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Early-Stage Investigator Lecture

Dietary Patterns To Prevent Cardiovascular Disease



Presented by:

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Dietary Patterns and Subclinical Cardiovascular Disease

Stephen P Juraschek, MD PhD
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Disclosures

- My work is support by grants from the National Institutes of Health



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Outline

- Review the isocaloric feeding studies behind dietary recommendations for cardiovascular risk reduction
 - DASH, DASH-Sodium, OmniHeart
- Adoption of DASH & dietary trends in the United States
- Enhancing Translation
 - Simplified message
 - Translational interventions



NHLBI Recommendations: The DASH Eating Plan

DASH Eating Plan - Daily Servings by Calories (NIH/NHLBI)			
Food Group	1,400 Cal	2,000 Cal	2,600 Cal
Grains	5-6	6-8	10-11
Vegetables	3-4	4-5	5-6
Fruits	3-4	4-5	5-6
Fat-free/low-fat dairy	2-3	2-3	3
Lean meats, poultry, fish	3 or less	6 or less	6 or less
Nuts, seeds, legumes	3 per week	4-5 per week	1

Restrict: Red meat, fat, saturated fat, sweets, sugary beverages



Wednesday, January 3, 2018

DASH ranked Best Diet Overall for eighth year in a row by U.S. News and World Report

Diet helps people prevent and treat high blood pressure, lower blood cholesterol.

Mediterranean Diet

 #1 in Best Diets Overall

With its emphasis on fruits, vegetables, olive oil, fish and other healthy fare, the Mediterranean diet is eminently sensible. [... more](#)

4.2/5 Overall Score | 3.0/5 Weight Loss | 4.9/5 Healthy



See Do's & Don'ts

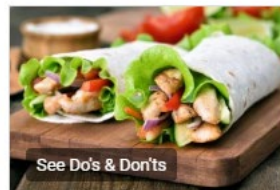
2019

DASH Diet

 #2 in Best Diets Overall

DASH fights high blood pressure and was praised for its nutritional completeness, safety, ability to prevent or control diabetes, and [... more](#)

4.1/5 Overall Score | 3.1/5 Weight Loss | 4.8/5 Healthy



See Do's & Don'ts



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The DASH Trial

The New England Journal of Medicine

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A CLINICAL TRIAL OF THE EFFECTS OF DIETARY PATTERNS ON BLOOD PRESSURE

LAWRENCE J. APPEL, M.D., M.P.H., THOMAS J. MOORE, M.D., EVA OBARZANEK, PH.D., WILLIAM M. VOLLMER, PH.D.,
LAURA P. SVETKEY, M.D., M.H.S., FRANK M. SACKS, M.D., GEORGE A. BRAY, M.D., THOMAS M. VOGT, M.D., M.P.H.,
JEFFREY A. CUTLER, M.D., MARLENE M. WINDHAUSER, PH.D., R.D., PAO-HWA LIN, PH.D., AND NJERI KARANJA, PH.D.,
FOR THE DASH COLLABORATIVE RESEARCH GROUP*



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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.

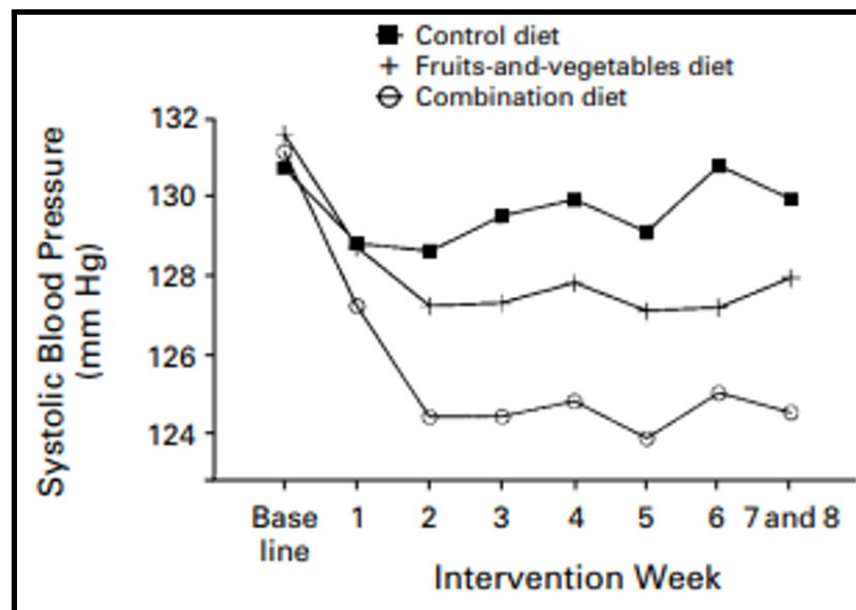
**DASH (Combination)
Diet:**

*“A diet rich in fruits,
vegetables, and low-fat
dairy foods and with
reduced saturated and
total fat”*



The DASH Trial

- Enrolled: 459 adults (mean age 45 years [SD, 11], 49% women, 60% black), with elevated BP or hypertension (26%), without CVD or hypertension medication use
 - Parallel design, 8 weeks of feeding



NEJM 1997

- Similar results for diastolic blood pressure, LDL-cholesterol



The DASH-Sodium Trial

The New England Journal of Medicine

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VOLUME 344

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NUMBER 1



EFFECTS ON BLOOD PRESSURE OF REDUCED DIETARY SODIUM AND THE DIETARY APPROACHES TO STOP HYPERTENSION (DASH) DIET

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FOR THE DASH-SODIUM COLLABORATIVE RESEARCH GROUP

*“Does the DASH diet lower blood pressure beyond the level
achievable by simply reducing sodium intake?”*

*“What is the combined effect of the DASH diet and reduced
sodium intake?”*



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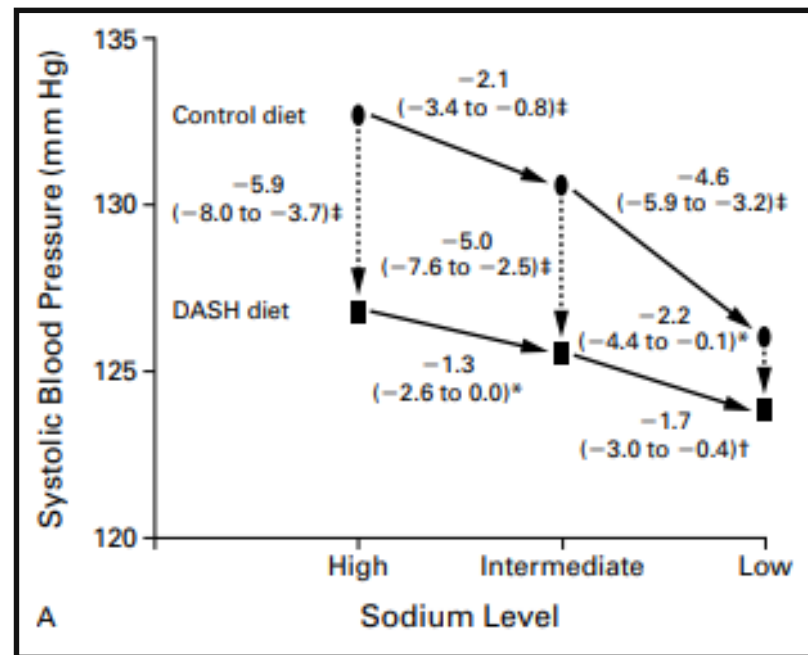
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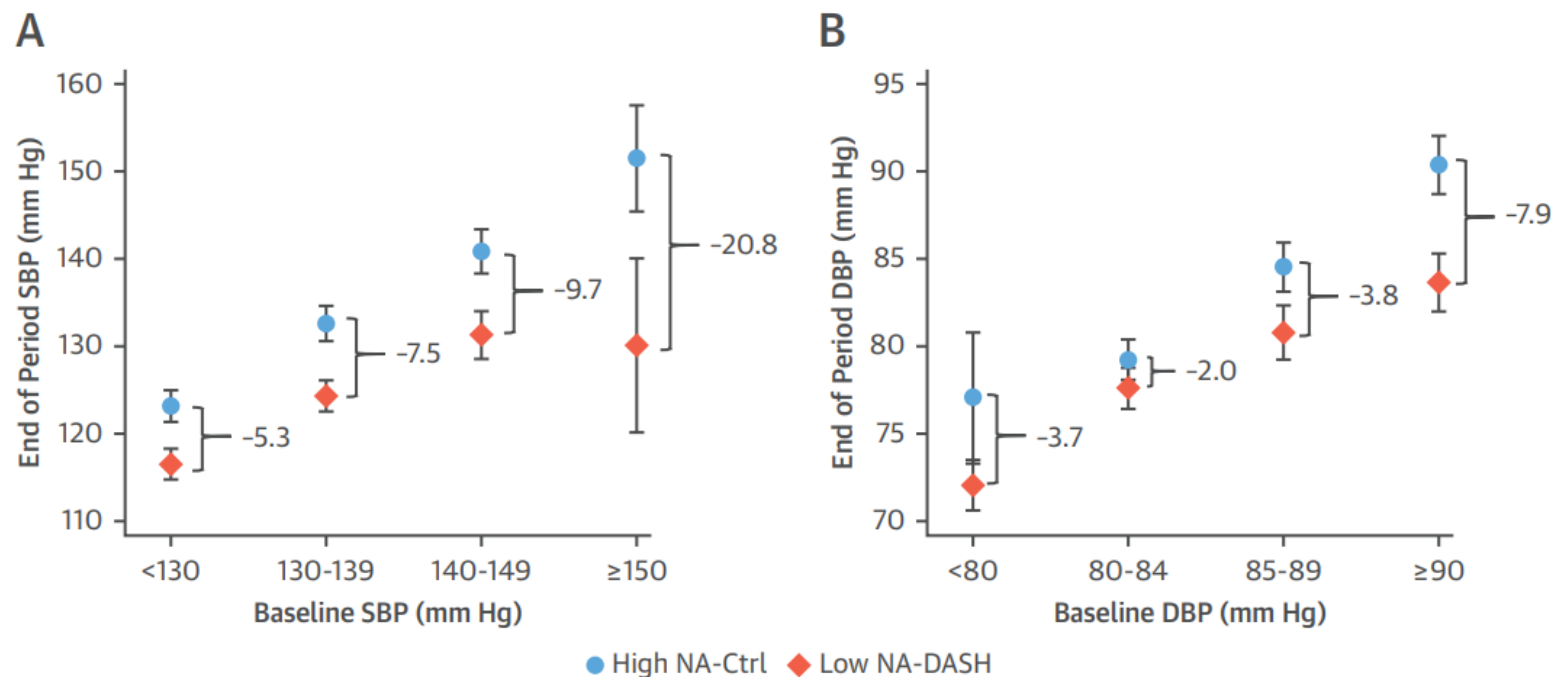
The DASH-Sodium Trial

- Enrolled: 412 participants, mean age 48 (SD, 10), 57% female, 57% black, 41% with hypertension
- Parallel design: 12 weeks of DASH vs control diet
- Crossover design: 4 weeks of 1 of 3 sodium levels (150, 100, 50 mmol/d for a 2100 kcal diet)



Effects are greater among adults with higher BP at baseline

FIGURE 1 The Combined Effects of Low Sodium and the DASH Diet According to BP



Juraschek et al, *JACC* 2017



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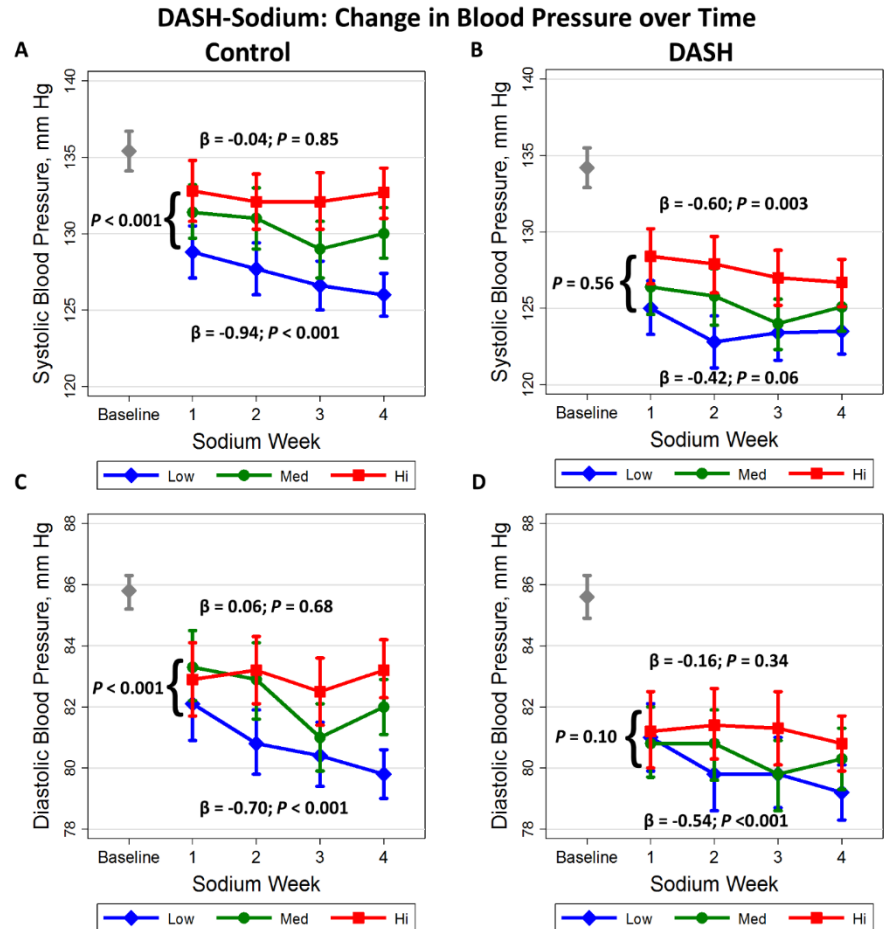
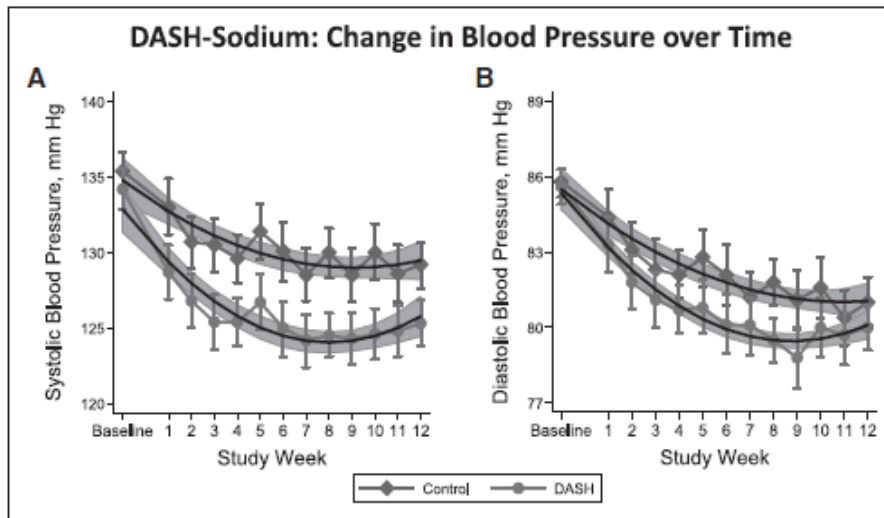


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Effects are rapid, sustained, and potentially underestimated (sodium)



Juraschek et al, *Hypertension* 2018



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OmniHeart

Original Contribution

November 16, 2005

Effects of Protein, Monounsaturated Fat, and Carbohydrate Intake on Blood Pressure and Serum Lipids Results of the OmniHeart Randomized Trial

Lawrence J. Appel, MD, MPH; Frank M. Sacks, MD; Vincent J. Carey, PhD; [et al](#)

» [Author Affiliations](#) | [Article Information](#)

JAMA. 2005;294(19):2455-2464. doi:10.1001/jama.294.19.2455

Objective: To determine whether partial replacement of carbohydrate with either unsaturated fat or protein could improve blood pressure and lipid risk factors



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Table 1. Nutrient Targets and Average Daily Servings of Foods by Diet at 2100 kcal

	Diet		
	Carbohydrate*	Protein	Unsaturated Fat
Nutrient targets, kcal%†			
Fat	27	27	37
Saturated	6	6	6
Monounsaturated	13	13	21
Polyunsaturated	8	8	10
Carbohydrate‡	58	48	48
Protein	15	25	15
Meat	5.5	9	5.5
Dairy	4	4	4
Plant§	5.5	12	5.5
Food groups, servings/d			
Fruit and juices	6.6	3.8	4.8
Vegetables	4.4	5.4	6.3
Grains	5.3	5	4.3
Low-fat dairy products	1.4	2.3	1.6
High-fat dairy products	0.7	0.2	0.3
Legumes, nuts, seeds, and other vegetable protein	1.3	3	1.2
Beef, pork, and ham	0.9	1.1	1
Poultry	1.6	2.6	1.8
Fish	1.1	1.3	1
Egg product substitutes	0.2	1.1	0.1
Desserts and sweets	4.6	2.5	1.7
Fats and oils	6	3.5	12

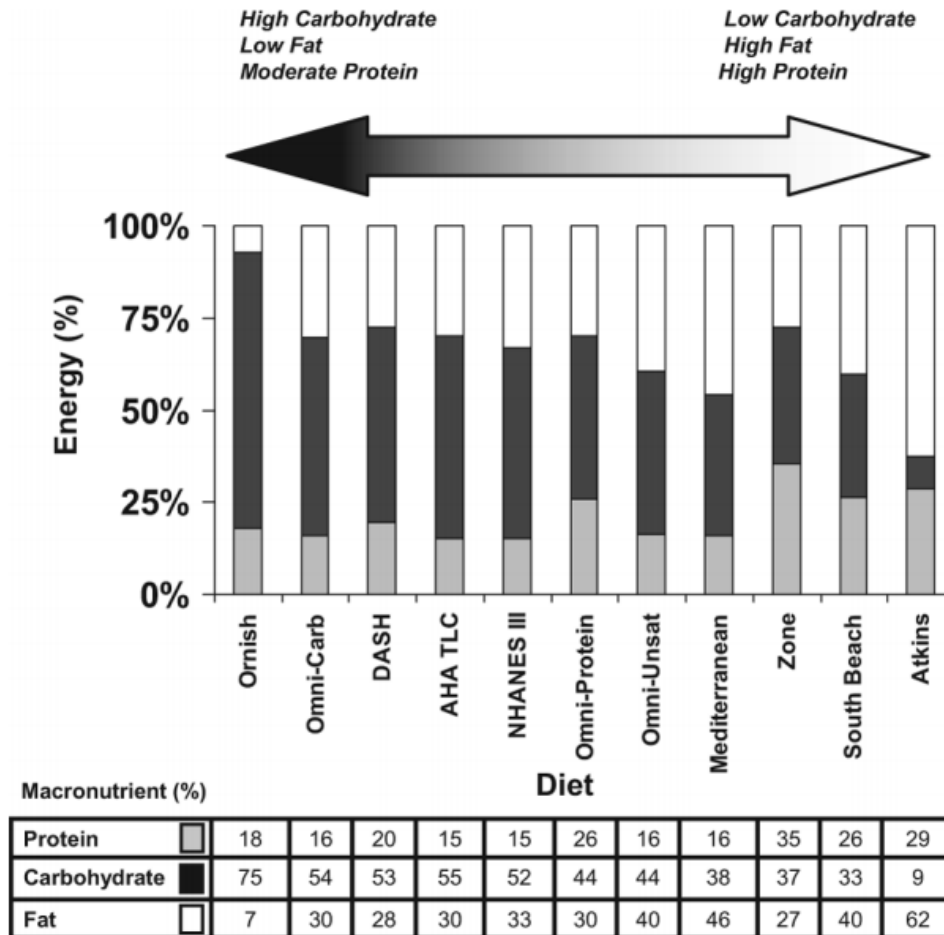
*The carbohydrate diet replicated the nutrient profile of the Dietary Approaches to Stop Hypertension (DASH) diet except that the percentage of kilocalories from protein and carbohydrates in the DASH diet were 18% and 55%, respectively.

†By design, the following nutrient targets were similar in each diet: cholesterol lower than 150 mg/d; fiber more than 30 g/d; sodium 2300 mg/d, potassium 4700 mg/d, magnesium 500 mg/d, and calcium 1200 mg/d.

‡The total dietary glycemic index of the 3 diets was moderate and similar (68 in the carbohydrate, 71 in the protein, and 75 in the unsaturated fat diets).

§The average daily intake of soy protein was 0.5 g in the carbohydrate, 7.3 g in the protein, and 0.5 g in the unsaturated fat diets.





De Souza et al, AJCN 2008



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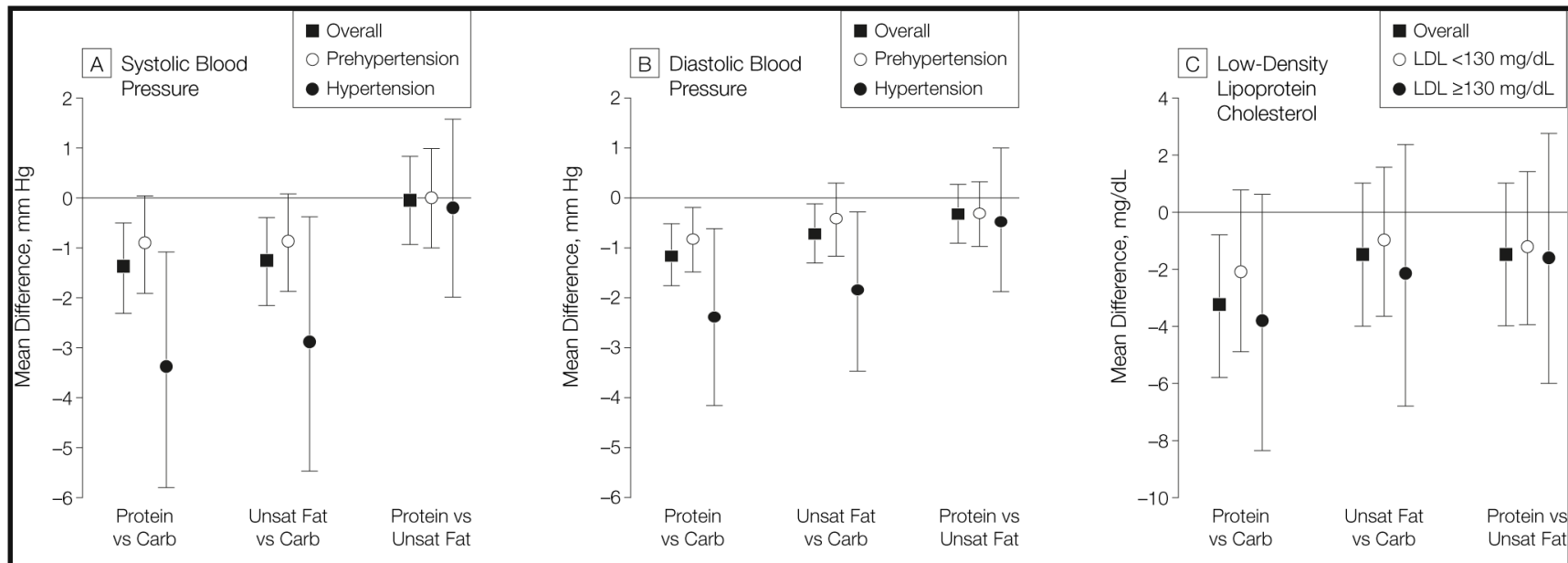
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Study features

- Crossover design, 6-week feeding periods, washout 2-4 weeks
- 164 adults completed at least 2 feeding periods
- Age 54 (SD, 11), 45% women, 55% black, 19% with hypertension



Key findings



Contrasts	Systolic Blood Pressure, mm Hg		LDL Cholesterol, mg/dL		Estimated 10-yr CHD risk, %
	Mean Difference	P	Mean Difference	P	Mean Difference
Carb vs baseline	-8.2	<0.01	-11.6	<0.01	-16.1
Prot vs baseline	-9.5	<0.01	-14.2	<0.01	-21.0
Unsat vs baseline	-9.3	<0.01	-13.1	<0.01	-19.6
Prot vs Carb	-1.4	<0.01	-3.3	0.01	-5.8
Unsat vs Carb	-1.3	<0.01	-1.5	0.22	-4.2



Conclusions

- DASH (combination) diet reduces systolic blood pressure and LDL-cholesterol beyond fruit and vegetables
- Sodium reduction has an independent effect on blood pressure
- Combined effects of DASH and sodium reduction are greater in adults with more poorly controlled blood pressure, have rapid onset, and seem to be sustained
- Blood pressure and cholesterol reduction greater with diets reduced in carbohydrates (higher protein & unsaturated fat)



Adoption of DASH and dietary trends in the United States



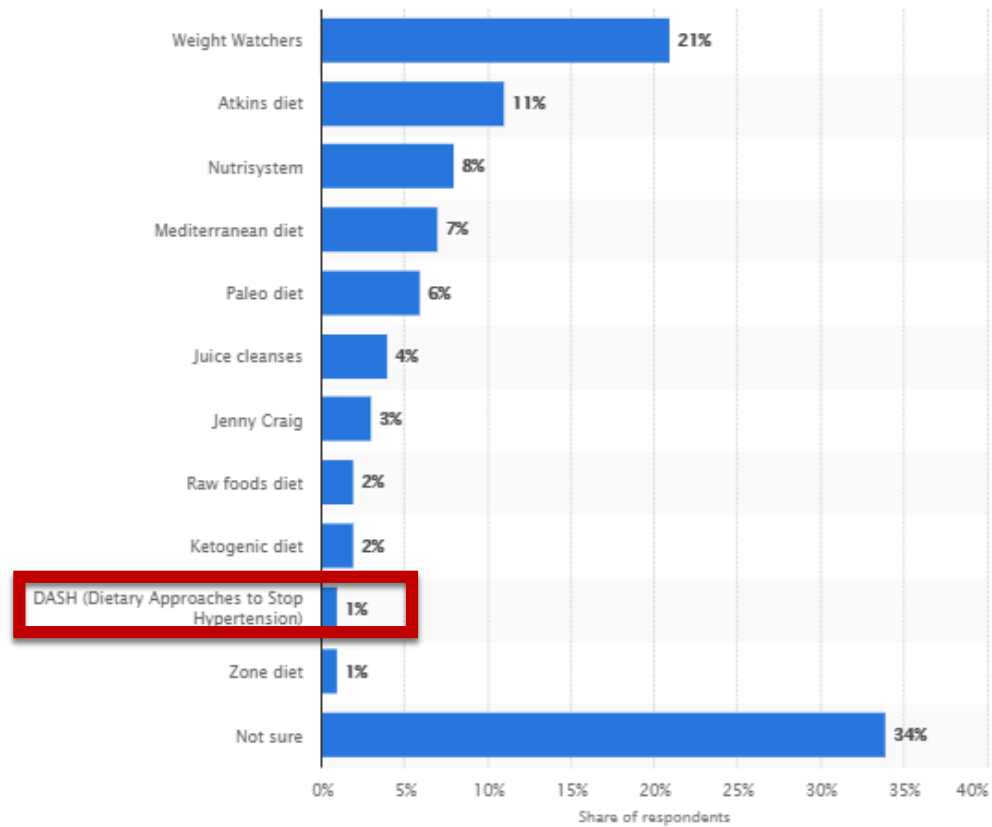
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Uptake in the U.S.



Statista, March 2017



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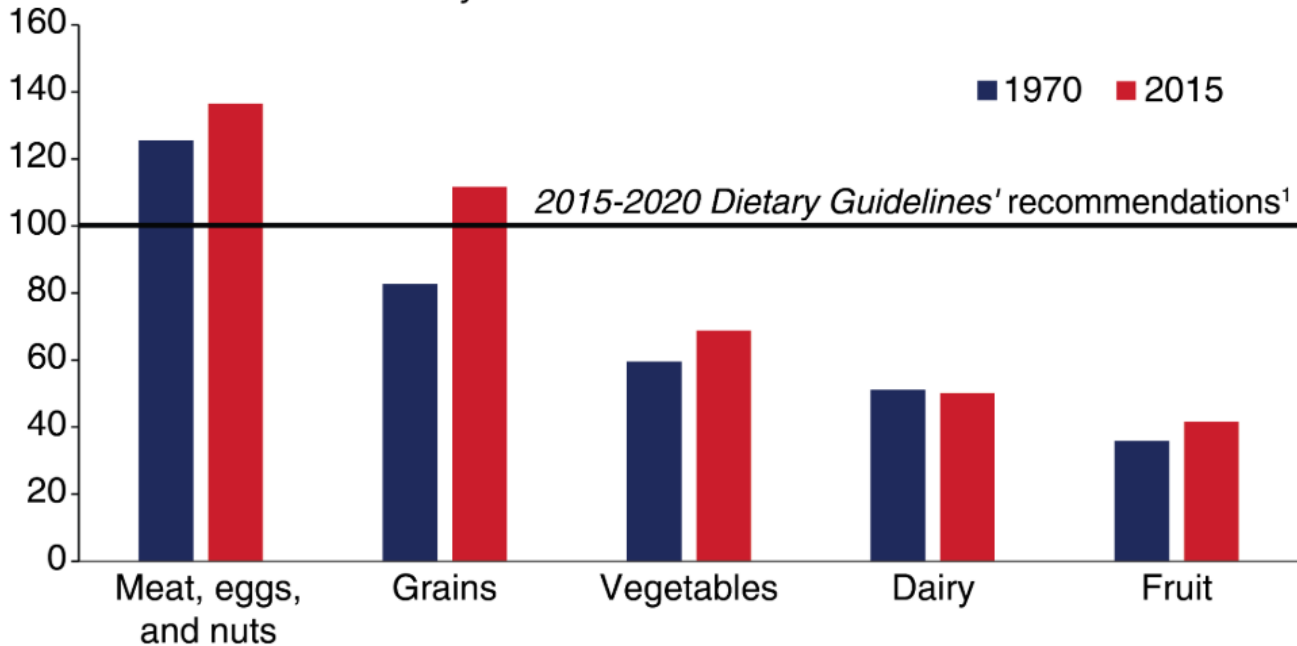
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Estimated average U.S. consumption compared to recommendations, 1970 and 2015

Percent of *2015-2020 Dietary Guidelines'* recommendations



¹Based on a 2,000-calorie-per-day diet.

Loss-adjusted food availability data are proxies for consumption. Rice availability data were discontinued and thus are not included in the grains group.

Source: USDA, Economic Research Service, Loss-Adjusted Food Availability Data and *2015-2020 Dietary Guidelines*.



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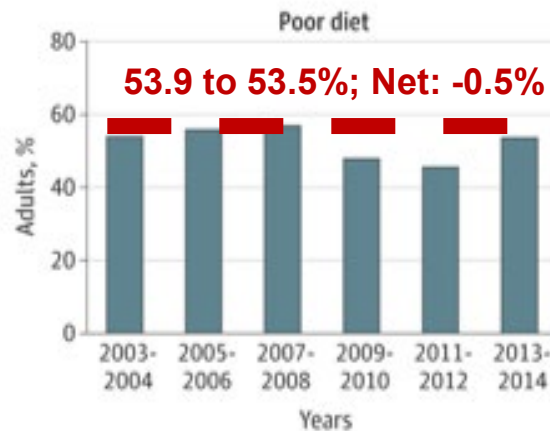
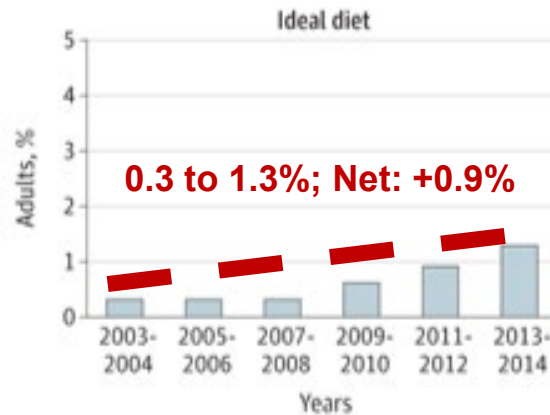


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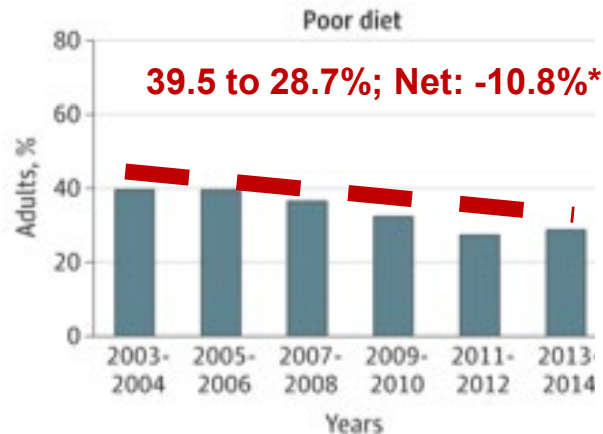
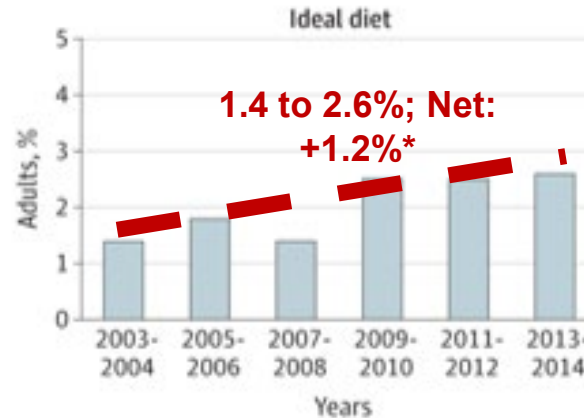


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SNAP Recipients



Higher Income Adults



SNAP: The Supplemental Nutrition Assistance Program (formerly known as food stamps), \$30/week

There were **42 million participants** nationwide in 2017 alone

* P -trend ≤ 0.01

Zhang et al, JAMA 2018



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Opportunities for Translation

Can we simplify our message? A look at direct organ damage



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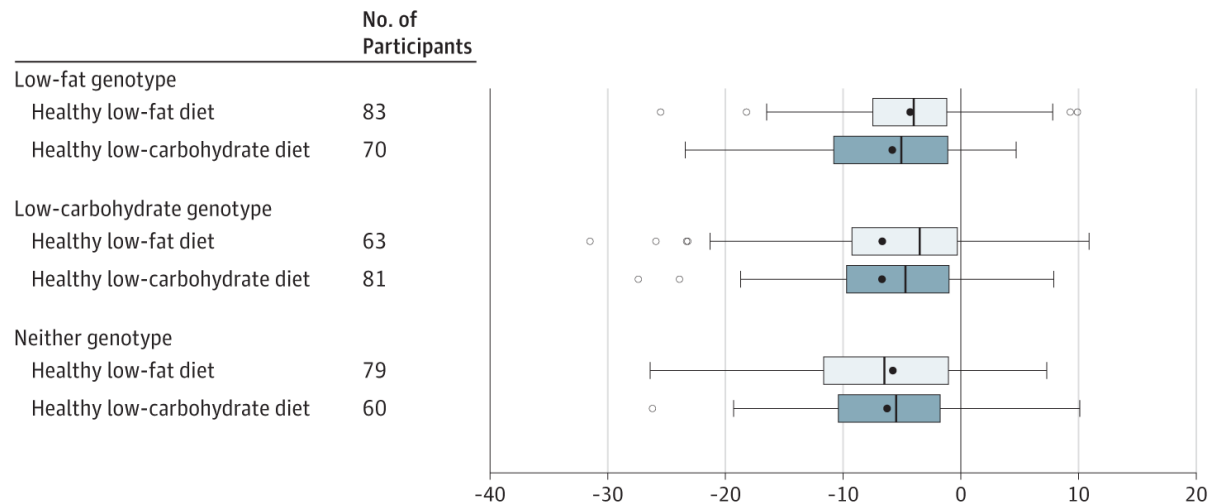
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DIETFITS Trial

A 12-mo Weight loss by diet and genotype



No significant difference in weight change between a healthy low-fat diet vs a healthy low-carbohydrate diet

Gardner et al, JAMA 2018



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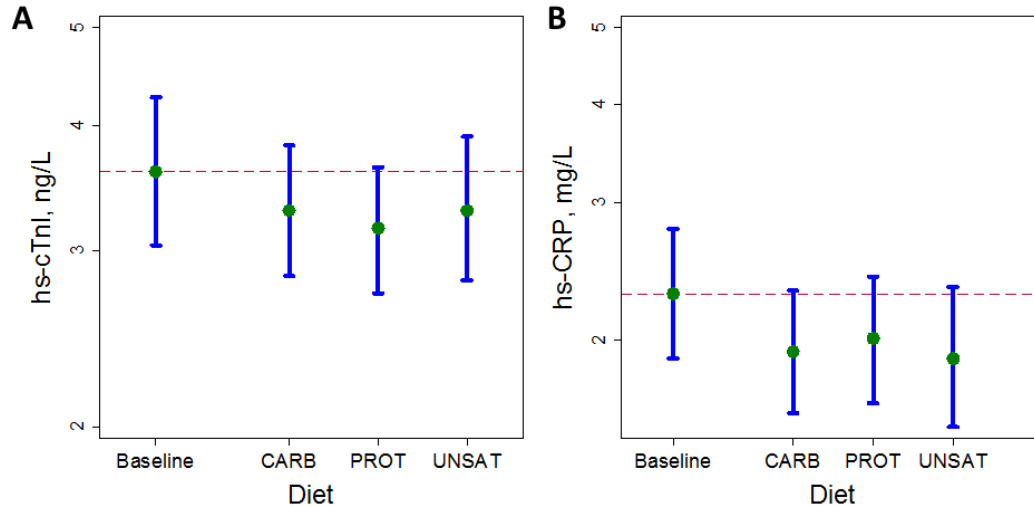
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Revisiting OMNIHEART (isocaloric feeding)

- Measurement of highly sensitive biomarkers:
 - High sensitivity cardiac troponin I: cardiac damage
 - Sensitive marker of cardiac muscle injury (highly specific)
 - Strongly associated with CVD events
 - Robust to freeze-thaw
 - High sensitivity C-reactive protein: ambient inflammation
 - Strongly associated with CVD events
 - Robust to freeze-thaw
- Question: Do dietary macronutrients alter subclinical cardiac damage and inflammation?



Cardiac injury and inflammation in OmniHeart



Kovell et al, IJC, 2018

Suggestive: Short-term dietary changes reduce cardiac injury and inflammation, but any healthy diet may matter more than a single macronutrient emphasis

Limitation: No true control (Hawthorne, regression to mean)

	Systolic Blood Pressure, mm Hg		LDL Cholesterol, mg/dL		High Sensitivity Troponin I, ng/L		High Sensitivity CRP, mg/L		Estimated 10-yr CHD risk, %
	Mean		Mean		Mean %		Mean %		
Contrasts	Diff	P	Diff	P	Diff	P	Diff	P	Mean Diff
Carb vs baseline	-8.2	<0.01	-11.6	<0.01	-8.6	0.04	-17.0	0.003	-16.1
Prot vs baseline	-9.5	<0.01	-14.2	<0.01	-10.8	0.01	-13.9	0.03	-21.0
Unsat vs baseline	-9.3	<0.01	-13.1	<0.01	-9.4	0.04	-16.0	0.01	-19.6
Prot vs Carb	-1.4	<0.01	-3.3	0.01	-2.4	0.49	3.7	0.52	-5.8
Unsat vs Carb	-1.3	<0.01	-1.5	0.22	-0.8	0.85	1.1	0.86	-4.2



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Associations Between Dietary Patterns and Subclinical Cardiac Injury

An Observational Analysis From the DASH Trial

Stephen P. Juraschek, MD, PhD; Lara C. Kovell, MD; Lawrence J. Appel, MD, MPH; Edgar R. Miller III, MD, PhD; Frank M. Sacks, MD; Robert H. Christenson, PhD; Heather Rebuck, MS; Alexander R. Chang, MD, MHS; and Kenneth J. Mukamal, MD, MPH, MA

- Obtained pre- and post-intervention specimens from 326 of the original 459 DASH participants
- Measured high sensitivity cardiac troponin I, N-terminal pro b-type natriuretic peptide, high sensitivity C-reactive protein
- Large effect in blood pressure and LDL cholesterol across diets
- Hypothesis: DASH would lower subclinical cardiac injury, strain, and inflammation

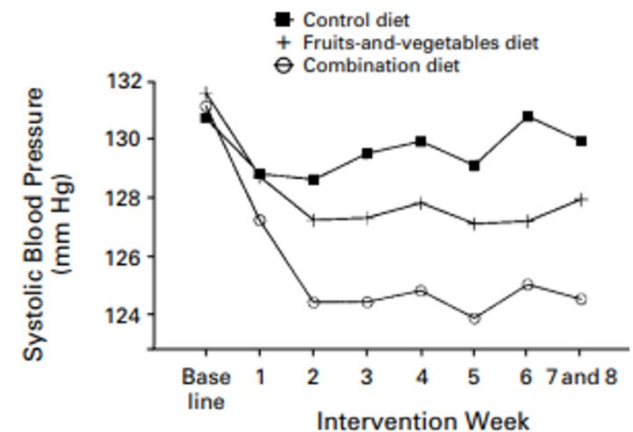
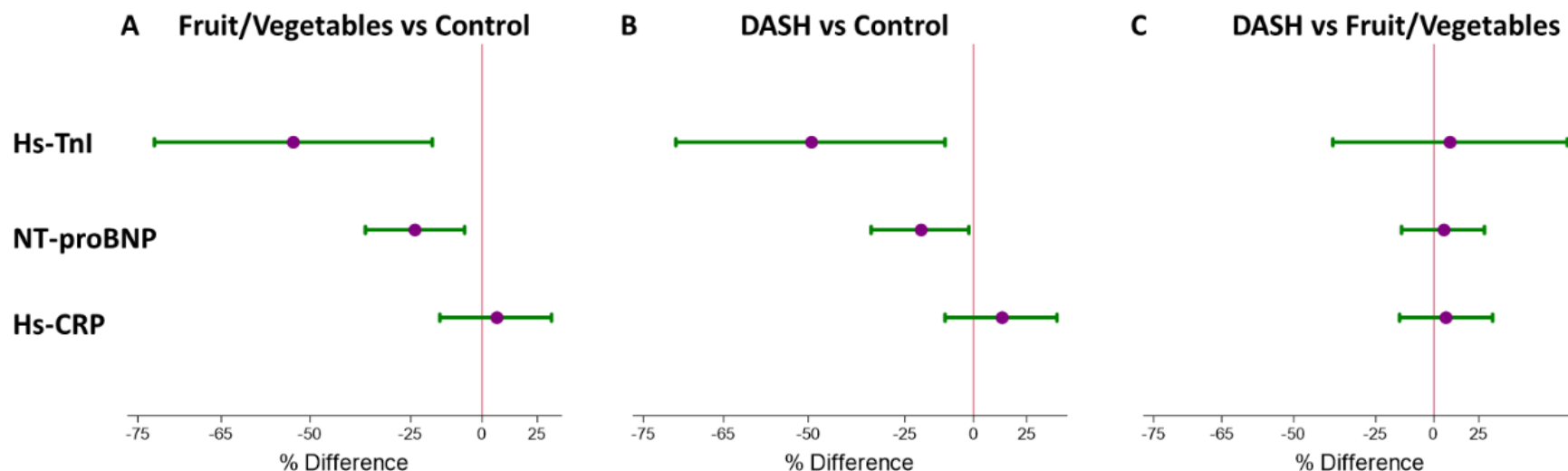


Figure. Percent difference in cardiac markers between the three diets tested in the DASH trial



Between diet change in cardiac biomarkers

	Fruit/Vegetable vs Control		Combination vs Control		Combination vs Fruit/Vegetable	
	Difference	P	Difference	P	Difference	P
Log[Hs-TnI]	-0.76 (-1.32,-0.20)	0.008	-0.68 (-1.25,-0.12)	0.02	0.08 (-0.50, 0.66)	0.79
Log[NT-proBNP]	-0.27 (-0.47,-0.07)	0.01	-0.22 (-0.43,-0.02)	0.04	0.05 (-0.16, 0.25)	0.64
Log[Hs-CRP]	0.06 (-0.17, 0.28)	0.63	0.12 (-0.12, 0.35)	0.33	0.06 (-0.17, 0.29)	0.60

Juraschek et al, Annals of Internal Medicine, 2020



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

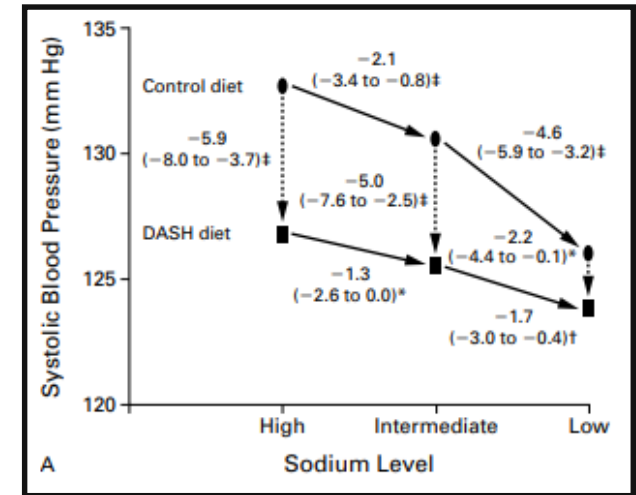
ITEM	CONTROL DIET		FRUITS-AND-VEGETABLES DIET		COMBINATION DIET	
	NUTRIENT TARGET	MENU ANALYSIS†	NUTRIENT TARGET	MENU ANALYSIS†	NUTRIENT TARGET	MENU ANALYSIS†
Nutrients						
X Fat (% of total kcal)	37	35.7	37	35.7	27	25.6
Saturated	16	14.1	16	12.7	6	7.0
Monounsaturated	13	12.4	13	13.9	13	9.9
Polyunsaturated	8	6.2	8	7.3	8	6.8
X Carbohydrates (% of total kcal)	48	50.5	48	49.2	55	56.5
X Protein (% of total kcal)	15	13.8	15	15.1	18	17.9
X 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
X 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	
X Low-fat dairy	0.1		0.0		2.0	
X Regular-fat dairy	0.4		0.3		0.7	
Nuts, seeds, and legumes	0.0		0.6		0.7	
X Beef, pork, and ham	1.5		1.8		0.5	
Poultry	0.8		0.4		0.6	
Fish	0.2		0.3		0.5	
X 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.

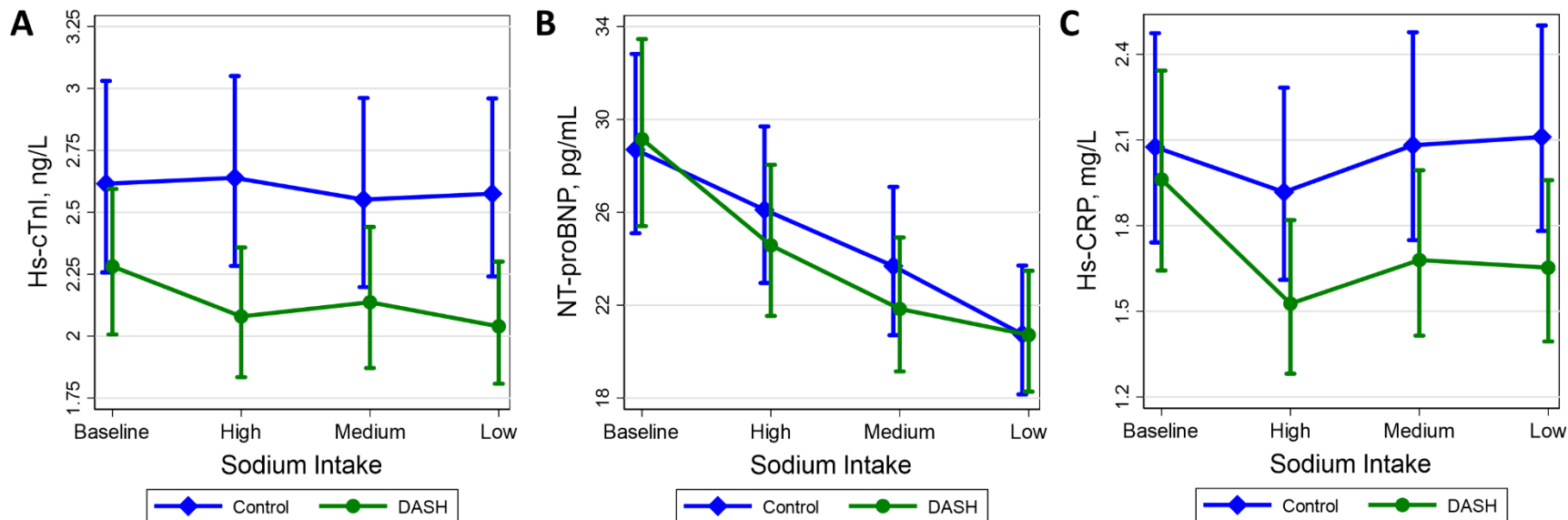


What about sodium?

- Obtained 1,545 specimens from the NHLBI BioLINCC (411 participants from original 412 DASH-Sodium participants)
- Measured high sensitivity cardiac troponin I, N-terminal pro b-type natriuretic peptide, high sensitivity C-reactive protein
- Hypothesis: DASH & sodium reduction would lower subclinical cardiac injury and strain, but not inflammation



Mean Biomarker Geometric Means



Quick Glance	Damage	Strain	Inflammation
DASH	-14%*	-5%	-13%*
Reduced Na	-5%	-19%*	+9%*

* $P < 0.05$

Juraschek et al, *JACC*, in press



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Low Sodium-DASH versus High Sodium-Control

Mean baseline, follow-up, and difference in concentrations of cardiac biomarkers comparing the low sodium-DASH diet to the high sodium-control diet, N = 410 unique persons

	Baseline*	Follow-up*	Change from Baseline (95% CI) %-Difference‡	Between Diet Comparison (95% CI) %-Difference‡
High sensitivity cardiac troponin I, ng/L				
High Sodium - Control	1.9 (0.2)	1.9 (0.2)	1.5 (-8.1, 12.2)	Ref
Low Sodium – DASH	1.6 (0.2)	1.3 (0.1)	-18.9 (-27.0, -9.9)	-20.1 (-30.9, -7.7)
N-terminal pro-brain natriuretic peptide, pg/mL				
High Sodium - Control	28.7 (1.9)	26.7 (1.8)	-7.1 (-15.4, 2.0)	Ref
Low Sodium – DASH	29.3 (1.9)	21.0 (1.4)	-28.4 (-34.8, -21.4)	-22.9 (-32.4, -12.0)
High sensitivity C-reactive protein, mg/L				
High Sodium - Control	2.0 (0.2)	1.9 (0.2)	-6.6 (-17.0, 5.1)	Ref
Low Sodium - DASH	1.9 (0.2)	1.7 (0.1)	-13.5 (-23.0, -2.8)	-7.4 (-21.6, 9.3)

There were 781 specimens contributing data for each of the biomarker comparisons.

*Exponentiated log-transformed markers or the geometric mean (SE)

†Difference in exponentiated log-transformed markers (i.e. difference in geometric means)

‡Exponentiated differences of the change on the log-scale



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Limitations & Strengths

- Limitations:
 - Generalizability to persons with prior cardiovascular disease, advanced chronic kidney disease, medication-treated diabetes
 - Short duration
 - Missing specimens (DASH)
 - Diet patterns vs specific food groups, nutrients
- Strengths:
 - Randomized trials with a diverse populations
 - High follow-up rates
 - Repeat measures
 - Tightly controlled and isocaloric diets
 - Clinically relevant biomarkers, representing distinct pathways



Conclusions

- Diets rich in fruits and vegetables lowered subclinical cardiac injury (maybe inflammation) regardless of macronutrients
- Sodium reduction reduces subclinical cardiac strain
- Simplified recommendations:
 - Consume more fruit, vegetables, nuts, seeds, and legumes
 - Eat fewer snacks, sweets, and sodium



Opportunities for Translation

Interventions to Improve Access



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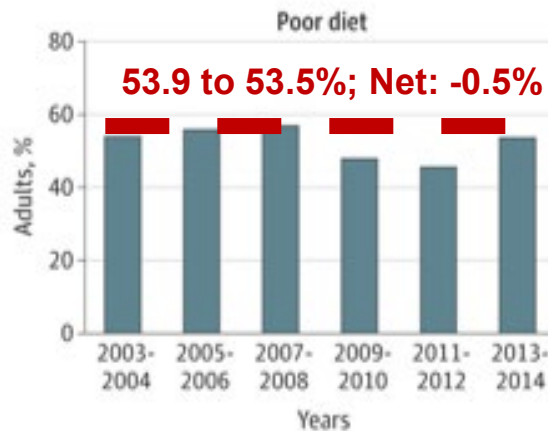
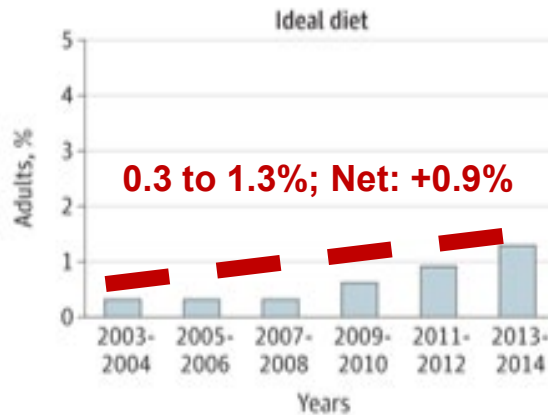


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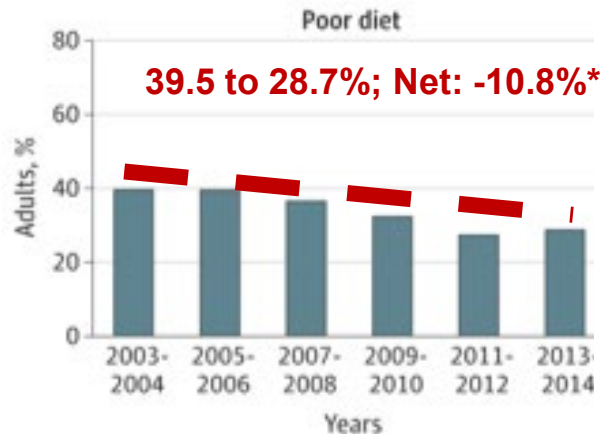
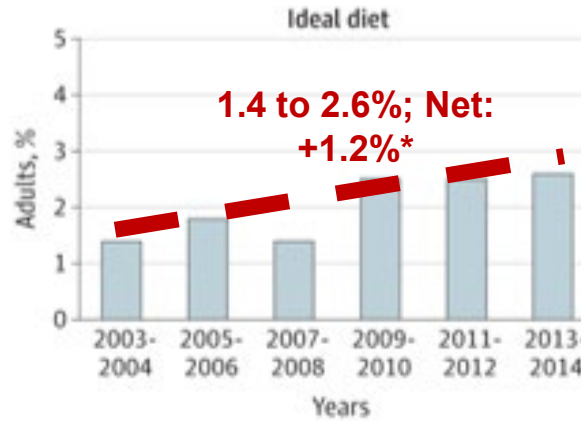


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SNAP Recipients



Higher Income Adults



SNAP: The Supplemental Nutrition Assistance Program (formerly known as food stamps), \$30/week

There were **42 million participants** nationwide in 2017 alone

* P -trend ≤ 0.01

Zhang et al, JAMA 2018



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Translational Projects on Food Insecurity:

1. Older adults of low socioeconomic status with limited transportation
2. Black adults living in urban food deserts



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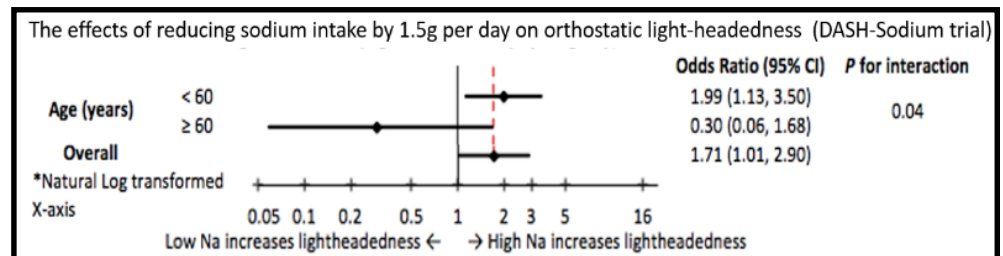
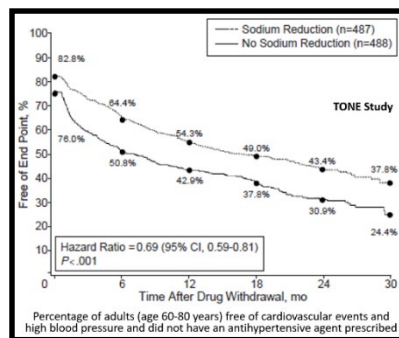
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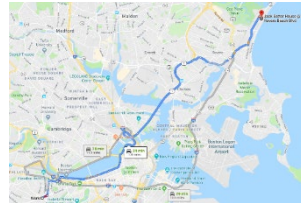
Background & Objective

- The CDC recommends low sodium meal plans as a strategy to reduce blood pressure in older adults (often dependent on others for food)
- Low sodium meal plans have not been tested in a general population with both normal and high blood pressure
- Objective: To determine the feasibility of a low sodium meal plan intervention aimed at reducing seated blood pressure (BP) in residents of a government-subsidized congregate, senior living facility



Low Sodium Meal Plans (SOTRUE)

Jack Satter House, a HUD-Subsidized Senior Housing Facility (Hebrew SeniorLife)



- **Design:** An individual-level, masked, randomized, controlled pilot trial (SOTRUE: NCT04074941)
- **Context:** Jack Satter House, Section 202 congregate living facility (Revere, MA)
- **Interventions:** Two meal plans: (1) typical sodium or (2) low sodium
 - 3 isocaloric meals with two snacks daily over a 14-day period
- **Primary outcome:** Seated systolic BP (SBP) averaged over 2 visits (days 10 and 14) using an Omron HEM-907XL automated cuff
 - Orthostatic hypotension, Timed-Up-and-Go test
 - Compliance measure: Urine sodium-creatinine ratio



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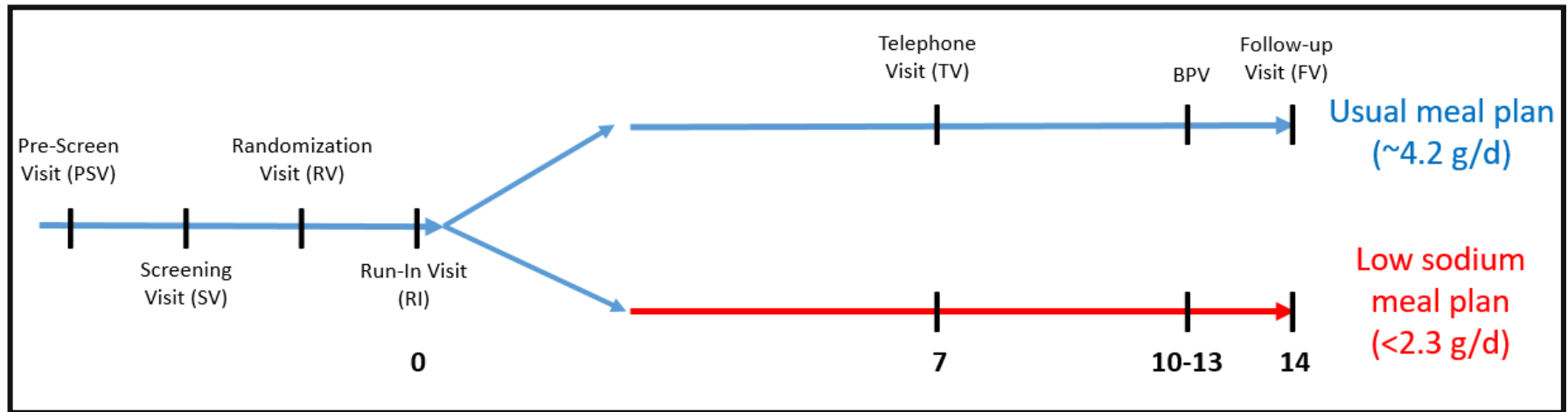


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Design Schematic



- Residents of Jack Satter House actively enrolled in Jack Satter House's mandatory meal plan
 - Age 60 years or older
 - Resting SBP of 100-149 mm Hg and DBP <100 mm Hg
 - Stable BP medications



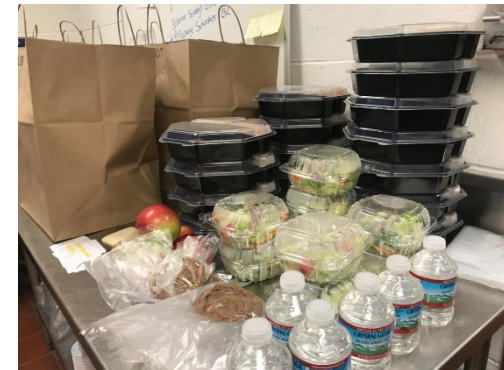
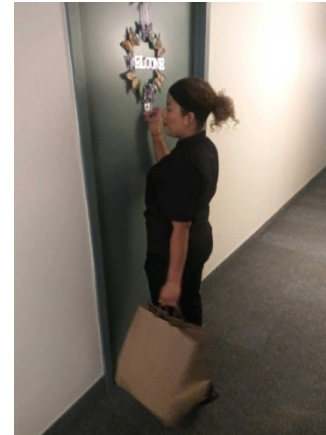
Intervention: Nutrient Composition of the Two Meal Plans in the SOTRUE Study

		Typical Sodium		Low Sodium	
		Targeted	Prepared	Targeted	Prepared
		>2.0	*	<0.95	*
Density target, mg/kcal					
High Calorie					
	Energy, kcal/d	2250	2262	2250	2167
	Carbohydrates, %	45-55	52	45-55	50
	Sodium, mg/d	>4500	4395	<2100	2096
	Potassium, mg/d	~4500	3319	~4500	3233
Medium Calorie					
	Energy, kcal/d	2000	2091	2000	1977
	Carbohydrates, %	45-55	52	45-55	49
	Sodium, mg/d	>4000	4071	<1900	1920
	Potassium, mg/d	~4000	3223	~4000	3047
Low Calorie					
	Energy, kcal/d	1750	1861	1750	1842
	Carbohydrates, %	45-55	52	45-55	49
	Sodium, mg/d	>3500	3589	<1650	1643
	Potassium, mg/d	~3500	2953	~3500	2966

*Achieved densities across high, medium, and low Calorie meals for typical sodium were: 1.94, 1.95, and 1.93 mg/kcal, respectively. Achieved densities across high, medium, and low Calorie meals for low sodium were: 0.97, 0.97, and 0.89 mg/kcal, respectively



Pictures from the field



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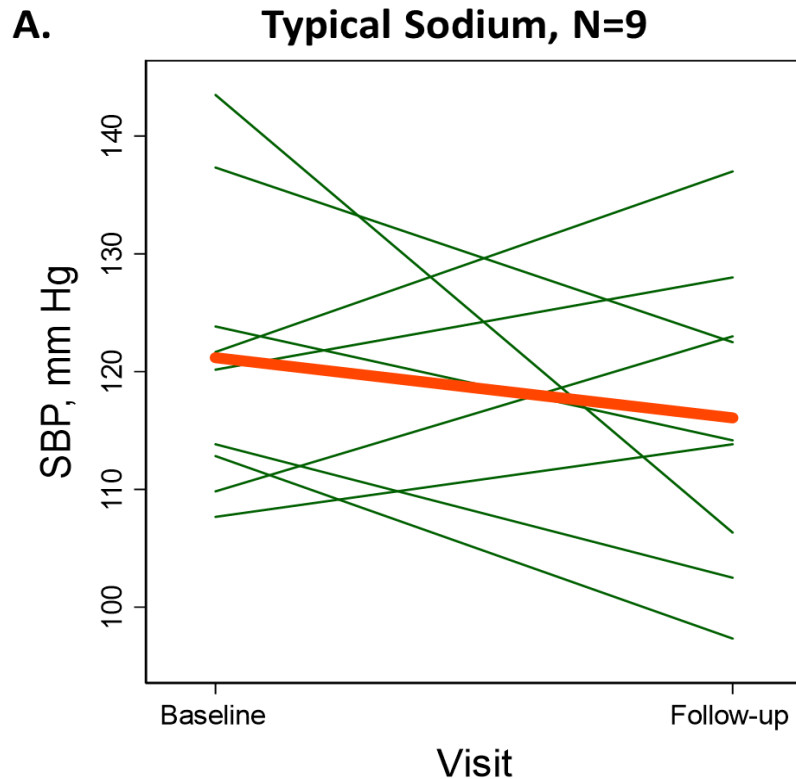
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Baseline Characteristics

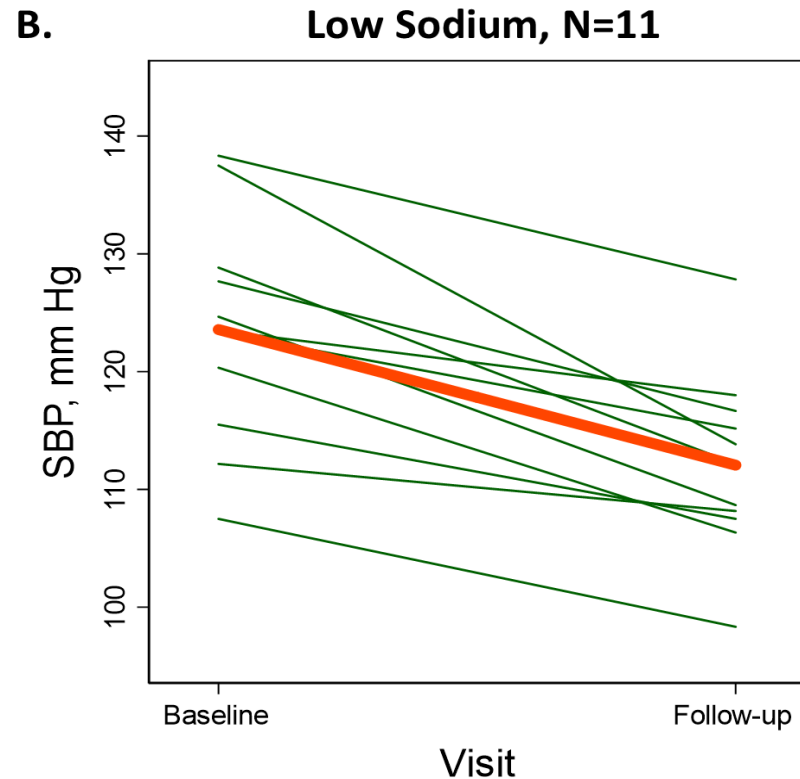
	Typical Sodium, N = 9		Low Sodium, N = 11
	Mean (SD) or %		Mean (SD) or %
Age, yr	79.6 (9.4)		76.9 (6.1)
Female, %	100		91
White, %	100		91
Systolic blood pressure, mmHg	121.1 (12.2)		123.5 (9.7)
Diastolic blood pressure, mmHg	62.2 (7.5)		65.3 (11.1)
Hypertension, %	56		55
Hypertension medication use, %	56		64
Self-reported orthostatic hypotension, %	33		9
Measured orthostatic hypotension, %	22		0
Falls resulting in fracture/emergency room, %	11		46



Effects on Systolic Blood Pressure



Mean difference: -5.0 mm Hg
(95% CI: -18.1, 8.1)



Mean difference: -11.5 mm Hg
(95% CI: -15.2, -7.7)



Effects of low versus typical sodium meals on primary and secondary outcomes

	Mean (95% CI)	P
Seated systolic blood pressure, mmHg	-4.78 (-14.41, 4.85)	0.31
Seated diastolic blood pressure, mmHg	-2.35 (-7.97, 3.28)	0.39
Orthostatic hypotension, OR	0.28 (0.04, 2.08)	0.21
Orthostatic symptoms, OR	5.87 (0.28, 123.01)	0.25
Body mass index, kg/m ²	-0.13 (-0.51, 0.25)	0.48
Timed-Up-and-Go, sec	-0.47 (-2.20, 1.26)	0.58

	%-Difference (95% CI)	P
Urinary sodium-creatinine	-36.0 (-60.3, 3.4)	0.07
Urinary potassium-creatinine	-4.4 (-31.2, 32.9)	0.79

All analyses adjusted for baseline values



Association of change in blood pressure from baseline with change in urine sodium or urine potassium

	Difference in SBP			Difference in DBP		
	β (95% CI)*	<i>P</i> *	<i>r</i>	β (95% CI)*	<i>P</i> *	<i>r</i>
Na/Cr, log[mmol/L per mg/dL]	5.70 (2.67, 8.72)	0.0003	0.30	2.91 (1.50, 4.32)	0.0001	0.32
K/Cr, log[mmol/L per mg/dL]	-3.65 (-8.71, 1.40)	0.16	-0.16	-0.01 (-2.39, 2.37)	0.99	-0.19

Abbreviations: Na, sodium; K, potassium; Cr, creatinine, SBP, systolic blood pressure; DBP, diastolic blood pressure

*Adjusted for age, sex, and race. However, given that there was only 1 male and 1 black participant, this is better viewed as age-adjusted.



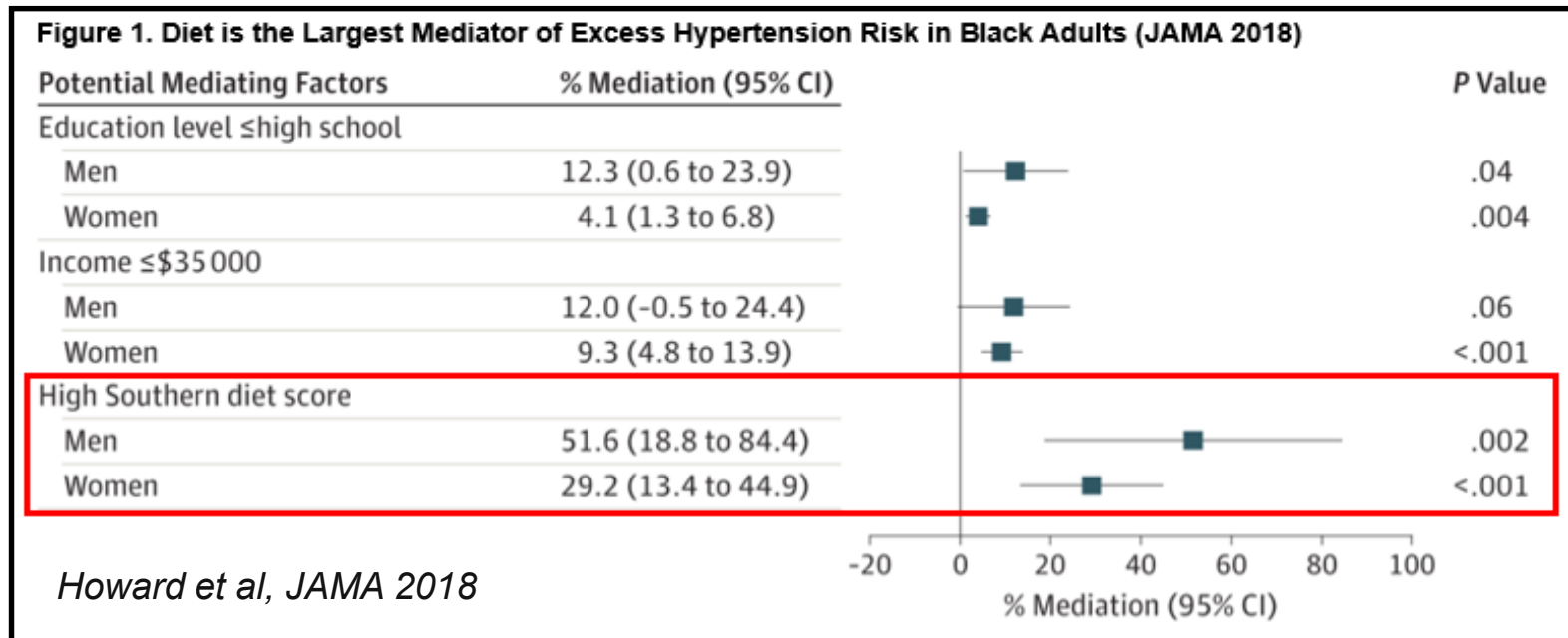
Conclusions

- A low sodium meal plan represents a feasible and practical approach to healthier eating
- Findings are suggestive for BP reduction for both normotensive and hypertensive older adults, but safety is unclear
- A definitive study with a larger sample size is needed to establish the efficacy and safety



DASH Grocery Delivery in Boston Urban Food Deserts

- **103 million adults** in the U.S. have hypertension
- Rising trends in hypertension are driven by increased consumption of high sodium, processed foods
 - Rampant among low-income, urban communities that are disproportionately black



Prior Work

Table 1. A greater clinical response is observed with more complete provision of dietary needs.

Prior Trials	5+ Nuts & Beans	DIGO	DASH-Sodium Trial
No. of participants (% Black)	121 (100)	43 (83)	412 (56)
Stipend or food provision	\$30/week	\$105/week	100% of Calorie needs
Servings of fruit & vegetables (per day)*	+1.4‡	+3.2‡	+6.0‡
Urine sodium, %-difference*	-20.3†	-22.4‡	-45.4‡
Systolic blood pressure, mm Hg*	+1.5	-1.0	-8.9‡
LDL cholesterol, mg/dL*	-1.1	-5.0	-12.8‡
*Difference compared to the control group or control period (DIGO). † $P < 0.05$. ‡ $P < 0.01$			



DASH Grocery Delivery in Boston Urban Food Deserts (NIMHD R21; PI: Juraschek)

Determine the effects of 4-weeks of DASH groceries (complete caloric replacement) on:

- Seated blood pressure
- Blood sugar, cholesterol
- Urine sodium-to-potassium ratio

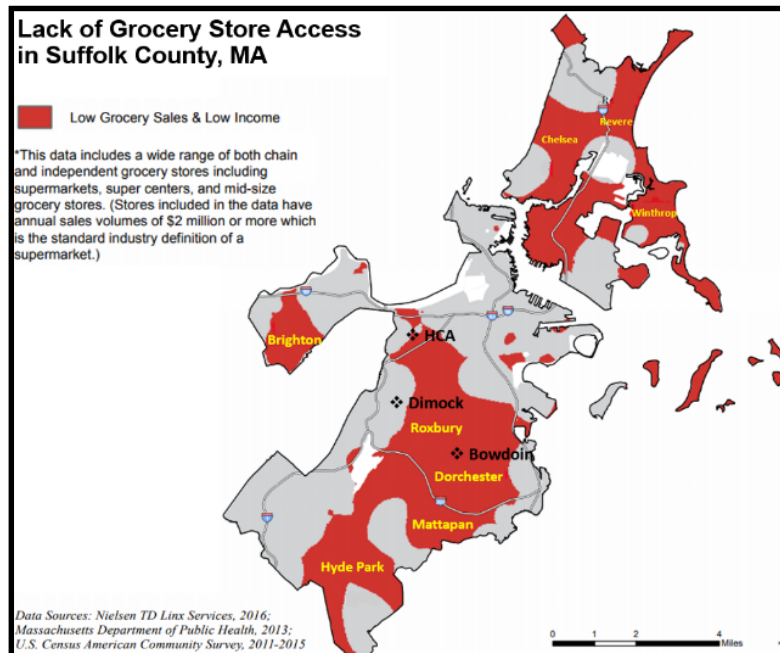
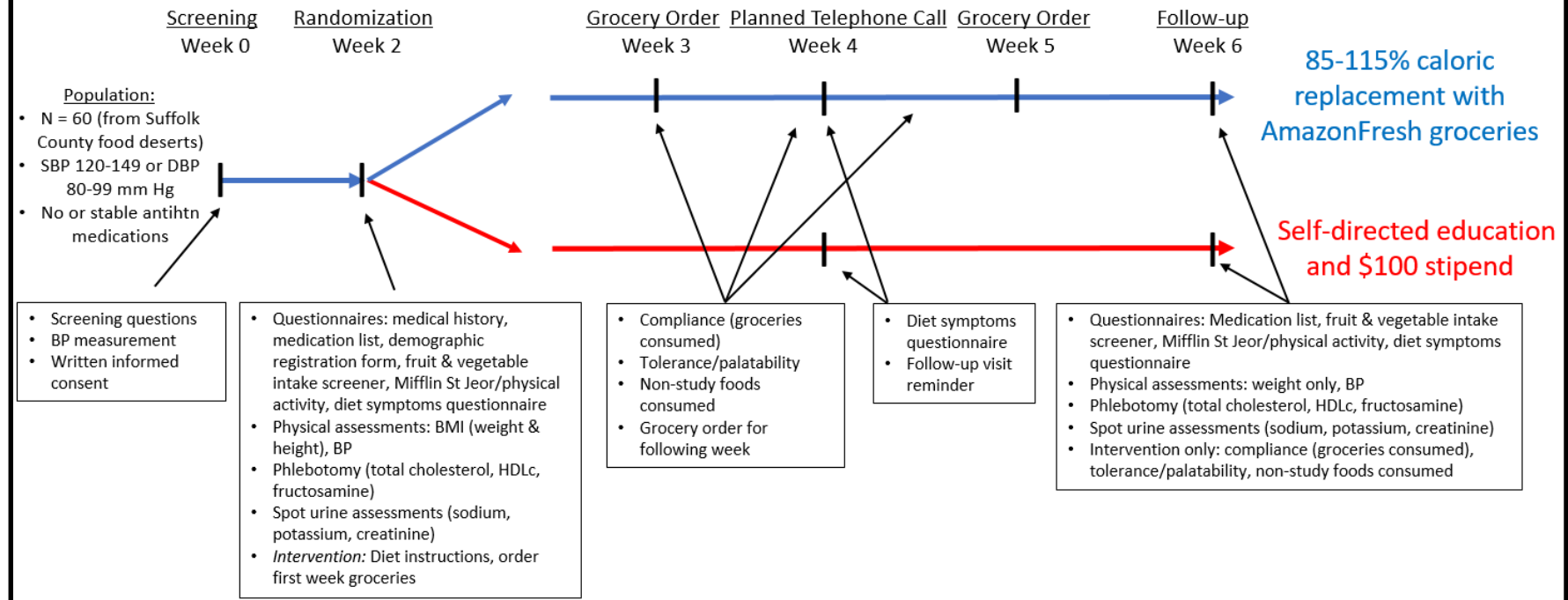


Figure. Pilot Trial Design



<u>Inclusion criteria</u>
Black or African American
Age ≥ 18 years
Resting SBP 120-149 mm Hg
Residence in Suffolk County Food Desert
<u>Exclusion criteria</u>
SBP ≥ 150 mm Hg or DBP ≥ 100 mm Hg
Diabetes or stage 4-5 chronic kidney disease (medical record)
Cognitive impairment
Terminal or mental illness



Conclusions

- Several decades of high quality feedings studies have established healthy dietary patterns to optimize cardiovascular risk factors
- Adoption in the U.S population is lacking
- Need for more evidence to simplify eating recommendations
- Need for scalable innovations to address access concerns and disparities in healthy eating



Thank you!



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