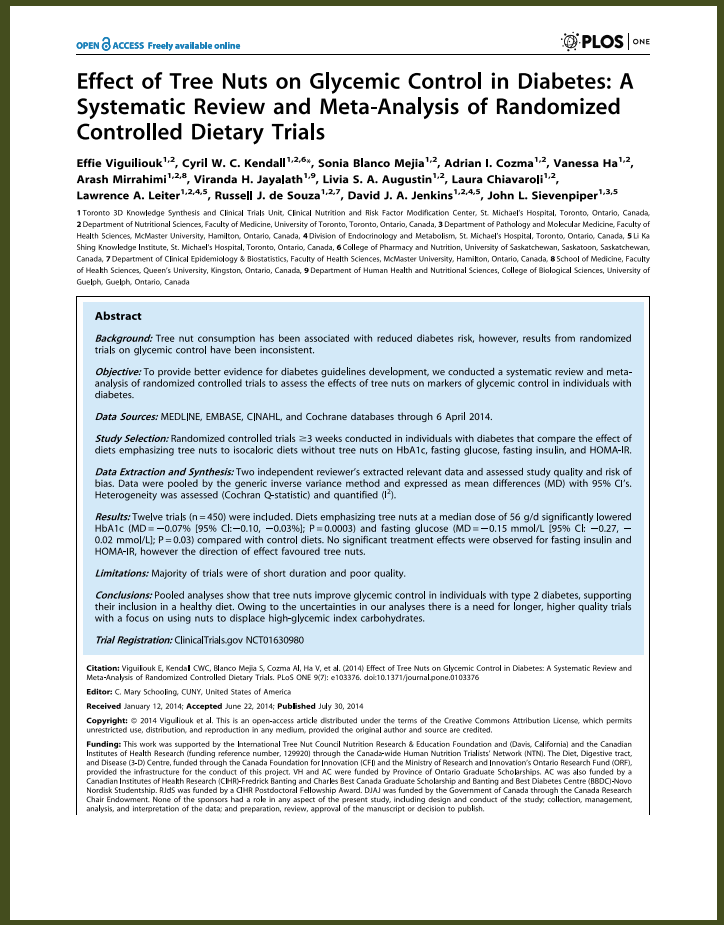
Table 1. Magnesium intake among United States (US) adults (>19 years) in NHANES 2001–2014.

Age (Years)	RDAs for Magnesium (mg/Day)	Magnesium Intake (mg/Day)	*p*
20–30 [a]	400.00	301.00 (215.00, 414.00)	<0.0001
31–85 [a]	420.00	299.00 (217.00, 400.00)	<0.0001
20–30 [b]	310.00	226.00 (164.00, 306.50)	<0.0001
31–85 [b]	320.00	234.00 (173.00, 314.00)	<0.0001

[a] Male; [b] Female.

Effects on A1c

- Less data on effects of tree nuts on glycemic control for patients with diabetes
- Meta-analysis of 12 trials (n=450) with median dose of 56 g/d over a median duration of ~8 weeks
- Overall significant lowering of HbA1c by -0.07% and fasting glucose by -2.7 mg/dL



OPEN ACCESS Freely available online

PLOS ONE

Effect of Tree Nuts on Glycemic Control in Diabetes: A Systematic Review and Meta-Analysis of Randomized Controlled Dietary Trials

Effie Viguiliouk[1,2], Cyril W. C. Kendall[1,2,6]*, Sonia Blanco Mejia[1,2], Adrian I. Cozma[1,2], Vanessa Ha[1,2], Arash Mirrahimi[1,2,8], Viranda H. Jayalath[1,9], Livia S. A. Augustin[1,2], Laura Chiavaroli[1,2], Lawrence A. Leiter[1,2,4,5], Russell J. de Souza[1,2,7], David J. A. Jenkins[1,2,4,5], John L. Sievenpiper[1,3,5]

1 Toronto 3D Knowledge Synthesis and Clinical Trials Unit, Clinical Nutrition and Risk Factor Modification Center, St. Michael's Hospital, Toronto, Ontario, Canada, **2** Department of Nutritional Sciences, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada, **3** Department of Pathology and Molecular Medicine, Faculty of Health Sciences, McMaster University, Hamilton, Ontario, Canada, **4** Division of Endocrinology and Metabolism, St. Michael's Hospital, Toronto, Ontario, Canada, **5** LI Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, Ontario, Canada, **6** College of Pharmacy and Nutrition, University of Saskatchewan, Saskatoon, Saskatchewan, Canada, **7** Department of Clinical Epidemiology & Biostatistics, Faculty of Health Sciences, McMaster University, Hamilton, Ontario, Canada, **8** School of Medicine, Faculty of Health Sciences, Queen's University, Kingston, Ontario, Canada, **9** Department of Human Health and Nutritional Sciences, College of Biological Sciences, University of Guelph, Guelph, Ontario, Canada

Abstract

Background: Tree nut consumption has been associated with reduced diabetes risk, however, results from randomized trials on glycemic control have been inconsistent.

Objective: To provide better evidence for diabetes guidelines development, we conducted a systematic review and meta-analysis of randomized controlled trials to assess the effects of tree nuts on markers of glycemic control in individuals with diabetes.

Data Sources: MEDLINE, EMBASE, CINAHL, and Cochrane databases through 6 April 2014.

Study Selection: Randomized controlled trials ≥3 weeks conducted in individuals with diabetes that compare the effect of diets emphasizing tree nuts to isocaloric diets without tree nuts on HbA1c, fasting glucose, fasting insulin, and HOMA-IR.

Data Extraction and Synthesis: Two independent reviewer's extracted relevant data and assessed study quality and risk of bias. Data were pooled by the generic inverse variance method and expressed as mean differences (MD) with 95% CI's. Heterogeneity was assessed (Cochran Q-statistic) and quantified (I^2).

Results: Twelve trials (n = 450) were included. Diets emphasizing tree nuts at a median dose of 56 g/d significantly lowered HbA1c (MD = −0.07% [95% CI: −0.10, −0.03%]; P = 0.0003) and fasting glucose (MD = −0.15 mmol/L [95% CI: −0.27, −0.02 mmol/L]; P = 0.03) compared with control diets. No significant treatment effects were observed for fasting insulin and HOMA-IR, however the direction of effect favoured tree nuts.

Limitations: Majority of trials were of short duration and poor quality.

Conclusions: Pooled analyses show that tree nuts improve glycemic control in individuals with type 2 diabetes, supporting their inclusion in a healthy diet. Owing to the uncertainties in our analyses there is a need for longer, higher quality trials with a focus on using nuts to displace high-glycemic index carbohydrates.

Trial Registration: ClinicalTrials.gov NCT01630980

Citation: Viguiliouk E, Kendall CWC, Blanco Mejia S, Cozma AI, Ha V, et al. (2014) Effect of Tree Nuts on Glycemic Control in Diabetes: A Systematic Review and Meta-Analysis of Randomized Controlled Dietary Trials. PLoS ONE 9(7): e103376. doi:10.1371/journal.pone.0103376

Editor: C. Mary Schooling, CUNY, United States of America

Received January 12, 2014; **Accepted** June 22, 2014; **Published** July 30, 2014

Funding: This work was supported by the International Tree Nut Council Nutrition Research & Education Foundation and (Davis, California) and the Canadian Institutes of Health Research (funding reference number, 129920) through the Canada-wide Human Nutrition Trialists' Network (NTN). The Diet, Digestive tract, and Disease (3-D) Centre, funded through the Canada Foundation for Innovation (CFI) and the Ministry of Research and Innovation's Ontario Research Fund (ORF), provided the infrastructure for the conduct of this project. VH and AC were funded by Province of Ontario Graduate Scholarships. AC was also funded by a Canadian Institutes of Health Research (CIHR)-Fredrick Banting and Charles Best Canada Graduate Scholarship and Banting and Best Diabetes Centre (BBDC)-Novo Nordisk Studentship. RJdS was funded by a CIHR Postdoctoral Fellowship Award. DJAJ was funded by the Government of Canada through the Canada Research Chair Endowment. None of the sponsors had a role in any aspect of the present study, including design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, approval of the manuscript or decision to publish.

Viguiliouk, E., Kendall, C. W., Blanco Mejia, S., Cozma, A. I., Ha, V., Mirrahimi, A., Jayalath, V. H., Augustin, L. S., Chiavaroli, L., Leiter, L. A., de Souza, R. J., Jenkins, D. J., & Sievenpiper, J. L. (2014). Effect of tree nuts on glycemic control in diabetes: a systematic review and meta-analysis of randomized controlled dietary trials. PloS one, 9(7), e103376. https://doi.org/10.1371/journal.pone.0103376.

Effects on Lipids

- Median dose of 56 g/d) over median duration of 4 weeks (3 to 26 weeks)
- When standardized to 1 serving per day, overall significant lowering of:
  - Total cholesterol by −4.7 mg/dL (95% CI: −5.3, −4.0 mg/dL)
  - LDL cholesterol by −4.8 mg/dL (95% CI: −5.5, −4.2 mg/dL),
  - ApoB by −3.7 mg/dL (95% CI: −5.2, −2.3 mg/dL)
  - Triglycerides by −2.2 mg/dL (95% CI: −3.8, −0.5 mg/dL)
- Stronger effect in ApoB reduction for those with diabetes by −11.5 mg/dL (95% CI: −16.2, −6.8 mg/dL)

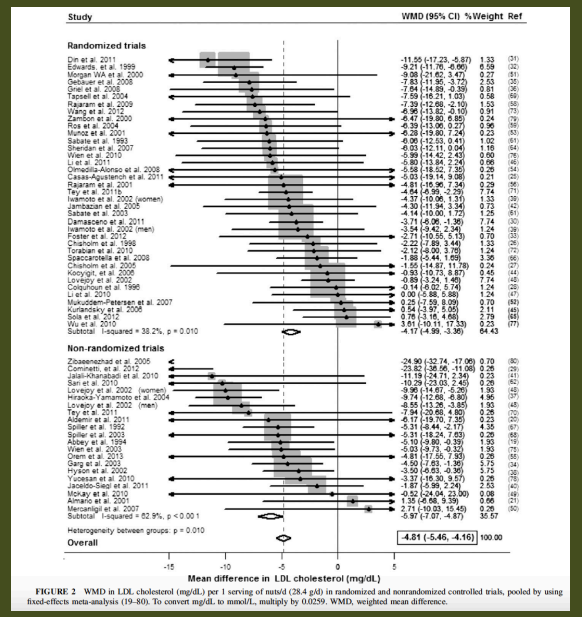


FIGURE 2 WMD in LDL cholesterol (mg/dL) per 1 serving of nuts/d (28.4 g/d) in randomized and nonrandomized controlled trials, pooled by using fixed-effects meta-analysis (19–80). To convert mg/dL to mmol/L, multiply by 0.0259. WMD, weighted mean difference.

Del Gobbo LC, Falk MC, Feldman R, Lewis K, Mozaffarian D. Effects of tree nuts on blood lipids, apolipoproteins, and blood pressure: systematic review, meta-analysis, and dose-response of 61 controlled intervention trials. Am J Clin Nutr. 2015 Dec;102(6):1347-56. doi: 10.3945/ajcn.115.110965. Epub 2015 Nov 11. PMID: 26561616; PMCID: PMC4658458

Effects on Lipids

- Although evidence is inconsistent for prevention of diabetes, tree nuts and seeds may be particularly helpful for lowering CVD risk in patients with diabetes
- Sunflower seeds (30 g/d) may be more effective than almonds at reducing CVD risk markers at 3 weeks in postmenopausal women with diabetes

Table 2: Effect of the almond and sunflower kernel diets on lipid and lipoprotein concentrations, blood pressure, and α-tocopherol.

	Diet	Baseline mean (SD)	Final mean (SD)	Difference (95% CI)	*P* value
Total cholesterol (mmol/L)	Almond	5.88 (0.66)	5.55 (0.65)	−0.14 (−0.29, 0.01)	0.073
	Sunflower kernel	6.11 (0.68)	5.56 (0.59)		
HDL cholesterol (mmol/L)	Almond	1.27 (0.32)	1.26 (0.31)	−0.04 (−0.085, −0.001)	0.045
	Sunflower kernel	1.32 (0.33)	1.25 (0.31)		
TC : HDL-C ratio	Almond	4.90 (1.22)	4.68 (1.26)	0.01 (−0.25, 0.26)	0.943
	Sunflower kernel	4.93 (1.41)	4.72 (1.22)		
LDL cholesterol (mmoL/L)	Almond	3.61 (0.64)	3.34 (0.64)	−0.05 (−0.19, 0.09)	0.607
	Sunflower kernel	3.77 (0.64)	3.42 (0.61)		
Triglyceride (mmoL/L)	Almond	2.10 (0.58)	2.08 (0.69)	−0.23 (−0.36, −0.09)	0.001
	Sunflower kernel	2.22 (0.71)	1.95 (0.60)		
Apo A1 (g/L)	Almond	1.41 (0.16)	1.37 (0.17)	−0.04 (−0.07, −0.02)	0.001
	Sunflower	1.45 (0.17)	1.35 (0.16)		
Apo B100 (g/L)	Almond	1.04 (0.16)	0.99 (0.17)	−0.05 (−0.08, −0.02)	<0.001
	Sunflower	1.09 (0.17)	0.98 (0.14)		
Oxidised LDL (U/L)†	Almond	50.67 (35–69)	47.39 (27–65)	0.96 (0.89,1.03)‡	0.268
	Sunflower	52.75 (29–84)	46.93 (29–58)		
Systolic BP (mmHg)	Almond	147.36 (18.31)	141.75 (22.48)	−2.36 (−11.99, 7.25)	0.630
	Sunflower kernel	145.16 (21.05)	137.82 (20.61)		
Diastolic BP (mmHg)	Almond	88.55 (9.67)	84.50 (9.97)	0.59 (−2.60, 3.77)	0.719
	Sunflower kernel	85.93 (9.35)	83.00 (9.45)		
α-Tocopherol (μmoL/L)†	Almond	32.21 (17.5–94.4)	33.33 (20.7–91.5)	0.94 (0.89, 0.99)‡	0.013
	Sunflower	34.87 (19.2–88.4)	33.35 (19.7–63.7)		

Values are adjusted for baseline and order, †results are presented as geometric mean and range, ‡results are presented as ratio of the geometric means, and *P* values are for the difference between AD and SKD.

Richmond K, Williams S, Mann J, Brown R, Chisholm A. Markers of cardiovascular risk in postmenopausal women with type 2 diabetes are improved by the daily consumption of almonds or sunflower kernels: a feeding study. *ISRN Nutr.* 2013;2013:626414.

What about Weight Gain?

- No adverse effect of nuts on body weight based on data from 86 RCTs including 5873 adults
- In one example randomized cross-over trial - Experimental addition of 320 calorie daily almond supplement (~2 oz) for 6 months with no dietary advice
- Did not cause significant weight gain in the whole sample, with weight loss observed in those who were moderately overweight and above at baseline

Nishi SK, Viguiliouk E, Blanco Mejia S, et al. Are fatty nuts a weighty concern? A systematic review and meta-analysis and dose-response meta-regression of prospective cohorts and randomized controlled trials. Obes Rev 2021;22:e13330; Fraser GE, Bennett HW, Jaceldo KB, Sabaté J. Effect on body weight of a free 76 Kilojoule (320 calorie) daily supplement of almonds for six months. J Am Coll Nutr. 2002 Jun;21(3):275-83. doi: 10.1080/07315724.2002.10719221. PMID: 12074256.

Nutrition Rx:

Pulses

TYPE

Lentils, split peas,
dry beans, or chickpeas.

AMOUNT

½ cup at a meal

FREQUENCY

Up to 2 meals per day.

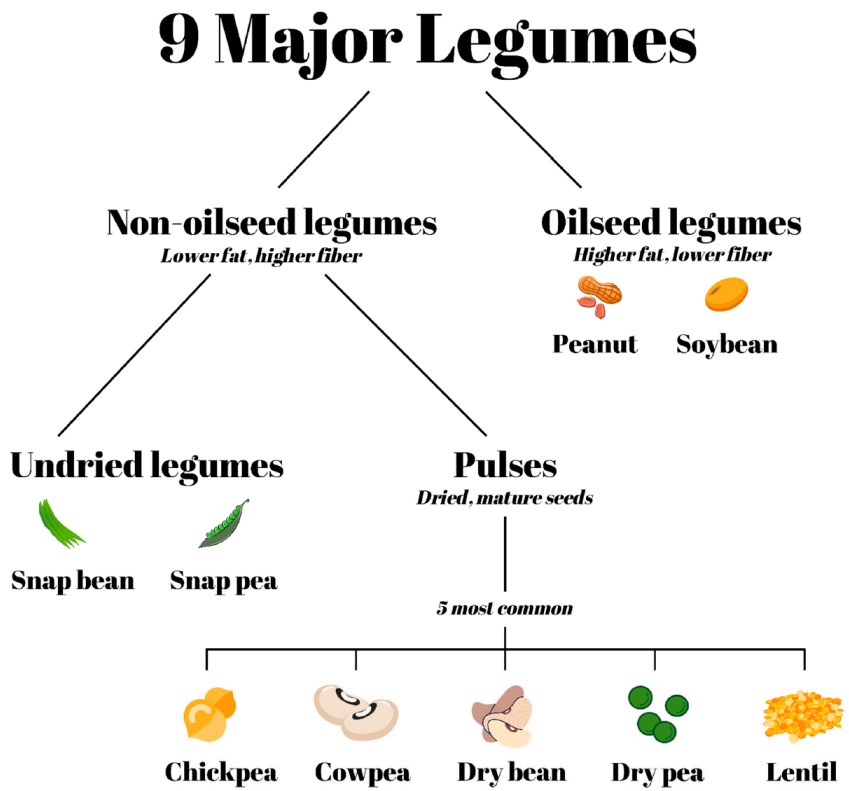


Figure 1. Commonly consumed types of legumes. After separating legumes into oilseed and non-oilseed legumes, non-oilseed legumes can be further divided into two categories: undried legumes and pulses. Pulses are the dried, edible seeds of grain legumes that are then cooked before being consumed.

what are PULSES?

Dried, edible seed legume family (non-oilseed varieties)

- Chickpeas
- Black-eyed peas
- Dry beans
- Split peas
- Lentils

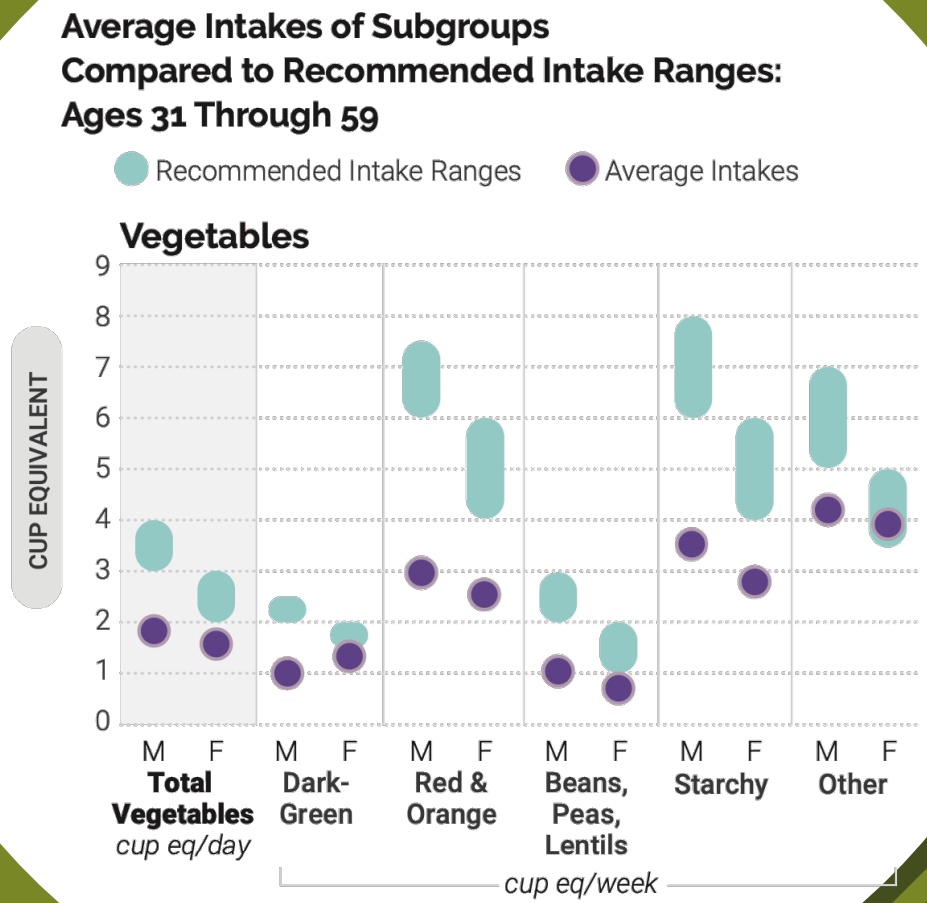
A basic part of the human diet since the advent of agriculture and development of civilization in the Middle East, Asia, the Americas, and Europe

Didinger C, Thompson HJ. Defining Nutritional and Functional Niches of Legumes: A Call for Clarity to Distinguish a Future Role for Pulses in the Dietary Guidelines for Americans. Nutrients 2021;13.

Pulses

Key Intake Gaps

- 2020-2025 US Dietary Guidelines recommend 1-3 cups per week based on calorie level
- Average per capita intake of dry beans is only 9.3 g/day (~2 Tbsp cooked)
- Because they are nutrient dense, increasing intake to just 4 Tbsp (1/4 cup) cooked pulses/day can help to fill multiple nutrient gaps, especially fiber, folate, potassium and magnesium



Mitchell DC, Marinangeli CPF, Pigat S, et al. Pulse Intake Improves Nutrient Density among US Adult Consumers. *Nutrients*. 2021;13(8):2668. Published 2021 Jul 31. doi:10.3390/nu13082668

Effects on A1c

- Meta-analysis of 65 RCTs (n=905 Type 2 Diabetes and n=1197 without Type 2 Diabetes)
- **Clinical response to pulses was strongest for those with Type 2 Diabetes**
- Pulses significantly reduced post-prandial glucose by >45 mg/dL with lentils being most effective, followed by dried peas, beans, and chickpeas; bean flours 50% effective
- ~9 mg/dL reduction in fasting glucose over a median of 8 weeks, as well as a mean reduction of ~0.3% in A1c

European Journal of Nutrition (2022) 61:809–824
https://doi.org/10.1007/s00394-021-02685-y

ORIGINAL CONTRIBUTION

Pulse consumption improves indices of glycemic control in adults with and without type 2 diabetes: a systematic review and meta-analysis of acute and long-term randomized controlled trials

Maryam S. Hafiz[1,2] · Matthew D. Campbell[3,4,5] · Lauren L. O'Mahoney[6] · Melvin Holmes[1] · Caroline Orfila[1] · Christine Boesch[1]

Received: 27 July 2020 / Accepted: 19 September 2021 / Published online: 29 September 2021

Abstract

Purpose Findings from randomized controlled trials (RCTs) inconsistent and conclusive evidence is lacking. The aim of th sumption on post-prandial and long-term glycemic control in

Methods Databases were searched for RCTs, reporting outcc ent pulse types on parameters of glycemic control in normogl random effect model and meta-regression was conducted to a type, form, dose, and study duration on ES.

Results From 3334 RCTs identified, 65 studies were eligib pulse intake significantly reduced peak post-prandial glu 95%CI −4.60, −1.21; $p \leq 0.001$; $I^2 = 93\%$) and without T2D porating pulse consumption into long-term eating patterns sig (ES −0.06; 95%CI −0.12, 0.00; $p \leq 0.05$; $I^2 = 30\%$). Whereas, glucose (ES −0.54; 95%CI −0.83, −0.24; $p \leq 0.001$; $I^2 = 78\%$) 0.00; $p \leq 0.05$; $I^2 = 78$) and homeostatic model assessment of in $p \leq 0.05$; $I^2 = 79\%$).

Conclusion Pulse consumption significantly reduced acute pc mic adults and > 2.5 mmol/L in those with T2D, and improve with and without T2D.

PROSPERO registry number (CRD42019162322).

Keywords Pulses · Glucose · Diabetes · Postprandial glycemi

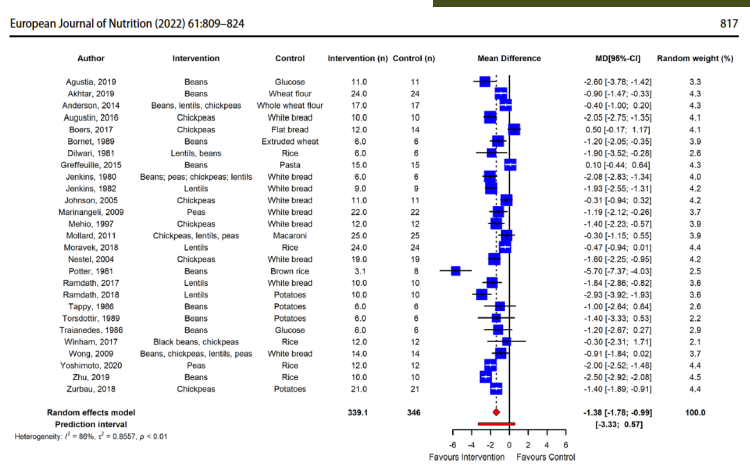


Fig. 2 Pooled effect using inverse-variance random effect model (mean difference and 95% CI) of acute trials investigating pulse intake on post-prandial glucose response among healthy individuals. The effect size was statistically significant for normoglycemic adults

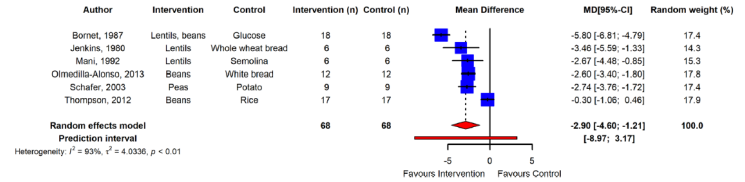


Fig. 3 Pooled effect using inverse-variance random effect model (mean difference and 95% CI) of acute trials investigating pulse intake on post-prandial glucose response among T2D individuals. The effect size was statistically significant for adults with T2D

Hafiz MS, Campbell MD, O'Mahoney LL, Holmes M, Orfila C, Boesch C. Pulse consumption improves indices of glycemic control in adults with and without type 2 diabetes: a systematic review and meta-analysis of acute and long-term randomized controlled trials. Eur J Nutr 2022;61:809-24.

Effects on Lipids

- 2014 meta-analysis of 26 RCTs totaling 1037 healthy and unhealthy individuals
- Median dose of 1 serving of beans per day (130 g) over median duration of 6 weeks
- Significantly lowered LDL cholesterol by a mean difference of 6.6 mg/dL relative to control diets (equals a 5% reduction).

Ha V, Sievenpiper JL, de Souza RJ, et al. Effect of dietary pulse intake on established therapeutic lipid targets for cardiovascular risk reduction: a systematic review and meta-analysis of randomized controlled trials. CMAJ 2014;186:E252-62.

What about Weight Gain?

- The therapeutic blood pressure and long-term glycemic effects of pulses may be partly due to their impact on body weight
- No adverse effect of pulses on body weight based on data from 19 RCTs reporting on 940 participants with an average BMI of 30
- Median daily dose of pulses (0.5-0.75 c/day) over median of 6 weeks
- 0.34 kg weight loss across all studies (increased to 0.6 kg among higher quality studies)

Kim SJ, de Souza RJ, Choo VL, et al. Effects of dietary pulse consumption on body weight: a systematic review and meta-analysis of randomized controlled trials. Am J Clin Nutr 2016;103:1213-23.

Professional Guidelines: Pulses

People with diabetes and those at risk for diabetes are encouraged to consume at least the amount of dietary fiber recommended for the general public; increasing fiber intake, preferably through food (vegetables, **pulses [beans, peas, and lentils]**, fruits, and whole intact grains) or through dietary supplement, may help in modestly lowering A1C.

Alison B. Evert, Michelle Dennison, Christopher D. Gardner, et al. Nutrition Therapy for Adults With Diabetes or Prediabetes: A Consensus Report. *Diabetes Care* 1 May 2019; 42 (5): 731–754. https://doi.org/10.2337/dci19-0014

Nutrition Rx:

Barley & Oats

TYPE

Barley or Oats

AMOUNT

½ cup at a meal

FREQUENCY

Up to 2 meals per day

Effects on

A1c & PPG

- Available evidence for barley and oats on glycemic control for people with diabetes is inconclusive.
- However, a 2021 meta-analyses of the effects of isolated soluble fiber via psyllium seed or other isolated supplements on glycemic control in adults with type 2 diabetes support the use of 7.6-8.3 g per day as a strategy for reducing A1c by an average of 0.63%, fasting plasma glucose by an average of 16 mg/dL, as well as fasting insulin, insulin resistance, 2-hr post-prandial glucose, and possibly BMI

Xie Y, Gou L, Peng M, Zheng J, Chen L. Effects of soluble fiber supplementation on glycemic control in adults with type 2 diabetes mellitus: A systematic review and meta-analysis of randomized controlled trials. Clin Nutr 2021;40:1800-10.

Effects on

Lipids

- Meta-analysis of RCTs of 14 trials involving 615 healthy and hypercholesterolemic participants
- Median dose of 6.5 g barley beta glucan for a median duration of 4 weeks lowered LDL by -9.8 mg/dL
- Median dose of 6.9 g barley beta glucan for a median duration of 4 weeks lowered non-HDL cholesterol by -12 mg/dL irrespective of baseline lipids.
- As a rule of thumb, the authors concluded that 7 g/day or barley beta glucan can reduce LDL and non-HDL cholesterol by 7%

Xie Y, Gou L, Peng M, Zheng J, Chen L. Effects of soluble fiber supplementation on glycemic control in adults with type 2 diabetes mellitus: A systematic review and meta-analysis of randomized controlled trials. Clin Nutr 2021;40:1800-10.

What about

Weight Gain?

- 2022 meta-analysis of 59 RCTs of 4937 participants that predominantly had underlying mild metabolic disturbances.
- Median study duration was 8 weeks with oats consumed in a variety of forms, including oat bran, meal, or porridge.
- When compared to control diets without oats, the effect of oat containing diets included lower BMI (-0.329 units), body weight (-0.943 kg), waist circumference (-1.058 cm)

Llanaj E, Dejanovic GM, Valido E, et al. Effect of oat supplementation interventions on cardiovascular disease risk markers: a systematic review and meta-analysis of randomized controlled trials. Eur J Nutr 2022.

Professional Guidelines: Soluble Fiber

Soluble fiber from foods such as oat bran, rolled oats, whole oat flour, or barley (supplying 3 g or more per day of B-glucan) or psyllium seed husk (7 g or more per day) as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease.

FDA Authorized Health Claims (21 CFR 101.81)

https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-101#101.81

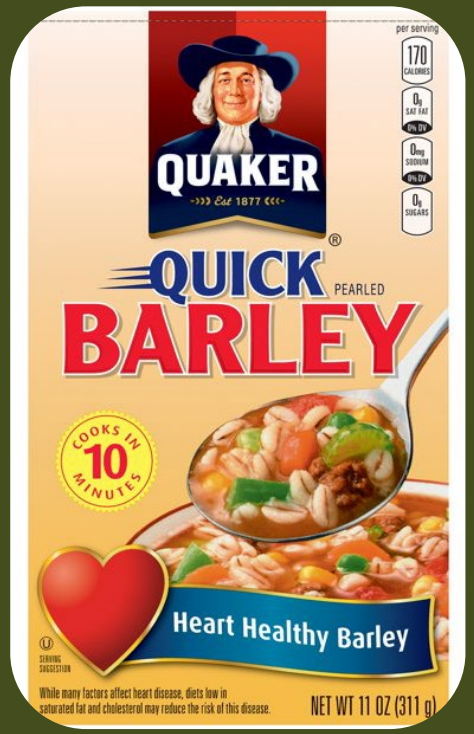
how much does this all

cost?

All 3 nut/seed, bean, and barley/oat prescriptions for as little as $0.83+tax per day

$1.79
$0.26 cents/day

$1.56 (2 cans)
$0.22 cents/day



$2.48
$0.35 cents/day

Nutrition Rx:

Non-starchy vegetables

TYPE

Non-starchy vegetables

AMOUNT

2+ varieties (1/2 plate)

FREQUENCY

3 meals per day

+/- with snacks

Using non-Starchy Veg to lower PPG

- Patients can maximize the benefits of non-starchy vegetables on blood sugar control by eating vegetables first at each mealtime, before moving on to carbohydrate-rich foods.
- In one experimental study that used continuous glucose monitoring found this eating strategy to be effective in significantly lowering glycemic response after meals for people with and without type 2 diabetes when compared to eating vegetables last.

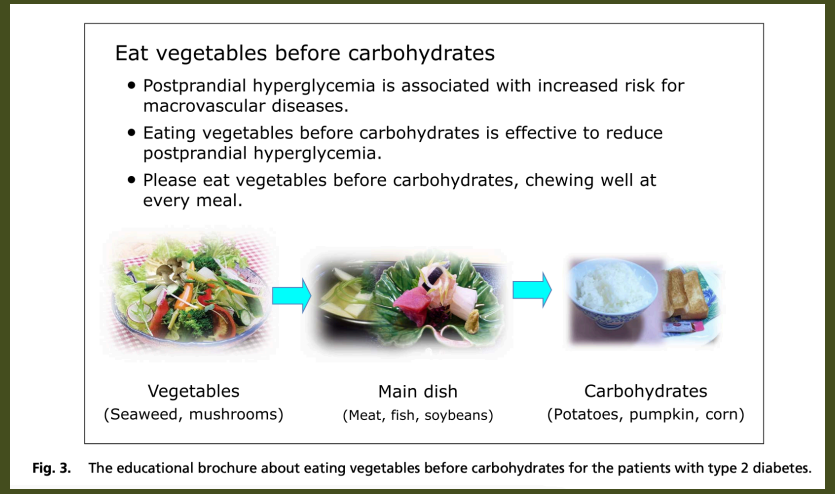


Fig. 3. The educational brochure about eating vegetables before carbohydrates for the patients with type 2 diabetes.

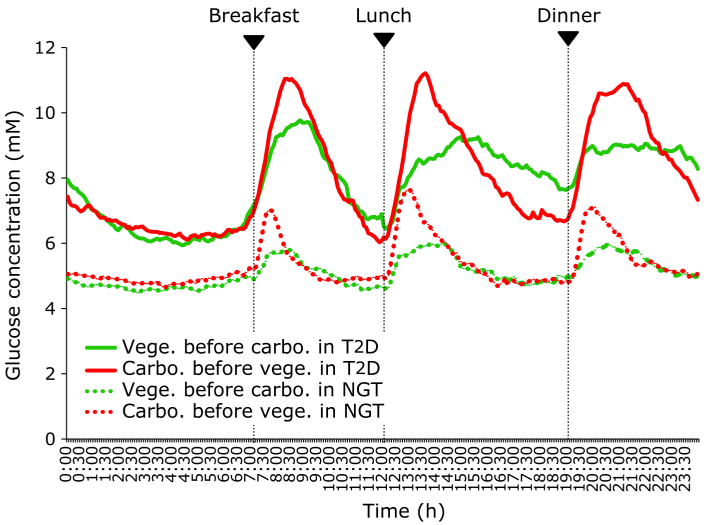
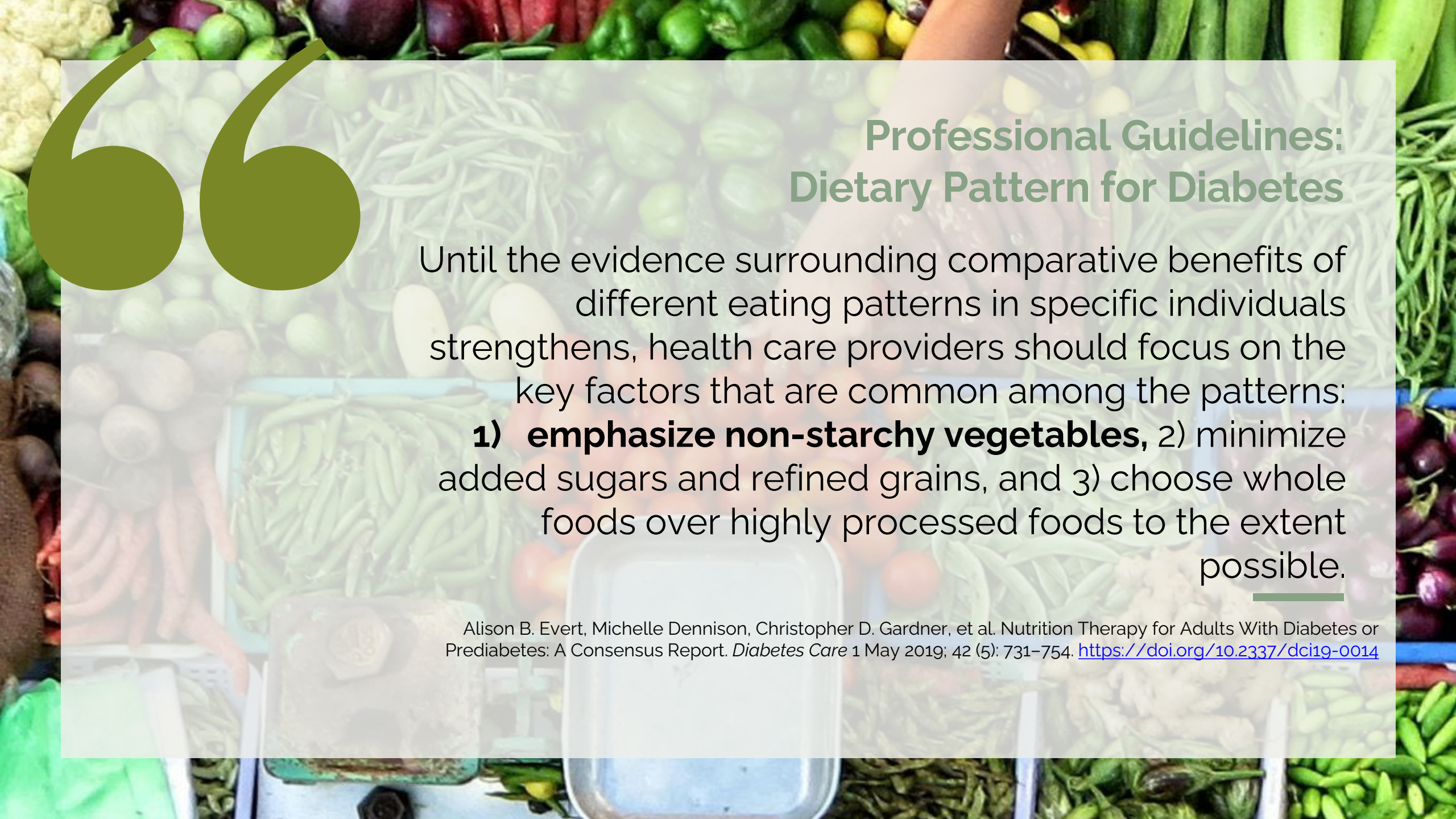


Fig. 2. The mean of the daily glucose values were plotted to show the reduction in glucose excursions by eating vegetables before carbohydrates compared to the reverse regimen in both subjects with type 2 diabetes (n = 19) and normal glucose tolerance (n = 21).

Imai S, Fukui M, Kajiyama S. Effect of eating vegetables before carbohydrates on glucose excursions in patients with type 2 diabetes. J Clin Biochem Nutr 2014;54:7-11.



Professional Guidelines: Dietary Pattern for Diabetes

Until the evidence surrounding comparative benefits of different eating patterns in specific individuals strengthens, health care providers should focus on the key factors that are common among the patterns: **1) emphasize non-starchy vegetables,** 2) minimize added sugars and refined grains, and 3) choose whole foods over highly processed foods to the extent possible.

Alison B. Evert, Michelle Dennison, Christopher D. Gardner, et al. Nutrition Therapy for Adults With Diabetes or Prediabetes: A Consensus Report. *Diabetes Care* 1 May 2019; 42 (5): 731–754. https://doi.org/10.2337/dci19-0014

Fruit's Effects on A1c

- Patients with diabetes can safely eat whole fruit with no added sugars.
- Experimental research has found that instruction to restrict fruit among patients with diabetes had no effect on HbA1c, weight loss or waist circumference compared to those who received instruction to eat a high fruit diet.

Christensen AS, Viggers L, Hasselström K, Gregersen S. Effect of fruit restriction on glycemic control in patients with type 2 diabetes--a randomized trial. Nutr J 2013;12:29.

The original Dietary Approaches to Stopping Hypertension (DASH) Diet Study

TABLE 1. NUTRIENT TARGETS, MENU ANALYSES, AND AVERAGE DAILY SERVINGS OF FOODS, ACCORDING TO DIET.*

ITEM	CONTROL DIET		FRUITS-AND-VEGETABLES DIET		COMBINATION DIET	
	NUTRIENT TARGET	MENU ANALYSIS†	NUTRIENT TARGET	MENU ANALYSIS†	NUTRIENT TARGET	MENU ANALYSIS†
Nutrients						
Fat (% of total kcal)	37	35.7	37	35.7	27	25.6
Saturated	16	14.1	16	12.7	6	7.0
Monounsaturated	13	12.4	13	13.9	13	9.9
Polyunsaturated	8	6.2	8	7.3	8	6.8
Carbohydrates (% of total kcal)	48	50.5	48	49.2	55	56.5
Protein (% of total kcal)	15	13.8	15	15.1	18	17.9
Cholesterol (mg/day)	300	233	300	184	150	151
Fiber (g/day)	9	NA	31	NA	31	NA
Potassium (mg/day)	1700	1752	4700	4101	4700	4415
Magnesium (mg/day)	165	176	500	423	500	480
Calcium (mg/day)	450	443	450	534	1240	1265
Sodium (mg/day)	3000	3028	3000	2816	3000	2859
Food groups (no. of servings/day)						
Fruits and juices	1.6		5.2		5.2	
Vegetables	2.0		3.3		4.4	
Grains	8.2		6.9		7.5	
Low-fat dairy	0.1		0.0		2.0	
Regular-fat dairy	0.4		0.3		0.7	
Nuts, seeds, and legumes	0.0		0.6		0.7	
Beef, pork, and ham	1.5		1.8		0.5	
Poultry	0.8		0.4		0.6	
Fish	0.2		0.3		0.5	
Fat, oils, and salad dressing	5.8		5.3		2.5	
Snacks and sweets	4.1		1.4		0.7	

*Values are for diets designed to provide an energy level of 2100 kcal.

†Values are the results of chemical analyses of the menus prepared during the validation phase and during the trial. NA denotes not available.

Table 1. Nutrient Targets, Menu Analyses, and Average Daily Servings of Foods, According to Diet.

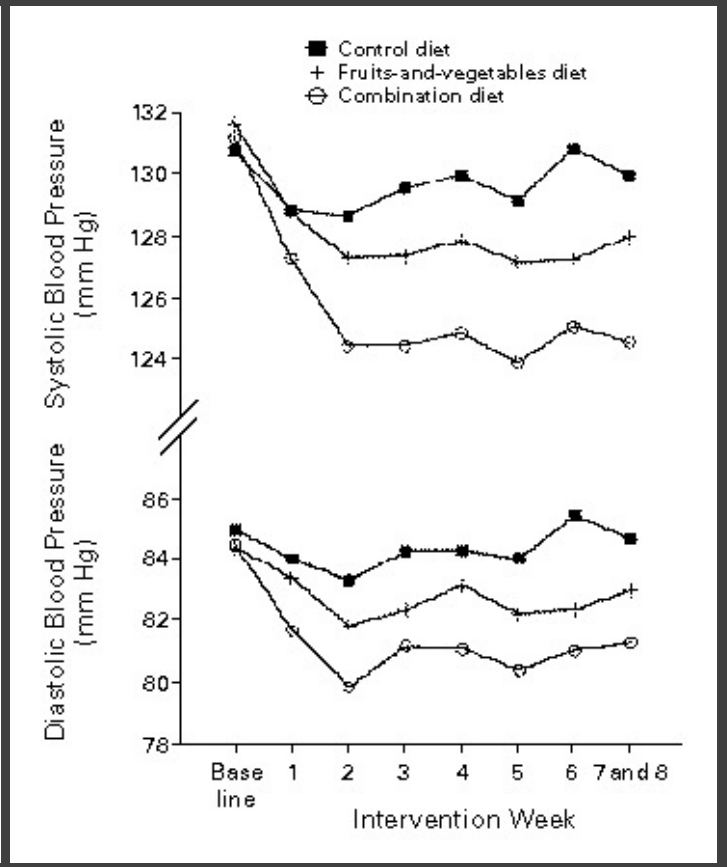


Figure 1. Mean Systolic and Diastolic Blood Pressures at Base Line and during Each Intervention Week, According to Diet, for 379 Subjects with Complete Sets of Weekly Blood-Pressure Measurements.

root cause FOOD equity LAB | OU-TULSA

Appel LJ, Moore TJ, Obarzanek E, Vollmer WM, Svetkey LP, Sacks FM, Bray GA, Vogt TM, Cutler JA, Windhauser MM, Lin PH, Karanja N. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. N Engl J Med. 1997 Apr 17;336(16):1117-24. doi: 10.1056/NEJM199704173361601. PMID: 9099655.

Professional Guidelines: Pulses

Development of heart disease depends on many factors. Eating a diet low in saturated fat and cholesterol and **high in fruits, vegetables**, and grain products that contain fiber may lower blood cholesterol levels and reduce your risk of heart disease.

FDA Authorized Health Claims (21 CFR 101.77)

Professional Guidelines: F&V

In general, heart-healthy dietary patterns, those patterns associated with low CVD risk, **contain primarily fruits and vegetables**.

American Heart Association

how much does this all

cost?

"High color" F&V prescription for as little as $2.86+tax per day

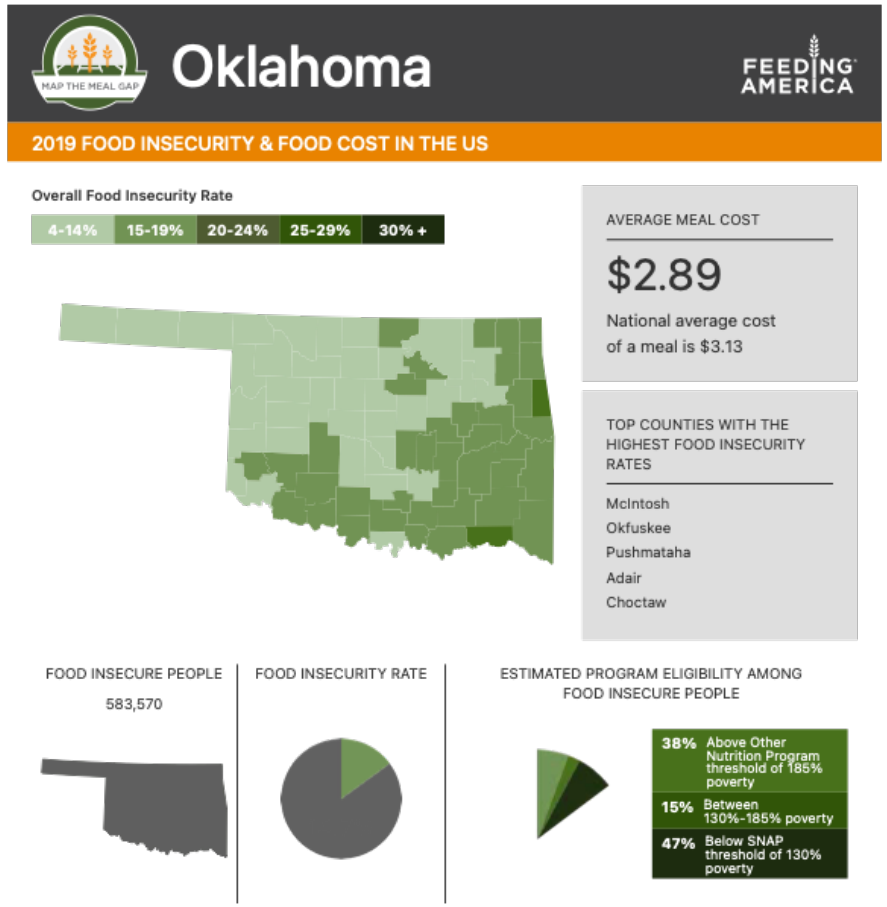
$6.66
$0.95 cents/day
for 3 servings veg

$10.45
$1.49 cents/day
for 2+ servings fruit

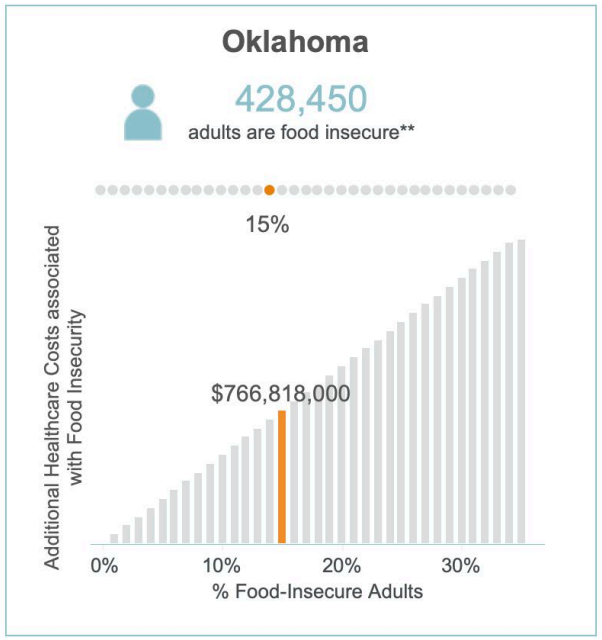
$2.97
$0.42 cents/day
for 2 servings veg

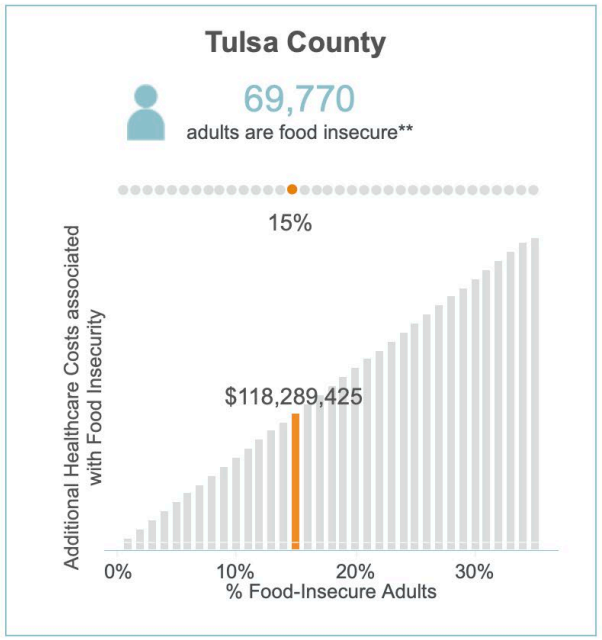
FOOD IS MEDICINE IMPLEMENTATION FRAMEWORKS

Food Insecurity Contributes to Excess Healthcare Costs in Oklahoma



https://public.tableau.com/app/profile/feeding.america.research/viz/TheHealthcareCostsofFoodInsecurity/HealthcareCosts





The excess healthcare costs associated with food insecurity: **$766,818,000**

Cost per food insecure adult: **$1,752**

Excess Total Healthcare Cost per Oklahoman: **$198**

Feeding America Research. (2019, August 12). The Healthcare Costs of Food Insecurity. Retrieved November 17, 2021, from https://public.tableau.com/app/profile/feeding.america.research/viz/TheHealthcareCostsofFoodInsecurity/HealthcareCosts.

Feeding America. (2020). Map the Meal Gap 2020. Feeding America. Retrieved November 17, 2021, from https://www.feedingamerica.org/research/map-the-meal-gap/how-we-got-the-map-data.

Identifying food insecurity: clinic setting

- Typically administered by healthcare worker other than the physician
- Important to normalize food insecurity as part of screening interview process to help reduce stigma
- **The American Diabetes Association and the American Academy of Pediatrics recommend clinician screening and referrals for food insecurity**

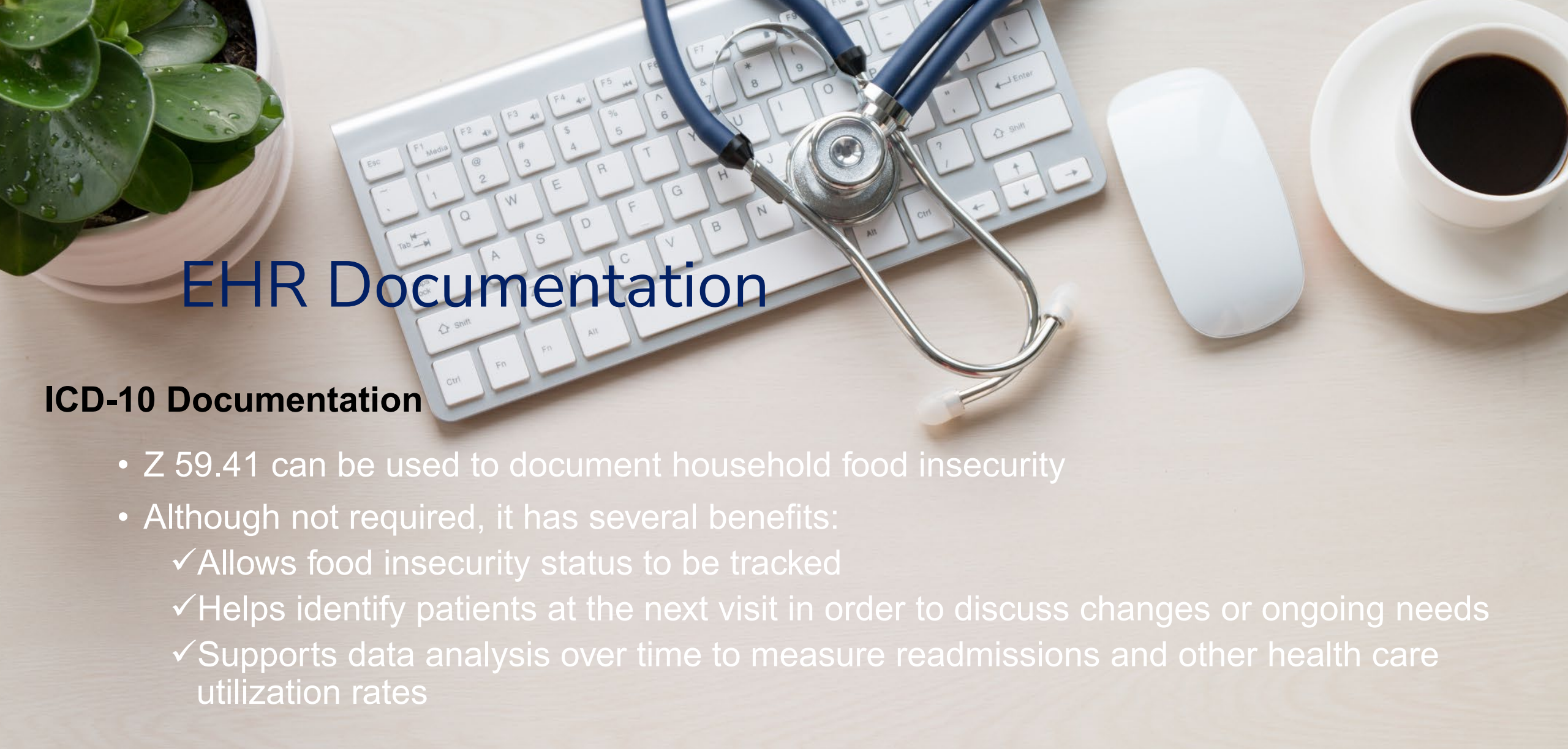
2-item "Hunger Vital Sign" food security screener

I'm going to read you two statements that people have made about their food situation. For each statement, please tell me whether the statement was **often true**, **sometimes true** or **never true** for your household in the last 12 months.

1. "We worried whether our food would run out before we got money to buy more." Was that **often** true, **sometimes** true or **never** true for your household in the last 12 months?
2. "The food that we bought just didn't last, and we didn't have money to get more." Was that **often**, **sometimes** or **never** true for your household in the last 12 months?

A response of "often true" or "sometimes true" to either question = positive screen for FI.

Standards of Medical Care in Diabetes-2019 Abridged for Primary Care Providers. Clinical diabetes : a publication of the American Diabetes Association, 2019. **37**(1): p. 11-34
Promoting Food Security for All Children. Pediatrics, 2015.



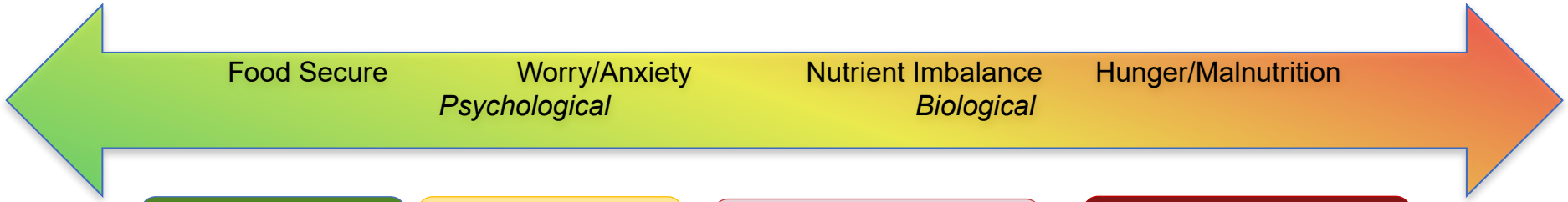
EHR Documentation

ICD-10 Documentation

- Z 59.41 can be used to document household food insecurity
- Although not required, it has several benefits:
  - ✓Allows food insecurity status to be tracked
  - ✓Helps identify patients at the next visit in order to discuss changes or ongoing needs
  - ✓Supports data analysis over time to measure readmissions and other health care utilization rates

Health Research & Educational Trust. (2017, June). Social determinants of health series: Food insecurity and the role of hospitals. Chicago, IL: Health Research & Educational Trust. Accessed at www.aha.org/foodinsecurity

Food Insecurity as a Continuum of Risk



Fully Food Secure	Marginal Food Security	Low Food Security	Very Low Food Security
Consistent access to the safe, healthy, affordable foods essential to optimal health and well-being.	Food Worry: Psychological stress about food running out	Reduced Quality: • Cannot afford balanced meals • Greater reliance on low-cost, energy dense processed foods to avoid food running out	Reduced Intake: • Cut size or skip meals • Eat less • Feel hungry Lose weight • Go full days without eating

Food Insecurity:
The limited or uncertain availability of nutritionally adequate and safe foods, or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.

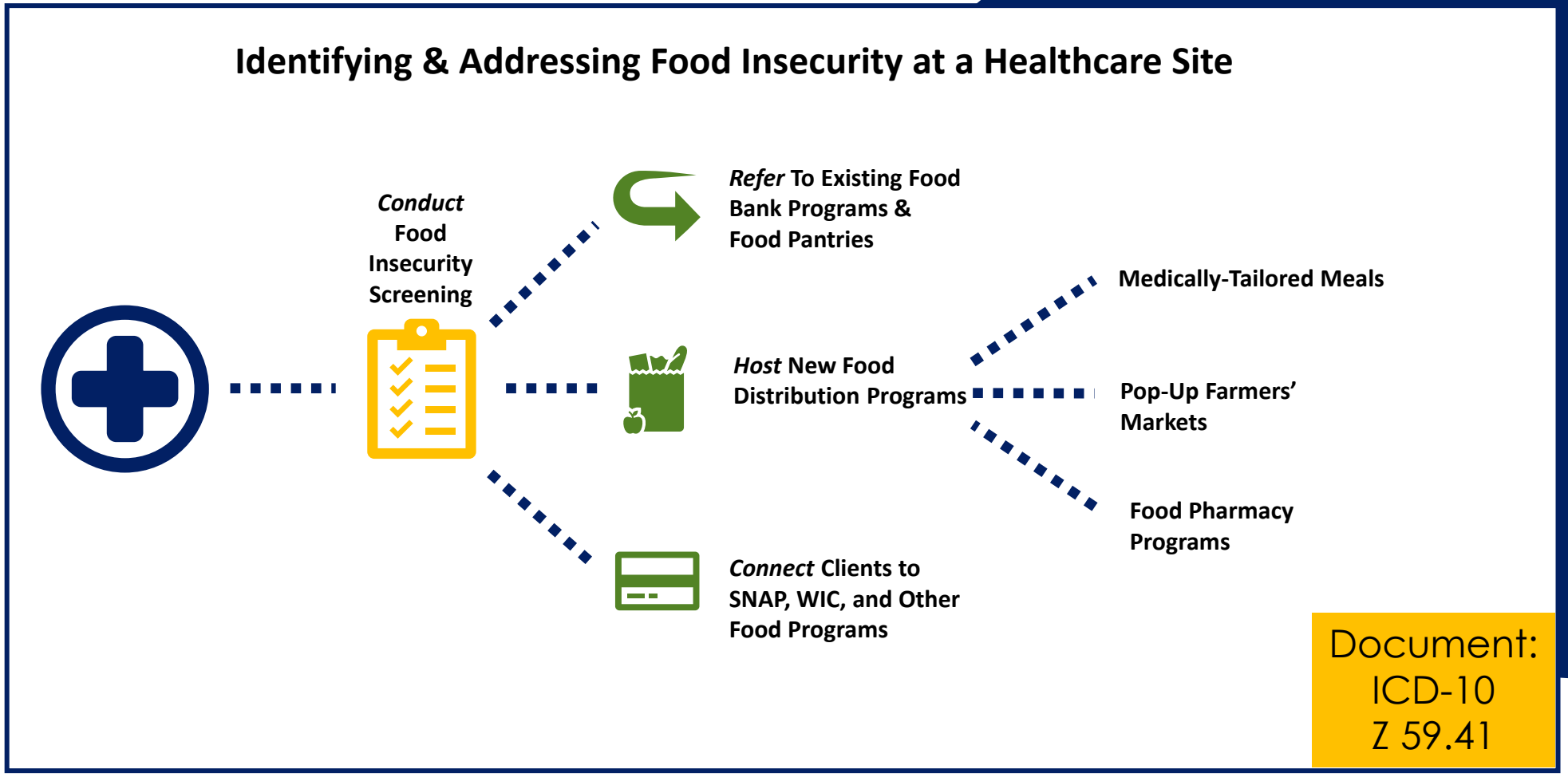
Life Sciences Research Office, S.A. Andersen, ed. (1990). "Core Indicators of Nutritional State for Difficult to Sample Populations," *The Journal of Nutrition*120:1557S-1600S.
Kendall, A., Olson, C. M., & Frongillo Jr, E. A. (1995). Validation of the Radimer/Cornell measures of hunger and food insecurity. The Journal of Nutrition, 125(11), 2793-2801.

Hierarchy of Food Needs

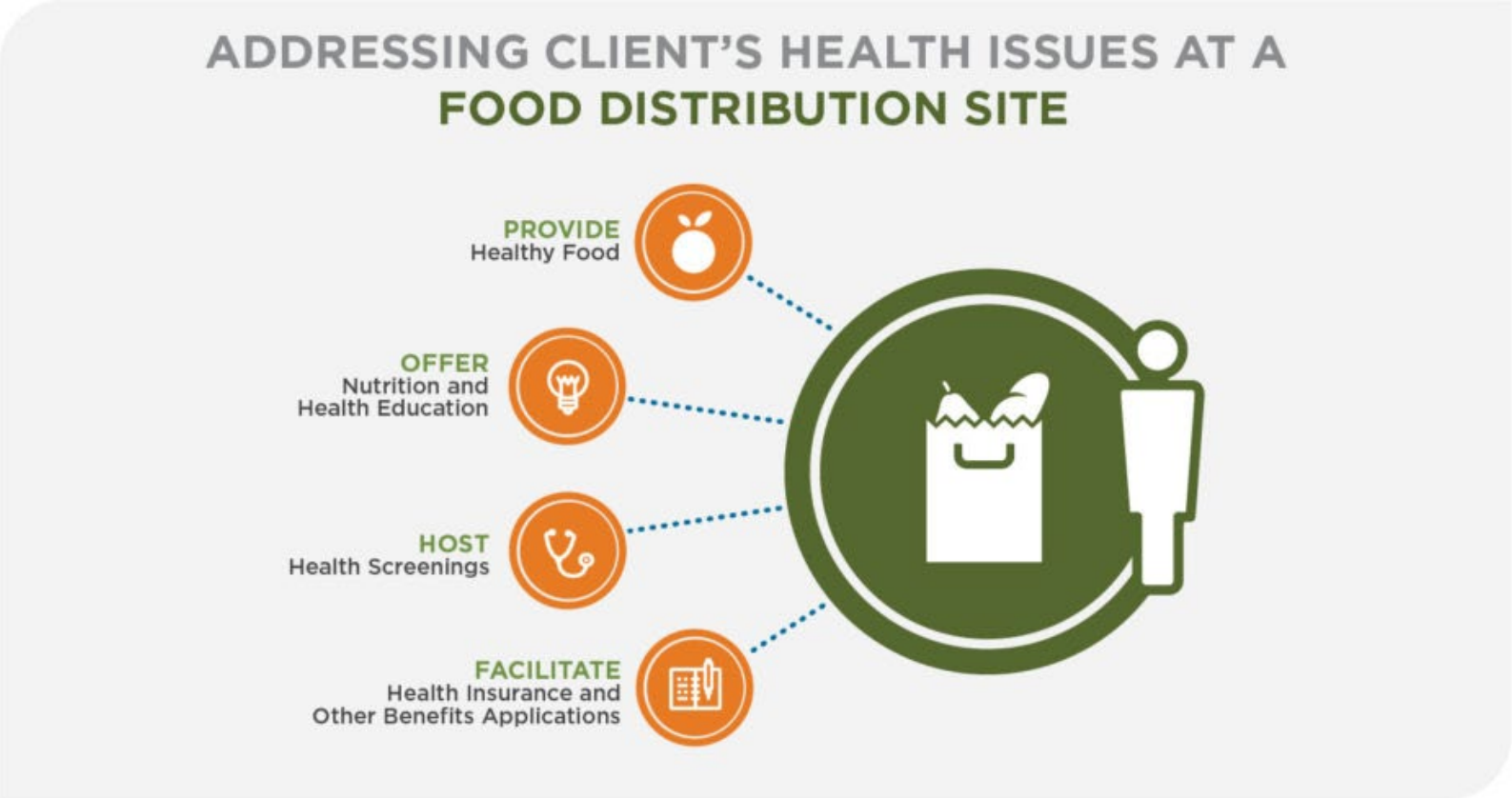
root cause
FOOD equity LAB | OU-TULSA

Satter, E. (2007). Hierarchy of food needs. Journal of Nutrition Education & Behavior, 39:S187-S188.

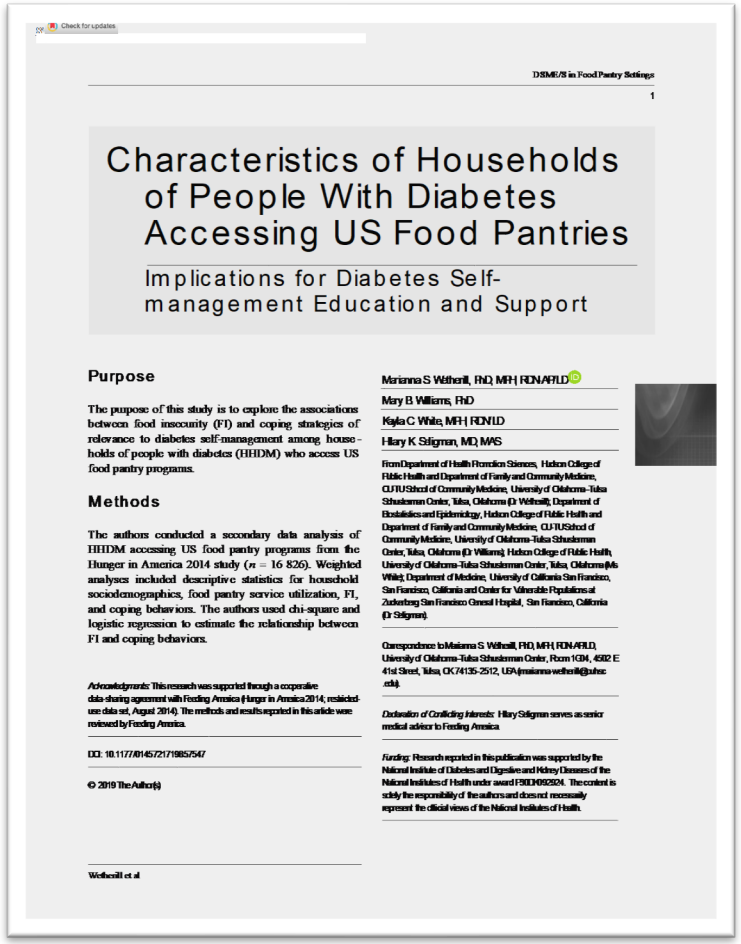
Clinic-to-Community Models



Community-to-Clinic Models



How common is food insecurity among diabetic households who access food pantries?



Check for updates

DSME/S in Food Pantry Settings

1

Characteristics of Households of People With Diabetes Accessing US Food Pantries

Implications for Diabetes Self-management Education and Support

Marianna S. Wetherill, PhD, MPH | RDN-AP/LD
Mary B. Williams, PhD
Kayla C. White, MPH | RDN/LD
Hilary K. Seligman, MD, MAS

Purpose

The purpose of this study is to explore the associations between food insecurity (FI) and coping strategies of relevance to diabetes self-management among households of people with diabetes (HHDM) who access US food pantry programs.

Methods

The authors conducted a secondary data analysis of HHDM accessing US food pantry programs from the Hunger in America 2014 study (n = 16 826). Weighted analyses included descriptive statistics for household sociodemographics, food pantry service utilization, FI, and coping behaviors. The authors used chi-square and logistic regression to estimate the relationship between FI and coping behaviors.

Acknowledgments: This research was supported through a cooperative data-sharing agreement with Feeding America (Hunger in America 2014; restricted-use data set, August 2014). The methods and results reported in this article were reviewed by Feeding America.

DOI: 10.1177/0145721719857547

From Department of Health Promotion Sciences, Hudson College of Public Health and Department of Family and Community Medicine, OU-TU Stitzel of Community Medicine, University of Oklahoma–Tulsa Schusterman Center, Tulsa, Oklahoma (Dr Wetherill); Department of Biostatistics and Epidemiology, Hudson College of Public Health and Department of Family and Community Medicine, OU-TU Stitzel of Community Medicine, University of Oklahoma–Tulsa Schusterman Center, Tulsa, Oklahoma (Dr Williams); Hudson College of Public Health, University of Oklahoma–Tulsa Schusterman Center, Tulsa, Oklahoma (Ms White); Department of Medicine, University of California San Francisco, San Francisco, California and Center for Vulnerable Populations at Zuckerberg San Francisco General Hospital, San Francisco, California (Dr Seligman).

Correspondence to Marianna S. Wetherill, PhD, MPH, RDN-AP/LD, University of Oklahoma–Tulsa Schusterman Center, Room 1GDM, 4502 E 41st Street, Tulsa, OK 74135-2512, USA (mariannawetherill@ouhsc.edu).

Declaration of Conflicting Interests: Hilary Seligman serves as senior medical advisor to Feeding America.

Funding: Research reported in this publication was supported by the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health under award F30DK092924. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Table 2

Food- and Nutrition-Related Resources and Coping Strategies Among HHDM Accessing US Food Pantry Programs, Hunger in America 2014 Study[a]

	n	Weighted %	95% CI
Decision to use food pantry services			
Wait until food is gone	4839	34.9	18.6-51.1
Plan on food as part of monthly budget	10 667	65.1	48.9-81.4
Months accessing food pantry in past year			
12	4367	24.3	11.3-37.2
6-11	3193	21.2	10.4-31.9
1-5	6200	45.0	31.1-58.9
First time	1283	9.6	2.3-16.8
Foods wanted most but do not usually get from this program			
Fresh fruits/vegetables	9740	57.6	35.4-79.8
Proteins	8135	49.6	29.1-70.1
Grains	2204	13.9	1.4-26.3
Dairy	7292	44.5	25.2-63.9
Beverages	2758	16.7	3.7-29.7
Kitchen and housing characteristics			
Cold storage	15 010	96.2	91.3-100
Cooking equipment	14 980	96.1	91.3-100
Stable housing[b]	15 696	93.8	84.7-100
Household food coping strategies			
Purchased inexpensive unhealthy food	12 903	81.7	71.0-92.4
Watered down food or drinks to make them last longer	6745	43.0	32.4-53.6
Ate food past expiration date	9774	60.7	47.7-73.8
Purchased foods in dented/damaged packages	9360	57.1	42.2-72.0
Grew food in a garden	4417	26.2	10.5-41.8
SNAP participation	9211	56.1	44.8-67.5
Choose between food and medical care			
Every month	6400	38.3	27.3-49.2
Some months	4130	25.6	12.0-39.3
1 or 2 times a year	1689	10.9	0.0-23.6
Never	4029	25.3	13.6-36.9
Household food security			
Food secure/marginal	1719	11.4	4.2-18.7
Low food security	4192	30.0	11.7-48.2
Very low food security	8460	58.6	38.9-78.2
Food security items related to irregular intake: adult members			
Cut size or skipped meals	10 819	66.0	50.3-81.8
Ate less than wanted	10 826	68.2	51.1-85.3
Did not eat balanced meals	13 573	85.9	78.4-93.4
Were hungry, didn't eat	8200	50.7	36.7-64.7

Abbreviations: HHDM, households of people with diabetes; SNAP, Supplemental Nutrition Assistance Program.
[a]Percentages have been adjusted for missing data.
[b]Stable housing includes house/townhouse, apartment, mobile home or trailer, military housing; does not include rented room/boarding house or temporary or no housing.

Wetherill et al

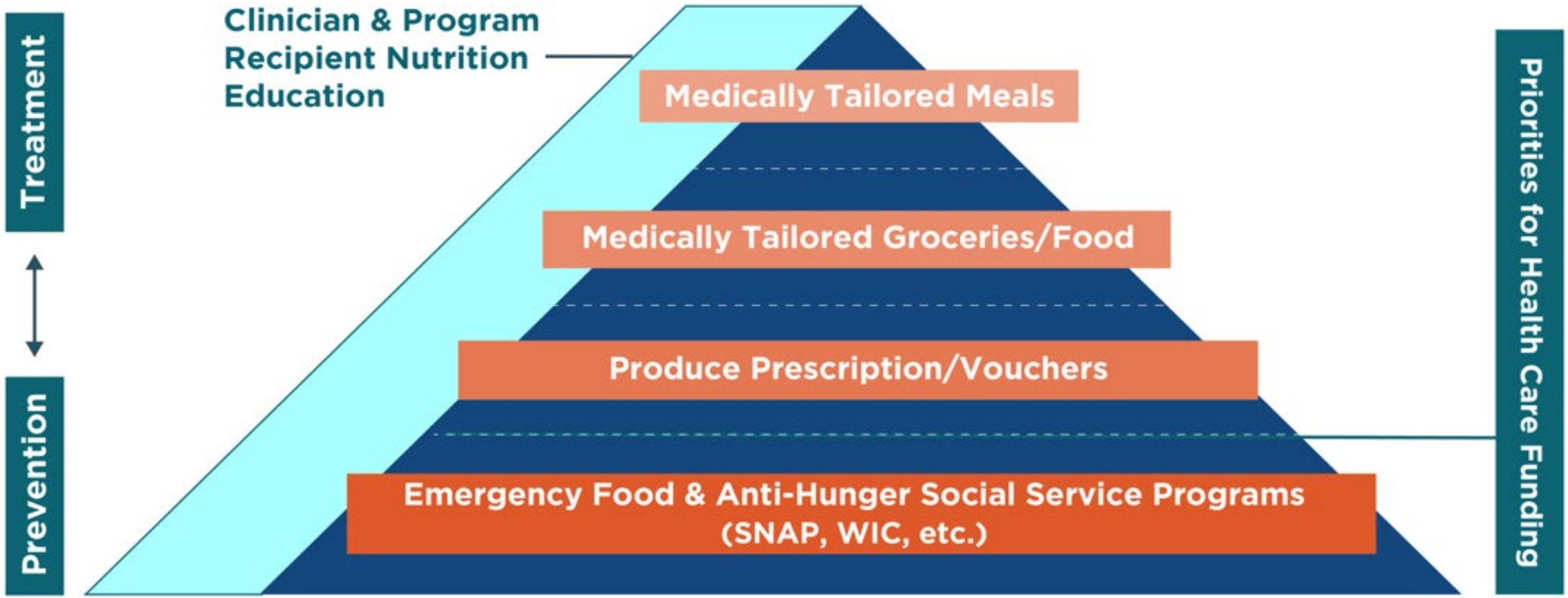
1 in 3 households served by Feeding America include at least one member with diabetes

Most households with at least one person with diabetes who accessed food pantries reported:

- Regular use of food pantries as part of monthly budget (65.1%)
- Wanting, but not receiving adequate amounts of fruits/vegetables (57.6%) and proteins (49.6%)
- Not eating balanced meals due to food insecurity (85.9%)
- Very low food security (58.6%)

root cause FOOD equity LAB | OU-TULSA

Wetherill MS, Williams MB, White KC, Seligman HK. Characteristics of Households of People With Diabetes Accessing US Food Pantries: Implications for Diabetes Self-Management Education and Support. *The Diabetes Educator*. 2019;45(4):397-407. doi:10.1177/0145721719857547


Treatment
Prevention
Clinician & Program
Recipient Nutrition
Education
Medically Tailored Meals
Medically Tailored Groceries/Food
Produce Prescription/Vouchers
Emergency Food & Anti-Hunger Social Service Programs
(SNAP, WIC, etc.)
Priorities for Health Care Funding

Three Primary Food as Medicine Models

Medically-tailored meals

Medically-tailored groceries (food pharmacies)

Fruit & vegetable voucher programs

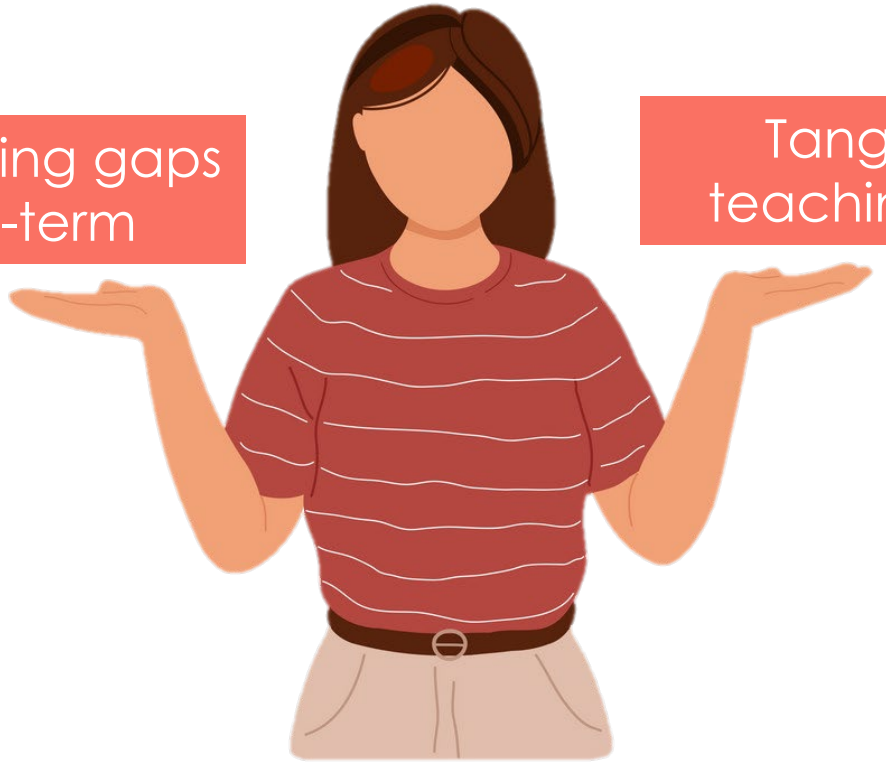
Medically-Tailored Meals

- Fully prepared meals designed by a Registered Dietitian Nutritionist (RDN)
- Address an individual's medical diagnosis, symptoms, allergies, medication management, and illness side effects

Medically-Tailored Groceries

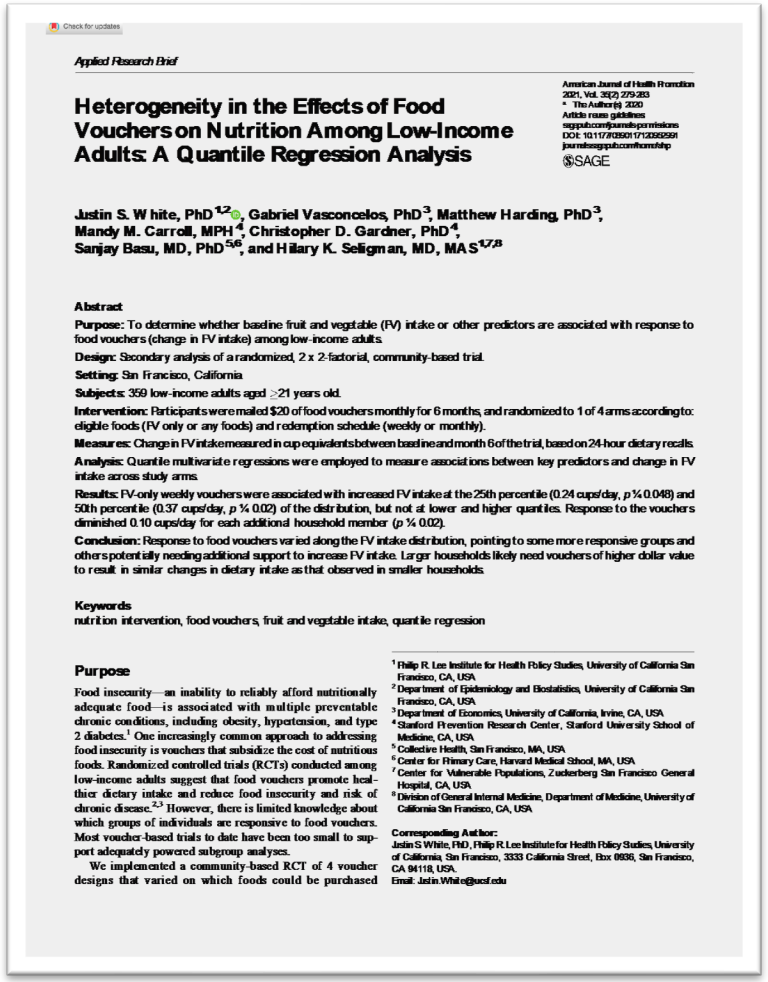
- Distributions of unprepared foods for patients to prepare at home
- Includes produce, whole grains, and/or lean proteins (e.g., legumes, nuts/seeds, fatty fish)
- All are foods considered essential to a healthy diet or for effective management of disease

Additional considerations: Medically-tailored groceries



Fruit & Vegetable Vouchers

- Distributions of produce, or vouchers that can be redeemed for produce, made available to recipients based on a health condition or health risk.



Applied Research Brief

Heterogeneity in the Effects of Food Vouchers on Nutrition Among Low-Income Adults: A Quantile Regression Analysis

American Journal of Health Promotion
2021, Vol. 35(2) 279-283
© The Author(s) 2020
Article reuse guidelines
sagepub.com/journals-permissions
DOI: 10.1177/0890117120959591
journals.sagepub.com/home/ahp
SAGE

Justin S. White, PhD[1,2], Gabriel Vasconcelos, PhD[3], Matthew Harding, PhD[3], Mandy M. Carroll, MPH[4], Christopher D. Gardner, PhD[4], Sanjay Basu, MD, PhD[5,6], and Hilary K. Seligman, MD, MAS[1,7,8]

Abstract

Purpose: To determine whether baseline fruit and vegetable (FV) intake or other predictors are associated with response to food vouchers (change in FV intake) among low-income adults.

Design: Secondary analysis of a randomized, 2 x 2-factorial, community-based trial.

Setting: San Francisco, California.

Subjects: 359 low-income adults aged ≥21 years old.

Intervention: Participants were mailed $20 of food vouchers monthly for 6 months, and randomized to 1 of 4 arms according to: eligible foods (FV only or any foods) and redemption schedule (weekly or monthly).

Measures: Change in FV intake measured in cup equivalents between baseline and month 6 of the trial, based on 24-hour dietary recalls.

Analysis: Quantile multivariate regressions were employed to measure associations between key predictors and change in FV intake across study arms.

Results: FV-only weekly vouchers were associated with increased FV intake at the 25th percentile (0.24 cups/day, p ¼ 0.048) and 50th percentile (0.37 cups/day, p ¼ 0.02) of the distribution, but not at lower and higher quantiles. Response to the vouchers diminished 0.10 cups/day for each additional household member (p ¼ 0.02).

Conclusion: Response to food vouchers varied along the FV intake distribution, pointing to some more responsive groups and others potentially needing additional support to increase FV intake. Larger households likely need vouchers of higher dollar value to result in similar changes in dietary intake as that observed in smaller households.

Keywords
nutrition intervention, food vouchers, fruit and vegetable intake, quantile regression

Purpose

Food insecurity—an inability to reliably afford nutritionally adequate food—is associated with multiple preventable chronic conditions, including obesity, hypertension, and type 2 diabetes.[1] One increasingly common approach to addressing food insecurity is vouchers that subsidize the cost of nutritious foods. Randomized controlled trials (RCTs) conducted among low-income adults suggest that food vouchers promote healthier dietary intake and reduce food insecurity and risk of chronic disease.[2,3] However, there is limited knowledge about which groups of individuals are responsive to food vouchers. Most voucher-based trials to date have been too small to support adequately powered subgroup analyses.

We implemented a community-based RCT of 4 voucher designs that varied on which foods could be purchased

[1] Philip R. Lee Institute for Health Policy Studies, University of California San Francisco, CA, USA
[2] Department of Epidemiology and Biostatistics, University of California San Francisco, CA, USA
[3] Department of Economics, University of California, Irvine, CA, USA
[4] Stanford Prevention Research Center, Stanford University School of Medicine, CA, USA
[5] Collective Health, San Francisco, MA, USA
[6] Center for Primary Care, Harvard Medical School, MA, USA
[7] Center for Vulnerable Populations, Zuckerberg San Francisco General Hospital, CA, USA
[8] Division of General Internal Medicine, Department of Medicine, University of California San Francisco, CA, USA

Corresponding Author:
Justin S White, PhD, Philip R Lee Institute for Health Policy Studies, University of California, San Francisco, 3333 California Street, Box 0936, San Francisco, CA 94118, USA.
Email: Justin.White@ucsf.edu

A deeper dive: Impact of FV Vouchers within Populations

The impact of FV intake was greatest among:

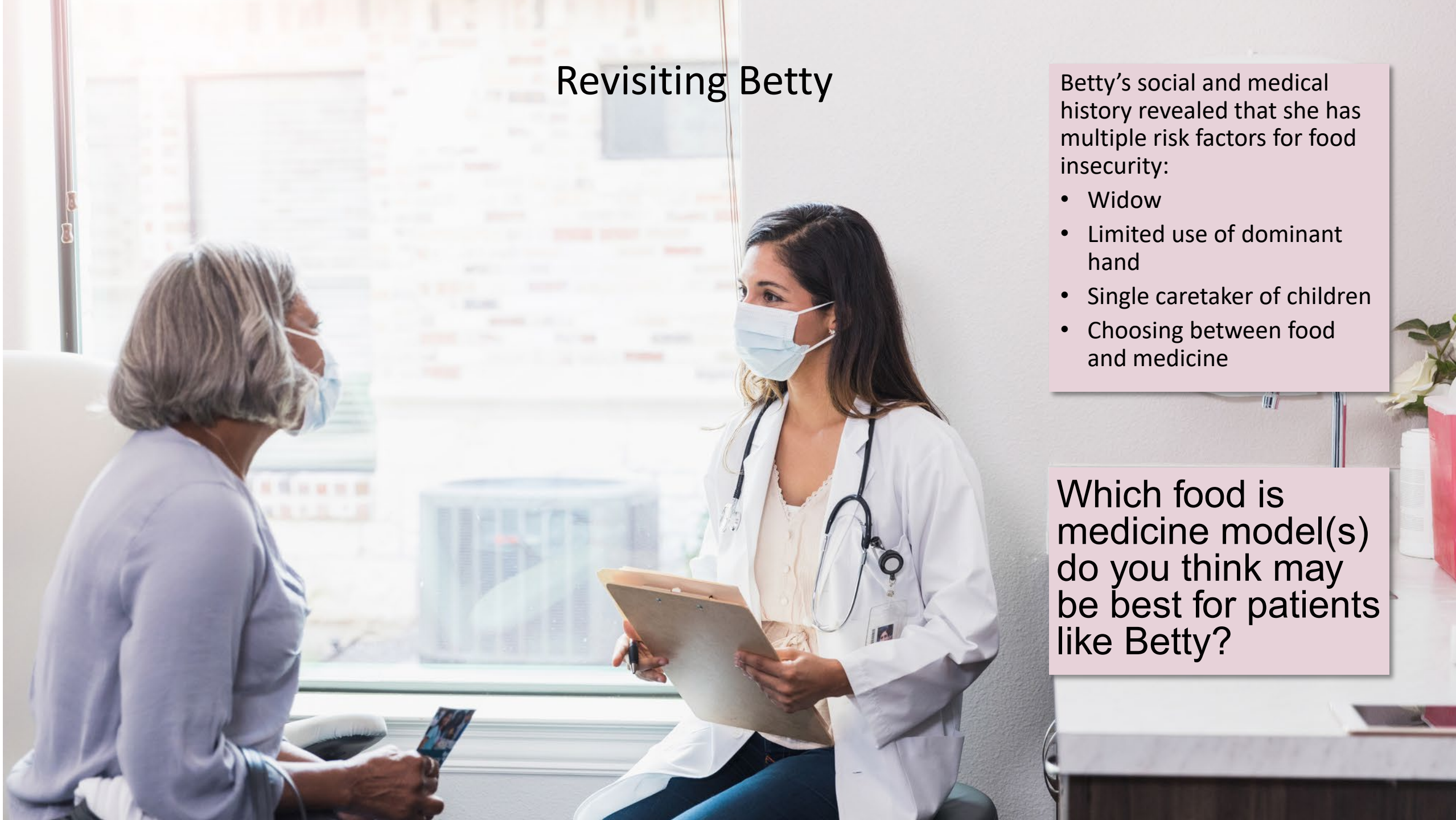
- People with baseline intake that is neither very low or very high
  - More resources may be needed for those with very low intake
- People living in the smallest households
- Smaller vouchers ($5) redeemable weekly may offer a slight advantage over larger vouchers ($20) redeemable monthly

root cause FOODequity LAB | OU-TULSA

White JS, Vasconcelos G, Harding M, Carroll MM, Gardner CD, Basu S, et al. Heterogeneity in the Effects of Food Vouchers on Nutrition Among Low-Income Adults: A Quantile Regression Analysis. *Am J Health Promot. 2021;35*(2):279-83.

Model	Medically-tailored meals	Medically-tailored groceries	Fruit and Vegetable Vouchers
Advantages	Lower burden on patients; meals are fully prepared and designed by a registered dietitian nutritionist for individual needs Largest dose (meets 67%-100% daily nutritional needs)	Lower per-patient cost than medically-tailored meals Can assist patients in meeting behavior change goals (e.g., eating more fruits and vegetables) Can introduce patients to new foods (e.g., whole grain foods, beans, or low-sodium spices and seasonings)	Requires lower amount of labor and coordination efforts Focuses on a single, discrete area of behavior change that can improve variety of health conditions and possibly lead to other areas of healthy eating behavior change
Disadvantages	Requires a high amount of labor and coordination efforts	Labor costs associated with medically-tailored meals passed on to patient Higher burden on the patient Patients are expected to transform raw ingredients into meals → Time, energy, food skills	Higher burden on the patient to shop and select their own produce Patients are expected to transform raw ingredients into meals → Time, energy, food skills

Revisiting Betty

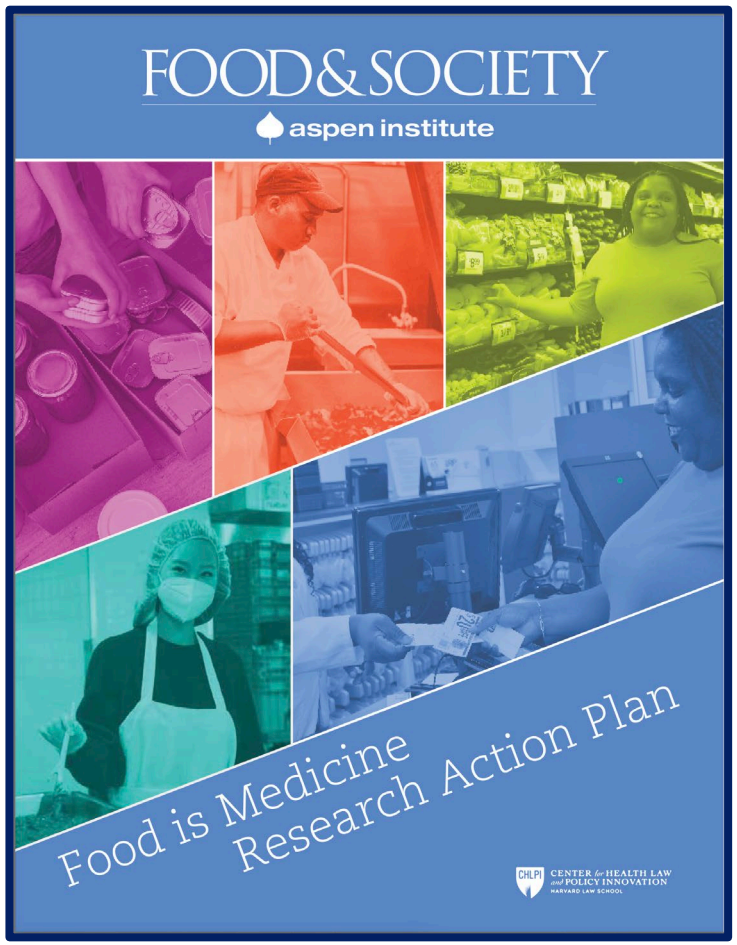


Betty's social and medical history revealed that she has multiple risk factors for food insecurity:

- Widow
- Limited use of dominant hand
- Single caretaker of children
- Choosing between food and medicine

Which food is medicine model(s) do you think may be best for patients like Betty?

Additional Reading



VI. Research on Food is Medicine Interventions

This section examines the published, peer-reviewed research on medically tailored meals, medically tailored groceries, and produce prescriptions—the three primary categories of Food is Medicine interventions described in Section III: Food is Medicine Defined. It provides an overview of what has been tested and how, for what purposes, and in what populations, while summarizing what this research tells us about impact and effectiveness and identifying gaps that remain.

Over the past decade, research on Food is Medicine has transformed the field and laid the groundwork for conversations about widespread adoption. The research demonstrates that Food is Medicine interventions are not only replicable and scalable but also effective. All three interventions examined in this report have been shown to reduce food insecurity, improve dietary intake, and support mental health.[267] Across multiple studies, medically tailored meals are associated with reductions in health care utilization and spending as well as improvements in disease-specific clinical outcomes.[268] Medically tailored groceries and produce prescriptions have also been associated with improvements in blood pressure, HbA1c, and diabetes self-management, though results vary with intervention design and duration.[269] Researchers have also undertaken qualitative assessments across all interventions, yielding critical insights about program design and implementation, participant satisfaction and engagement, and health care provider perspectives.

As the research tables in this report demonstrate, the volume and rigor of research has increased each year. And this trend is set to continue with an impressive number of forthcoming studies and ongoing research that explore a vast range of health care, patient, and health condition-specific outcomes. The opportunities for investigation also continue to expand as exciting new programs and policy innovations are implemented across the country. The challenge now is how best to propel rigorous, high-impact, translatable research that can quickly bring necessary reforms to our health care and food systems.

The findings in this section are drawn exclusively from the published, peer-reviewed research. In addition to undergoing the rigors of the peer-review and publication process, this research is also what is most readily available to and requested by those making key decisions about Food is Medicine program design, implementation, and funding. It is important to note however, that this focus omits many important facets of the larger body of evidence on the efficacy and value of Food is Medicine, including forthcoming studies, gray literature, and program evaluations. In addition, the resources required to undertake research on the health impact of Food is Medicine interventions and seek publication in a peer-reviewed journal are not available to all program implementers. One goal of this Action Plan is to encourage deployment of additional resources to ensure that future research engages a wide range of perspectives and captures the full impact of Food is Medicine interventions.

At a Glance: Food is Medicine Peer-Reviewed Studies

	Medically Tailored Meals	Medically Tailored Groceries	Produce Prescriptions
Number of studies reviewed	10	12	27
Health condition(s) of study participants	Type 2 diabetes, HIV/AIDS, heart failure, chronic liver disease, and multiple health conditions including type 2 diabetes, cancer, end-stage renal disease, and congestive heart failure	Type 2 diabetes, prediabetes, cancer, hypertension, hyperlipidemia, and multiple health conditions including type 2 diabetes, cancer, HIV/AIDS, hypertension, and heart disease	Type 2 diabetes, prediabetes, obesity, cancer, hypertension, pregnancy, and multiple health conditions (not specified)
Study designs	RCT, pilot RCT, randomized cross-over trial, retrospective matched cohort, retrospective chart review, pre-post with comparison group, pre-post with no comparison group, qualitative evaluation	RCT, pilot RCT, nested cohort study, pre-post with no comparison group, retrospective chart review, mixed-methods evaluation, qualitative evaluation	Pilot RCT, non-randomized, parallel, controlled trial, non-controlled longitudinal intervention trial, pre-post with no comparison group, pre-post with comparison group, quasi-experimental prospective study with comparison group, longitudinal retrospective cohort study, mixed-methods evaluation, qualitative evaluation
Primary outcomes	Inpatient admissions, emergency department visits, admissions to a skilled nursing facility, rehospitalizations, health care costs, diet quality, food insecurity, BMI, frailty/disability, independence in activities of daily living, health-related quality of life, cost-related medication underuse, hypoglycemia, hemoglobin A1c, diabetes distress, diabetes self-efficacy, depressive symptoms, internalized HIV stigma, ART adherence, chronic liver disease-specific outcomes, and heart failure-specific outcomes	Food security, dietary intake, fruit and vegetable intake, hemoglobin A1c, diabetes self-management, diabetes self-efficacy, medication adherence, hypoglycemic episodes, BMI, physical activity, and depression scores	Food insecurity, dietary intake, preterm birth weights, infant weight, breastfeeding, blood pressure, hemoglobin A1c, BMI, exercise, and mood
Process and engagement measures assessed	Participant experience and satisfaction, participant feedback, adherence to intervention food, food consumed outside of intervention food, intervention food thrown away or shared, and cost of intervention	Participant experience and satisfaction, health care provider experience and satisfaction, program utilization, and cost of intervention	Participant experience and satisfaction, accessibility, health care provider experience, purchasing behaviors, nutrition knowledge, voucher redemption rates, and cost of intervention

References

Anderson, S. (1990). Core indicators of nutritional state for difficult-to-sample populations. *The Journal of Nutrition, 120*(11S), 1559-1600.

Berkowitz, S. A., Karter, A. J., Corbie-Smith, G., Seligman, H. K., Ackroyd, S. A., Barnard, L. S., ... & Wexler, D. J. (2018). Food insecurity, food "deserts," and glycemic control in patients with diabetes: a longitudinal analysis. *Diabetes care*, *41*(6), 1188-1195.

Berkowitz, S.A., X. Gao, and K.L. Tucker, Food-insecure dietary patterns are associated with poor longitudinal glycemic control in diabetes: results from the Boston Puerto Rican Health study. Diabetes Care, 2014. 37(9): p. 2587-92.

Ding, M., Keiley, M. K., Garza, K. B., Duffy, P. A., & Zizza, C. A. (2015). Food insecurity is associated with poor sleep outcomes among US adults. *The Journal of Nutrition*, *145*(3), 615-621.

Feeding America. (2020). *Map the Meal Gap 2020*. Feeding America. Retrieved November 17, 2021, from https://www.feedingamerica.org/research/map-the-meal-gap/how-we-got-the-map-data.

Feeding America Research. (2019, August 12). *The Healthcare Costs of Food Insecurity*. Retrieved November 17, 2021, from https://public.tableau.com/app/profile/feeding.america.research/viz/TheHealthcareCostsofFoodInsecurity/HealthcareCosts.

Food Research and Action Center. (2015, October). *Understanding the Connections: Food Insecurity and Obesity*. Retrieved November 17, 2021, from https://frac.org/wp-content/uploads/frac_brief_understanding_the_connections.pdf.

Grilo SA, Shallcross AJ, Ogedegbe G, Odedosu T, Levy N, Lehrer S , et al. Food Insecurity and Effectiveness of Behavioral Interventions to Reduce Blood Pressure, New York City, 2012–2013. Prev Chronic Dis 2015;12:140368.

Gowda, C., Hadley, C., & Aiello, A. E. (2012). The association between food insecurity and inflammation in the US adult population. *American Journal of Public Health*, *102*(8), 1579-1586.

Health Research & Educational Trust. (2017, June). Social determinants of health series: Food insecurity and the role of hospitals. Chicago, IL: Health Research & Educational Trust. Accessed at www.aha.org/foodinsecurity

Jacka, F.N., O'Neil, A., Opie, R. et al. A randomised controlled trial of dietary improvement for adults with major depression (the 'SMILES' trial). BMC Med 15, 23 (2017).

Kendall, A., Olson, C. M., & Frongillo Jr, E. A. (1995). Validation of the Radimer/Cornell measures of hunger and food insecurity. *The Journal of Nutrition*, *125*(11), 2793-2801.

López, A., & Seligman, H. K. (2012). Clinical management of food-insecure individuals with diabetes. *Diabetes Spectrum, 25*(1), 14-18.

Mangurian C, Sreshta N, Seligman H. Food insecurity among adults with severe mental illness. *Psychiatr Serv*. 2013;64(9):931-932. doi:10.1176/appi.ps.201300022

Mayer, V. L., McDonough, K., Seligman, H., Mitra, N., & Long, J. A. (2016). Food insecurity, coping strategies and glucose control in low-income patients with diabetes. *Public health nutrition, 19*(6), 1103-1111.

Parletta N, Zarnowiecki D, Cho J, Wilson A, Bogomolova S, Villani A, Itsiopoulos C, Niyonsenga T, Blunden S, Meyer B, Segal L, Baune BT, O'Dea K. A Mediterranean-style dietary intervention supplemented with fish oil improves diet quality and mental health in people with depression: A randomized controlled trial (HELFIMED). Nutr Neurosci. 2019 Jul;22(7):474-487. doi: 10.1080/1028415X.2017.1411320. Epub 2017 Dec 7. PMID: 29215971.

Promoting Food Security for All Children. Pediatrics, 2015.

Satter, E. (2007). Hierarchy of food needs. *Journal of Nutrition Education and Behavior*, *39*(5), S187-S188.

Seligman, H. K., & Schillinger, D. (2010). Hunger and socioeconomic disparities in chronic disease. *N Engl J Med*, *363*(1), 6-9.

Seligman, H. K., Laraia, B. A., & Kushel, M. B. (2010). Food insecurity is associated with chronic disease among low-income NHANES participants. *The Journal of Nutrition*, *140*(2), 304-310.

Standards of Medical Care in Diabetes-2019 Abridged for Primary Care Providers. Clinical diabetes: A publication of the American Diabetes Association, 2019. **37**(1): p. 11-34

root cause
FOOD equity LAB | OU-TULSA

Q & A

HUNGER ★ FREE OKLAHOMA

Collaborative Learning in ACTION!

Don't forget to visit the debrief boards between sessions!

Share what you learned and resources that might help others.

#HungryForActionOK

HUNGER ★ FREE OKLAHOMA

Scan to Give Session Feedback

...and find lots of other resources!

#HungryForActionOK