

Produce and Health

Enhancing Fruit and Vegetable Consumption

Many industry groups, activist non-governmental organizations (NGOs), and government agencies at international, national, provincial, state and local level have put forward programs or policies to enhance consumption of fresh fruits and vegetables. Unfortunately, there has been little scientific assessment of the efficacy of different programs. And, without objective assessments, it is difficult for industry and taxpayers to decide which initiatives provide the best return on investment.

One U.S. government agency, the Centers for Disease Control and Prevention, best known by its initials CDC, has taken an increasing interest in this topic because of its traditional role in helping fight disease, and its more recent concerns about rising levels of obesity, especially among youth. It also has an enhanced role in monitoring foodborne diseases under the new Food Safety Modernization Act.

State Indicator Report

The CDC has just issued the 2013 edition of its "State Indicator Report on Fruits and Vegetables." The report provided some insights on what factors the CDC deems relevant to increased consumption of fresh fruits and vegetables. It also provided a current data base that can be used to test the validity of some of these factors in enhancing consumption of fruits and vegetables.

Two Measures of Consumption

The CDC report provided two separate measures of consumption for fruits, (1) the percentage of adults in each state who report consuming fruits less than one time daily and (2) the median daily intake (times per day) of fruits. It reported the same two measures for vegetables. Separate data were available for 50 states and for the District of Columbia (D.C.) area.

Preliminary analysis indicated that the two measures were highly correlated (0.87 for fruits and 0.90 for vegetables), so one could not be used to explain the other. In subsequent analysis, we focused on how various factors reported by the CDC related to just one, median daily intake. The median for the United States was 1.1 times per day for fruit and 1.6 times per day for vegetables.

Potential Factors Explaining Consumption Levels

The CDC provided data for each state on a number of factors thought to be "indicators" of fruit and vegetable consumption. One indicator related to a favorable retail environment. It was measured as the "Percentage of census tracts in a state that have at least one healthier food retailer located within the tract or within half a mile of tract boundaries." Healthier food retailers included supermarkets, supercenters, grocery stores, warehouse clubs and fruit and vegetable specialty stores. Among other availability indicators were "Number of farmers markets per 100,000 state residents," and "Percentage of farmers markets that accept WIC Farmers Market Nutrition Program coupons."

Other indicators related to state policies included "State-level healthier food retail policy," "State child care regulations align with national standards for serving fruits / vegetables," and "State-level farm to school or preschool policy."

The CDC also included indicators of food system support for improving access to fruits and vegetables. These included "Number of food hubs in each state," "Percentage of cropland acreage harvested for fruits and vegetables," and the presence or absence of a "State-level food policy council." Food hubs are

normally set up to service small producers in situations where they cannot access existing wholesaling operations.

Testing the Significance of CDC Indicators

We ran separate regressions for fruits and vegetables on the following selected numerical CDC indicators:

1. Healthier food retail (percentage of census tracts in each state).
2. Number of farmers markets (per 100,000 state residents).
3. Farmers markets accepting WIC coupons (percentage of state total).
4. Number of food hubs.
5. Cropland harvested for fruits and vegetables (percent of total cropland).
6. State-level food policy council (1 = yes, 0 = no).

The indicators most highly correlated with frequency of daily fruit intake were farmers markets (0.40), fruit and vegetable acreage (0.39) and acceptance of WIC coupons (0.39). Those most highly correlated with frequency of vegetable intake were acceptance of WIC coupons (0.48), fruit and vegetable acreage (0.41) and healthier food retail (0.37).

Multiple Regression Results

Multiple regressions were run separately for frequency of fruit intake and frequency of vegetable intake by state using the above six explanatory variables. Overall, the six variables explained 48 percent of the variation in fruit intake by state and 42 percent of the variation in vegetable intake. The attached table shows the parameters and their levels of significance.

U.S. States: Factors Impacting Frequency of Intake of Fruits and Vegetables, 2013

Indicator	Unit	Frequency of Fruit Intake (parameter)	Frequency of Fruit Intake (t-value)	Frequency of Vegetable Intake (parameter)	Frequency of Vegetable Intake (t-value)
Intercept	#	0.7483	6.075 *	1.1777	7.971 *
Healthier food retail	%	0.0032	1.837	0.0046	2.201 *
Farmers markets	#	0.0204	3.637 *	0.0090	1.340
WIC acceptance	%	0.0013	1.373	0.0035	3.011 *
Food hubs	#	0.0035	1.225	0.0004	0.124
Fruit/vegetable acr.	%	0.0013	2.126 *	0.0024	1.489
Food council	1 or 0	- 0.0259	1.085	-0.0033	0.116
Goodness of fit	R ²	0.48	n.a.	0.42	n.a.

* Statistically significant at the 5 percent level.

The tabular results show that the intercept term explained 68 percent of average fruit intake and 74 percent of average vegetable intake. Parameters on the other explanatory variables were uniformly small. All except the presence of a state-level food policy council had the expected positive sign. The results suggest that state of residence was not a major influence on frequency of intake of either fruits or vegetables.

Two variables were statistically significant in explaining fruit intake, the number of farmers markets and the percent of cropland harvested for fruits and vegetables. Two different variables were statistically significant in explaining vegetable intake, a healthier food retail environment and acceptance of WIC coupons at farmers markets. The number of food hubs, or the presence of a state-level food council, had little measureable effect on fruit or vegetable intake.

Missing Explanations

Unfortunately, the CDC omitted two factors that most economists would consider key influences on a state's average fruit and vegetable consumption, income levels, and prices of fruits and vegetables. In 2011, household incomes in Maryland averaged \$70,004, almost twice the average level of \$36,919 in Mississippi. Seven other states plus D.C. (Alaska, Connecticut, Hawaii, Massachusetts, New Hampshire, New Jersey and Virginia) had household incomes above \$60,000, while two states (Arkansas and West Virginia) had household incomes below \$40,000.

It would also be informative to know the average cost of a representative bundle of fruits and vegetables in each state. Unfortunately, such data are not available. However, data from the Bureau of Labor Statistics Consumer Price Index reports show wide disparities on individual items by region. For example, in 2012, the North Central region reported retail prices of Red Delicious apples 24 percent higher than in the West, prices of oranges 22 percent higher, and prices of bananas 18 percent lower. In the case of table grapes and strawberries, despite the fact that most domestic supplies come from the West Region, North Central retail prices for these items were 10 percent lower and 2 percent lower respectively. Clearly, price also needs to be included as an indicator of consumption.

Effect of Household Income

When a variable for household income by state was included and that for presence of a state-level food policy council was omitted, the goodness of fit measure (R^2) jumped to 0.60 for fruit intake and 0.51 for vegetable intake. In both cases, the household income variable was positive and significant.

A 10 percent increase in a state's household income was associated with a 2.1 percent increase in fruit intake and a 1.4 percent increase in vegetable consumption.

Need for More Objective Analysis

Clearly, we are still a long way from knowing what factors have in the past, or could in the future, help increase intake of fruits and vegetables. Some of the indicators included by the CDC may have a positive influence. Others, such as state-level policy councils or food hubs, clearly have much less influence than indicators excluded by the CDC, such as relative incomes and prices.

It would appear that the key to increasing fruit and vegetable consumption is raising household incomes, not social engineering of food councils or food hubs. If governments want to increase the intake of fruits and vegetables, they need to focus more of their efforts on the much more challenging task of ensuring that more citizens have high-paying jobs.

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