

Does 5-a-Day Pay?

Potential Gains to Growers from Increasing Consumption of Fruits and Vegetables to Recommended Levels in a Cancer Prevention Diet

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There is a clear link between the amount and variety of fruits and vegetables consumed daily and a reduction in chronic diseases, especially cancer. Despite the benefits, many people do not eat recommended levels. In addition to public health benefits, increased consumption of fruits and vegetables would benefit fruit and vegetable growers through increased demand for production. This *AIC Issues Brief* explores the effects of increased fruit and vegetable consumption and estimates the benefits to growers should California consumers adopt one of three alternative recommended diets: the minimum 5-a-day recommendation for fruits and vegetables, the 7-a-day minimum recommendation for most men and active women, and the 7-a-day specific commodity subgroup recommendations for a cancer prevention diet.

Fruit and vegetable consumption and cancer prevention

Increased consumption of fruits and vegetables has been linked to a decrease in the risk of cancer. According to the evidence, about 35 percent of all cancers can be prevented through increased fruit and vegetable consumption (World Cancer Research Fund International 1997). Cancers of the mouth, esophagus, lung, cervix, and bladder can be reduced by about 20 percent. The incidence of pancreatic, gallbladder, breast and endometrial cancers may be cut in half by consuming recommended amounts of fruits and vegetables.

Further, there is convincing evidence linking the consumption of specific fruit and vegetable groups to a reduction in certain types of cancers (WCRF 1997). For example, diets high in dark green vegetables protect against lung and stomach cancers. Consuming cruciferous vegetables (cabbage, broccoli, cauliflower, etc.) reduces the risk of colorectal and thyroid cancers. Therefore, the cancer risk reduction diet provides recommendations for the composition of fruit and vegetable consumption, as well as the total amount.

Daily recommended levels of fruit and vegetable consumption

The USDA's minimum general recommendation for fruit and vegetable consumption for everyone is 5 servings of fruits and vegetables a day, with 2 servings as fruit and 3 as vegetables (USDA and U.S. Department of Health and Human Services 2000). While the minimum target for the general population is 5 servings of fruits and vegetables a day, the USDA's minimum recommendation for most men and active women is 3 fruit servings and 4 vegetable servings a day (McNamara et al. 1999; USDA and USDHHS 2000).

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Table 1. Current servings per day consumed in California by household income

Category	Lower income <\$15,000	Higher income >\$15,000	Difference
Fruit	1.850	1.870	0.019
Citrus/berry/melon	0.741	0.758	0.017
Other fruit	1.109	1.112	0.003
Vegetable	1.874	2.191	0.317
Starchy	0.227	0.261	0.035
Salad	0.406	0.540	0.135
Other vegetable	0.454	0.523	0.069
Tomato	0.251	0.284	0.033
Dark - noncruciferous	0.195	0.201	0.006
Dark - cruciferous	0.091	0.106	0.015
Other cruciferous	0.089	0.089	0.001
Potato			
Including French fries, chips	0.862	0.886	0.024
Without French fries, chips	0.162	0.186	0.024
Total	3.725	4.061	0.336

Source: a) California Dietary Practices Survey, biennial surveys 1993-1999, California Department of Health Services. b) Kantor, 1998. Because the CSDP does not include French fries and chips in its dietary estimates, the California data for potato consumption were adjusted to include them for purposes of comparison using the national U.S. average of 0.7 servings of French fries or chips consumed daily.

Because certain fruits and vegetables are higher in the nutrients and phytochemicals that appear to reduce cancer risk, minimum recommendations for specific subgroups were developed by the Cancer Prevention and Nutrition Services (CPNS) unit of the California Department of Health Services (CDHS) based on a wide body of literature (see, for example, World Cancer Research Fund, 1997). The more specific cancer-prevention recommendations for fruit are at least 1 serving from the citrus/berry/melon group and at least 2 additional servings of any fruit. For vegetables, the recommendations are at least 1 serving of dark colored (dark green and deep orange) vegetables, 1 serving of salad, 0.5 serving of a starchy vegetable (potatoes, corn, etc.), at least 0.5 serving of cruciferous vegetables, 0.3 serving of tomato, and 0.7 additional serving of any vegetable.

Fruit and vegetable consumption falls short

National surveys indicate that, on average, adults consume 3.9 servings of fruits and vegetables a day, excluding potatoes consumed as French fries or chips (McNamara et al. 1999). In some cases, the gap between average and recommended consumption is quite large.

For instance, McNamara et al. (1999) estimate that adult per capita consumption of dark vegetables would need to increase by over 300 percent to meet the 1 serving a day recommendation.

People living in households earning less than \$15,000 a year consume, on average, even fewer servings per day than do people in higher income households. Based on the California Dietary Practices Survey (CSDP), average consumption for low-income consumers is 1.850 servings a day for fruit and 1.874 a day for vegetables (Table 1). Higher income consumers eat slightly more fruits and vegetables. Average consumption by high-income consumers is 1.870 servings of fruit a day and 2.191 servings of vegetables (Table 1). Note that while fruit consumption between low- and high-income consumers is similar, high-income households eat 17 percent more vegetable servings a day than low-income households.

When food categories are broken down into subgroups, greater variation in the gap in meeting targeted levels for the cancer prevention diet becomes apparent. Among all food categories, both low- and high-income consumers in California come closest to meeting the recommended target of 0.3 serving for tomatoes. Low-

income consumers need to increase consumption of tomatoes by only 0.049 serving, and high-income consumers by just 0.016 serving to reach the recommended 0.3 serving a day for a cancer prevention diet. At the other end of the spectrum, consumption of dark vegetables would need to increase by 0.714 servings for low-income households and by 0.693 servings for high-income consumers to meet the 1 serving a day recommendation.

Determining the benefits to fruit and vegetable growers

An increase in demand for fruits and vegetables by Californians would cause market prices to increase, causing adjustments in production and trade. Production from within California and the rest of the United States would increase. Imports from other regions into California also would increase, and shipments out of California would decline. Therefore, agricultural industries would benefit significantly should consumers achieve the recommended levels of fruit and vegetable consumption, and California, as the country's largest producer of fruits and vegetables, would gain a significant share of the benefits.

The first step in assessing the benefits to growers is to simulate the impacts on prices and quantities of inputs and farm outputs. The net benefits to fruit and vegetable growers come from increases in production and grower prices and less increases in input costs such as labor. We use a market model to determine the changes in prices, production and trade. The demand side of the model includes equations for low-income and high-income consumers in California, and for low- and high-income consumers from the rest of the U.S. The supply side of the model contains equations for net U.S. trade, market quantity supplied from the agricultural marketing sector (processors and handlers), and production supplied to the marketing sector from growers in California and the rest of the U.S. The demand and supply equations for California's agricultural input markets are derived from the equation for California production. The result is a model that links supply and demand in the final market to the supply and demand in the marketing sector, grower production, and supply and demand in agricultural input markets.

Thirty-seven commodities are included in this analysis. The final fruits and vegetables selected were those for which complete supply and demand data sets were available. The commodities included in our study and the cancer prevention subgroups to which they belong are shown in Box 1.

Box 1. Commodity subgroups

Citrus/berry/melon

Cantaloupe, grapefruit, honeydew melon, oranges, strawberries, tangerines and other citrus, watermelon

Other fruit

Apples, apricots, avocados, bananas, cherries, grapes, peaches and nectarines, pears, pineapples, plums and prunes

Starchy vegetables

Corn (fresh market sweet), sweet potatoes

Salad vegetables

Lettuce (green leaf, head, romaine, endive, etc.)

Other vegetables

Artichokes, asparagus, beans (snap), celery, cucumbers, eggplant, onions, peas, peppers (bell)

Tomatoes

Fresh market, processing

Dark green and orange vegetables

Carrots, spinach, broccoli

Cruciferous vegetables

Cabbage, cauliflower

Potatoes

All varieties

Potatoes are a starchy vegetable but are listed separately because the demand for potatoes will decrease to account for the elimination of French fries and potato chips from the diet.

The effects on prices and production for the 5-a-day, 7-a-day and 7-a-day cancer prevention recommendations are estimated using the percentage change in demand required to attain the recommended levels under each scenario (Table 2). Under the 5-a-day and 7-a-day scenarios, the increase for each fruit subgroup and each vegetable subgroup is the same because only the total fruit consumption target or total vegetable consumption target is of interest. For the 7-a-day cancer prevention scenario each subgroup has a different percentage increase because each subgroup target needs to be met. When shifting from the 7-a-day scenario to the 7-a-day cancer prevention scenario, the percentage increase in consumption for the other fruit, other vegetable, and tomato subgroups falls. For example, under the 7-a-day scenario the percentage increase needed to achieve the recommended levels of consumption of other fruit for low-income consumers is 62 percent. Under the cancer prevention scenario it falls to only 42 percent.

Table 2. **Percentage increase in consumption needed to achieve recommended levels**

Category	5-a-day		7-a-day		7-a-day cancer prevention	
	Income		Income		Income	
	Lower	Higher	Lower	Higher	Lower	Higher
Citrus/berry/melon	8	7	62	60	92	87
Other fruits	8	7	62	60	42	42
Starchy vegetables	75	50	134	100	157	120
Salad	75	50	134	100	187	113
Other vegetables	75	50	134	100	16	15
Tomatoes	75	50	134	100	39	21
Dark green and orange veg.	75	50	134	100	307	275
Cruciferous	75	50	134	100	139	101
Potatoes	-67	-69	-56	-58	-52	-54

Source: Calculations based on dietary guidelines and current consumption data (see sources in Table 1).

We stress that this analysis assumes a dietary change only for California consumers. Different and much larger impacts would result if all U.S. consumers ate more fruits and vegetables. We are currently completing this larger study.

Benefits to fruit and vegetable growers

The solution to the system of equations in the market model is the percentage change in retail and grower

prices, agricultural input prices, final quantity demanded by each income group in each region in the study, and production by growers in each region. The percentage change in grower prices, input prices and production are used to calculate the net annual benefits to growers. Details of the impacts are provided in the full report (<http://aic.ucdavis.edu/research1/5aDay.pdf>). A few highlights are provided here.

Table 3. **Percentage change in the California grower price and output**

Category	5-a-day		7-a-day		7-a-day cancer prevention	
	Price	Output	Price	Output	Price	Output
Citrus/berry/melon						
Cantaloupe	0.67	0.57	5.29	4.98	7.06	6.74
Oranges	0.69	0.43	5.46	3.83	6.96	4.95
Strawberries	0.73	0.59	5.65	5.23	7.52	7.09
Other fruit						
Apples	0.82	0.55	6.66	4.8	4.95	3.51
Avocados	0.81	0.5	6.35	4.45	5.06	3.47
Grapes	0.84	0.5	6.48	4.44	5.22	3.48
Peaches, nectarines	0.86	0.54	6.73	4.72	5.25	3.61
Plums, prunes	0.41	0.23	3.09	2.08	2.44	1.58
Salad						
Lettuce, all	7.16	3.52	14.32	6.96	16.37	7.99
Tomatoes						
Fresh market	5.21	2.56	10.49	5.12	4.14	1.94
Processing	7.22	3.55	14.41	7.01	4.17	1.9
Dark vegetables						
Carrots	6.92	3.42	13.89	6.83	31.91	15.83
Spinach	7.11	3.49	14.24	6.91	35.6	17.59
Broccoli	7.24	3.55	14.49	7.04	36.24	17.91
Cruciferous						
Cauliflower	5.54	2.7	11.15	5.37	11.19	5.38

Source: Author simulation model results.

As expected, the percentage change in prices is greater for the 7-a-day scenario than for the 5-a-day scenario and for the commodities in the cancer prevention subgroups that have the greatest increase in consumption (Table 3). For example, the change in quantity demanded by Californians needed to reach the targeted levels of the 7-a-day cancer prevention diet compared to the 7-a-day general recommendation is higher for lettuce but lower for processed tomatoes. The percentage change in the price of lettuce in the 7-a-day cancer prevention scenario is greater than the percentage change in the price of processed tomatoes.

Within the commodity subgroups, the percentage change in prices is generally lower for commodities that have large imports or exports. For example, about 62 percent of plums and prunes are exported from the United States to other countries, but only about 5 percent of peaches and nectarines are exported. The percentage change in the price of plums and prunes is less than half the percentage change in peaches and nectarines.

The annual benefits for California growers from changes in California consumption are \$316 million for the 5-a-day scenario, \$788 million for the 7-a-day scenario, and \$836 million for the 7-a-day cancer prevention scenario (Table 4). The benefits to California growers are concentrated in the commodity groups in which California specializes—lettuce, processed tomatoes, broccoli, spinach, and carrots (Table 4). Growers in the rest of the United States benefit more from greater production in the citrus/berry/melon, starchy vegetable, and cruciferous subgroups. For all growers in the United States, the annual net benefits are estimated to be \$460 million if California consumers were to meet the minimum 5-a-day recommendations, \$1.5 billion for the 7-a-day general recommendation, and \$1.44 billion for the 7-a-day cancer prevention recommendation.

Health economists emphasize the value of the health benefits from increased consumption of fruits and vegetables. However, significant benefits also will accrue to fruit and vegetable growers. This study has estimated the market effects of improved diets and provided the first quantitative evidence of grower benefits. ■

Table 4. **Net benefits to growers**

Category	5-a-day		7-a-day		7-a-day cancer prevention	
	\$ mil	% of revenue	\$ mil	% of revenue	\$ mil	% of revenue
California						
Citrus/berry/melon	8	0.5	65	4.1	86	5.4
Other fruit	15	0.7	117	5.7	92	4.5
Starchy vegetables	10	7.3	21	15.2	24	17.4
Salad	90	7.3	183	14.8	211	17.0
Other vegetable	61	5.5	123	11.2	27	2.4
Tomatoes	60	6.1	123	12.4	37	3.7
Dark	65	6.9	133	14.1	336	35.7
Cruciferous	13.7	5.2	27.8	10.6	27.9	10.6
Potatoes	-7	-3.8	-5	-2.7	-5	-2.7
Total	316	3.7	788	9.3	836	9.8
Total U.S.						
Citrus/berry/melon	20	0.6	171	5.2	228	7.0
Other fruit	29	0.7	243	5.6	186	4.3
Starchy vegetables	106	11.8	214	23.9	252	28.1
Salad	117	7.2	238	14.7	274	17.0
Other vegetables	181	5.5	365	11.2	80	2.5
Tomatoes	84	4.6	170	9.4	54	3.0
Dark vegetables	83	7.0	169	14.3	428	36.1
Cruciferous	46	8.6	92.8	17.3	93.3	17.4
Potatoes	-206	-8.4	-165	-6.7	-153	-6.2
Total	460	2.4	1,500	7.8	1,442	7.5

Source: Author calculations based on simulation results.

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