Wasted Food, Wasted Nutrients: Nutrient Loss from Wasted Food in the United States and Comparison to Gaps in Dietary Intake

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ABSTRACT

Background Previous research has estimated that wasted food in the United States contains between 1,249 and 1,400 kcal per capita per day, but little is known about amounts of other nutrients embedded in the 31% to 40% of food that is wasted.

Objective This research aimed to calculate the nutritional value of food wasted at the retail and consumer levels in the US food supply, and contextualize the amount of nutrient loss in terms of gaps between current and recommended intakes and estimated food recovery potential.

Design Data from the National Nutrient Database for Standard Reference were used to calculate the nutritional value of retail- and consumer-level waste of 213 commodities in the US Department of Agriculture Loss-Adjusted Food Availability data series for 27 nutrients in 2012.

Results Food wasted at the retail and consumer levels of the US food supply in 2012 contained 1,217 kcal, 33 g protein, 5.9 g dietary fiber, 1.7 μg vitamin D, 286 mg calcium, and 880 mg potassium per capita per day. Using dietary fiber as an example, 5.9 g dietary fiber is 23% of the Recommended Dietary Allowance for women. This is equivalent to the fiber Recommended Dietary Allowance for 74 million adult women. Adult women in 2012 underconsumed dietary fiber by 8.9 g/day, and the amount of wasted fiber is equivalent to this gap for 206.6 million adult women.

Conclusions This was the first study to document the loss of nutrients from wasted food in the US food supply, to our knowledge. Although only a portion of discarded food can realistically be made available for human consumption, efforts to redistribute surplus foods where appropriate and prevent food waste in the first place could increase the availability of nutrients for Americans, while saving money and natural resources.
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IN THE UNITED STATES, BETWEEN 31% AND 40% OF THE food supply is wasted before it reaches consumers.[1,2] Policies and interventions to reduce waste and redirect surplus food can reduce food costs, benefit the environment, and improve food security.[3-6] As described in a recent report from the Academy of Nutrition and Dietetics, nutrition and dietetics practitioners have an important role to play in addressing this waste while advancing nutrition, such as promoting consumer behavior change through nutrition education.[7] In this article, "nutrient loss" refers to the nutrient content embedded within food loss and waste. Although the terms "food loss," "food waste" and "wasted food" are sometimes used interchangeably, in this article "wasted food" is primarily used.*

**In this article, "wasted food" (verb-noun) is used primarily because it emphasizes that an action, waste, is being done to a product, food. By contrast, "food waste" (adjective-noun) treats food as a type of waste, which is an unappetizing frame when food recovery is part of the goal.*

Tracking Caloric and Nutrient Losses

Most research efforts to quantify wasted food have focused on food weight or economic value, or on waste as a proportion of available food by supply chain level.[8-11] The few studies examining nutritional value have focused primarily on calories. For example, Buzby and colleagues[1] linked US Department of Agriculture (USDA) data with underlying loss assumptions, estimating that retail- and consumer-level food loss in 2010 was equivalent to 1,249 kcal per capita per day.

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Hall and colleagues[2] estimated that food loss and waste across the US supply chain accounted for approximately 1,400 kcal per person per day in 2003. This estimate represented the difference between food available to the US population (according to Food and Agriculture Organization food balance sheets) and average caloric intake, using a mathematical model incorporating energy requirements, demographic distribution, and dietary intake data from the National Health and Nutrition Examination Survey (NHANES). Kummu and colleagues[4] also used Food and Agriculture Organization food balance sheet data, together with other country-level data, to estimate 1,334 kcal per person per day embedded in food loss and waste in North America and Oceania.

Focusing on only the caloric value of wasted food may overrepresent the influence of calorie-dense foods, losing sight of other nutrients that are wasted.[12] Nutrient-dense foods such as vegetables, fruits, seafood, and dairy products are wasted at disproportionately high rates,[1,13] suggesting that wasted food may have a substantial influence on the supply of micronutrients.[14] To our knowledge, only two published studies have examined the nutrient content of wasted food beyond calories. Love and colleagues[15] estimated the calorie, protein, and eicosapentaenoic and docosahexaenoic acid content in the 40% to 47% of seafood that is lost in the United States. A project funded by the European Commission Framework Programme examined waste of nine indicator food products (apples, tomatoes, potatoes, bread, milk, beef, pork, chicken, and whitefish) in European Union member countries, reporting substantial losses of vitamin A, beta carotene, vitamin C, fiber, iron, zinc, n-3 fatty acids, lysine, and methionine.[16] Still absent from the literature is a broad quantification of nutrient losses across the US food supply.

Such an examination is feasible through publicly available data sources. The USDA Food Availability data series tracks more than 200 commodities, taking into account quantities produced and imported, and subtracting food used for nonfood purposes (eg, exports and farm inputs).[17] The Loss-Adjusted Food Availability (LAFA) data series further refines the amount of food available for human consumption by excluding nonedible food portions and food losses occurring at the primary (ie, farm or producer), retail, and consumer levels.[18] These losses include cooking loss, spoilage, food discarded due to aesthetic standards, and consumer plate waste. The USDA also maintains the Nutrient Availability data series, which includes data on the availability of 27 nutrients and food components based on the Food Availability data series.[19] No such nutrient data exist for the LAFA data series, so current figures overestimate nutrient availability in the food supply because they include the nutrient content of 133 billion pounds of food loss unavailable for human consumption.[1] This study aimed to estimate the nutrient content of those discarded foods, thereby providing the first quantification of a comprehensive set of nutrients wasted at the retail and consumer levels of the US food supply.

Gaps in Dietary Intake and Potential for Food Recovery

Wasted food coexists with widespread need. Fourteen percent of US households were food insecure in 2014, meaning they struggled to provide food at some point in the year, whereas 5.6% had very low food security, meaning lack of resources led to disrupted eating patterns such as skipped meals or reduced overall intake.[20] In addition to food quantity, nutritional quality is also important, and certain micronutrients are consumed at levels below the Estimated Average Requirement (EAR) or Adequate Intake (AI) levels at a population level. The 2015-2020 Dietary Guidelines for Americans (DGA) reported that these underconsumed nutrients include dietary fiber; calcium; choline; magnesium; potassium; and vitamins A, C, D, and E for all population groups and iron for adolescent girls and women of reproductive age.[21] The DGA identified a subset—dietary fiber, calcium, potassium, and vitamin D—as “nutrients of public health concern” due to the health consequences that can result from underconsumption.[21]

It is neither practical nor desirable to divert all wasted food to anti-hunger efforts or to helping Americans obtain needed nutrients. The US Environmental Protection Agency describes a food recovery hierarchy in which the top priority is waste prevention, followed by feeding the food to those who are hungry (food recovery), feeding it to animals, diverting food toward industrial uses, and composting, with discarding food in a landfill as a last resort.[22] A report by Rethink Food Waste Through Economics and Data (ReFED), a collaboration of business, nonprofit, philanthropic, and government leaders, estimated that annually in the United States, 1.7 million tons of food are recovered for distribution to those in need, but still 52.4 million tons are discarded in landfills and 10.1 million tons are left in farm fields, totaling 62.5 million tons.[23] ReFED estimated that 20% of this discarded food could be diverted from landfills by implementing a set of cost-effective activities with three goals: food recovery, composting, and waste prevention. These activities can contribute to the goal set by the USDA and the Environmental Protection Agency to halve US food loss and waste by 2030.[24]

Purpose and Research Questions

This study aimed to estimate the amount of nutrient loss, on a per capita per day basis, in the US food supply during 2012. To provide context, the nutrient loss is expressed relative to recommended intakes, gaps between recommended and mean current intakes, and estimates of the amount of food that could be recovered. The resultant nutrient loss estimates illustrate how waste of food represents a loss to food security, nutrition, and the broader society. They can thus help justify investments in food recovery and prevention, and support the case for engagement by registered dietitian nutritionists in these efforts. These estimates can also serve as a baseline to measure progress toward waste reduction and recovery.

MATERIALS AND METHODS

Data Sources

Two USDA data sources were used for the primary analysis: the LAFA data series[18] was used for estimates of food availability and loss, and the National Nutrient Database For Standard Reference, Release 28 (US Department of Agriculture, Agricultural Research Service Nutrient Data Laboratory) (SR-28) was used to obtain nutrient composition data for each commodity in the LAFA data series. The LAFA data series provides estimates for the availability of 213 commodities (pounds per capita per year) and percentages of food loss at the primary, retail, and consumer levels annually from 1974 to 2012. Estimates from 2012 were used except for nine foods (primarily fats and oils) for which data were unavailable; for those, the most recent estimates were used. Although the data series does not include every food available for consumption in the United States—for example, it includes kale and collard greens, but not Swiss chard—it forms the most comprehensive representation of the US food supply for which data on food loss are currently available. Consistent with the methods presented by Buzby and colleagues,[1] this analysis excluded nonedible portions of food and focused only on the retail and consumer levels due to inconsistent data availability at the primary level.

Additional data sources, described below, included NHANES What We Eat in America,[25] the Dietary Reference Intakes,[26] and US Census Bureau estimates of population size for the 2012 midpoint (ie, July 1).[27]

Calculations of Nutrient Loss

For each commodity in the LAFA data series, a representative food or an average of representative foods was matched from the SR-28 database, resulting in 290 SR-28 food codes.[1,28] For example, butter was represented by the average of: "01001: butter, salted" and "01145: butter, without salt."[1,28] The choice of codes was based on previous USDA research efforts described in Table 1 (available online at www.jandonline.org), which also contains the full codebook and detailed rationale. For each selection, nutrient composition was obtained from SR-28 for a standardized 100-g unit of food.

A detailed explanation of all calculations appears in Table 2 (available online at www.jandonline.org). Because the analysis was restricted to the retail and consumer levels due to the unavailability of consistent data at the primary level, calculations were performed to isolate annual per capita waste at the retail and consumer levels for each of the commodities, thereby excluding waste at the primary level or from nonedible portions. Subsequently, the amount of each nutrient present in this amount of waste was calculated, and amounts were summed by nutrient to estimate nutrient loss per capita per year resulting from the waste of all 213 commodities. To estimate losses on a per capita per day basis, nutrient loss per capita per year was divided by 365. To estimate losses on a per population per day basis, nutrient loss per capita per day was multiplied by the 2012 total population size (313,914,040) as specified by the US Census Bureau.[27] In some calculations, the 2012 adult population size (226,456,000) was used to relate the amount of nutrient loss per population per day to the amount of nutrients that would be recommended for adults in the population.

Calculations to Compare Nutrient Loss to Dietary Intake

To contextualize nutrient loss, gaps between current and recommended dietary intakes were calculated. Mean current nutrient intakes were obtained from What We Eat in America, the dietary interview component of the NHANES 2011-2012 survey, on usual dietary intakes for adults aged 20 years and older.[29] NHANES data are gathered from 24-hour dietary recalls and are a useful indicator of consumption, given that the USDA Food Availability and LAFA data series reflect food availability and losses but not dietary consumption. Recommended intakes are also presented, based on the Recommended Dietary Allowance (RDA) or the AI. The RDA is the level of daily nutrient intake that will meet the needs of 97.5% of healthy individuals, and it is set at two standard deviations above the EAR, the intake level that will meet the needs of 50% of healthy individuals.[26] The AI is an observed or experimentally derived analog of the RDA used for nutrients for which it is not feasible to determine the EAR. All values presented for the RDA and AI are the most recent estimates from the Dietary Reference Intakes from the Institute of Medicine.[30] For recommended intakes, "adult" refers to the RDA or AI for the age group 19 to 30 years; for many nutrients, the recommendations for this age group are equivalent to the recommendations for the 31 to 50 years and 51 to 70 years age groups. For energy, 2,000 kcal/day was used as the recommended intake for both men and women, although actual needs depend on height, weight, and physical activity.[26]

For underconsumed nutrients, gaps in dietary consumption were calculated, defined as the difference between mean current intakes and recommended intakes. Although the DGA defines underconsumed nutrients in relation to the EAR,[21] this analysis used the RDA because the RDA is intended for recommendations at the individual level. In addition, given that the RDA is higher than the EAR by two standard deviations,[26] the RDA provides a more conservative estimate of the potential influence of food loss on nutrient availability (ie, a given amount of nutrients can provide more people with the EAR than it can the RDA).

Calculations were also performed to estimate the nutritional value that could be recovered if the US were to achieve the potential for food recovery suggested by ReFED's analysis. ReFED aggregated multiple primary and secondary data sources including expert interviews, estimating that currently only 1.7 million tons (2.7%) of wasted food are recovered.[23] ReFED projected that a maximum of 5.8 million additional tons of food per year (9.2% of the estimated amount currently wasted) could feasibly be made available for human consumption through recovery efforts over the next 10 years, and that 1.1 million additional tons of food per year (1.75% of the estimated amount wasted) could be recovered over the next 10 years by scaling up only the top seven most cost-effective food recovery activities. As such, 1.75% and 9.21% were used as the boundaries for this set of calculations.

Data Management and Ethical Approval

The above-described methods are depicted graphically in Figure 1. Data from the LAFA data series and SR-28 were downloaded and compiled into spreadsheets in Microsoft Excel (Microsoft Corp) for calculations. Nutrient composition data for each food were stored in a separate file, and a MATLAB script[31] was developed to compile data from all 290 SR-28 food codes in a single Excel spreadsheet. For all data that were transferred from one file to another, a 5% subsample was double checked by a second author, and discrepancies were resolved by referring to the original data sets. This research was reviewed and classified as exempt by the institutional review board at the Johns Hopkins Bloomberg School of Public Health because all data were derived from existing, publicly available sources and no original research involving human subjects was conducted.

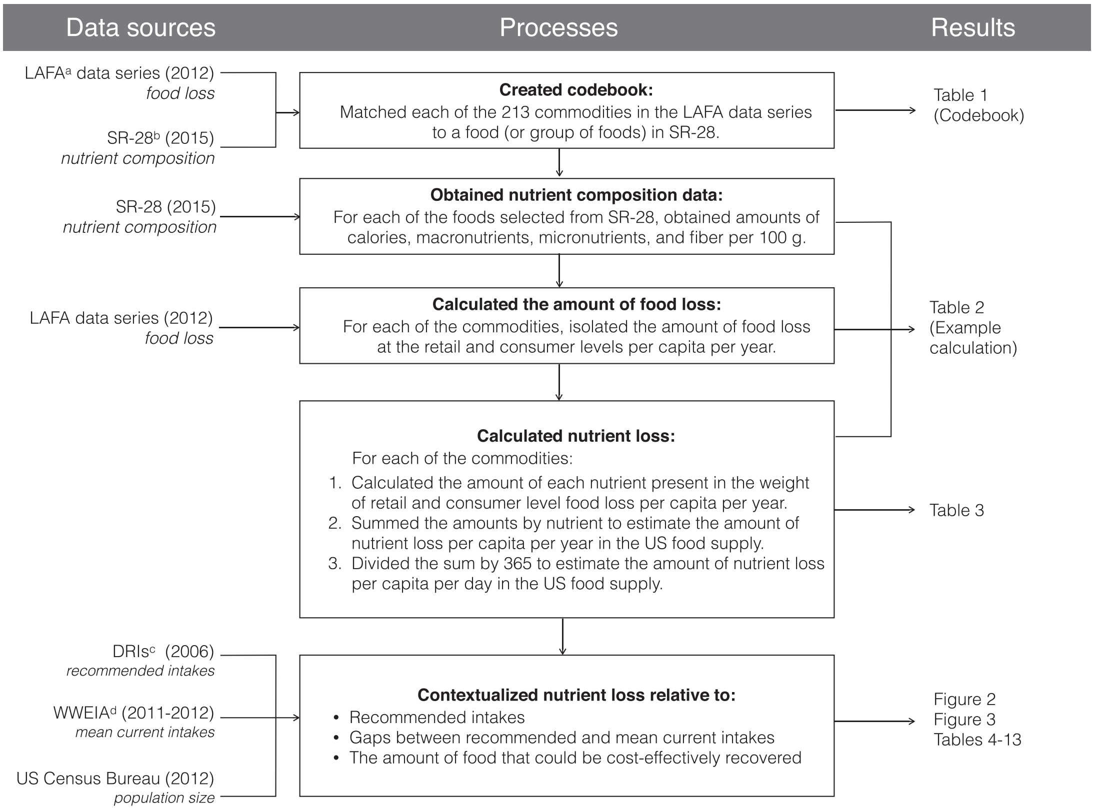

Figure 1. Diagram of data sources and calculations used to generate estimates of nutrient loss in the US food supply in 2012, and locations of results within the article. [a]LAFA=Loss Adjusted Food Availability.[18] [b]SR-28=National Nutrient Database for Standard Reference, Release 28 (US Department of Agriculture, Agricultural Research Service Nutrient Data Laboratory). [c]DRI=Dietary Reference Intakes.[26] [d]WWEIA=What We Eat in America.[25]

RESULTS

Magnitude of Nutrient Loss in the US Food Supply

Table 3 shows the nutritional value embedded in the retail and consumer level waste of 213 commodities in the US food supply during 2012. Wasted food at the retail and consumer levels contained an average of 1,217 kcal, 146 g carbohydrates, 33 g protein, 57 g total fat, 5.9 g dietary fiber, 1.7 μg vitamin D, 286 mg calcium, and 880 mg potassium per capita per day. Quantities for additional wasted nutrients are shown in Table 3. Nutrients such as *trans* fats, for which data were not consistently available for all commodities, are not reported.

Table 4 (available online at www.jandonline.org) presents the percentage contribution from the retail and the consumer levels. For all nutrients presented except polyunsaturated fat and vitamin K, the majority of loss occurred at the consumer level.

Tables 5, 6, and 7 (all available online at www.jandonline.org) show the percentage contribution of nutrient loss from various food groups, illustrating that some food groups contributed an especially large proportion of wasted nutrients. For example, retail- and consumer-level waste of meat, poultry, and fish accounted for a substantial portion of the loss of vitamin B-12 (50% of the total loss), zinc (47%), protein (46%), niacin (42%), vitamin B-6 (42%), and cholesterol (40%). Added fats and oils accounted for 63% of the loss of vitamin E across the food supply. Looking to nutrients of public health concern, loss of dietary fiber was due primarily to waste of grains (39%), vegetables (34%), and fruits (22%). Loss of calcium was due primarily to waste of dairy (72%) and, to a lesser extent, vegetables (10%). Loss of vitamin D was accounted for primarily by waste of dairy (53%); meat, poultry, and fish (27%); and eggs (15%).

Comparison of Nutrient Loss to Gaps in Dietary Intake

For macronutrients, underconsumed nutrients, and nutrients of public health concern, the amount of nutrient loss from Table 3 is contextualized in Table 8 as the equivalent number of adult women and men for whom the gap between actual and recommended intakes could be filled and the recommended intakes (eg, RDA or AI) could be provided. Similar estimates are provided for an additional 14 nutrients in Table 9 (available online at www.jandonline.org). These estimates are provided for context, recognizing that not all wasted food can feasibly be recovered for human consumption. To use dietary fiber as an example, on an average day in 2012, waste of 213 commodities at the retail and consumer levels contained 5.9 g dietary fiber per capita, equivalent to upward of 1.8 billion g dietary fiber across the 2012 US population (not shown in Table 8). Adult women and men in 2012 consumed an average of 8.9 and 17.7 g less than the recommended intake of dietary fiber per day, respectively; 1.8 billion g dietary fiber equals the gap between actual and recommended intakes for upward of 206.6 million adult women or 103.9 million adult men. Alternatively, 1.8 billion g dietary fiber is equivalent to

Table 3. Magnitude of daily per capita nutrient loss of 213 commodities at the retail and consumer levels of the US food supply in 2012

Nutrient	Nutrient loss
Energy, macronutrients, and fiber	
Energy (kcal)	1,216.5
Carbohydrates (g)	146.4
Protein (g)	32.8
Total fat (g)	57.2
Saturated fat (g)	18.1
Monounsaturated fat (g)	18.6
Polyunsaturated fat (g)	16.9
Cholesterol (mg)	137.7
Dietary fiber (g)[ab]	5.9
Minerals	
Calcium (mg)[ab]	286.1
Iron (mg)[a]	5.3
Magnesium (mg)[a]	85.0
Phosphorus (mg)	450.3
Potassium (mg)[ab]	880.2
Sodium (mg)	264.2
Zinc (mg)	3.9
Vitamins	
Vitamin A (μg)[ac]	308.3
Thiamin (mg)	0.9
Riboflavin (mg)	0.8
Niacin (mg)	9.0
Vitamin B-6 (mg)	0.6
Folate (μg)	268.5
Vitamin B-12 (μg)	1.5
Vitamin C (mg)[a]	35.4
Vitamin D (μg)[ab]	1.7
Vitamin E (mg)	3.6
Vitamin K (μg)	79.2

[a]Underconsumed nutrients.
[b]Nutrients of public health concern.
[c]Retinol activity equivalents.

the full RDA for dietary fiber for 73.6 million adult women or 48.4 adult men each day, equivalent to 27% of the US adult population, taking the average of the proportions for women and men, as shown in Figure 2. Table 10 (available online at www.jandonline.org) provides supporting information for Figure 2, including additional nutrients, the proportions for women and men separately, and the contributions from the retail and consumer levels separately.

For underconsumed nutrients, Figure 3 depicts the amount of loss in terms of the percentage of recommended intake. For example, waste of 213 commodities at the retail and consumer levels in 2012 contained dietary fiber (5.9 g per capita per day) equivalent to 23% of the RDA for women or 15% of the RDA for men, averaging to 19%. Table 11 (available online at www.jandonline.org) provides supporting information for Figure 3, including additional nutrients, the proportions for women and men separately, and the contributions from the retail and consumer levels separately.

Table 12 (available online at www.jandonline.org) shows the results of the calculations to estimate the nutritional value that could be recovered if the United States were to achieve the potential for food recovery suggested by ReFED's analysis. If food were recovered in the same proportions as it were wasted, scaling up the top seven most cost-effective food recovery activities over the next 10 years (resulting in recovering 1.75% of food currently wasted), this would translate into 2,000 kcal per day for 3.3 million adults. Looking to nutrients of public health concern, at this rate the recovered food would be equivalent to the calcium RDA for 1.6 million adult women or men, the potassium RDA for 1.0 million adult women or men, the dietary fiber RDA for 1.3 million adult women or 0.8 million adult men, and the vitamin D RDA for 0.6 million adult women or men. If some food recovery interventions were included that were not highly cost-effective, the estimated maximum recoverable amount of food (9.21% of food currently wasted) would translate into 2,000 kcal per day for 17.6 million adults.

DISCUSSION

US landfills represent vast repositories of lost nutrition. In 2012, enough food was discarded at the retail and consumer levels alone to provide 2,000 kcal per day to 84% of the US adult population. Reducing waste of food may be particularly beneficial for the availability of nutrients currently underconsumed in the United States. Although only a portion of this nutritional value can be recovered for human consumption, the magnitude of loss and the associated lost money and resources mean there is great opportunity in focusing on that effort. Quantifying the loss can motivate related investments and support the case for engagement by registered dietitian nutritionists with these efforts. The estimates can also serve as a baseline for tracking the influence of interventions.

The DGA emphasize the benefit of a whole-diet perspective for promoting good eating patterns, rather than focusing too heavily on component nutrients.[21] Yet, underlying the desirability of some dietary patterns over others is the ability to obtain a variety of nutrients in sufficient quantities. By breaking down wasted foods into their nutritional components, findings can be better compared to specific nutrient requirements. Losses of underconsumed nutrients were striking. For example, at the retail and consumer levels alone, discarded food contained enough dietary fiber to fill the gap between actual and recommended intake for 206.6 million women or 103.9 million men. Adequate fiber intake is inversely associated with chronic disease, and the Academy of Nutrition and Dietetics recommends consuming fiber in its food form (as opposed to dietary supplements),[32] which reinforces the importance of preventing waste of the food sources of nutrients.

Table 8. Comparison of daily population-level nutrient loss of 213 commodities at the retail and consumer levels of the US food supply in 2012 with recommended and current intakes: energy, macronutrients, and underconsumed nutrients[a]

	Recommended and Current Intakes			Equivalence to Wasted Food	
Nutrient	Recommended intake (RDA[b] or AI[c], age 19-30 y)	Mean current intake (age ≥20 y)	Average gap in dietary intake for adults[d]	Equivalent number of gaps in dietary intake (millions of adults)[e]	Equivalent number of recommended intakes (millions of adults)[f]
Adult women					
Energy (kcal)[g]	2,000.0	1,765.0	—[h]	—	190.9
Carbohydrates (g)	130.0	221.0	—	—	353.4
Protein (g)	46.0	67.1	—	—	223.7
Total fat (g)	—	66.4	—	—	—
Dietary fiber (g)[ij]	25.0	16.1	−8.9	206.6	73.6
Calcium (mg)[ij]	1,000.0	868.0	−132.0	680.3	89.8
Iron (mg)[i]	18.0	13.6	−4.4	379.0	92.6
Magnesium (mg)[i]	310.0	274.0	−36.0	740.8	86.0
Potassium (mg)[ij]	4,700.0	2,412.0	−2,288.0	120.7	58.8
Vitamin A (μg)[i]	700.0	603.0	−97.0	997.7	138.3
Vitaimin C (mg)[i]	75.0	77.8	—	—	148.0
Vitamin D (μg)[ij]	15.0	3.9	−11.1	49.4	36.6
Vitamin E (mg)[i]	15.0	7.7	−7.3	155.9	75.9
Adult men					
Energy (kcal)[d]	2,000.0	2514.0	—	—	190.9
Carbohydrates (g)	130.0	297.0	—	—	353.4
Protein (g)	56.0	98.4	—	—	183.7
Total fat (g)	—	94.5	—	—	—
Dietary fiber (g)[ij]	38.0	20.3	−17.7	103.9	48.4
Calcium (mg)[ij]	1,000.0	1,116.0	—	—	89.8
Iron (mg)[i]	8.0	18.1	—	—	208.5
Magnesium (mg)[i]	400.0	356.0	−44.0	606.1	66.7
Potassium (mg)[ij]	4,700.0	3,195.0	−1,505.0	183.6	58.8
Vitamin A (μg)[i]	900.0	749.0	−151.0	640.9	107.5
Vitamin C (mg)[i]	90.0	92.1	—	—	123.4
Vitamin D (μg)[ij]	15.0	5.5	−9.5	57.8	36.6
Vitamin E (mg)[i]	15.0	10.3	−4.7	242.1	75.9

[a]Table 8 expresses the results from Table 3 in relation to the gap between current and recommended intakes.
[b]RDA=Recommended Dietary Allowance.
[c]AI=Adequate Intake.
[d]Gap in dietary intake is recommended intake−mean current intake.
[e]Millions of adults equivalent to the gap in dietary intake was calculated as the daily loss per population divided by the gap in dietary intake. The daily loss per population was calculated as the daily loss per capita (from Table 3) multiplied by the size of total US population on July 1, 2012 (ie, 313,914,040).
[f]Millions of adults equivalent to the recommended intake was calculated as the daily loss per population divided by the recommended intake.
[g]For energy, 2,000 kcal/day was used instead of an estimated energy requirement based on age, sex, height, and weight.
[h]Cells with no values indicate either that there was no RDA for this nutrient, or that the gap between current and recommended intakes was not calculated because mean current intake exceeded the recommended intake.
[i]Underconsumed nutrients.
[j]Nutrients of public health concern.

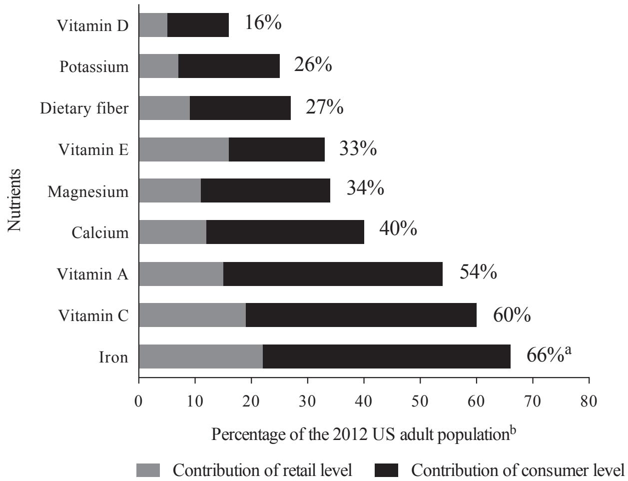

Figure 2. Equivalent number of recommended intakes embedded in daily population-level nutrient loss in the US food supply in 2012, expressed as a percentage of the 2012 US adult population (age 20 years and older). [a]Example interpretation: In 2012, the amount of iron embedded in food wasted at the retail and consumer levels each day (per population) was equivalent to the Recommended Dietary Allowance for iron for 92 million adult women (age 19 to 30 years) or 208 million adult men (age 19 to 30 years), which averages to 150 million adults, which was 66% of the adult population. [b]The US adult population on July 1, 2012, was 226,456,000 people.[27] (NOTE: Information from this figure is available online at www.jandonline.org as part of a PowerPoint presentation.)

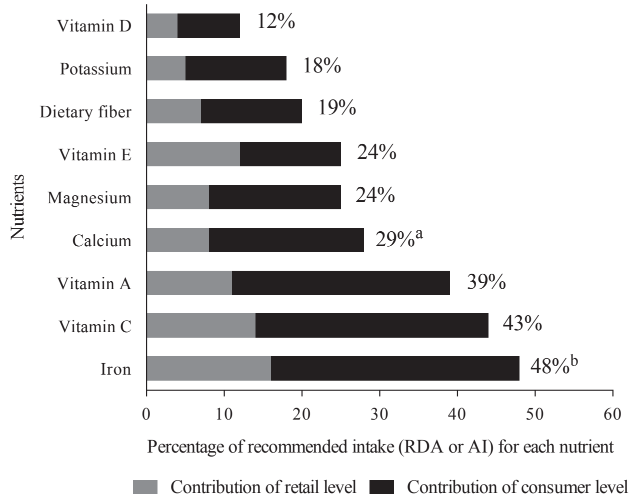

Figure 3. Amount of nutrient loss per capita per day in the US food supply in 2012, expressed as a percentage of the Recommended Dietary Allowance (RDA) or Adequate Intake (AI) for each nutrient for adults ages 19 to 30 years. [a]Example interpretation: Food wasted at the retail and consumers levels each day in 2012 contained an amount of calcium equivalent to 29% of the calcium RDA for adult women and men (age 19 to 30 years). Twenty-nine percent represents the average between the equivalent percentage of the adult women's RDA and the equivalent percentage of the adult men's RDA. [b]The RDA for iron differs greatly between men and women; daily per capita iron loss in the US food supply is equivalent to 30% of the adult women's RDA and 66% of the adult men's RDA, which averages to 48%. For other nutrients shown, differences between the RDA for men and women were not as large. (NOTE: Information from this figure is available online at www.jandonline.org as part of a PowerPoint presentation.)

Perishable foods such as fruits and vegetables are lost at particularly high rates, leading to exceptional losses of underconsumed nutrients. More broadly, there was considerable variation in the food groups contributing to losses for each nutrient. For example, for vitamin D, dairy was the greatest contributor, whereas for fiber it was grains, vegetables, and fruit, and for vitamin E it was fats and oils.

For all nutrients presented except polyunsaturated fat and vitamin K, losses were estimated to be higher at the consumer level than the retail level, potentially reflecting food perishability over time, among other factors. The substantial amount of nutrient loss at the consumer level points to the need for interventions targeted toward consumers. ReFED highlighted two consumer oriented interventions— standardized date labeling and consumer education—as being particularly cost effective.[23] In the United Kingdom, a broad suite of interventions including policy, retailers, and consumer behavior change communication contributed to a 21% reduction in household food waste between 2007 and 2012.[13] Specific strategies to reduce food waste in the household have been described elsewhere.[33]

These findings should not be interpreted as implying that all lost nutrient content could be recovered and fed to people, nor that the food that could be feasibly recovered would necessarily result in a palatable or nutritious diet. Some food will inevitably be discarded. Food safety concerns are paramount, and protecting food safety can mean setting stringent standards that err on the discard side. In addition, some logistical challenges of perishability, transportation, storage, and timing cannot be addressed in a cost-effective manner. Only a portion of waste can be prevented through retail and restaurant strategies such as improved prediction of consumer demand, or food packages and portion sizes targeted to consumption patterns and nutrition needs. Cultural shifts are also needed, although they cannot eliminate all waste. These include changing consumer preferences for aesthetically perfect produce, and making it acceptable for stores, restaurants, and homes to occasionally run out of items rather than always providing food in abundance. In addition, food that reaches the consumer level generally cannot be recovered unless it is nonperishable and remains in sealed packaging. Finally, not all food meets standards of quality or social acceptability for human consumption. The Environmental Protection Agency Food Recovery Hierarchy indicates three uses for such food that are superior to landfilling: feeding animals, industrial uses, and composting.[22] Regarding food items that may be perceived as lesser value—such as misshapen or damaged produce, socially undesirable food products, food in damaged packaging, and food that is older but still safe—consuming these foods and purchasing them at discount prices may become more normalized as food waste interventions spread, thereby reducing stigma and increasing use of such foods across the population. Efforts to enhance food recovery should incorporate ethical considerations regarding cultural preferences and foodways, measures of perceived and objective quality, and product diversity.

These findings demonstrate that even if only an additional 1.75% of wasted food were recovered for human consumption (based on ReFED's estimate), substantial nutritional value would be made available. According to ReFED, the three most cost-effective measures for increasing food recovery are donation tax incentives, standardized donation regulations (eg, local and state food safety laws), and improved donation matching software.[23] The nature of these measures suggests that improved recovery requires multifaceted efforts from government and industry stakeholders.

Although recovering surplus food plays an essential mitigation role by filling nutrition gaps while diverting food from landfills, it does not address the root causes of food insecurity, malnutrition, or wasted food. To address food insecurity, it would be preferable to reduce the need for food donations in the first place. To address underconsumption of key nutrients, food recovery may improve affordability, but demand creation remains a critical gap. From a food waste perspective, a more preferable way of reducing the resource loss inherent in waste is to work toward matching production to consumer demand and minimizing surplus and waste in the first place, rather than finding alternate uses for wasted food.

Comparison to Similar Studies

The estimate of 1,217 kcal wasted per capita per day in 2012 from this analysis differed by only 3% from the estimate by Buzby and colleagues[1] of 1,249 kcal per capita per day in 2010. This discrepancy is likely due to food supply changes and minor methodologic differences; for example, Buzby and colleagues[1] calculated caloric value by using food pattern equivalents (previously known as servings), whereas this analysis used weight. A side-by-side comparison of caloric value by food group from both studies is presented in Table 13 (available online at www.jandonline.org).

Two additional studies did not limit their analyses to the retail and consumer levels, but included the entire food supply chain. The estimate of calories wasted per capita per day from this analysis was 15% lower than the estimate from Hall and colleagues[2] (1,400 kcal), which is to be expected due to this different scope plus major methodologic differences. Love and colleagues[15] provided low and high estimates of the per capita per day caloric value of wasted seafood (9.6 to 11.2 kcal [calculation by the authors]), which is 37% to 60% higher than the estimate of 7 kcal from the seafood group from this analysis. Love and colleagues[15] also estimated protein losses in seafood waste at 1.8 to 1.9 g per capita per day (calculation by the authors), which is 31% to 37% higher than the estimate of 1.4 g per capita per day from the seafood group from our analysis. The difference may be because Love and colleagues[15] included the full seafood supply chain and used multiple data sources specifically intended to avoid underestimation of seafood loss.

Limitations and Strengths

This analysis is subject to the limitations of its primary data sources. Limitations in the LAFA data series include underlying loss assumptions that may not be sensitive to changes across time (eg, changes in food processing methods may change the amount of food discarded).[18] In addition, the LAFA data from 2012 do not include more recent estimates of wholesale and retail loss indicating that fresh fruit and vegetable losses may be 4.3% and 1% higher, respectively.[34]

In addition to limitations in the underlying food loss data, there are challenges specific to estimating nutrient loss. Nutrient composition varies within and across food categories, and across cultivars; this analysis was based on 290 SR-28 food codes representing 213 commodity food groups, and was thus unable to capture all foods and cultivars. The selected SR-28 codes generally corresponded to raw foods (eg, raw beans instead of cooked beans), although the actual nutritional value of wasted food may differ according to its state at the time of discard. Another challenge is that food may lose nutritional value as it deteriorates.[35] Some food waste recovery efforts may involve collecting food that has become less fresh, particularly when the intent is to process the food. That said, food that is wasted is not necessarily inferior; for example, apples with scabs—which may be more likely to be discarded due to aesthetic standards, or to not be harvested at all—may have higher levels of phenolic compounds.[36] In addition, this analysis did not differentiate between nutrition content of food recovered directly from farms (likely to consist primarily of fruits and vegetables) and food recovered from nonfarm donations (likely to consist of additional food groups). For context, it has been estimated that 27% of recovered food comes from farms.[23]

A limitation of the calculations based on the ReFED analysis is that the ReFED estimates of food recovery potential were based on the entire supply chain, which poses a challenge for comparing the results to estimates of nutrient loss at the retail and consumer levels only. It should be emphasized that these estimates are for illustrative purposes and are not exact projections of the potential for food recovery and its influence on nutrition.

A key strength of this research is that it presents the first estimate of the loss of a comprehensive set of nutrients across commodities that represent the US food supply. This analysis allows for a nuanced view of nutrient loss, including proportions of loss by food group and by supply chain level. In addition, the research is built on the USDA's most current estimates of food losses at the retail and consumer levels, which allow for the exclusion of inedible components of food. The codebook was developed based on similar research efforts, for improved comparability to previous studies.[1,28] The findings demonstrate consistency with similar studies, with an estimate of caloric waste within 3% of the estimate Buzby and colleagues[1] reached using similar methods. This study also placed nutrient loss within the context of underconsumed nutrients and nutrients of public health concern. Researchers have called for better national-level metrics of nutrient quality as a dimension of food security, and this study has broad significance as a demonstration of how the magnitude of nutrient loss can be calculated at a national level.[37]

CONCLUSIONS

This study is the first to demonstrate the substantial amount of nutrients, including many underconsumed nutrients, wasted due to food discarded at the retail and consumer levels of the US food supply. Although only a portion of discarded food can realistically be made available for human consumption, efforts to redistribute surplus foods where appropriate and prevent food waste in the first place could increase the availability of nutrients for Americans while saving money and natural resources. The United States has established a target of halving food loss and waste by 2030. This research supports the case for action and for registered dietitian nutritionists bringing their expertise to the effort.

PRACTICE IMPLICATIONS

What Is the Current Knowledge on this Topic?

Although previous research has shown that that 31% to 40% of food in the United States is wasted before it reaches consumers and that this waste contains between 1,249 and 1,400 kcal per capita per day, little is known about the composition of other nutrients embedded in wasted food.

How Does the Current Research Add to Knowledge on this Topic?

Food wasted at the retail and consumer levels in the US food supply in 2012 contained 1,217 kcal, 33 g protein, 5.9 g dietary fiber, 1.7 μg vitamin D, 286 mg calcium, and 880 mg potassium per capita per day. Many nutrients that are currently consumed below recommended levels are wasted in substantial amounts.

How Might this Knowledge Influence Current Dietetics Practice?

Educational messages about shopping, food preparation, food storage, and portion sizes can incorporate strategies to reduce food waste. For example, recommendations to consume fruits and vegetables can include frozen and canned foods, which are less perishable than fresh produce. Reducing food waste benefits consumers by reducing food costs and minimizing the loss of important nutrients.

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For more information on the subject discussed in this article, see the Sites in Review in this month's New in Review section.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a]

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Dairy (34 commodities)			
Plain whole milk	01077	Milk, whole, 3.25% milkfat, with added vitamin D	1
Plain 2% milk	01079	Milk, reduced fat, fluid, 2% milkfat, with added vitamin A and vitamin D	1
Plain 1% milk	01082	Milk, low-fat, fluid, 1% milkfat, with added vitamin A and vitamin D	1
Skim milk	01085	Milk, nonfat, fluid, with added vitamin A and vitamin D (fat free or skim)	1
Whole flavored milk	01102	Milk, chocolate, fluid, commercial, whole, with added vitamin A and vitamin D	1
Low-fat flavored milk, code 1	01103	Milk, chocolate, fluid, commercial, reduced fat, with added vitamin A and vitamin D	1
Low-fat flavored milk, code 2	01104	Milk, chocolate, low-fat, with added vitamin A and vitamin D	1
Buttermilk	01088	Milk, buttermilk, fluid, cultured, low fat	1
Refrigerated yogurt, code 1	01116	Yogurt, plain, whole milk, 8 g protein per 8 oz	1
Refrigerated yogurt, code 2	01118	Yogurt, plain, skim milk, 13 g protein per 8 oz	1
Cheddar cheese	01009	Cheese, Cheddar	1
Other American cheese, code 1	01011	Cheese, Colby	1
Other American cheese, code 2	01025	Cheese, Monterey	1
Provolone cheese	01035	Cheese, provolone	1
Romano cheese	01038	Cheese, Romano	1
Parmesan cheese	01032	Cheese, Parmesan, grated	1
Mozzarella cheese, code 1	01026	Cheese, mozzarella, whole milk	1
Mozzarella cheese, code 2	01027	Cheese, mozzarella, whole milk, low moisture	1
Mozzarella cheese, code 3	01028	Cheese, mozzarella, part-skim milk	1
Mozzarella cheese, code 4	01029	Cheese, mozzarella, low moisture, part-skim	1
Ricotta cheese, code 1	01036	Cheese, ricotta, whole milk	1
Ricotta cheese, code 2	01037	Cheese, ricotta, part-skim milk	1
Other Italian cheese, code 1	01035	Cheese, provolone	1
Other Italian cheese, code 2	01038	Cheese, Romano	1
Other Italian cheese, code 3	01032	Cheese, parmesan, grated	1
Other Italian cheese, code 4	01026	Cheese, mozzarella, whole milk	1
Other Italian cheese, code 5	01027	Cheese, mozzarella, whole milk, low moisture	1
Other Italian cheese, code 6	01028	Cheese, mozzarella, part skim milk	1
Other Italian cheese, code 7	01029	Cheese, mozzarella, low moisture, part-skim	1
Other Italian cheese, code 8	01036	Cheese, ricotta, whole milk	1
Other Italian cheese, code 9	01037	Cheese, ricotta, part-skim milk	1
Swiss cheese	01040	Cheese, Swiss	1
Brick cheese	01005	Cheese, brick	1
Muenster cheese	01030	Cheese, Muenster	1
Blue cheese	01004	Cheese, blue	1

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a] (*continued*)

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Other miscellaneous cheese, code 1	01040	Cheese, Swiss	1
Other miscellaneous cheese, code 2	01005	Cheese, brick	1
Other miscellaneous cheese, code 3	01030	Cheese, Muenster	1
Other miscellaneous cheese, code 4	01004	Cheese, blue	1
Regular cottage cheese	01015	Cheese, cottage, low-fat, 2% milkfat	1
Low-fat cottage cheese	01016	Cheese, cottage, low-fat, 1% milkfat	1
Regular ice cream	19095	Ice creams, vanilla	1
Low-fat ice cream (ice milk)	19088	Ice creams, vanilla, light	1
Frozen yogurt and other miscellaneous frozen products	19293	Frozen yogurt, vanilla, soft-serve	1
Evaporated and condensed canned whole milk	01096	Milk, canned, evaporated, with added vitamin D and without added vitamin A	1
Evaporated and condensed bulk whole milk	01096	Milk, canned, evaporated, with added vitamin D and without added vitamin A	1
Evaporated and condensed bulk and canned skim milk	01097	Milk, canned, evaporated, nonfat, with added vitamin A and vitamin D	1
Dry whole milk	01090	Milk, dry, whole, with added vitamin D	1
Nonfat dry milk	01091	Milk, dry, nonfat, regular, without added vitamin A and vitamin D	1
Dry buttermilk	01094	Milk, buttermilk, dried	1
Dairy share of half and half[c]	01049	Cream, fluid, half and half	1
Dairy share of eggnog	01057	Eggnog	1
Fat (13 commodities)			
Butter, code 1	01001	Butter, salted	3
Butter, code 2	01145	Butter, without salt	3
Margarine, code 1[c]	04610	Margarine, regular, 80% fat, composite, stick, with salt	3
Margarine, code 2[c]	04618	Margarine, regular, 80% fat, composite, tub, without salt	3
Lard[c]	04002	Lard	3
Edible beef tallow[c]	04001	Fat, beef tallow	3
Shortening[c]	04544	Shortening, household, lard and vegetable oil	3
Salad and cooking oils[c]	4044	Oil, soybean, salad or cooking	3
Other edible fats and oils, code 1[c]	01001	Butter, salted	3
Other edible fats and oils, code 2[c]	01145	Butter, without salt	3
Other edible fats and oils, code 3[c]	04610	Margarine, regular, 80% fat, composite, stick, with salt	3
Other edible fats and oils, code 4[c]	04618	Margarine, regular, 80% fat, composite, tub, without salt	3
Other edible fats and oils, code 5[c]	04002	Lard	3
Other edible fats and oils, code 6[c]	04001	Fat, beef tallow	3
Other edible fats and oils, code 7[c]	04544	Shortening, household, lard and vegetable oil	3
Other edible fats and oils, code 8[c]	04044	Oil, soybean, salad or cooking	3
Fat share of half and half[c]	01049	Cream, fluid, half and half	1
Light cream	01050	Cream, fluid, light (coffee cream or table cream)	1

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a] (*continued*)

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Heavy cream[c]	01053	Cream, fluid, heavy whipping	1
Sour cream, code 1	01055	Cream, sour, reduced fat, cultured	1
Sour cream, code 2	01056	Cream, sour, cultured	1
Cream cheese, code 1	01031	Cheese, neufchatel	4
Cream cheese, code 2	01017	Cheese, cream	4
Fat share of eggnog	01057	Eggnog	1
Fruits (62 commodities)			
Fresh oranges	09200	Oranges, raw, all commercial varieties	1
Fresh tangerines	09218	Tangerines (mandarin), raw	1
Fresh grapefruit	09111	Grapefruit, raw, pink and red and white, all areas	1
Fresh lemons	09150	Lemons, raw, without peel	1
Fresh limes	09159	Limes, raw	1
Fresh apples	09003	Apples, raw, with skin	1
Fresh apricots	09021	Apricots, raw	1
Fresh avocados	09037	Avocados, raw, all commercial varieties	1
Fresh bananas	09040	Bananas, raw	1
Fresh blueberries	09050	Blueberries, raw	2
Fresh cantaloupe	09181	Melons, cantaloupe, raw	1
Fresh cherries	09070	Cherries, sweet, raw	1
Fresh cranberries	09078	Cranberries, raw	1
Fresh grapes	09131	Grapes, American type (slip skin), raw	1
Fresh honeydew	09184	Melons, honeydew, raw	1
Fresh kiwifruit	09148	Kiwifruit, green, raw	2
Fresh mangoes	09176	Mangoes, raw	1
Fresh papaya	09226	Papayas, raw	1
Fresh peaches	09236	Peaches, raw	4
Fresh pears	09252	Pears, raw	1
Fresh pineapple	09266	Pineapple, raw, all varieties	1
Fresh plums	09279	Plums, raw	1
Fresh raspberries	09302	Raspberries, raw	2
Fresh strawberries	09316	Strawberries, raw	1
Fresh watermelon	09326	Watermelon, raw	1
Canned apples and applesauce	09019	Applesauce, canned, unsweetened, without added ascorbic acid (includes US Department of Agriculture commodity)	2
Canned apricots	09023	Apricots, canned, water pack, without skin, solids and liquids	4
Canned sweet cherries	09071	Cherries, sweet, canned, water pack, solids and liquids	1
Canned tart cherries	09064	Cherries, sour, red, canned, water pack, solids and liquids (includes US Department of Agriculture commodity red tart cherries, canned)	1
Canned peaches	09237	Peaches, canned, water pack, solids and liquids	2
Canned pears	09253	Pears, canned, water pack, solids and liquids	1

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a] (*continued*)

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Canned pineapple	09267	Pineapple, canned, water pack, solids and liquids	1
Canned plums	09281	Plums, canned, purple, water pack, solids and liquids	1
Canned olives	09193	Olives, ripe, canned (small through extra large)	2
Frozen blackberries	09048	Blackberries, frozen, unsweetened	1
Frozen blueberries	09054	Blueberries, frozen, unsweetened	1
Frozen raspberries	09518	Raspberries, frozen, unsweetened	4
Frozen strawberries	09318	Strawberries, frozen, unsweetened	1
Frozen other berries	09048	Blackberries, frozen, unsweetened	2
Frozen apples	09014	Apples, frozen, unsweetened, unheated	1
Frozen apricots	09035	Apricots, frozen, sweetened	4
Frozen sweet cherries	09076	Cherries, sweet, frozen, sweetened	2
Frozen tart cherries	09068	Cherries, sour, red, frozen, unsweetened	1
Frozen peaches	09250	Peaches, frozen, sliced, sweetened	4
Frozen plums and prunes	09014	Apples, frozen, unsweetened, unheated	1
Dried apples	09011	Apples, dried, sulfured, uncooked	1
Dried apricots	09032	Apricots, dried, sulfured, uncooked	1
Dried dates	09087	Dates, deglet noor	1
Dried figs	09094	Figs, dried, uncooked	1
Dried peaches	09246	Peaches, dried, sulfured, uncooked	1
Dried pears	09259	Pears, dried, sulfured, uncooked	1
Dried plums	09291	Plums, dried (prunes), uncooked	1
Raisins	09298	Raisins, seedless	1
Grapefruit juice	09112	Grapefruit juice, raw, pink and red, all areas	4
Lemon juice	09152	Lemon juice, raw	2
Lime juice	09160	Lime juice, raw	2
Orange juice	09206	Orange juice, raw	4
Apple juice	09016	Apple juice, canned or bottled, unsweetened, without added ascorbic acid	1
Cranberry juice	43382	Cranberry juice, unsweetened	2
Grape juice	09135	Grape juice, canned or bottled, unsweetened, without added ascorbic acid	1
Pineapple juice	09273	Pineapple juice, canned or bottled, unsweetened, without added ascorbic acid	1
Prune juice	09294	Prune juice, canned	1
Grains (8 commodities)			
Wheat flour	20081	Wheat flour, white, all-purpose, enriched, bleached	2
Rice, code 1[c]	20044	Rice, white, long-grain, regular, raw, enriched	1
Rice, code 2[c]	20050	Rice, white, medium-grain, raw, enriched	1
Rice, code 3[c]	20052	Rice, white, short-grain, enriched, uncooked	1
Rye flour	20064	Rye flour, medium	1
Corn flour and meal, code 1	20022	Cornmeal, degermed, enriched, yellow	1

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a] (*continued*)

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Corn flour and meal, code 2	20016	Corn flour, whole-grain, yellow	1
Corn flour and meal, code 3	20017	Corn flour, masa, enriched, white	1
Corn flour and meal, code 4	20018	Corn flour, yellow, degermed, unenriched	1
Corn flour and meal, code 5	20020	Cornmeal, whole-grain, yellow	1
Corn hominy and grits	08159	Cereals, corn grits, yellow, regular and quick, enriched, dry	1
Corn starch	20027	Cornstarch	1
Barley products	20005	Barley, pearled, raw	1
Oat products	08120	Cereals, oats, regular and quick, not fortified, dry	1
Meat (24 commodities)			
Beef	13796	Beef, composite of trimmed retail cuts, separable lean and fat, trimmed to 1/8-in fat, all grades, cooked	2
Veal	17089	Veal, composite of trimmed retail cuts, separable lean and fat, cooked	1
Pork	10188	Pork, fresh, composite of trimmed retail cuts (leg, loin, shoulder, and spareribs), separable lean and fat, cooked	1
Lamb	17002	Lamb, domestic, composite of trimmed retail cuts, separable lean and fat, trimmed to 1/4-in fat, choice, cooked	1
Chicken	05004	Chicken, broilers or fryers, meat and skin and giblets and neck, roasted	1
Turkey	05166	Turkey, whole, meat and skin, cooked, roasted	2
Fresh and frozen fish, code 1	15008	Fish, carp, raw	4
Fresh and frozen fish, code 2	15016	Fish, cod, Atlantic, cooked, dry heat	1
Fresh and frozen fish, code 3	15029	Fish, flatfish (flounder and sole species), cooked, dry heat	1
Fresh and frozen fish, code 4	15032	Fish, grouper, mixed species, cooked, dry heat	1
Fresh and frozen fish, code 5	15034	Fish, haddock, cooked, dry heat	1
Fresh and frozen fish, code 6	15037	Fish, halibut, Atlantic and Pacific, cooked, dry heat	1
Fresh and frozen fish, code 7	15060	Fish, perch, mixed species, raw	4
Fresh and frozen fish, code 8	15062	Fish, pike, northern, raw	4
Fresh and frozen fish, code 9	15067	Fish, pollock, Alaska, cooked, dry heat (may have been previously frozen)	1
Fresh and frozen fish, code 10	15086	Fish, salmon, Sockeye, cooked, dry heat	1
Fresh and frozen fish, code 11	15091	Fish, sea bass, mixed species, raw	4
Fresh and frozen fish, code 12	15101	Fish, snapper, mixed species, raw	4
Fresh and frozen fish, code 13	15241	Fish, trout, rainbow, farmed, cooked, dry heat	4
Fresh and frozen fish, code 14	15118	Fish, tuna, fresh, bluefin, cooked, dry heat	4
Fresh and frozen fish, code 15	15133	Fish, whiting, mixed species, cooked, dry heat	1
Fresh and frozen shellfish	15146	Crustaceans, crayfish, mixed species, wild, cooked, moist heat	4
Canned salmon	15260	Fish, salmon, pink, canned, drained solids	4
Canned sardines, code 1	15088	Fish, sardine, Atlantic, canned in oil, drained solids with bone	4
Canned sardines, code 2	15089	Fish, sardine, Pacific, canned in tomato sauce, drained solids with bone	4

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a] (*continued*)

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Canned tuna	15121	Fish, tuna, light, canned in water, drained solids	4
Canned shellfish	15152	Crustaceans, shrimp, mixed species, canned	4
Other canned fish	15017	Fish, cod, Atlantic, canned, solids and liquid	1
Cured fish	15077	Fish, salmon, Chinook, smoked	4
Eggs	01129	Egg, whole, cooked, hard-boiled	1
Peanuts	16087	Peanuts, all types, raw	1
Almonds	12061	Nuts, almonds	1
Hazelnuts (filberts)	12120	Nuts, hazelnuts or filberts	1
Pecans	12142	Nuts, pecans	1
Walnuts	12155	Nuts, walnuts, english	1
Macademia nuts	12131	Nuts, macadamia nuts, raw	1
Pistachio nuts	12151	Nuts, pistachio nuts, raw	1
Other tree nuts, code 1	12078	Nuts, brazilnuts, dried, unblanched	1
Other tree nuts, code 2	12147	Nuts, pine nuts, dried	1
Other tree nuts, code 3	12085	Nuts, cashew nuts, dry roasted, without salt added	1
Coconut	12108	Nuts, coconut meat, dried (desiccated), not sweetened	1
Sugar (6 commodities)			
Cane and beet sugar	19335	Sugars, granulated	3
High fructose corn sweetener	19351	Syrups, corn, high-fructose	3
Glucose	19335	Sugars, granulated	3
Dextrose	19335	Sugars, granulated	3
Honey	19296	Honey	3
Edible syrups, code 1	19355	Syrups, sorghum	3
Edible syrups, code 2	19353	Syrups, maple	3
Edible syrups, code 3	19304	Molasses	3
Edible syrups, code 4	19362	Syrups, table blends, corn, refiner, and sugar	3
Vegetables (66 commodities)			
Fresh artichokes	11007	Artichokes, (globe or french), raw	2
Fresh asparagus	11011	Asparagus, cooked, raw	2
Fresh bell peppers	11333	Peppers, sweet, green, raw	1
Fresh broccoli	11090	Broccoli, raw	1
Fresh Brussels sprouts	11098	Brussels sprouts, raw	2
Fresh cabbage	11109	Cabbage, raw	1
Fresh carrots	11124	Carrots, raw	1
Fresh cauliflower	11135	Cauliflower, raw	1
Fresh celery	11143	Celery, raw	1
Fresh collard greens	11161	Collards, raw	2
Fresh sweet corn	11167	Corn, sweet, yellow, raw	2
Fresh cucumbers	11206	Cucumber, peeled, raw	1
Fresh eggplant	11209	Eggplant, raw	2

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a] (*continued*)

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Fresh escarole and endive	11213	Endive, raw	1
Fresh garlic	11215	Garlic, raw	1
Fresh kale	11223	Kale, raw	4
Fresh head lettuce, code 1	11252	Lettuce, iceberg (includes crisphead types), raw	1
Fresh head lettuce, code 2	11250	Lettuce, butterhead (includes Boston and bibb types), raw	1
Fresh Romaine and leaf lettuce, code 1	11251	Lettuce, cos or romaine, raw	1
Fresh Romaine and leaf lettuce, code 2	11253	Lettuce, green leaf, raw	1
Fresh lima beans	11031	Lima beans, immature seeds, raw	2
Fresh mushrooms	11260	Mushrooms, white, raw	1
Fresh mustard greens	11270	Mustard greens, raw	2
Fresh okra	11278	Okra, raw	2
Fresh onions	11282	Onions, raw	2
Fresh potatoes, code 1	11363	Potatoes, baked, flesh, without salt	1
Fresh potatoes, code 2	11367	Potatoes, boiled, cooked without skin, flesh, without salt	1
Fresh pumpkin	11422	Pumpkin, raw	1
Fresh radishes	11429	Radishes, raw	1
Fresh snap beans	11052	Beans, snap, green, raw	2
Fresh spinach	11457	Spinach, raw	1
Fresh squash	11641	Squash, summer, all varieties, raw	2
Fresh sweet potatoes	11507	Sweet potato, raw, unprepared	4
Fresh tomatoes	11529	Tomatoes, red, ripe, raw, year-round average	1
Fresh turnip greens	11568	Turnip greens, raw	2
Canned asparagus	11015	Asparagus, canned, drained solids	1
Canned snap beans	11056	Beans, snap, green, canned, regular pack, drained solids	1
Canned cabbage (sauerkraut)	11439	Sauerkraut, canned, solids and liquids	1
Canned carrots	11128	Carrots, canned, regular pack, drained solids	1
Canned sweet corn	11172	Corn, sweet, yellow, canned, whole kernel, drained solids	1
Canned cucumbers (pickles), code 1	11941	Pickles, cucumber, sour	1
Canned cucumbers (pickles), code 2	11940	Pickles, cucumber, sweet (includes bread and butter pickles)	1
Canned green peas	11308	Peas, green (includes baby and Le Suer types), canned, drained solids, unprepared	1
Canned mushrooms	11264	Mushrooms, canned, drained solids	1
Canned chile peppers	11329	Peppers, hot chili, green, canned, pods, excluding seeds, solids and liquids	1
Canned potatoes	43311	Potatoes, canned, drained solids, no salt added	4
Canned tomatoes	11531	Tomatoes, red, ripe, canned, packed in tomato juice	2
Other canned vegetables, code 1	11084	Beets, canned, drained solids	1
Other canned vegetables, code 2	11461	Spinach, canned, regular pack, drained solids	1

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a] (*continued*)

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Frozen asparagus	11019	Asparagus, frozen, cooked, boiled, drained, without salt	2
Frozen snap beans	11061	Beans, snap, green, frozen, cooked, boiled, drained without salt	1
Frozen broccoli	11093	Broccoli, frozen, chopped, cooked, boiled, drained, without salt	1
Frozen carrots	11131	Carrots, frozen, cooked, boiled, drained, without salt	1
Frozen cauliflower	11138	Cauliflower, frozen, cooked, boiled, drained, without salt	1
Frozen sweet corn	11179	Corn, sweet, yellow, frozen, kernels cut off cob, boiled, drained, without salt	1
Frozen green peas	11313	Peas, green, frozen, cooked, boiled, drained, without salt	1
Frozen lima beans	11040	Lima beans, immature seeds, frozen, baby, cooked, boiled, drained, without salt	2
Frozen potatoes	11400	Potatoes, frozen, whole, unprepared	2
Frozen spinach	11464	Spinach, frozen, chopped or leaf, cooked, boiled, drained, without salt	2
Miscellaneous frozen vegetables, code 1	11038	Lima beans, immature seeds, frozen, Fordhook, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 2	11164	Collards, frozen, chopped, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 3	11196	Cowpeas (blackeyes), immature seeds, frozen, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 4	11273	Mustard greens, frozen, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 5	11281	Okra, frozen, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 6	11464	Spinach, frozen, chopped or leaf, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 7	11474	Squash, summer, crookneck and straightneck, frozen, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 8	11567	Turnips, frozen, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 9	11575	Turnip greens, frozen, cooked, boiled, drained, without salt	1
Miscellaneous frozen vegetables, code 10	11791	Kale, frozen, cooked, boiled, drained, with salt	1
Miscellaneous frozen vegetables, code 11	11486	Squash, winter, butternut, cooked, baked, without salt	4
Dehydrated onions	11284	Onions, dehydrated flakes	1
Dehydrated potatoes	11378	Potatoes, mashed, dehydrated, flakes without milk, dry form	1
Potato chips and shoestring potatoes	19410	Snack, potato chips, made from dried potatoes, plain	1
Dry peas and lentils, code 1	16070	Lentils, mature seeds, cooked, boiled, without salt	1
Dry peas and lentils, code 2	16086	Peas, split, mature seeds, cooked, boiled, without salt	1
Dry black beans	16015	Beans, black, mature seeds, cooked, boiled, without salt	1
Dry great northern beans	16326	Beans, great northern, mature seeds, canned, low sodium	4

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Table 1. Codebook for commodities in the Loss-Adjusted Food Availability (LAFA) data series and National Nutrient Database for Standard Reference, Release 28 (SR-28)[a] (*continued*)

Commodity, as it appears in the LAFA data series	SR-28 Code	Description of SR-28 Code	Source[b]
Dry lima beans	16072	Lima beans, large, mature seeds, cooked, boiled, without salt	1
Dry navy beans	16038	Beans, navy, mature seeds, cooked, boiled, without salt	2
Dry pinto beans	16043	Beans, pinto, mature seeds, cooked, boiled, without salt	1
Dry red kidney beans	16033	Beans, kidney, red, mature seeds, cooked, boiled, without salt	1
Other dry beans, code 1	16041	Beans, pink, mature seeds, cooked, boiled, without salt	1
Other dry beans, code 2	16050	Beans, white, mature seeds, cooked, boiled without salt	1
Other dry beans, code 3	16057	Chickpeas (garbanzo beans, bengal gram), mature seeds, cooked, boiled, without salt	1
Other dry beans, code 4	11040	Lima beans, immature seeds, frozen, baby, cooked, boiled, drained, without salt	1
Other dry beans, code 5	11192	Cowpeas (blackeyes), immature seeds, cooked, boiled, drained, without salt	1

[a]The table contains the codebook that matches the commodities identified in the LAFA data series to food items in SR-28. The LAFA data series contains estimates of retail and consumer level loss for 213 commodities The LAFA data series contains 215 commodities. This study uses the data from 213 commodities, because two of the commodities (1. white and whole wheat flour and 2. durum flour) duplicate the values contained in the commodity "wheat flour."

[b]This column identifies the following methods of selecting codes:

1. This SR-28 code matches the code used by Kantor.[28]
2. This SR-28 code matches the code used by Buzby and colleagues[1] because Kantor[28] did not contain a code for this commodity, or contained a code that was not the closest match to the LAFA commodity, or contained a code that was no longer available in SR-28.
3. This SR-28 code was selected by the authors as the closest match to the LAFA commodity because Kantor[28] and Buzby and colleagues[1] did not contain a code for this commodity.
4. This SR-28 code was selected by the authors as the closest match to the LAFA commodity, even though Kantor[28] or Buzby and colleagues[1] used a different code for this commodity. Reasons for selecting a code that differed from Kantor[28] or Buzby and colleagues[1] included preferences for certain characteristics such as raw or cooked commodities, or the availability of codes with more comprehensive information on nutrient composition.

When calculations from Kantor[28] or Buzby and colleagues[1] did not contain a code for a commodity, or when that code was not the closest match to the LAFA commodity, the authors used the following general preferences:

- Vegetables: Raw options were selected whenever possible, under the assumption that most discarded food at the retail and consumer levels (more so at the retail level) is likely to be raw.
- Fruit: Unsweetened options were selected whenever possible. As such, the nutrient totals are likely to underestimate the loss of sugar and carbohydrates.
- Fish: Kantor[28] and Buzby and colleagues[1] used SR-28 codes for cooked fish. In this study, SR-28 codes for cooked fish were used, except when the codes for cooked fish did not contain comprehensive information on nutrient composition; in these cases, when the codes for raw fish contained more comprehensive information, the codes for raw fish were used.

[c]The most recent data were from before 2012. In most of these cases, the most recent data were from 2010.

Table 2. Example calculation of nutrient loss for estimating the amount of per capita per day nutrient loss of 213 commodities at the retail and consumer levels of the US food supply in 2012

An example calculation for one nutrient (in this case, protein) for one food (in this case, eggs):

Step 1: How much protein is contained in a standardized unit of egg?

According to the National Nutrient Database for Standard Reference — Release 28 (SR-28; US Department of Agriculture, Agricultural Research Service Nutrient Data Laboratory), for the code 01129 (which refers to "Egg, whole, cooked, hard-boiled"), 100 g egg contains 12.58 g protein.

Step 2: How much egg is lost at the retail and consumer levels?

The Loss-Adjusted Food Availability (LAFA) data series[18] provides the following information about eggs:

						Loss at consumer level			
Year	Primary weight (lb/y)	Loss from primary to retail weight (%)	Retail weight (lb/y)	Loss from retail/ institutional to consumer level (%)	Consumer weight (lb/y)	Nonedible share (%)	Other (cooking loss and uneaten food) (%)	Total loss, all levels (%)	Per capita availability adjusted for loss (lb/y)
2012	32.6	1.5	32.2	9.0	29.3	12.0	23.0	41.7	19.0

The above table provides the percentage of weight that is lost from one stage to the next, but it does not isolate the amount that is lost at any particular stage. In other words, the table shows how much weight is lost from the primary to the retail level, but it does not show how much of the total loss is due to loss at the retail level only.

The stages that are of interest to this study are:

- The loss that occurs from the retail to the consumer level, and
- The loss that occurs at the consumer level from cooking loss and uneaten food, referred to here as "edible consumer loss."

When combined, the loss at these two stages comprises the "retail- and consumer-level loss" that is the subject of the study's main research question.

The stages that do not need to be included for this study are:

- The loss that occurs from the primary to the retail level. This data was not used in the analysis by Buzby and colleagues[1] because the data were not consistently available for all 213 commodities, and
- The loss that occurs at the consumer level from the non-edible portion. This loss does not reflect preventable food waste and is therefore not relevant to the research question. Note that the US Department of Agriculture conceptualizes all loss from nonedible portions as occurring at the consumer level.

Using the information from the LAFA data series, the following calculations were used to isolate the loss from the retail to the consumer level and the loss at the edible consumer level. In the following example calculations, all numbers that come directly from the LAFA data series are in boldface type; all other numbers are the result of calculations performed by the authors.

According to the 2012 LAFA data series, the primary weight per capita of egg was 32.65 lb/y, before accounting for any food loss.

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Table 2. Example calculation of nutrient loss for estimating the amount of per capita per day nutrient loss of 213 commodities at the retail and consumer levels of the US food supply in 2012 (*continued*)

From the primary (ie, producer or farm) level to retail level, 1.5% of these 32.65 lb were lost, leaving 32.16 lb:

$$\begin{aligned}\textbf{\textit{A}}.\ \textit{Per capita availability, adjusted for loss at the primarylevel} &= \textit{Primary weight per capita (lbs)} \times (1 - \%\ \textit{loss at the primary level})\\ &= 32.65\ \text{lb} \times (1 - 1.5\%)\\ &= \textit{32.16 lb available}\end{aligned}$$

→ Taking the difference between the primary weight and A isolates the amount of loss from the primary level to the retail level only:

$$\begin{aligned}\textit{Loss from the primary level to the retail level} &= \textit{Primary weight per capita (lb)} - \textit{Per capita availability, adjusted for loss at the primary level}\\ &= 32.65\ \textit{lb} - 32.16\ \textit{lb}\\ &= \textit{0.49 lb lost from primary to retail level}\end{aligned}$$

From the retail to the consumer level, 9% of the 32.16 lb were lost, leaving 29.26 lb:

$$\begin{aligned}\textbf{\textit{B}}.\ \textit{Per capita availability, adjusted for loss at the primary and retail levels} &= \textit{Primary weight per capita (lb)} \times\\ &\quad (1 - \%\ \textit{loss at the primary level}) \times\\ &\quad (1 - \%\ \text{loss at the retail level})\\ &= 32.65\ \textit{lb} \times (1 - 1.5\%) \times (1 - 9\%)\\ &= \textit{29.26 lb available}\end{aligned}$$

→ Taking the difference between A and B isolates the amount of loss from the retail level to the consumer level:

$$\begin{aligned}\textit{Loss from the retail level to the consumer level} &= \textit{Per capita availability, adjusted for loss at the primary level} - \textit{Per capita availability, adjusted for loss at}\\ &\quad \textit{the primary \& retail levels}\\ &= 32.16\ \textit{lb} - 29.26\ \textit{lb}\\ &= \textit{2.9 lb lost from retail to consumer level}\end{aligned}$$

At the consumer level, a total of 35% was lost (35% is the sum of 12% and 23%):

$$\begin{aligned}\textbf{\textit{C}}.\ \textit{Per capita availability, adjusted for loss at the primary, retail, and consumer levels (nonedible \& edible)} &= \textit{Primary weight per capita (lb)} \times\\ &\quad (1 - \%\ \textit{loss at the primary level}) \times\\ &\quad (1 - \%\ \textit{loss at the retail level}) \times\\ &\quad (1 - \%\ \textit{loss at consumer level,}\\ &\quad \textit{nonedible and edible})\\ &= 32.65\ \text{lb} \times (1 - 1.5\%) \times (1 - 9\%) \times (1 - 35\%)\\ &= \textit{19.02 lb available}\end{aligned}$$

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Table 2. Example calculation of nutrient loss for estimating the amount of per capita per day nutrient loss of 213 commodities at the retail and consumer levels of the US food supply in 2012 (*continued*)

→Taking the difference between B and C isolates the amount of loss at the consumer level (nonedible and edible)

$$\begin{aligned} \textit{Loss at the consumer level (nonedible and edible)} &= \textit{Per capita availability, adjusted for loss at the primary and retail levels} - \\ &\quad \textit{Per capita availability, adjusted for loss at the primary, retail, and consumer levels} \\ &= 29.26\ lb - 19.02\ lb \\ &= 10.45\ \textit{lb lost at the consumer level} \end{aligned}$$

Of the 10.45 lb lost at the consumer level only, we separated the proportions of loss from the nonedible portion and edible portion, as shown below:

$$\begin{aligned} \textit{Consumer-level: nonedible loss} &= \textit{Loss at the consumer level (nonedible and edible)} \times [\%\ \textit{nonedible loss} \div (\%\ \text{nonedible loss} + \%\ \text{edible loss})] \\ &= 10.45\ lb \times [12\% \div (12\% + 23\%)] \\ &= 3.59\ \textit{lb lost as the nonedible portion of the consumer level} \end{aligned}$$

$$\begin{aligned} \textit{Consumer-level: edible loss} &= \textit{Loss at the consumer level (nonedible \& edible)} \times [\%\ \textit{edible loss} \div (\%\ \text{nonedible loss} + \%\ \text{edible loss})] \\ &= 10.45\ \text{lb} \times [23\% \div (12\% + 23\%)] \\ &= 6.87\ \textit{lb lost as the edible portion of the consumer level} \end{aligned}$$

The above calculations demonstrate that for every 32.65 lb eggs available per capita per year in the US food supply in 2012, there was a total of 10.45 lb of loss from all levels of the supply chain, leaving 19.02 pounds available. A summary of these calculations is shown in the table below.

	From the primary to the retail level	From the retail to the consumer level	At the consumer level
Starting weight	32.65 lb	32.16 lb	29.26 lb
Proportion of loss from one level to the next	1.5%	9%	35% (12% from nonedible, 23% from edible)
Pounds remaining available after this stage	32.16 lb	29.26 lb	19.02 lb
Pounds of loss during this stage	32.65 − 32.16 = 0.49 lb	32.16 − 29.26 = 2.9 lb	29.26 − 19.02 = 10.45 lb nonedible portion = 3.59 lb edible portion = 6.87 lbs

To finish Step 2, we took the sum of the loss from the retail to the consumer level (2.9 lb) and the edible portion of the consumer level loss (6.87 lb) to yield the total loss of egg at the retail and consumer (edible) levels: 9.62 lb per capita per year

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Table 2. Example calculation of nutrient loss for estimating the amount of per capita per day nutrient loss of 213 commodities at the retail and consumer levels of the US food supply in 2012 (*continued*)

Step 3: How much protein is contained in the amount of egg lost at the retail- and consumer-levels?

The 9.62 lb egg loss per capita per year calculated in Step 2 was first converted into grams:

$$\begin{aligned} \textit{Grams of egg loss at the retail and consumer (edible) levels, per capita per year} &= \textit{Pounds of egg loss at the retail and consumer (edible) levels} \times 453.592\ g/lb \\ &= 9.62\ lb \times 453.592\ g/lb \\ &= \textit{4365.69 g egg loss per capita per year} \end{aligned}$$

We then converted the number of grams of egg loss per capita per year into the number of 100-g units, so that it would be comparable to Step 1 (in which we calculated the number of grams of protein in a standardized 100-g unit of eggs):

$$\begin{aligned} \textit{Number of } 100\text{–}g \textit{ units of egg loss at the retail and consumer (edible) levels, per capita per year} &= \textit{Grams of egg loss at the retail and consumer (edible) levels} \div 100 \\ &= 4365.69\ g \div 100 \\ &= \textit{43.66 100–g units of egg loss per capita per year} \end{aligned}$$

If 43.66 100-g units of egg are lost at the retail- and consumer-levels per capita per year, and if a 100-gunit of egg contains 12.58 g protein, then there are 549.24 g protein embedded in the amount of egg lost at the retail and consumer levels, per capita per year:

$$\begin{aligned} \textit{Grams of protein embedded in the amount of egg loss at the retail and consumer (edible) levels, per capita per year} &= 100 - g \textit{ units of egg loss per capita per year} \times \\ &\qquad \textit{grams of protein per } 100\ g \textit{ egg} \\ &= 43.66\ 100g \textit{ units} \times 12.58\ g \textit{ protein per } 100\ g \textit{ egg} \\ &= \textit{549.24 g protein} \end{aligned}$$

Flow of work

Steps 1, 2, and 3 were performed for each of 213 commodities and for each of 27 nutrients. Amounts of loss were summed by nutrient to produce estimates of the amount of nutrients lost across all 213 commodities at the retail- and consumer-levels (edible portion only), per capita per year. Per capita per year estimates were divided by 365 to produce the per capita per day estimates that appear in Table 1 (available online at www.jandonline.org).

Table 4. Magnitude of daily per capita nutrient loss of 213 commodities in the US food supply in 2012: Percent contribution from retail-level and consumer-level loss[a]

Nutrient	Average daily per capita loss of nutrients at the retail and consumer levels	Contribution from Retail-Level Loss	Contribution from Consumer-Level Loss
		←n (%)	→
Energy, macronutrients, and fiber			
Energy (kcal)	1,216.5	457.6 (38)	758.9 (62)
Carbohydrates (g)	146.4	47.3 (32)	99.1 (68)
Protein (g)	32.8	8.5 (26)	24.3 (74)
Total Fat (g)	57.2	26.6 (47)	30.6 (53)
Saturated Fat (g)	18.1	7.5 (42)	10.6 (58)
Monounsaturated Fat (g)	18.6	8.1 (44)	10.5 (56)
Polyunsaturated Fat (g)	16.9	9.5 (56)	7.4 (44)
Cholesterol (mg)	137.7	36.8 (27)	100.9 (73)
Dietary Fiber (g)	5.9	2.0 (34)	3.9 (66)
Minerals			
Calcium (mg)	286.1	83.2 (29)	202.9 (71)
Iron (mg)	5.3	1.9 (34)	3.5 (66)
Magnesium (mg)	85.0	26.5 (31)	58.5 (69)
Phosphorus (mg)	450.3	126.9 (28)	323.4 (72)
Potassium (mg)	880.2	254.1 (29)	626.2 (71)
Sodium (mg)	264.2	70.9 (27)	193.3 (73)
Zinc (mg)	3.9	1.0 (25)	2.9 (75)
Vitamins			
Vitamin A[b] (μg)	308.3	86.3 (28)	222.0 (72)
Thiamin (mg)	0.9	0.3 (33)	0.6 (67)
Riboflavin (mg)	0.8	0.3 (32)	0.6 (68)
Niacin (mg)	9.0	2.6 (29)	6.4 (71)
Vitamin B-6 (mg)	0.6	0.2 (25)	0.5 (75)
Folate (μg)	268.5	98.8 (37)	169.7 (63)
Vitamin B12 (μ-g)	1.5	0.4 (24)	1.2 (76)
Vitamin C (mg)	35.4	11.1 (32)	24.2 (68)
Vitamin D (μg)	1.7	0.6 (32)	1.2 (68)
Vitamin E (mg)	3.6	1.7 (48)	1.9 (52)
Vitamin K (μg)	79.2	41.0 (52)	38.2 (48)

[a]Row percentages may not add up to 100 due to rounding.
[b]Retinal activity equivalents.

Table 5. Contribution of food groups to daily per capita nutrient loss in the US food supply in 2012: Energy, macronutrients, fats, cholesterol, and fiber[a]

Food group	Energy (kcal)	Carbohydrates (g)	Protein (g)	Total Fat (g)	Saturated Fat (g)	Monounsaturated Fat (g)	Polyunsaturated Fat (g)	Cholesterol (mg)	Dietary Fiber (g)
	←				n (%-)				→
Total	1,216.5	146.4	32.8	57.2	18.1	18.6	16.9	137.7	5.9
Grains	270.9[b] (22)[c]	57.4 (39)	6.8 (21)	0.9 (2)	0.2 (1)	0.2 (1)	0.4 (2)	0.0 (0)	2.3 (39)
Fruit	40.2 (3)	9.4 (6)	0.5 (2)	0.5 (1)	0.1 (0)	0.3 (2)	0.1 (1)	0.0 (0)	1.3 (22)
Vegetables	47.0 (4)	10.1 (7)	1.7 (5)	0.4 (1)	0.1 (1)	0.1 (0)	0.2 (1)	0.0 (0)	2.0 (34)
Dairy	103.5 (9)	8.4 (6)	6.3 (19)[d]	5.0 (9)	3.0 (17)	1.4 (7)	0.2 (1)	17.9 (13)	0.1 (2)
Meat, poultry, fish	130.9 (11)	0.0 (0)	15.2 (46)[d]	7.3 (13)	2.6 (14)	3.1 (17)	0.9 (5)	55.6 (40)	0.0 (0)
Meat	82.6 (7)	0.0 (0)	8.7 (27)	5.1 (9)	1.9 (11)	2.2 (12)	0.4 (2)	29.2 (21)	0.0 (0)
Poultry	41.3 (3)	0.0 (0)	5.1 (16)	2.1 (4)	0.6 (3)	0.8 (4)	0.5 (3)	20.2 (15)	0.0 (0)
Fish	7.0 (1)	0.0 (0)	1.4 (1)	0.1 (0)	0.0 (0)	0.0 (0)	0.0 (0)	6.3 (5)	0.0 (0)
Eggs	18.5 (2)	0.1 (0)	1.5 (5)	1.3 (2)	0.4 (2)	0.5 (3)	0.2 (1)	44.6 (32)	0.0 (0)
Tree nuts, peanuts	13.5 (1)	0.4 (0)	0.5 (1)	1.2 (2)	0.2 (1)	0.6 (3)	0.4 (2)	0.0 (0)	0.2 (4)
Added sweeteners[e]	230.0 (19)	60.2 (41)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
Added fats and oils	362.0 (30)	0.2 (0)	0.2 (1)	40.5 (71)	11.6 (64)	12.6 (68)	14.6 (86)	19.5 (14)	0.0 (0)

[a]Column percentages may not add to 100%, due to rounding.
[b]The numerical values are per capita per day amounts of nutrients embedded in the waste of commodities at the retail and consumer levels in the United States food supply in 2012.
[c]The percentage values represent the proportion of all loss for each nutrient that can be attributed to each food group.
[d]Example interpretation: of the 32.8 g protein per capita per day embedded in food loss in the US food supply, 19% of those grams come from dairy and 46% of those grams come from meat, poultry, and fish.
[e]Added sweeteners is used here as a category for classification, and may not match other definitions for added sweeteners such as that used in the Dietary Guidelines for Americans.

Table 6. Contribution of food groups to daily per capita nutrient loss in the US food supply in 2012: Minerals[a]

Food group	Calcium (mg)	Iron (mg)	Magnesium (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)	Zinc (mg)
	←——— *n (%)* ———→						
Total	286.1	5.3	85.0	450.3	880.2	264.2	3.9
Grains	12.2[b] (4)[c]	3.2 (60)	22.5 (27)	87.8 (19)	89.6 (10)	2.3 (1)	0.6 (16)
Fruit	10.7 (4)	0.2 (4)	8.8 (10)	12.1 (3)	140.2 (16)	5.1 (2)	0.1 (2)
Vegetables	28.4 (10)[d]	0.6 (12)	17.3 (20)	39.8 (9)	258.0 (29)	46.4 (18)	0.3 (7)
Dairy	207.1 (72)[d]	0.1 (2)	15.3 (18)	153.6 (34)	185.9 (21)	127.6 (48)	0.8 (21)
Meat, poultry, fish	11.7 (4)	0.9 (17)	14.4 (17)	120.9 (27)	165.3 (19)	44.5 (17)	1.8 (47)
Meat	5.5 (2)	0.5 (10)	7.3 (9)	66.9 (15)	102.2 (12)	17.9 (7)	1.3 (34)
Poultry	2.8 (1)	0.3 (5)	4.7 (6)	36.5 (8)	41.4 (5)	16.2 (6)	0.4 (11)
Fish	3.4 (1)	0.1 (1)	2.3 (3)	17.4 (4)	21.7 (2)	10.4 (4)	0.1 (2)
Eggs	6.0 (2)	0.1 (3)	1.2 (1)	20.6 (5)	15.1 (2)	14.8 (6)	0.1 (3)
Tree nuts, peanuts	3.1 (1)	0.1 (2)	4.6 (5)	9.4 (2)	15.2 (2)	0.2 (0)	0.1 (2)
Added sweeteners[e]	0.7 (0)	0.0 (1)	0.2 (0)	0.1 (0)	2.4 (0)	1.0 (0)	0.0
Added fats and oils	6.3 (2)	0.0 (0)	0.6 (1)	6.1 (1)	8.6 (1)	22.3 (8)	0.0 (1)

[a]Column percentages may not add to 100%, due to rounding.
[b]The numerical values are per capita per day amounts of nutrients embedded in the waste of commodities at the retail and consumer levels in the US food supply in 2012.
[c]The percentage values represent the proportion of all loss for each nutrient that can be attributed to each food group.
[d]Example interpretation: of the 286.1 mg calcium per capita per day embedded in food loss in the US food supply, 10% come from vegetables, and 72% of those milligrams come from dairy.
[e]Added sweeteners is used here as a category for classification, and may not match other definitions for added sweeteners such as that used in the Dietary Guidelines for Americans.

Table 7. Contribution of food groups to daily per capita nutrient loss in the US food supply in 2012: Vitamins[a]

Food group	Vitamin A (μg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin B-6 (mg)	Folate (μg)	Vitamin B-12 (μg)	Vitamin C (mg)	Vitamin D (μg)	Vitamin E (mg)	Vitamin K (μg)
	←———					*n (%)*					———→
Total	308.3	0.9	0.8	9.0	0.6	268.5	1.5	35.4	1.7	3.6	79.2
Grains	0.9[b] (0)[c]	0.5 (59)	0.3 (34)	3.9 (43)	0.1 (10)	203.7 (76)	0.0 (0)	0.0 (0)	0.0 (0)	0.1 (2)	0.2 (0)
Fruit	14.1 (5)	0.0 (4)	0.0 (3)	0.3 (3)	0.1 (11)	12.3 (5)	0.0 (0)	17.9 (51)[d]	0.0 (0)	0.2 (5)	2.0 (3)
Vegetables	125.4 (41)	0.1 (15)	0.1 (7)	0.8 (9)	0.2 (25)	29.6 (11)	0.0 (0)	16.9 (48)[d]	0.0 (0)	0.4 (12)	31.5 (40)
Dairy	74.7 (24)	0.0 (5)	0.2 (28)	0.1 (1)	0.0 (8)	7.2 (3)	0.6 (40)	0.4 (1)	0.9 (53)	0.1 (2)	0.4 (0)
Meat, poultry, fish	29.1 (9)	0.1 (15)	0.1 (16)	3.8 (42)	0.3 (42)	7.4 (3)	0.8 (50)	0.1 (0)	0.5 (27)	0.2 (5)	0.6 (1)
Meat	0.8 (0)	0.1 (13)	0.1 (10)	1.9 (21)	0.2 (26)	1.5 (1)	0.4 (27)	0.0 (0)	0.2 (11)	0.1 (2)	0.2 (0)
Poultry	25.4 (8)	0.0 (1)	0.0 (5)	1.6 (18)	0.1 (13)	4.3 (2)	0.2 (12)	0.1 (0)	0.0 (1)	0.0 (1)	0.3 (0)
Fish	2.9 (1)	0.0 (1)	0.0 (1)	0.3 (3)	0.0 (2)	1.6 (1)	0.2 (11)	0.1 (0)	0.3 (15)	0.1 (2)	0.0 (0)
Eggs	17.8 (6)	0.0 (1)	0.1 (7)	0.0 (0)	0.0 (2)	5.3 (2)	0.1 (9)	0.0 (0)	0.3 (15)	0.1 (3)	0.0 (0)
Tree nuts, peanuts	0.0 (0)	0.0 (1)	0.0 (1)	0.1 (2)	0.0 (1)	2.7 (1)	0.0 (0)	0.0 (0)	0.0 (0)	0.3 (7)	0.1 (0)
Added sweeteners[e]	0.0 (0)	0.0 (0)	0.0 (2)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)
Added fats and oils	46.4 (15)	0.0 (0)	0.0 (1)	0.0 (0)	0.0 (0)	0.4 (0)	0.0 (1)	0.0 (0)	0.1 (5)	2.3 (63)	44.4 (56)

[a]Column percentages may not add to 100%, due to rounding.

[b]The numerical values are per capita per day amounts of nutrients embedded in the waste of commodities at the retail and consumer levels in the US food supply in 2012.

[c]The percentage values represent the proportion of all loss for each nutrient that can be attributed to each food group.

[d]Example interpretation: of the 35.4 mg vitamin C per capita per day embedded in food loss in the US food supply, 51% of those milligrams come from fruit and 48% come from vegetables.

[e]Added sweeteners is used here as a category for classification, and may not match other definitions for added sweeteners such as that used in the Dietary Guidelines for Americans.

Table 9. Comparison of daily population-level nutrient loss of 213 commodities at the retail and consumer levels in the US food supply in 2012 with recommended and current intakes: Additional nutrients[a]

	Recommended and Current Intakes			Equivalence to Wasted Food	
Nutrient	Recommended intake (RDA[b] or AI[c], aged 19-30 y)	Mean current intake (aged ≥20 y)	Average gap in dietary intake for adults[d]	Equivalent number of gaps in dietary intake (millions of adults)[e]	Equivalent number of recommended intakes (millions of adults)[f]
Adult women					
Saturated fat (g)	—[g]	22.3	—	—	—
Monounsaturated fat (g)	—	24.3	—	—	—
Polyunsaturated fat (g)	—	16.8	—	—	—
Cholesterol (mg)	—	229.0	—	—	—
Phosphorus (mg)	700.0	1,194.0	—	—	201.9
Sodium (mg)	1,500.0	2,997.0	—	—	55.3
Zinc (mg)	8.0	9.5	—	—	153.9
Thiamin (mg)	1.1	1.4	—	—	251.4
Riboflavin (mg)	1.1	1.8	—	—	237.8
Niacin (mg)	14.0	20.9	—	—	201.9
Vitamin B-6 (mg)	1.3	1.8	—	—	155.3
Folate	400.0	493.0	—	—	210.7
Vitamin B-12 (μg)	2.4	4.2	—	—	199.8
Vitamin K (μg)	90.0	121.7	—	—	276.2
Adult men					
Saturated fat (g)	—	30.9	—	—	—
Monounsaturated fat (g)	—	34.8	—	—	—
Polyunsaturated fat (g)	—	22.7	—	—	—
Cholesterol (mg)	—	338.0	—	—	—
Phosphorus (mg)	700.0	1,653.0	—	—	201.9
Sodium (mg)	1,500.0	4,218.0	—	—	55.3
Zinc (mg)	11.0	13.7	—	—	111.9
Thiamin (mg)	1.2	1.9	—	—	230.4
Riboflavin (mg)	1.3	2.5	—	—	201.2
Niacin (mg)	16.0	31.6	—	—	176.7
Vitamin B-6 (mg)	1.3	2.6	—	—	155.3
Folate	400.0	651.0	—	—	210.7
Vitamin B-12 (μg)	2.4	6.8	—	—	199.8
Vitamin K (μg)	120.0	138.4	—	—	207.2

[a]This Table expresses the results from Table 3 in relation to the gap between current and recommended intakes.

[b]RDA=Recommended Dietary Allowance.

[c]AI=Adequate Intake.

[d]Gap in dietary intake=recommended intake − mean current intake.

[e]Millions of adults equivalent to the gap in dietary intake was calculated as the daily loss per population divided by the gap in dietary intake. The daily loss per population was calculated as the daily loss per capita (from Table 3) multiplied by the size of total US population on July 1, 2012 (313,914,040).

[f]Millions of adults equivalent to the recommended intake was calculated as the daily loss per population divided by the recommended intake.

[g]Cells with no values indicate either that there was no RDA for this nutrient, or that the the gap between current and recommended intakes was not calculated because mean current intake exceeded recommended intakes.

Table 10. Supporting information for Figure 2 (Equivalent number of recommended intakes embedded in daily population-level nutrient loss in the US food supply in 2012, expressed as a percentage of the 2012 US adult population [aged ≥20 years])[a]

	Nutrient Loss in the US Food Supply Is Equivalent to the Recommended Intake (RDA[b] or AI[c]) for Number of Adults per Day (aged 19-30 y)			Average between Women and Men, Expressed as a Percentage of the US Adult Population in 2012[d]	Percent Contribution of the Average Loss from Each Level of the Supply Chain[e]	
	Women	Men	Average		Retail	Consumer
				←——— % ———	———	———→
Nutrients shown in Figure 2						
Vitamin A (μg)	138,251,315	107,528,800	122,890,057	**54**	**28**	**72**
Vitamin C (mg)	148,020,554	123,350,462	135,685,508	**60**	**32**	**68**
Vitamin D (μg)	36,580,790	36,580,790	36,580,790	**16**	**32**	**68**
Vitamin E (mg)	75,856,016	75,856,016	75,856,016	**33**	**48**	**52**
Calcium (mg)	89,805,567	89,805,567	89,805,567	**40**	**29**	**71**
Iron (mg)	92,651,241	208,465,293	150,558,267	**66**	**34**	**66**
Magnesium (mg)	86,024,769	66,669,196	76,346,982	**34**	**31**	**69**
Potassium (mg)	58,789,193	58,789,193	58,789,193	**26**	**29**	**71**
Dietary Fiber (g)	73,564,735	48,397,852	60,981,293	**27**	**34**	**66**
Additional nutrients						
Calories (kcal)	190,933,428	190,933,428	190,933,428	**84**	**38**	**62**
Carbohydrates (g)	353,442,030	353,442,030	353,442,030	**156**	**32**	**68**
Protein (g)	223,685,738	183,741,856	203,713,797	**90**	**26**	**74**
Phosphorus (mg)	201,934,371	201,934,371	201,934,371	**89**	**28**	**72**
Sodium (mg)	55,291,056	55,291,056	55,291,056	**24**	**27**	**73**
Zinc (mg)	153,896,228	111,924,530	132,910,379	**59**	**26**	**75**
Thiamin (mg)	251,388,150	230,439,138	240,913,644	**106**	**32**	**66**
Riboflavin (mg)	237,748,927	201,172,169	219,460,548	**97**	**33**	**71**
Niacin (mg)	201,932,318	176,690,778	189,311,548	**84**	**29**	**71**
Vitamin B6 (mg)	155,345,876	155,345,876	155,345,876	**69**	**27**	**80**
Folate[f] (μg)	210,742,850	210,742,850	210,742,850	**93**	**37**	**63**
Vitamin B-12 (μg)	199,792,333	199,792,333	199,792,333	**88**	**24**	**77**
Vitamin K (μg)	276,213,381	207,160,035	241,686,708	**107**	**52**	**48**

[a]The bolded values are represented directly in Figure 2, whereas the values without bold are provided to demonstrate how the proportions were calculated. Not all calculations are shown.
[b]RDA=Recommended Dietary Allowance.
[c]AI=Adequate Intake.
[d]The US adult population on July 1, 2012 was 226,456,000.[27]
[e]Row percentages may not add to 100 due to rounding.
[f]Dietary folate equivalents.

Table 11. Supporting Information for Figure 3 (amount of nutrient loss per capita per day in the US food supply in 2012, expressed as a percentage of the Recommended Dietary Allowance [RDA] or Adequate Intake [AI] for each nutrient for adults aged 19-30 years)[a]

	Amount of Nutrient Loss at the Retail Level, as a Percentage of the RDA or AI			Amount of Nutrient Loss at the Consumer Level, as a Percentage of the RDA or AI			Amount of Nutrient Loss at the Retail and Consumer Levels, as a Percentage of the RDA or AI		
	Adult women (age ≥19 y)	Adult men (age ≥19 y)	Average (This is the contribution of retail level shown in Figure 3)	Adult women (age ≥19 y)	Adult men (age ≥19 y)	Average (This is the contribution of consumer level shown in Figure 3)	Adult women (age ≥19 y)	Adult men (age ≥19 y)	Average (This is the total percentage shown in Figure 3)
Nutrients shown in Figure 3									
Vitamin A (μg)	12	10	**11**	32	25	**28**	44	34	**39**
Vitamin C (mg)	15	12	**14**	32	27	**30**	47	39	**43**
Vitamin D (μg)	4	4	**4**	8	8	**8**	12	12	**12**
Vitamin E (mg)	12	12	**12**	13	13	**13**	24	24	**24**
Calcium (mg)	8	8	**8**	20	20	**20**	29	29	**29**
Iron (mg)	10	22	**16**	20	44	**32**	30	66	**48**
Magnesium (mg)	9	7	**8**	19	15	**17**	27	21	**24**
Potassium (mg)	5	5	**5**	13	13	**13**	18	19	**18**
Dietary fiber (g)	8	5	**7**	15	10	**13**	23	15	**19**
Additional nutrients									
Calories (kcal)	23	23	**23**	38	38	**38**	61	61	**61**
Carbohydrates (g)	36	36	**36**	76	76	**76**	113	113	**113**
Protein (g)	18	15	**17**	53	43	**48**	71	59	**65**
Phosphorus (mg)	18	18	**18**	46	46	**46**	64	64	**64**
Sodium (mg)	5	5	**5**	13	13	**13**	18	18	**18**
Zinc (mg)	12	9	**11**	37	27	**32**	49	35	**42**
Thiamin (mg)	26	24	**25**	54	49	**52**	82	75	**77**
Riboflavin (mg)	24	20	**22**	52	44	**48**	73	62	**70**
Niacin (mg)	19	16	**17**	46	40	**43**	64	56	**60**
Vitamin B-6 (mg)	12	12	**12**	37	37	**37**	46	46	**49**
Folate[b] (μg)	25	25	**25**	42	42	**42**	67	67	**67**
Vitamin B-12 (μg)	15	15	**15**	48	48	**48**	63	63	**64**
Vitamin K (μg)	46	34	**40**	42	32	**37**	88	66	**77**

[a]The boldface values are represented directly in Figure 3, whreas the values not in boldface are provided to demonstrate how the proportions were calculated. Not all calculations are shown.
[b]Dietary folate equivalents.

Table 12. Nutrient loss adjusted for the proportions of food that could be recovered, as estimated by the Rethink Food Waste through Economics and Data (ReFED) collaboration

Step 1: Extracting proportions from ReFED report[23]

The maximum feasible amount of recovery: ReFED estimated the maximum feasible amount of recovery as 5.8 million tons of food per year, which is 9.21% of the 63 million tons of food currently wasted each year. (5.8 million/63 million=9.2%)

The amount of recovery possible by scaling up seven cost-effective activities: ReFED estimated that scaling up seven cost-effective strategies for food recovery could result in an additional 1.1 million tons of food recovered per year, which is 1.75% of the 63 million tons of food currently wasted each year. (1.1 million/63 million=1.75%)

Step 2: Applying proportions to amounts of nutrient loss, and expressing amounts of loss as the equivalent number of recommended intakes

Title	Nutrient Loss per Capita per Day	Maximum Feasible Amount of Recovery	Amount of Nutrient Loss in the Previous Column is Equivalent to the RDA[a] or AI[b] for X Number of Adults Aged 19-30 y		Amount of Cost-Effective Recovery	Amount of Nutrient Loss in the Previous Column Is Equivalent to the RDA or AI for X Number of Adults Aged 19-30 y	
			(Maximum Feasible Amount of Recovery × 2012 US Total Population[c])/RDA or AI			(Amount of Cost-Effective Recovery × 2012 US Total Population)/RDA or AI	
Data source or calculation	**From Table 3**	**Nutrient Loss per Capita × 9.21%**	**Women**	**Men**	**Nutrient Loss per Capita × 1.75%**	**Women**	**Men**
Energy and macronutrients							
Calories (kcal)	1,216.5	112.0	17,577,998	17,577,998	21.2	3,333,758	3,333,758
Carbohydrates (g)	146.4	13.5	32,539,108	32,539,108	2.6	6,171,210	6,171,210
Protein (g)	32.8	3.0	20,593,290	16,915,917	0.6	3,905,624	3,208,191
Fat (g)	57.2	5.3	No RDA	No RDA	1.0	No RDA	No RDA
Underconsumed nutrients							
Vitamin A (μg)	308.3	28.4	12,727,899	9,899,477	5.4	2,413,912	1,877,487
Vitamin C (mg)	35.4	3.3	13,627,289	11,356,074	0.6	2,584,486	2,153,738
Vitamin D (μg)	1.7	0.2	3,367,755	3,367,755	0.0	638,712	638,712
Vitamin E (mg)	3.6	0.3	6,983,570	6,983,570	0.1	1,324,470	1,324,470
Calcium (mg)	286.1	26.3	8,267,814	8,267,814	5.0	1,568,034	1,568,034
Iron (mg)	5.3	0.5	8,529,797	19,192,043	0.1	1,617,720	202,215
Magnesium (mg)	85.0	7.8	7,919,741	6,137,799	1.5	1,699,365	1,164,065
Potassium (mg)	880.2	81.0	5,412,338	5,412,338	15.4	1,026,478	1,026,478
Dietary fiber (g)	5.9	0.5	6,772,626	4,455,675	0.1	1,284,464	845,042

[a]RDA=Recommended Dietary Allowance.
[b]AI=Adequate Intake.
[c]The US total population on July 1, 2012, was 313,914,040.[27]

Table 13. Comparison of estimated caloric value of nutrient loss by food group to estimates from similar analyses by Buzby and colleagues, Hall and colleagues, and Love and colleagues

Caloric value of per capita per day nutrient loss from each food group	Estimates from this analysis	Estimates from other analysis	Absolute difference	Percent difference (%)
Comparison to Buzby and colleagues[1a]				
Grains	271	271	0	0
Fruit	40	38	2	5
Vegetables	47	45	2	4
Dairy	104	109	−6	−5
Meat, poultry, fish	131	152	−21	−16
Meat	83	99	−16	−20
Poultry	41	43	−2	−4
Fish	7	9	−2	−29
Eggs	19	16	3	14
Tree nuts, peanuts	14	12	2	11
Added sweeteners	230	256	−26	−11
Added fats and oils	362	349	13	4
Total calories	1,217	1,249	−33	−3
Comparison to Hall and colleagues[2b]				
Total calories	1,217	1,400	−184	15
Comparison to Love and colleagues[15cd]				
Seafood calories - low	7.0	9.6	−2.6	−37
Seafood calories - high	7.0	11.2	−4.2	−60
Seafood protein - low	1.4	1.8	−0.4	−31
Seafood protein - high	1.4	1.9	−0.5	−37

[a]Buzby and colleagues[1] used LAFA data from 2010.
[b]Hall and colleagues[2] used data from 2003.
[c]Love and colleagues[15] used data from 2009-2013.
[d]The estimates that originally appear in the study by Love and colleagues[15] are presented per population per year. In this Table, estimates have been converted to calories or grams of protein per capita per day, so that they are directly comparable with findings from this analysis.