Designing a Nutrition Intervention to Impact Metabolic, Microbiome and Vascular Health in Young Adults at Risk for Disease: FRUVEDomic Pilot Study

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Public Health Relevance

Obesity remains a worldwide problem due to the risk of exacerbating health conditions and the contributions to healthcare costs, further creating a need for interventions. Increasing trends of obesity are seen among college students, ages 18-25. In addition to obesity, the metabolic syndrome (metS) affects more than 20% of U.S. adults, where it has been reported that at least 27% of college students have one component of metS. However, links between certain biomarkers of poor metabolic health have not been strongly explored which presents an urgent need to better understand as individualized medical treatment is becoming highly popular.

Objective

To design a multi-disciplinary, free-living, nutrition intervention based on the 2010 Dietary Guidelines for Americans, using nutrition education, culinary toolkit distribution and one-on-one counseling, to impact metabolomics, cardiovascular, and microbiome health in "at risk" young adults (18-28 years) for metS. Post-study analysis will include amino acid, carbohydrate, fatty acid, and sphingolipid metabolism in our metabolomics approach.

Project Description and Approach

Recruitment/Randomization

Due to the increased popularity and necessity of exploratory, translation work, scientists from various disciplines (nutrition, metabolomics, microbiome, cardiovascular, microcirculation and physiology) worked together to implement this pilot study. Recruited 37 young adults "at risk" for metS. All undergraduate and graduate students were invited to be screened and consented into this project via two MIX announcements. Over 200 interested individuals contacted the researchers to participate. Subjects were randomized into one of 3 groups (n=12/group; 9):

1. "Fruved" diet (50% Fruit and Vegetable)
2. "Fruved+LowCHO" diet (Low Refined Carbohydrate)
3. "Fruved+LowFat" diet (Low Fat)

Education

Group nutrition education delivered before start of intervention included:

- Nutrition 101
- Budget/Grocery Shopping Tips
- Healthy Eating Out
- Food Label Reading
- Culinary Toolkit Distribution

Measurements

Anthropometrics, body composition, venous blood samples, stool samples, arterial stiffness and a ~300 question lifestyle behaviors survey were collected at baseline and again at post. Venous blood samples were collected additionally at weeks 2 and 5 of the intervention, resulting in a total 4 repeated blood samples for metabolomic assessment.

Intervention Aderhence

Participants underwent individual weekly consultations with the Registered Dietitian Nutritionist, using food logs, food pictures and receipt management to assess adherence and cost of the intervention.

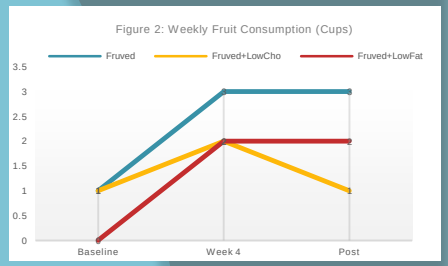
Baseline Results

Table 1: Demographics

Variable	Frequency (n=36)	Percent
Race		
White	23	63.9
African American	4	11.1
Hispanic	4	11.1
Asian	4	11.1
Indian/Native American	1	2.8
Appalachian Origin		
Appalachian	17	47.2
Not Appalachian	19	52.8
metS Risk Category		
High	13	36.1
Medium/High	13	36.1
Medium	8	22.2
Low	2	5.6
Actual metS Breakdown		
3 criteria	1	2.8
2 criteria	3	8.3
1 criteria	11	30.6
0 criteria	21	58.3
Sex		
Female	21	58.3
Male	15	41.7
BMI Category		
Underweight	0	0
Healthy	16	44.4
Overweight	14	38.9
Obese	5	13.9
Morbid Obese	1	2.8

Table 2: Participant Blood Chemistry and Anthropometrics

Variable	Baseline Mean (SD)	Post Mean (SD)
BMI		
Males (n=15)	27.4 (4.3)	27.2 (4.7)
Females (n=21)	26.7 (7.0)	26.5 (7.1)
Waist (cm)		
Males	91.5 (10.7)	88.4 (10.4)*
Females	79.2 (12.6)	77.2 (12.2)*
Blood Pressure		
Males	124.1/60.1 (15.7/9.4)	115.1*/58.9 (8.9/7.2)
Females	113.3/64.1 (14.7/10.5)	108.9/62.9 (9.4/7.5)
Body Fat %		
Males	25.2 (17.2)	20.9 (8.9)
Females	33.0 (10.1)	32.6 (10.1)
Glucose (mg/dL)		
Males	89.6 (6.3)	90.3 (8.2)
Females	85.4 (8.2)	85.2 (9.0)
Triglycerides (mg/dL)		
Males	92.7 (34.8)	87.2 (47.9)
Females	92.4 (32.1)	96.6 (34.8)
Total Cholesterol (mg/dL)		
Males	185.1 (27.9)	169.7 (30.5)*
Females	173.0 (26.8)	175.7 (25.3)
LDL Cholesterol (mg/dL)		
Males	115.4 (19.6)	107.5 (23.2)
Females	95.0 (19.5)	99.7 (22.0)
HDL Cholesterol (mg/dL)		
Males	51.1 (12.7)	44.7 (8.8)*
Females	59.6 (13.0)	56.5 (12.7)
C Reactive Protein (mg/dL)		
Males	0.2 (0.1)	1.9 (3.1)*
Females	0.5 (0.6)	1.7 (4.0)
*p<0.05		



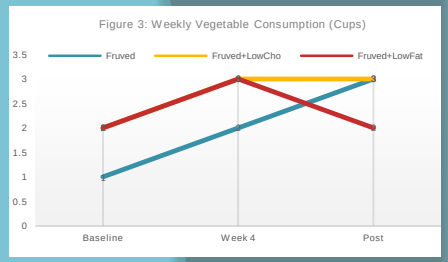


Figure 3: Macronutrient Distribution: Low-Fat Intervention

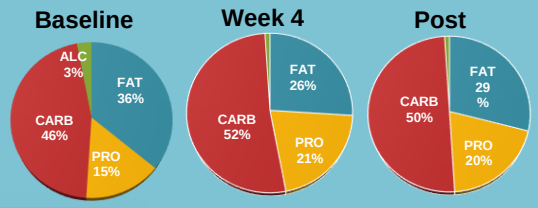


Table 3: Average Fiber, Sugar & Empty Calorie Consumption: Low-Refined CHO Intervention

Variable	Baseline	Week 4	Post
Empty Calories	1065	313	316
Sugar (g)	70	84	76
Fiber (g)	17	24	27

Impact and Reach

The connection between nutrition and health has long been recognized, but precisely how nutrients interact with human physiology to elicit health or disease is in its infancy. With this new era of -omics (i.e genomics, metabolomics, and nutrigenomics), it allows us to measure thousands of biological events and pose questions on the relationship between diet and health at the fundamental level. As a result of this emerging science and inclusion of more multidisciplinary work, nutrition research has shifted from epidemiology and physiology with population-based recommendations, to a molecular and individual level of counseling.

More importantly, identifying markers among those "at risk" of metS and other co-morbidities will help quantify disease risk and generate **"personalized nutrition"** prescription. Additionally, targeting of college-aged students is an added benefit, as higher education is often the catalyst of where behavior is learned and lifestyle modification can be promoted for a sustainable future.

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