The United States Food Supply Is Not Consistent with Dietary Guidance: Evidence from an Evaluation Using the Healthy Eating Index-2010

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ABSTRACT
The US food system is primarily an economic enterprise, with far-reaching health, environmental, and social effects. A key data source for evaluating the many effects of the food system, including the overall quality and extent to which it provides the basic elements of a healthful diet, is the Food Availability Data System. The objective of the present study was to update earlier research that evaluated the extent to which the US food supply aligns with the most recent federal dietary guidance, using the current Healthy Eating Index-2010 (HEI-2010) and food supply data extending through 2010. The HEI-2010 was applied to 40 years of food supply data (1970-2010) to examine trends in the overall food supply as well as specific components related to a healthy diet, such as fruits and vegetables. The HEI-2010 overall summary score hovered around half of optimal for all years evaluated, with an increase from 48 points in 1970 to 55 points (out of a possible 100 points) in 2010. Fluctuations in scores for most individual components did not lead to sustained trends. Our study continues to demonstrate sizable gaps between federal dietary guidance and the food supply. This disconnect is troublesome within a context of high rates of diet-related chronic diseases among the population and suggests the need for continual monitoring of the quality of the food supply. Moving toward a food system that is more conducive to healthy eating requires consideration of a range of factors that influence food supply and demand.
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THE US FOOD SYSTEM IS PRIMARILY AN ECONOMIC enterprise, driven by factors such as trade, costs, prices, and demand,[1] with far-reaching health, environmental, and social effects. A key source of data for evaluating the many effects of the US food system is the national Food Availability Data System.[2] Food availability data—herein referred to as the food supply—represent the sum total of food that enters retail distribution channels and are calculated for each year by summing production, imports, and past-year stores and subtracting exports and current-year stores. Traditionally, these data have been used to examine the capacity of a country's food supply to meet the nutrition needs of its people, examine trends in food supplies over time, monitor food insecurity, project future trends in food insecurity, and guide food and agricultural policy.[2,3]

The extent to which the food system provides the basic elements of a healthful diet is a critical consideration in evaluating its merit given the relationship between diet and health. The federal government's policy on what constitutes a healthy diet is enumerated every 5 years in the Dietary Guidelines for Americans (DGA).[4-10] The key principles have remained relatively stable since the first DGA in 1980, with updates and refinements to guidance reflecting nuances rather than dramatic shifts in the evidence base. The core tenets of a healthy diet have consistently included an emphasis on fruits and vegetables and moderation in consumption of sodium, saturated fats, and added sugars.

Earlier research[11] examined the healthfulness of the US food supply from 1970 through 2007 using the Healthy Eating Index-2005 (HEI-2005), a density-based diet quality index that assesses conformance with the 2005 DGA. Since this previous work, which noted sizable gaps between federal dietary guidance and the food supply, both the HEI and the food supply data have been updated.[2,12] The HEI-2010 reflects the evolution of, and nuances in, the guidance provided by the 2010 DGA[4] compared with the prior DGA, including the recommendations to consume fewer saturated fatty acids by replacing them with mono- and polyunsaturated fatty acids, limit refined grains, and emphasize seafood and plant proteins. The purpose of the present study was to update earlier research that evaluated the extent to which the US food supply aligns with the most recent federal dietary guidance,

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using the current HEI and food supply data extending through 2010.

METHODS

HEI-2010 scores were calculated for the years 1970-2010 using publicly available datasets that provide the best estimates of the food supply as of January 2013. The calculations required to generate scores for each HEI-2010 component are shown in Figure 1. The study was not subject to institutional review board review because all data were from existing, publicly available sources and no original research involving human subjects was conducted.

HEI-2010

The HEI-2010 has 12 components,[12] nine of which assess adequacy (Total Fruit, Whole Fruits, Total Vegetables, Greens and Beans, Whole Grains, Dairy, Total Protein Foods, Seafood and Plant Proteins, and Fatty Acids), and three of which capture moderation (Refined Grains, Sodium, and Empty Calories). The minimum score for all components is 0, whereas the maximum score varies between 5, 10, and 20. Details regarding the development and scoring of the HEI-2010 have been published previously[12] and can be found in a technical report and fact sheet provided by the US Department of Agriculture.[13]

Data Sources. Four datasets were drawn upon for this analysis. These included two obtained from the US Department of Agriculture Economic Research Service (ERS), including the Loss-Adjusted Food Availability Data (LAFAD) and ERS Nutrient Availability Data (NAD).[2] The LAFAD, which account for losses due to food spoilage and waste, provide daily per capita quantities in units that align with current dietary guidance. The NAD include the estimated non-loss-adjusted nutrient content of the food available for domestic consumption.[2] The data available from ERS include only a portion of the sodium in the food supply: naturally occurring sodium and that from salt found in canned vegetables and cheese. Therefore, data on salt sold for human consumption were obtained from the Salt Institute[14] (a North American nonprofit trade association); these estimates include salt used in processing, cooking, and at the table.[14] Estimates of per capita alcohol consumption (derived from annual alcohol sales data) were obtained from the National Institute on Alcohol Abuse and Alcoholism (NIAAA) Alcohol Epidemiologic Data System.[15]

Data required for nine of the 12 components, plus two of the Empty Calories subcomponents (ie, added sugars and solid fat), were available through 2010 from the LAFAD. For the remaining components (Sodium, Fatty Acids, and the alcohol subcomponent of Empty Calories), it was necessary to draw upon the remaining databases and to perform imputation for the most recent years. The NAD provide estimates through 2006; values for sodium (in cheese and canned vegetables) and fatty acids were ascribed for 2007-2010 by carrying forward the ratio of each respective nutrient to total calories from 2006 and applying it to the total calories from the LAFAD in 2007, 2008, 2009, or 2010. Salt values for 2008-2010 were also imputed. Given an observed decrease in the salt supply from 2005 to 2007, a continued downward trend was assumed and the average annual percentage decline starting in 2005 (1.65%) was used to generate values of sodium from salt for 2008 through 2010. The 2009 alcohol values were attributed to 2010 because the supply of alcohol has remained stable since 1970.

Calculations

Total daily per capita cup or ounce equivalents of the foods required to calculate quantities of the following components were obtained from the LAFAD: Total Fruit, Whole Fruit, Refined Grains, Whole Grains, Dairy, Total Protein Foods, Seafood and Plant Proteins, Greens and Beans, and Total Vegetables. Most calculations required summing or subtracting certain foods to calculate each component (further details are available in Figure 1 and at http://appliedresearch.cancer.gov/tools/hei/tools.html). To calculate Whole Grains, 5% of wheat flour—the portion considered to be whole wheat (personal communication, Cynthia Harriman, Whole Grains Council, 2012)—was added to the sum of total oat, barley, and rye, plus 0.6 oz (the amount of unreported whole grains per capita per day in the food supply according to the ERS).[16] Grams of solid fats and added sugars also were obtained from the LAFAD for the calculation of Empty Calories.

NAD were used to obtain values for sodium and saturated, polyunsaturated, and monounsaturated fatty acids. Because loss-adjusted nutrient data were unavailable for these nutrients, the unadjusted values were calibrated by multiplying by the total loss-adjusted calories for the given year from LAFAD and dividing by the total unadjusted calories from the NAD for that year. To calculate the alcohol subcomponent of Empty Calories, annual gallons of ethanol from beer, wine, and liquor were obtained from the NIAAA and converted to grams of ethanol per capita per day.

For the Sodium component, the calibrated value based on NAD was considered in conjunction with the Salt Institute Sales Data. These data include annual tons of salt sold for human consumption, which were converted to mg of sodium per capita per day. To avoid double counting the sodium from salt added during the canning of vegetables and the processing of milk to cheese, the NAD estimates were adjusted to remove sodium from these sources. Subsequently, the remaining intrinsic sodium from the NAD and the sodium from the Salt Institute Sales Data were summed and used to calculate the Sodium component.

To estimate energy in the food supply, total calories from the LAFAD were combined with calories from alcoholic beverages from the NIAAA.

The ratio of each dietary component to energy, or the ratio of polyunsaturated and monounsaturated to saturated fatty acids, was calculated. The resulting value was then compared with the standard established for the respective component, and the component and total HEI-2010 scores were determined. The code for deriving HEI-2010 scores that can be applied to food supply data is available at http://appliedresearch.cancer.gov/tools/hei/tools.html.

RESULTS AND DISCUSSION

Our study results indicate that the quality of the US food supply is not aligned with federal dietary guidance. Although the key principles espoused by the DGA have remained relatively stable over time, the summary HEI-2010 score for the food supply hovered around half of optimal (100 points) for all years (Figure 2, panel A). This finding is consistent with