Title
Pre-meal fruit and vegetable consumption for weight loss: evidence and personalized calculator website

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Abstract: Obesity and its accompanying morbidity and mortality is arguably one of the greatest health care challenges currently facing the United States. Recently studies have shown that the vast majority of Americans do not meet fruit and vegetable recommendations. Other studies have suggested that humans tend to eat the same mass of food irrespective of the type of food eaten. This finding suggests that one of the reasons fruits and vegetables support weight loss is that they generally have low calories per unit mass and thereby displace foods that have high calorie density. Most people associate weight loss with diet and exercise, and most people associate diet with restricting type/quantity of food leading to cravings/hunger. This project proposes a different mental framework for those trying to lose weight: instead of restricting yourself from eating certain types/amounts of food, make an effort to eat the recommended portions of fruits and vegetables before each meal. This approach to weight loss is almost completely absent from popular culture and given the enormous number of Americans who are overweight/obese, even if only a small fraction of them benefited from exposure to this approach it would be a worthwhile endeavor.

I developed a website (http://nosasdiet.com) that explains the evidence and logic for this type of approach and provides a personalized calculator that tells users exactly how much fruit and vegetables they should buy weekly and consume daily given their taste preferences to meet USDA recommendations. The website shows which foods are in season and the calculator includes a cost estimate as well as a summary of relevant micro and macronutrients contained in the recommended fruits and vegetables. I also included charts showing energy density, protein per energy, and fiber per energy for fruits, vegetables, and many other common foods so people can quantitatively compare foods to help make informed choices.

Background/Rationale: The U.S. Department of Health and Human Services estimates that 35.1% of adults over the age of 20 years old are obese and 69% are overweight (including obesity). Obesity greatly increases the risk of coronary heart disease, hypertension, stroke, type 2 diabetes, hyperlipidemia, metabolic syndrome, cancer, osteoarthritis, sleep apnea, obesity hypoventilation syndrome, infertility, and gallstones. Recent estimates by the U.S. Centers for Disease Control and Prevention
show that 87% of Americans do not meet fruit intake recommendations and 91% do not meet vegetable recommendations. Studies have shown that people tend to eat the same mass of food irrespective of the amount of calories the food contains. Thus, eating foods that are low in energy density (calories/gram) can reduce a person’s caloric intake because foods that are high in energy density are essentially crowded out or displaced. “Cues related to the amount of food consumed have a greater influence on short-term intake than does the amount of energy consumed.” Fruits and vegetables have a relatively low energy density (largely due to their high fiber and water content). Therefore, increased fruit and vegetable consumption has the potential benefit of reducing total energy consumption and producing weight loss without causing feelings of hunger.

General, non-specific recommendations of eating more fruits and vegetables have not been effective in the context of a dramatic rise in advertising/availability of highly palatable, cheap, convenient, and energy-dense foods. Fruits and vegetables simply cannot compete in terms of taste and convenience with energy-dense processed foods, and absent a highly disciplined approach, most Americans do not eat adequate quantities. In addition, the vast majority of Americans will attempt dieting when trying to lose weight which consists of restricting either types or quantities of foods invariably leading to hunger or cravings. For many, persistent hunger/cravings is not sustainable in the long term. Accordingly, this project proposes flipping the concept of dieting on its end. Instead of restricting food intake when dieting, participants make a concerted effort to eat the recommended quantity of fruits and vegetables before meals. The quantity or quality of the food is not restricted after the fruits and vegetables; however, research suggests that participants will naturally restrict themselves because they will feel full. Eating the fruits and vegetables first is important for two reasons: 1) research suggests people eat less calories and feel equally satiated when they eat in this order, and 2) without imposing this restriction many people will eat the more palatable, energy dense foods first, thereby bypassing the displacement effect.

**Objectives:**

This project aimed to build a website that:
1) explains the evidence for the potential benefit of eating the recommended quantity of fruits and vegetables especially before meals,
2) contains a functioning calculator that provides a personalized shopping list detailing exactly how much fruits and vegetables the user should buy weekly and consume daily to meet national recommendations, and
3) provides a cost estimate and summary of the macro/micronutrients contained in the food on the list.

**Project Implementation/Methods:**
The largest portion of the time devoted to this project was learning HTML, CSS, Javascript, jQuery, PHP, and web hosting. I had no background in any of these tools before this project and it ended up being a considerable undertaking. Research into every commonly available fruit and vegetable and data entry for micro and macronutrients and seasonality was also a significant undertaking. Most data used in the website came from the USDA Food Composition Databases\(^1\), and dietary recommendations (which are dependent on age, sex, and activity status) came from the USDA Dietary Guidelines for Americans 2015-2020\(^2\).

**Future Work:**

I plan to continue to learn website programming and development and continue to add functionality to the website including adding options for users to save profiles and add other family members to create a shopping list for multiple people. I also plan to learn about structured data and search engine optimization to help make this website more visible and accessible.

**Evaluation/Achievements:**

As described in my ISP proposal from April 21, 2016: “The project will be deemed complete when a functioning website exists that 1) explains the evidence for the potential benefit of eating the recommended quantity of fruits and vegetables especially before meals, 2) contains a functioning calculator that provides a personalized shopping list detailing exactly how much fruits and vegetables the user should buy weekly and consume daily to meet national recommendations, and 3) provides a cost estimate and summary of the macro/micronutrients contained in the food on the list.” These three criteria have been met and accordingly the ISP project is complete.

**References:**


\(^3\) Moore LV, Thompson FE. Adults Meeting Fruit and Vegetable Intake Recommendations — United States, 2013. *Morbidity and Mortality Weekly Report, Centers for Disease Control and Prevention*. July 10, 2015 / 64(26);709-713.


Low-Energy-Dense Foods and Weight Management: Cutting Calories While Controlling Hunger. *National Center for Chronic Disease Prevention and Health*
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